

MACROECONOMICS

Theory, Models & Policy

by Douglas Curtis and Ian Irvine

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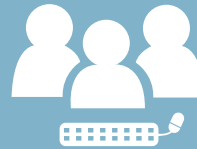
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Macroeconomics: Theory, Models & Policy

Douglas Curtis and Ian Irvine

Version 2015 — Revision A

The content of this edition has been revised in several respects. Chapter 5 has been modified to provide a more concise AD/AS model and a framework for the material covered in later chapters. The development of the $AD\pi/AS\pi$ model in Chapter 12 is now presented using diagrams comparable to those used in the development of the AD/AS in Chapter 11. Empirical examples and illustrations of economic performance have been updated in all chapters along with some additional discussions of economic performance and policy.

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Glossary

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About the Authors

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Our Philosophy

Macroeconomic: Theory, Models and Policy is focused on the material that students need to cover in a first introductory course. It is slightly more compact than the majority of introductory macroeconomics books in the Canadian marketplace. Decades of teaching experience and textbook writing has led the authors to avoid the encyclopedic approach that characterizes the recent trends in textbooks.

Consistent with this approach, there are no appendices or 'afterthought' chapters. If important material is challenging then it is still included in the main body of the text; it is not relegated elsewhere for a limited audience; the text makes choices on what issues and topics are important in an introductory course. This philosophy has resulted in a Macro book of just 15 chapters, with three introductory chapters and the International Trade chapter, common to both Micro and Macro.

Examples are domestic and international in their subject matter and are of the modern era – financial markets, monetary and fiscal policies aimed at inflation and debt control, globalization and the importance of trade flows in economic structure and concerns about slow growth and the risk of deflation are included.

The title is intended to be informative. Students are introduced to the concepts of models early, and the working of such models is illustrated in every chapter. Calculus is avoided; but students

learn to master and solve linear models. Hence straight line equations and diagrams are introduced early and are used throughout.

Structure of the Text

Macroeconomics: Theory, Models and Policy, provides complete, concise coverage of introductory macroeconomic theory and policy. It examines the Canadian economy as an economic system, and embeds current Canadian institutions and approaches to monetary policy and fiscal policy within that system. Particular attention is given to the recent structure, performance, and evolution of the Canadian economy, and to the current targets and instruments of Canadian monetary and fiscal policy.

These are exciting and challenging times in which to study macroeconomics. We focus on short-run macroeconomic performance, analysis, and policy motivated by the recessions of the early 1980s and 1990s, the financial crisis and recession of 2008–2009, and the prolonged recovery in most industrial countries. To that end, the text examines macroeconomic institutions, performance, and policies in ways that help students understand and evaluate critically the news media coverage and broader public discussion of:

- Recessions and recoveries, unemployment, inflation, deflation and conditions in financial markets—topics of ongoing reporting, discussion, and debate.
- Monetary and fiscal policy announcements and discussions focused on inflation targets, interest rate settings, budget balances, tax rates, expenditures, and public debt targets as these affect economic performance.
- Exports, imports, international capital flows, foreign exchange rates, and the importance of the international sector of the Canadian economy.
- Economic growth, productivity growth, and the importance of productivity growth for standards of living in Canada and other countries.

A traditional Aggregate Demand and Supply model is introduced to provide a consistent analytical framework for development of sector topics that follow. The analysis builds on a study of short-run business cycle fluctuations in output and employment, under *constant equilibrium price* conditions. The balance of payments, exchange rate policy, and monetary and fiscal policy under different exchange rate systems complete the short-run open economy model.

A basic modern Aggregate Demand and Supply model of output and the *inflation rate* is also developed based on:

- Current Canadian monetary policy based on inflation targets, interest rate policy instruments, and current Bank of Canada operating techniques, including the potential for quantitative or credit easing.
- Current Canadian fiscal policy based on deficit and debt control targets, the government's budget function, the temporary shift to fiscal stimulus in 2009 and the implications for budget balances and the public debt.

Numerical examples, diagrams, and basic algebra are used in combination to illustrate and explain economic relationships. Students learn about the importance of trade flows, consumption; government budgets; money supply; financial asset prices, yields, and interest rates; employment and unemployment; and other key relationships in the economy. Canadian and selected international data are used to provide real world examples and comparisons.

Part One

Introduction

1. Introduction to key ideas
2. Theories, models and data
3. The classical marketplace – demand and supply

Economics is everywhere. It is about how society deals with the problems of scarcity and the allocation of resources among alternatives. It is the study of individual behaviours based on economic motives and the interactions among individual behaviours that result in societal and economy wide outcomes. Sometimes it makes sense to use markets and sometimes we need other solutions. Sometimes what seems to be common sense for individuals or individual families is nonsense for the economy as a whole. Economic analysis helps us to think about the need for and design of government policies to influence economic behaviour and outcomes.

This part of the text uses three chapters to introduce economics issues, economic questions, economic theory, economic tools of analysis and simple economic models

Chapter 1

Introduction to key ideas

In this chapter we will explore:

- 1.1 The big issues in economics
- 1.2 Understanding through the use of models
- 1.3 Opportunity cost and the market
- 1.4 A model of exchange and specialization
- 1.5 Production possibilities for the economy
- 1.6 Aggregate output, growth and cycles

1.1 What's it all about?

The big issues

Economics is the study of human behaviour. Since it uses scientific methods it is called a social science. We study human behaviour to better understand and improve our world. During his acceptance speech, a recent Nobel Laureate in Economics suggested:

Economics, at its best, is a set of ideas and methods for the improvement of society. It is not, as so often seems the case today, a set of ideological rules for asserting why we cannot face the challenges of stagnation, job loss and widening inequality.

Christopher Sims, Nobel Laureate in Economics 2011

This is an elegant definition of economics and serves as a timely caution about the perils of ideology. Economics evolves continuously as current observations and experience provide new evidence about economic behaviour and relationships. Inference and policy recommendations based on earlier theories, observations and institutional structures require constant analysis and updating if they are to furnish valuable responses to changing conditions and problems.

Much of today's developed world faces severe challenges as a result of the financial crisis that began in 2008. Unemployment rates among young people are at historically high levels in several economies, government balance sheets are in disarray, and inequality is on the rise. In addition to the challenges posed by this severe economic cycle, the world simultaneously faces structural upheaval: overpopulation, climate change, political instability and globalization challenge us to understand and modify our behaviour.

These challenges do not imply that our world is deteriorating. Literacy rates have been rising dramatically in the developing world for decades; child mortality has plummeted; family size is a fraction of what it was 50 years ago; prosperity is on the rise in much of Asia; life expectancy is increasing universally and deaths through wars are in a state of long term decline.

These developments, good and bad, have a universal character and affect billions of individuals. They involve an understanding of economies as large organisms with interactive components. The study of economies as large interactive systems is called **macroeconomics**. Technically, macroeconomics approaches the economy as a complete system with feedback effects among sectors that determine national economic performance. Feedbacks within the system mean we cannot aggregate from observations on one household or business to the economy as a whole. Application Box 1.1 gives an example.

Macroeconomics: the study of the economy as system in which feedbacks among sectors determine national output, employment and prices.

Individual behaviours

Individual behaviour underlies much of our social and economic interactions. Some individual behaviours are motivated by self-interest, others are socially motivated. The Arab Spring of 2011 was sparked by individual actions in North Africa that subsequently became mass movements. These movements were aimed at improving society at large. Globalization, with its search for ever less costly production sources in Asia and elsewhere, is in part the result of cost-reducing and profit-maximizing behaviour on the part of developed-world entrepreneurs, and in part attributable to governments opening their economies up to the forces of competition, in the hope that living standards will improve across the board. The increasing income share that accrues to the top one percent of our population in North America and elsewhere is primarily the result of individual self-interest.

At the level of the person or organization, economic actions form the subject matter of microeconomics. Formally, **microeconomics** is the study of individual behaviour in the context of scarcity.

Microeconomics: the study of individual behaviour in the context of scarcity.

Individual economic decisions need not be world-changing events, or motivated by a search for profit. For example, economics is also about how we choose to spend our time and money. There are quite a few options to choose from: sleep, work, study, food, shelter, transportation, entertainment, recreation and so forth. Because both time and income are limited we cannot do all things all the time. Many choices are routine or are driven by necessity. You have to eat and you need a place to live. If you have a job you have committed some of your time to work, or if you are a student some of your time is committed to lectures and study. There is more flexibility in other choices. Critically, microeconomics seeks to understand and explain how we make choices and how those choices affect our behaviour in the workplace and society.

A critical element in making choices is that there exists a *scarcity* of time, or income or productive resources. Decisions are invariably subject to limits or constraints, and it is these constraints that make decisions both challenging and scientific.

Microeconomics also concerns business choices. How does a business use its funds and management skill to produce goods and services? The individual business operator or firm has to decide what to produce, how to produce it, how to sell it and in many cases, how to price it. To make and sell pizza, for example, the pizza parlour needs, in addition to a source of pizza ingredients, a store location (land), a pizza oven (capital), a cook and a sales person (labour). Payments for the use of these inputs generate income to those supplying them. If revenue from the sale of pizzas is greater than the costs of production, the business earns a profit for the owner. A business fails if it cannot cover its costs.

In these micro-level behaviours the decision makers have a common goal: to do as well as he or she can, *given the constraints imposed by the operating environment*. The individual wants to mix work and leisure in a way that makes her as happy or contented as possible. The entrepreneur aims at making a profit. These actors, or agents as we sometimes call them, are *maximizing*. Such maximizing behaviour is a central theme in this book and in economics at large.

Finance Minister Jim Flaherty and Bank of Canada Governor Mark Carney in 2011 urged Canadian households to increase their savings in order to reduce their record high debt-to-income ratio. On an individual level this makes obvious sense. If you could save more and spend less you could pay down the balances on credit cards, your line of credit, mortgage and other debts.

But one household's spending is another household's income. For the economy as a system, an increase in households' saving from say 5 percent of income to 10 percent reduces spending accordingly. But lower spending by all households will reduce the purchases of goods and services produced in the economy, and therefore has the potential to reduce national incomes. Furthermore, with lower income the trouble some debt-to-income ratio will not fall, as originally intended. Hence, while higher saving may work for one household in isolation, higher saving by all households may not. The interactions and feed backs in the economic system create a 'paradox of thrift'.

The paradox can also create problems for government finances and debt. Following the recession that began in 2008/09, many European economies with high debt loads cut spending and increased taxes to in order to balance their fiscal accounts. But this fiscal austerity reduced the national incomes on which government tax revenues are based, making deficit and debt problems even more problematic. Feedback effects, within and across economies, meant that European Union members could not all cut deficits and debt simultaneously.

Application Box 1.1: The paradox of thrift

Markets and government

Markets play a key role in coordinating the choices of individuals with the decisions of business. In modern market economies goods and services are supplied by both business and government. Hence we call them **mixed economies**. Some products or services are available to those who wish to buy them and have the necessary income - as in cases like coffee and wireless services. Other services are provided to all people through government programs like law enforcement and health care.

Mixed economy: goods and services are supplied both by private suppliers and government.

Markets offer the choice of a wide range of goods and services at various prices. Individuals can use their incomes to decide the pattern of expenditures and the bundle of goods and services they prefer. Businesses sell goods and services in the expectation that the market price will cover costs and yield a profit.

The market also allows for specialization and separation between production and use. Rather than each individual growing her own food, for example, she can sell her time or labour to employers in return for income. That income can then support her desired purchases. If businesses can produce food more cheaply than individuals the individual obviously gains from using the market – by both having the food to consume, and additional income with which to buy other goods and services. Economics seeks to explain how markets and specialization might yield such gains for individuals and society.

We will represent individuals and firms by envisaging that they have explicit objectives – to maximize their happiness or profit. However, this does not imply that individuals and firms are concerned only with such objectives. On the contrary, much of microeconomics and macroeconomics focuses upon the role of government: how it manages the economy through fiscal and monetary policy, how it redistributes through the tax-transfer system, how it supplies information to buyers and sets safety standards for products.

Since governments perform all of these socially-enhancing functions, in large measure governments reflect the social ethos of voters. So, while these voters may be maximizing at the individual level in their everyday lives, and our models of human behaviour in microeconomics certainly emphasize this optimization, economics does not see individuals and corporations as being devoid of civic virtue or compassion, nor does it assume that only market-based activity is important. Governments play a central role in modern economies, to the point where they account for more than one third of all economic activity in the modern mixed economy.

While governments supply goods and services in many spheres, governments are fundamental to the just and efficient functioning of society and the economy at large. The provision of law and order, through our legal system broadly defined, must be seen as more than simply accounting for some percentage our national economic activity. Such provision supports the whole private sector of the economy. Without a legal system that enforces contracts and respects property rights the private sector of the economy would diminish dramatically as a result of corruption, uncertainty and insecurity. It is the lack of such a secure environment in many of the world's economies that inhibits their growth and prosperity.

Let us consider now the methods of economics, methods that are common to science-based disciplines.

1.2 Understanding through the use of models

Most students have seen an image of Ptolemy's concept of our Universe. Planet Earth forms the centre, with the other planets and our sun revolving around it. The ancients' anthropocentric view of the universe necessarily placed their planet at the centre. Despite being false, this view of our world worked reasonably well – in the sense that the ancients could predict celestial motions, lunar patterns and the seasons quite accurately.

More than one Greek astronomer believed that it was more natural for smaller objects such as the earth to revolve around larger objects such as the sun, and they knew that the sun had to be larger as a result of having studied eclipses of the moon and sun. Nonetheless, the Ptolemaic description of the universe persisted until Copernicus wrote his treatise “On the Revolutions of the Celestial Spheres” in the early sixteenth century. And it was another hundred years before the Church accepted that our corner of the universe is heliocentric. During this time evidence accumulated as a result of the work of Brahe, Kepler and Galileo. The time had come for the Ptolemaic *model* of the universe to be supplanted with a better *model*.

All disciplines progress and develop and explain themselves using models of reality. A **model** is a formalization of theory that facilitates scientific inquiry. Any history or philosophy of science book will describe the essential features of a model. First, it is a stripped down, or reduced, version of the phenomenon that is under study. It incorporates the key elements while disregarding what are considered to be secondary elements. Second, it should accord with reality. Third, it should be able to make meaningful predictions. Ptolemy’s model of the known universe met these criteria: it was not excessively complicated (for example distant stars were considered as secondary elements in the universe and were excluded); it corresponded to the known reality of the day, and made pretty good predictions. Evidently not all models are correct and this was the case here.

Model: a formalization of theory that facilitates scientific inquiry.

In short, models are frameworks we use to organize how we think about a problem. Economists sometimes interchange the terms theories and models, though they are conceptually distinct. A **theory** is a logical view of how things work, and is frequently formulated on the basis of observation. A model is a formalization of the essential elements of a theory, and has the characteristics we described above. As an example of an economic model, suppose we theorize that a household’s expenditure depends on its key characteristics: such a model might specify that wealth, income, and household size determine its expenditures, while it might ignore other, less important, traits such as the household’s neighbourhood or its religious beliefs. The model reduces and simplifies the theory to manageable dimensions. From such a reduced picture of reality we develop an analysis of how an economy and its components work.

Theory: a logical view of how things work, and is frequently formulated on the basis of observation.

An economist uses a model as a tourist uses a map. Any city map misses out some detail—traffic lights and speed bumps, for example. But with careful study you can get a good idea of the best route to take. Economists are not alone in this approach; astronomers, meteorologists, physicists, and genetic scientists operate similarly. Meteorologists disregard weather conditions in South Africa when predicting tomorrow’s conditions in Winnipeg. Genetic scientists concentrate on the interactions of limited subsets of genes that they believe are the most important for their purpose.

Even with huge computers, all of these scientists build *models* that concentrate on the essentials.

1.3 Opportunity cost and the market

Individuals face choices at every turn: In deciding to go to the hockey game tonight, you may have to forgo a concert; or you will have to forgo some leisure time this week order to earn additional income for the hockey game ticket. Indeed, there is no such thing as a free lunch, a free hockey game or a free concert. In economics we say that these limits or constraints reflect opportunity cost. The **opportunity cost** of a choice is what must be sacrificed when a choice is made. That cost may be financial; it may be measured in time, or simply the alternative foregone.

Opportunity cost: what must be sacrificed when a choice is made.

Opportunity costs play a determining role in markets. It is precisely because individuals and organizations have different opportunity costs that they enter into exchange agreements. If you are a skilled plumber and an unskilled gardener, while your neighbour is a skilled gardener and an unskilled plumber, then you and your neighbour not only have different capabilities, you also have different opportunity costs, and *you could gain by trading your skills*. Here's why. Fixing a leaking pipe has a low opportunity cost for you in terms of time: you can do it quickly. But pruning your apple trees will be costly because you must first learn how to avoid killing them and this may require many hours. Your neighbour has exactly the same problem, with the tasks in reverse positions. In a sensible world you would fix your own pipes *and* your neighbour's pipes, and she would ensure the health of the apple trees in both backyards.

If you reflect upon this 'sensible' solution—one that involves each of you achieving your objectives while minimizing the time input—you will quickly realize that it resembles the solution provided by the marketplace. You may not have a gardener as a neighbour, so you buy the services of a gardener in the marketplace. Likewise, your immediate neighbour may not need a leaking pipe repaired, but many others in your neighbourhood do, so you sell your service to them. You each specialize in the performance of specific tasks as a result of having different opportunity costs or different efficiencies. Let us now develop a model of exchange to illustrate the advantages of specialization and trade, and hence the markets that facilitate these activities. This model is developed with the help of some two-dimensional graphics.

1.4 A model of exchange and specialization

We have two producers and two goods: Amanda and Zoe produce vegetables (V) and or fish (F). Their production capabilities are defined in Table 1.1 and in Figure 1.1, where the quantity of V appears on the vertical axis and the quantity of F on the horizontal axis. Zoe and Amanda each have 36-hour weeks and they devote that time to producing the two goods. But their efficiencies differ: Amanda requires two hours to produce a unit of V and three hours for a unit of F . As a consequence, if she devotes all of her time to V she can produce 18 units, or if she devotes all of her time to F she can produce 12 units. Or, she could share her time between the two.

	Hours/ fish	Hours/ vegetable	Fish production	Vegetable production
Amanda	3	2	12	18
Zoe	2	4	18	9

Table 1.1: Production possibilities in a two-person economy

Each producer has a time allocation of 36 hours. By allocating total time to one activity, Amanda can produce 12 F or 18 V , Zoe can produce 18 F or 9 V . By splitting their time each person can also produce a combination of the two.

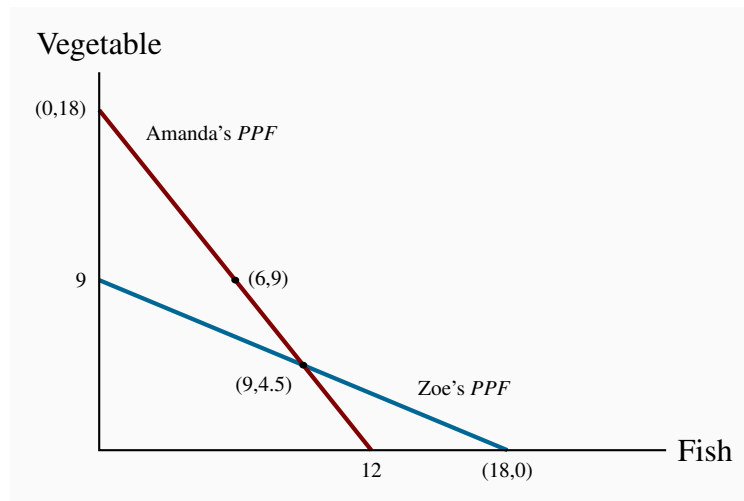


Figure 1.1: Absolute advantage – production

Amanda's initial consumption is (6,9) and Zoe's is (9,4.5). Amanda's consumption with specialization is (0,18) and Zoe's is (18,0). With specialization they can produce a greater total (18,18) than when operating individually. Hence, if they trade, after specializing, they each have the *potential* to consume more.

In Figure 1.1 Amanda's capacity is represented by the line that meets the vertical axis at 18 and the horizontal axis at 12. The vertical point indicates that she can produce 18 units of V if she produces zero units of F – keep in mind that where V has a value of 18, Amanda has no time left for fish production. Likewise, if she devotes all of her time to fish she can produce 12 units, since each unit requires 3 of her 36 hours. The point $F = 12$ is thus another possibility for her. In addition to these two possibilities, which we can term 'specialization', she could allocate her time to producing some of each good. For example, by dividing her 36 hours equally she could produce 6 units of F and 9 units of V . A little computation will quickly convince us that different allocations of her time will lead to combinations of the two goods that lie along a straight line joining the specialization points. We will call this straight line Amanda's **production possibility frontier (PPF)**: it is the combination of goods she can produce while using all of her resources – time. She could not produce combinations of goods represented by points beyond this line (to the top right). She could indeed produce combinations below it (lower left) – for example a combination of 4 units of V and 4 units of F ; but such points would not require all of her time. The (4,4) combination would require just 20 hours. In sum, points beyond this line are not feasible, and points within it do not require all of her time resources.

Production possibility frontier (PPF): the combination of goods that can be produced using all of the resources available.

Having developed Amanda's PPF, it is straightforward to develop a corresponding set of possibil-

ities for Zoe. If she requires 4 hours to produce a unit of V and 2 hours to produce a unit of F , then her 36 hours will enable her to specialize in 9 units of V or 18 units of F ; or she could produce a combination represented by the straight line that joins these two specialty extremes.

Consider now what we term the opportunity costs for each person. If Amanda, from a starting point of 18 V and zero F , wishes to produce some F , and less V she must sacrifice 1.5 units of V for each unit of F she decides to produce. This is because F requires 50% more hours than V . Her trade-off is 1.5:1.0, or equivalently 3:2. In the graphic, for every 3 units of V she does not produce she can produce 2 units of F , reflecting the hours she must devote to each. Yet another way to see this is to recognize that if she stopped producing the 18 units of V entirely, she could produce 12 units of F ; and the ratio 18:12 is again 3:2. This then is her opportunity cost: the cost of an additional two units of F is that 3 units of V must be ‘sacrificed’.

Zoe’s opportunity cost, by the same reasoning, is 1:2 — 1 unit of V for 2 units of F .

So we have established two things about Amanda and Zoe’s production possibilities. First, if Amanda specializes in V she can produce more than Zoe, just as Zoe can produce more than Amanda if Zoe specializes in F . Second, their opportunity costs are different: Amanda must sacrifice more V than Zoe in producing one more unit of F .

To illustrate the gains from specialization and trade, let us initially suppose that Amanda and Zoe are completely self-sufficient (they consume exactly what they produce), and they each divide their production time equally between the two goods. Hence, Amanda produces and consumes 6 F and 9 V , whereas Zoe’s combination is 9 F and 4.5 V . These combinations must lie on their respective *PPFs* and are illustrated in Figure 1.1.

Upon realizing that they are not equally efficient in producing the two goods, they decide to specialize completely in producing just the single good where they are most efficient. Amanda specializes in V and Zoe in F . Right away we notice that this allocation of time will realize 18 V and 18 F , which is more than the combined amounts they produce and consume when not specializing — 15 F and 13.5 V . Logic dictates that each should be able to consume more following specialization. What they must do however, is negotiate a rate at which to exchange V for F . Since Amanda’s opportunity cost is 3:2 and Zoe’s is 1:2, perhaps they agree to exchange V for F at an intermediate rate of 2:2 (or 1:1, which is the same). With Amanda specializing in V and Zoe in F they now trade one unit of V for one unit of F . Consider Figure 1.2.

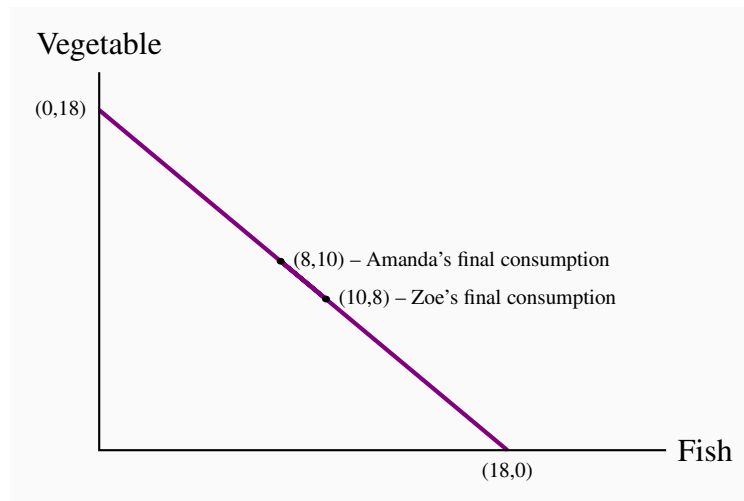


Figure 1.2: Absolute advantage – consumption

With specialization and trade they consume along the line joining the specialization points. Amanda's initial consumption is (6,9) and Zoe's is (9,4.5). Amanda's consumption with specialization is (0,18) and Zoe's is (18,0). If Amanda trades 8V to Zoe in return for 8F, Amanda moves to the point (8,10) and Zoe to (10,8). Both consume more after specialization.

If Amanda can trade at a rate of 1:1 her consumption opportunities have improved dramatically: if she were to trade away all of her 18V, she would get 18 fish in return, whereas when consuming what she produced, she was limited to 12 fish. Suppose she wants to consume both V and F and she offers Zoe 8V. Clearly she will get 8F in return, and she will consume $(8F + 10V)$ – more than she consumed prior to specializing.

By the same reasoning, after specializing in producing 18 fish, Zoe trades away 8F and receives 8V from Amanda in return. Therefore Zoe consumes $(10F + 8V)$. The result is that *they are now each consuming more than in the initial allocation. Specialization and trade have increased their consumption.*¹

1.5 Economy-wide production possibilities

The *PPFs* in Figure 1.1 define the amounts of the goods that each *individual* can produce while using all of their productive capacity—time in this instance. The national, or economy-wide, *PPF*

¹In the situation we describe above one individual is absolutely more efficient in producing one of the goods and absolutely less efficient in the other. We will return to this model in Chapter 15 and illustrate that consumption gains of the type that arise here can also result if one of the individuals is absolutely more efficient in produce both goods, but that the degree of such advantage differs across goods.

for this two-person economy reflects these individual possibilities combined. Such a frontier can be constructed using the individual frontiers as the component blocks.

First let us define this economy-wide frontier precisely. The **economy-wide PPF** is the set of goods combinations that can be produced in the economy when all available productive resources are in use. Figure 1.3 contains both of the individual frontiers plus the aggregate of these, represented by the kinked line *ace*. The point on the *V* axis, $a=27$, represents the total amount of *V* that could be produced if both individuals devoted all of their time to it. The point $e=30$ on the horizontal axis is the corresponding total for fish.

Economy-wide PPF: the set of goods combinations that can be produced in the economy when all available productive resources are in use.

To understand the point *c*, imagine initially that all resources are devoted to *V*. From such a point, *a*, we consider a reduction in *V* and an increase in *F*. The most efficient way of increasing *F* production at the point *a* is to use the individual whose opportunity cost of *F* is least – Zoe. She can produce one unit of *F* by sacrificing just 1/2 unit of *V*. Amanda on the other hand must sacrifice 1.5 units of *V* to produce 1 unit of *F*. Hence, at this stage Amanda should stick to *V* and Zoe should devote some time to fish. In fact as long as we want to produce more fish Zoe should be the one to do it, until she has exhausted her time, which occurs after she has produced 18*F* and has ceased producing *V*. At this point the economy will be producing 18*V* and 18*F* – the point *c*.

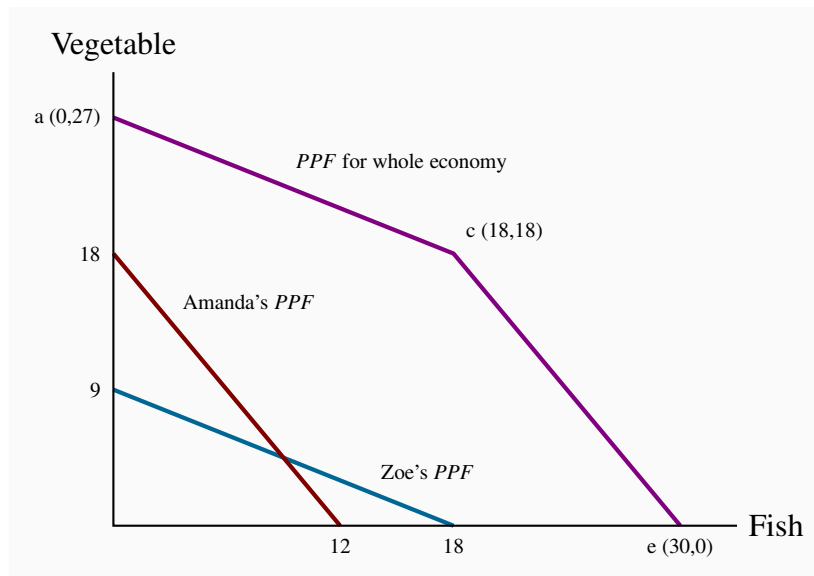


Figure 1.3: Economy-wide PPF

From a, to produce Fish it is more efficient to use Zoe because her opportunity cost is less (segment ac). When Zoe is completely specialized, Amanda produces (ce). With complete specialization this economy can produce 27V or 30F.

From this combination, if the economy wishes to produce more fish Amanda must become involved. Since her opportunity cost is 1.5 units of V for each unit of F , the next segment of the economy-wide PPF must see a reduction of 1.5 units of V for each additional unit of F . This is reflected in the segment ce. When both producers allocate all of their time to F the economy can produce 30 units. Hence the economy's PPF is the two-segment line ace. Since this has an outward kink, we call it concave (rather than convex).

As a final step consider what this PPF would resemble if the economy were composed of many persons with differing degrees of comparative advantage. A little imagination suggests (correctly) that it will have a segment for each individual and continue to have its outward concave form. Hence, a four-person economy in which each person had a different opportunity cost could be represented by the segmented line abcde, in Figure 1.4. Furthermore, we could represent the PPF of an economy with a very large number of such individuals by a somewhat smooth PPF that accompanies the 4-person PPF. The logic for its shape continues to be the same: as we produce less V and more F we progressively bring into play resources, or individuals, whose opportunity cost, in terms of reduced V is higher.

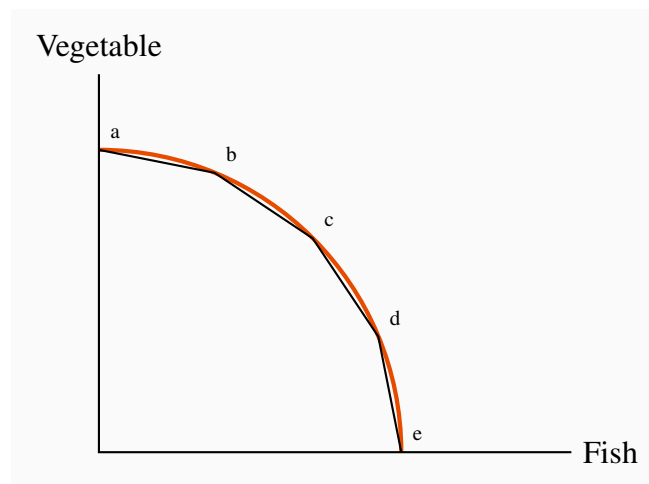


Figure 1.4: A multi-person PPF

The PPF for the whole economy, abcde, is obtained by allocating productive resources most efficiently. With many individuals we can think of the PPF as the *concave envelope* of the individual capabilities.

The outputs V and F in our economic model require just one input – time. But the argument for a concave *PPF* where the economy uses machines, labour, land etc. to produce different products is the same. Furthermore, we generally interpret the *PPF* to define the output possibilities *when it is running at its normal capacity*. In this example, we consider a work week of 36 hours to be the ‘norm’. Yet it is still possible that the economy’s producers might work some additional time in exceptional circumstances, and this would increase total production possibilities. This event would be represented by an outward movement of the *PPF*.

1.6 Aggregate output, growth and business cycles

The *PPF* can also be used to illustrate three aspects of macroeconomics: the level of a nation’s output, the growth of national and per capita output over time, and short run business-cycle fluctuations in national output and employment.

Aggregate output

An economy’s capacity to produce goods and services depends on its endowment of resources and the productivity of those resources. The two-person, two-product examples in the previous section reflect this.

The **productivity of labour**, defined as output per worker or per hour, depends on:

- Skill, knowledge and experience of the labour force;
- **Capital stock**: buildings, machinery, and equipment, and software the labour force has to work with; and
- Current technological trends in the labour force and the capital stock.

The **productivity of labour** is the output of goods and services per worker.

An economy's **capital stock** is the buildings, machinery, equipment and software used in producing goods and services.

The economy's output, which we define by Y , can be defined as the output per worker times the number of workers; hence, we can write:

$$Y = (\text{number of workers employed}) \times (\text{output per worker}).$$

When the employment of labour corresponds to 'full employment' in the sense that everyone willing to work at current wage rates and normal hours of work is working, the economy's actual output is also its capacity output Y_c . We also term this capacity output as **full employment output**:

Full employment output $Y_c = (\text{number of workers at full employment}) \times (\text{output per worker})$.

Suppose the economy is operating with full employment of resources producing outputs of two types: goods and services. In Figure 1.5, PPF_0 shows the different combinations of goods and services that the economy could produce in a particular year using all its labour, capital and the best technology available at the time.

An aggregate economy produces a large variety of outputs in two broad categories. Goods are the products of the agriculture, forestry, mining, manufacturing and construction industries. Services are provided by the wholesale and retail trade, transportation, hospitality, finance, health care, legal and other service sectors. As in the two-product examples used earlier, the shape of the PPF illustrates the opportunity cost of increasing the output of either product type.

Point X_0 on PPF_0 shows one possible structure of capacity output. This combination may reflect the pattern of demand and hence expenditures in this economy. Output structures differ among economies with different income levels. High-income economies spend more on services than

goods and produce higher ratios of services to goods. Middle income countries produce lower ratios of services to goods, and low income countries much lower ratios of services to goods. Different countries also have different *PPF*s and different output structures, depending on their labour forces, labour productivity and expenditure patterns.

Economic growth

Three things contribute to growth in the economy. The labour supply grows as the population expands; the stock of capital grows as spending by business on new offices, factories, machinery and equipment expands; and labour-force productivity grows as a result of experience, the development of scientific knowledge combined with product and process innovations, and advances in the technology of production. Combined, these developments expand capacity output. In Figure 1.5 economic growth shifts the *PPF* out from PPF_0 to PPF_1 .

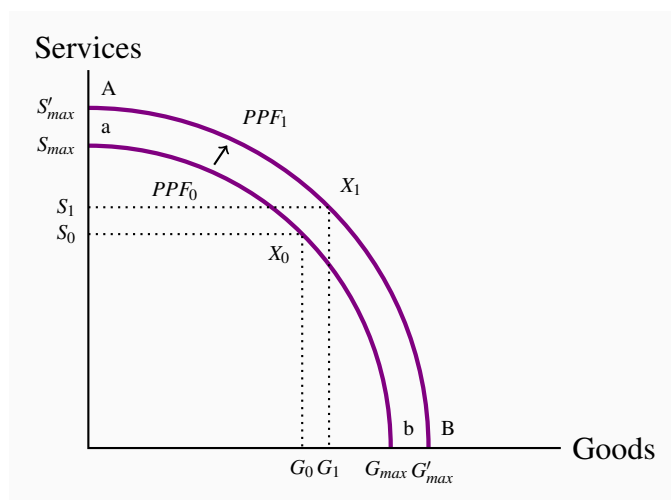


Figure 1.5: Growth and the PPF

Economic growth or an increase in the available resources can be envisioned as an outward shift in the *PPF* from PPF_0 to PPF_1 . With PPF_1 the economy can produce more in both sectors than with PPF_0 .

This basic description of economic growth covers the key sources of growth in total output. Economies differ in their rates of overall economic growth as a result of different rates of growth in labour force, in capital stock, and improvements in the technology. But improvements in standards of living require more than growth in total output. Increases in output *per worker* and *per person* are necessary. Sustained increases in living standards require sustained growth in labour productivity based on advances in the technologies used in production.

Recessions and booms

The objective of economic policy is to ensure that the economy operates on or near the *PPF* – it would use its resources to capacity and have minimal unemployment. However, economic conditions are seldom tranquil for long periods of time. Unpredictable changes in business expectations of future profits, in consumer confidence, in financial markets, in commodity and energy prices, in output and incomes in major trading partners, in government policy and many other events disrupt patterns of expenditure and output. Some of these changes disturb the level of total expenditure and thus the demand for total output. Others disturb the conditions of production and thus the economy's production capacity. Whatever the exact cause, the economy may be pushed off its current *PPF*. If expenditures on goods and services decline the economy may experience a **recession**. Output would fall short of capacity output and unemployment would rise. Alternatively, times of rapidly growing expenditure and output may result in an economic **boom**: output and employment expand beyond capacity levels.

An **economic recession** occurs when output falls below the economy's capacity output.

A **boom** is a period of high growth that raises output above normal capacity output.

Recent history provides examples. Following the U.S financial crisis in 2008-09 many industrial countries were pushed into recessions. Expenditure on new residential construction collapsed for lack of income and secure financing, as did business investment, spending and exports. Lower expenditures reduced producers' revenues, forcing cuts in output and employment and reducing household incomes. Lower incomes led to further cutbacks in spending. In Canada in 2009 aggregate output declined by 2.9 percent, employment declined by 1.6 percent and the unemployment rate rose from 6.1 percent in 2008 to 8.3 percent. Although economic growth recovered, that growth had not been strong enough to restore the economy to capacity output at the end of 2011. The unemployment rate fell to 7.4 but did not return to its pre-recession value.

An economy in a recession is operating inside its *PPF*. The fall in output from X to Z in Figure 1.6 illustrates the effect of a recession. Expenditures on goods and services have declined. Output is less than capacity output, unemployment is up and some plant capacity is idle. Labour income and business profits are lower. More people would like to work and business would like to produce and sell more output but it takes time for interdependent product, labour and financial markets in the economy to adjust and increase employment and output. Monetary and fiscal policy may be needed to stimulate demand, increase output and employment and move the economy back to capacity output and full employment. The development and implementation of such policies form the core of macroeconomics.

Alternatively, an unexpected increase in demand for exports would increase output and employment. Higher employment and output would increase incomes and expenditure, and in the process spread the effects of higher output sales to other sectors of the economy. The economy would

move outside its *PPF* as at W in Figure 1.6 by using its resources more intensively than normal. Unemployment would fall and overtime work would increase. Extra production shifts would run plant and equipment for longer hours and work days than were planned when it was designed and installed. Output at this level may not be sustainable, because shortages of labour and materials along with excessive rates of equipment wear and tear would push costs and prices up. Again we will examine how the economy reacts to such a state in our macroeconomic analysis.

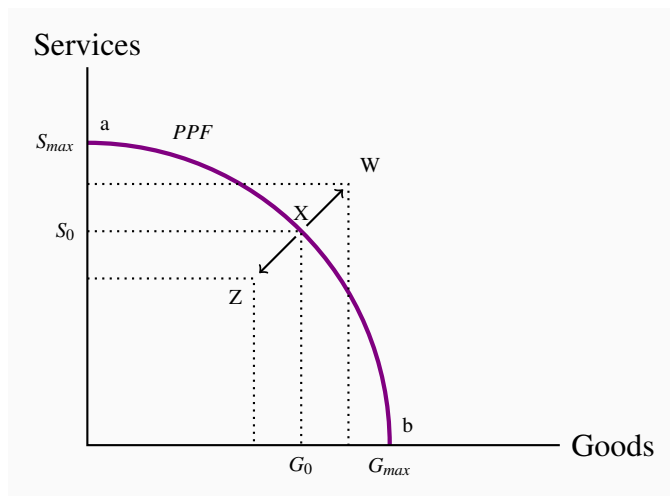


Figure 1.6: Booms and recessions

Economic recessions leave the economy below its normal capacity; the economy might be driven to a point such as Z. Economic expansions, or booms, may drive capacity above its normal level, to a point such as W.

Output and employment in the Canadian economy over the past twenty years fluctuated about growth trend in the way Figure 1.6 illustrates. For several years prior to 2008 the Canadian economy operated slightly above the economy's capacity; but once the recession arrived monetary and fiscal policy were used to fight it – to bring the economy back from a point such as Z to a point such as X on the *PPF*.

Macroeconomic models and policy

The *PPF* diagrams illustrate the main dimensions of macroeconomics: capacity output, growth in capacity output and business cycle fluctuations in actual output relative to capacity. But these diagrams do not offer explanations and analysis of macroeconomic activity. We need a macroeconomic *model* to understand and evaluate the causes and consequences of business cycle fluctuations. As we shall see, these models are based on explanations of expenditure decisions by households and business, financial market conditions, production costs and producer pricing decisions at different levels of output. Models also capture the objectives fiscal and monetary policies

and provide a framework for policy evaluation. A full macroeconomic model integrates different sector behaviours and the feedback across sectors that can moderate or amplify the effects of changes in one sector on national output and employment.

Similarly, an economic growth model provides explanations of the sources and patterns of economic growth. Demographics, labour market structures and institutions, household expenditure and saving decisions, business decisions to spend on new plant and equipment and on research and development, government policies in support of education, research, patent protection, competition and international trade conditions interact in the growth process. They drive the growth in the size and productivity of the labour force, the growth in the capital stock, and the advances in technology that are the keys to growth in aggregate output and output per person.

Conclusion

We have covered a lot of ground in this introductory chapter. It is intended to open up the vista of economics to the new student in the discipline. Economics is powerful and challenging, and the ideas we have developed here will serve as conceptual foundations for our exploration of the subject. Our next chapter deals with methods and models in greater detail.

KEY CONCEPTS

Macroeconomics studies the economy as system in which feedback among sectors determine national output, employment and prices.

Microeconomics is the study of individual behaviour in the context of scarcity.

Mixed economy: goods and services are supplied both by private suppliers and government.

Model is a formalization of theory that facilitates scientific inquiry.

Theory is a logical view of how things work, and is frequently formulated on the basis of observation.

Opportunity cost of a choice is what must be sacrificed when a choice is made.

Production possibility frontier (PPF) defines the combination of goods that can be produced using all of the resources available.

Economy-wide PPF is the set of goods combinations that can be produced in the economy when all available productive resources are in use.

Productivity of labour is the output of goods and services per worker.

Capital stock: the buildings, machinery, equipment and software used in producing goods and services.

Full employment output $Y_c = (\text{number of workers at full employment}) \times (\text{output per worker})$.

Recession: when output falls below the economy's capacity output.

Boom: a period of high growth that raises output above normal capacity output.

EXERCISES FOR CHAPTER 1

Exercise 1.1. An economy has 100 workers. Each one can produce four cakes or three shirts, regardless of the number of other individuals producing each good. Assuming all workers are employed, draw the *PPF* for this economy, with cakes on the vertical axis and shirts on the horizontal axis.

- How many cakes can be produced in this economy when all the workers are cooking?
- How many shirts can be produced in this economy when all the workers are sewing?
- Join these points with a straight line; this is the *PPF*.
- Label the inefficient and unattainable regions on the diagram.

Exercise 1.2. In the table below are listed a series of points that define an economy's production possibility frontier for goods *Y* and *X*.

<i>Y</i>	1000	900	800	700	600	500	400	300	200	100	0
<i>X</i>	0	1600	2500	3300	4000	4600	5100	5500	5750	5900	6000

- Plot these points to scale, on graph paper, or with the help of a spreadsheet.
- Given the shape of this *PPF* is the economy made up of individuals who are similar or different in their production capabilities?
- What is the opportunity cost of producing 100 more *Y* at the combination ($X = 5500, Y = 300$).
- Suppose next there is technological change so that at every output level of good *Y* the economy can produce 20 percent more *X*. Compute the co-ordinates for the new economy and plot the new *PPF*.

Exercise 1.3. Using the *PPF* that you have graphed using the data in Exercise 1.2, determine if the following combinations are attainable or not: ($X = 3000, Y = 720$), ($X = 4800, Y = 480$).

Exercise 1.4. You and your partner are highly efficient people. You can earn \$50 per hour in the workplace; your partner can earn \$60 per hour.

- What is the opportunity cost of one hour of leisure for you?
- What is the opportunity cost of one hour of leisure for your partner?

- (c) Now draw the *PPF* for yourself where hours of leisure is on the horizontal axis and income in dollars is on the vertical axis. You can assume that you have 12 hours of time each day to allocate to work (income generation) or leisure.
- (d) Draw the *PPF* for your partner.
- (e) If there is no domestic cleaning service in your area, which of you should do the housework, assuming that you are equally efficient at housework?

Exercise 1.5. Louis and Carrie Anne are students who have set up a summer business in their neighbourhood. They cut lawns and clean cars. Louis is particularly efficient at cutting the grass – he requires one hour to cut a typical lawn, while Carrie Anne needs one and one half hours. In contrast, Carrie Anne can wash a car in a half hour, while Louis requires three quarters of an hour.

- (a) If they decide to specialize in the tasks, who should cut the grass and who should wash cars?
- (b) If they each work a twelve hour day, how many lawns can they cut and how many cars can they wash if they specialize in performing the work?

Exercise 1.6. In Exercise 1.5, illustrate the *PPF* for each individual where lawns are on the horizontal axis and car washes on the vertical axis. Carefully label the intercepts. Then construct the economy-wide *PPF* using this information.

Exercise 1.7. Continuing with the same data set, suppose Carrie Anne’s productivity improves so that she can now cut grass as efficiently as Louis; that is, she can cut grass in one hour, and can still wash a car in one half of an hour.

- (a) In a new diagram draw the *PPF* for each individual.
- (b) In this case does specialization matter if they are to be as productive as possible as a team?
- (c) Draw the new *PPF* for the whole economy, labelling the intercepts and kink point coordinates.

Exercise 1.8. Using the economy-wide *PPF* you have constructed in Exercise 1.7, consider the impact of technological change in the economy. The tools used by Louis and Carrie Anne to cut grass and wash cars increase the efficiency of each worker by a whopping 25%. Illustrate graphically how this impacts the aggregate *PPF* and compute the three new sets of coordinates.

Exercise 1.9. Going back to the simple *PPF* plotted for Exercise 1.1 where each of 100 workers can produce either four cakes or three shirts, suppose a recession reduces demand for the outputs to 220 cakes and 129 shirts.

- (a) Plot this combination of outputs in the diagram that also shows the *PPF*.
- (b) How many workers are needed to produce this output of cakes and shirts?
- (c) What percentage of the 100 worker labour force is unemployed?

In this chapter we will explore:

- 2.1 Economic theories and models
- 2.2 Variables, data & index numbers
- 2.3 Testing, accepting, and rejecting models
- 2.4 Diagrams and economic analysis
- 2.5 Ethics, efficiency and beliefs

Economists, like other scientists and social scientists are interested observers of behaviour and events. Economists are concerned primarily with the economic causes and consequences of what they observe. They want to understand the economics of an extensive range of human experience including: money, government finances, industrial production, household consumption, inequality in income distribution, war, monopoly power, professional and amateur sports, pollution, marriage, music, art and much more.

Economists approach these issues using economic theories and models. To present, explain, illustrate and evaluate their theories and models they have developed a set of techniques or tools. These involve verbal descriptions and explanations, diagrams, algebraic equations, data tables and charts and statistical tests of economic relationships.

This chapter covers these basic techniques of economic analysis.

2.1 Observations, theories and models

In recent years the prices of residential housing have been rising at the same time as conventional mortgage interest rates have been low and falling relative to earlier time periods. These changes might be unrelated, each arising from some other conditions, or they might be related with rising housing prices pushing interest rates down, or perhaps low and falling mortgage rates push housing prices up. Each is a possible hypothesis or theory about the relationship between house prices and interest rates.

An economist would choose the third explanation based on economic logic. Mortgage rates determine the cost of financing the purchase of a house. A lower mortgage rate means lower monthly payments per dollar of financing. As a result buyers can purchase higher priced houses for any given monthly payment. Low and falling mortgage rates allow potential buyers to offer higher prices and potential sellers to expect higher prices. Lower mortgage rates may be an important cause of higher house prices. The reverse argument follows, namely that rising mortgage rates would cause lower house prices. In general terms, house prices are *inversely related* to mortgage interest rates.

A two dimensional diagram such as Figure 2.1 is an effective way to illustrate this basic model. Mortgage interest rates are measured on the vertical axis. Average house prices are measured on the horizontal axis. The *downward sloping line* in the diagram illustrates the *inverse* relationship between a change in mortgage rates and house prices predicted by the model. In the diagram, a fall in mortgage rates from 6.0 percent to 5.0 percent raises average house prices from P_1 to P_2 .



Figure 2.1: House prices and mortgage prices

Of course this model is very simple and naive. It formalizes an essential economic element of the theory. House prices may also depend on other things such as population growth and urbanization, new house construction, rental rates, family incomes and wealth, confidence in future employment and economic growth and so forth. By concentrating on interest rates and house prices the model argues that this relationship is the key explanation of short term changes in house prices. Other factors may be important but they evolve and change more slowly than mortgage rates.

A model reduces and simplifies. Its focus is on the relationship the economist sees as the most important. In this example it assumes that things other than the mortgage rate that might affect house prices are constant. A change in one or more of the conditions assumed constant might

change house prices at every interest rate. That would mean a change the *position* of the mortgage rate-house price line but not the basic mortgage rate-house price relationship.

The mortgage rate-house price model can also be illustrated using simple algebra. Equation 2.1 describes average house price P_H in terms of a constant P_{H_0} and the mortgage rate MR .

$$P_H = P_{H_0} - bMR \quad (2.1)$$

The negative sign in the equation defines the inverse relationship between house prices and mortgage rates suggested by the model. A fall in the mortgage rate MR would cause an increase in the average house price P_H .

The size of the change in the average house price caused by a change in the mortgage rate is measured by the parameter b in the equation. We argue that the sign attached to b is negative and of that b is significantly large, but that argument needs to be tested. A model is only useful if the economic relationship it defines is supported by actual observations. Observations generate the facts or data needed for the conception and testing of a model.

2.2 Variables, data and index numbers

Economic theories and models are concerned with economic variables. **Variables** are measures that can take on different sizes. The interest rate on a student loan, for example, is a variable with a certain value at a point in time but perhaps a different value at an earlier or later date. Economic theories and models explain the causal relationships between variables.

Variables: measures that can take on different values.

Data are the recorded values of variables. Sets of data provide specific values for the variables we want to study and analyze. Knowing that the Don Valley Parkway is congested does not tell us how slow our trip to downtown Toronto will be. To choose the best route downtown we need to ascertain the *degree of congestion*—the data on traffic density and flow on alternative routes. A model is useful because it defines the variables that are most important and to the analysis of travel time and the data that are required for that analysis.

Data: recorded values of variables.

Sets of data also help us to test our models or theories, but first we need to pay attention to the economic logic involved in observations and modelling. For example, if sunspots or baggy pants were found to be correlated with economic expansion, would we consider these events a coincidence or a key to understanding economic growth? The observation is based on facts or data but it need not have any economic content. The economist's task is to distinguish between coincidence and economic causation.

While the more frequent wearing of loose clothing in the past may have been associated with economic growth because they both occurred at the same time (correlation), one could not argue on a logical basis that this behaviour causes good economic times. Therefore, the past association of these variables should be considered as no more than a coincidence.

Once specified on the basis of economic logic, a model must be tested to determine its usefulness in explaining observed economic events. The earlier example of a model of house prices and mortgage rates was based on the economics of the effect of financing cost on expenditure and prices. But we did not test that model by confronting it with the data. It may be that effects of mortgages rates are insignificant compared to other influences on house prices.

Time-series data

Data come in several forms. One form is **time-series**, which reflects a set of measurements made in sequence at different points in time. Table 2.1 reports the annual time series values for several price series. Such information may also be presented in charts or graphs. Figure 2.1 plots the data from column 2, and each point represents the data observed for a specific time period. The horizontal axis reflects time in years, the vertical axis price in dollars.

Time-series: a set of measurements made sequentially at different points in time.

1	2	3	4	5
Date	Price of detached bungalows, N. Vancouver	House price index	CPI	Real house price index
1999Q1	330,000	100.0	100.00	100.00
2000Q1	345,000	104.55	101.29	103.21
2001Q1	350,000	106.06	104.63	101.37
2002Q1	360,000	109.09	105.49	103.41
2003Q1	395,000	119.70	108.61	110.21
2004Q1	434,000	131.52	110.01	119.55
2005Q1	477,000	144.55	112.81	128.13
2006Q1	580,000	175.76	114.32	153.75
2007Q1	630,000	190.91	117.33	162.71
2008Q1	710,000	215.15	118.62	181.38
2009Q1	605,000	183.33	120.56	152.07
2010Q1	740,000	224.24	125.40	178.96
2011Q1	800,000	242.42	129.06	187.83
2012Q1	870,000	263.33	131.00	210.02

Table 2.1: House prices and price indexes

Source: Prices for North Vancouver houses come from Royal Le Page; CPI from Statistics Canada, CANSIM II, V41692930 and author's calculations.

Annual data report one observation per year. We could, alternatively, have presented them in quarterly, monthly, or even weekly form. The frequency we use depends on the purpose: If we are interested in the longer-term trend in house prices, then the annual form suffices. In contrast, financial economists, who study the behaviour of stock prices, might not be content with daily or even hourly prices; they may need prices minute-by-minute. Such data are called **high-frequency** data, whereas annual data are **low-frequency** data.

High (low) frequency data: series with short (long) intervals between observations.

When data are presented in charts or when using diagrams the scales on the axes have important visual effects. Different scales on either or both axes alter the perception of patterns in the data. To illustrate this, the data from columns 1 and 2 of Table 2.1 are plotted in Figures 2.2 and 2.3, but with a change in the scale of the vertical axis.

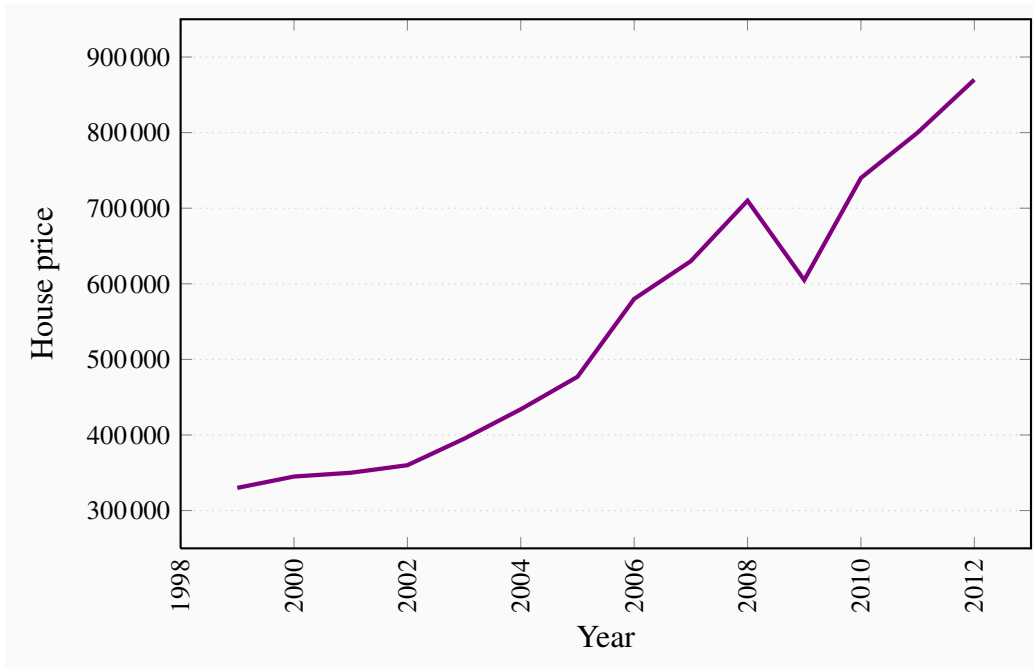


Figure 2.2: House prices in dollars North Vancouver 1999-2012

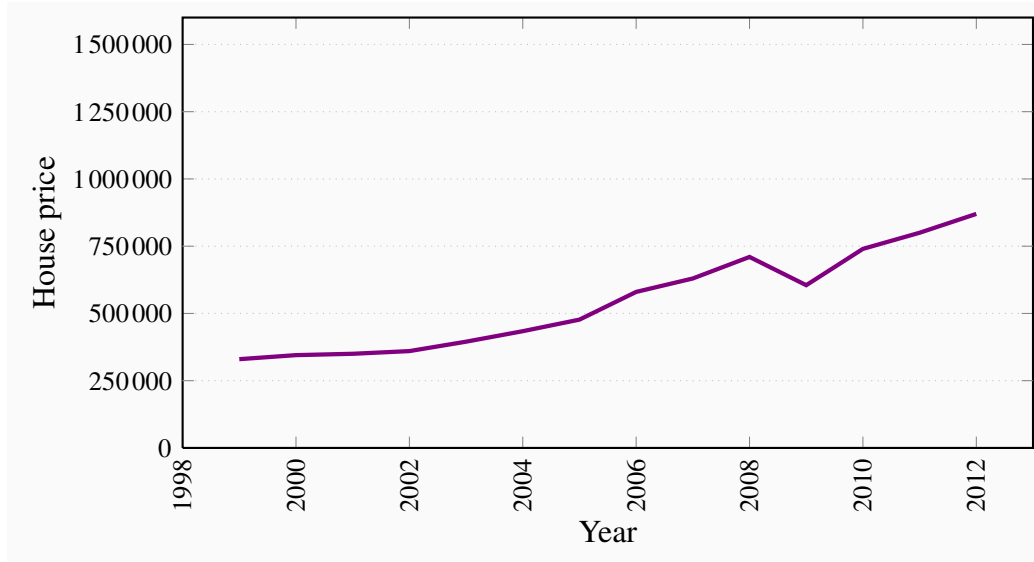


Figure 2.3: House prices in dollars North Vancouver 1999-2012

The greater *apparent* slope in Figure 2.2 might easily be interpreted to mean that prices increased more steeply than suggested in Figure 2.3. But a careful reading of the axes reveals that this is not so; using different scales when plotting data or constructing diagrams can mislead the unaware viewer.

Cross-section data

In contrast to time-series data, **cross-section** data record the values of different variables at a point in time. Table 2.2 contains a cross-section of unemployment rates for Canada and Canadian provinces economies. For January 2012 we have a snapshot of the provincial economies at that point in time, likewise for the months until June. This table therefore contains **repeated cross-sections**.

When the unit of observation is the same over time such repeated cross sections are called longitudinal data. For example, a health survey that followed and interviewed the same individuals over time would yield longitudinal data. If the individuals differ each time the survey is conducted, the data are repeated cross sections. **Longitudinal data** therefore follow the same units of observation through time.

	Jan	Feb	Mar	Apr	May	Jun
CANADA	7.6	7.4	7.2	7.3	7.3	7.2
NFLD	13.5	12.9	13.0	12.3	12.0	13.0
PEI	12.2	10.5	11.3	11.0	11.3	11.3
NS	8.4	8.2	8.3	9.0	9.2	9.6
NB	9.5	10.1	12.2	9.8	9.4	9.5
QUE	8.4	8.4	7.9	8.0	7.8	7.7
ONT	8.1	7.6	7.4	7.8	7.8	7.8
MAN	5.4	5.6	5.3	5.3	5.1	5.2
SASK	5.0	5.0	4.8	4.9	4.5	4.9
ALTA	4.9	5.0	5.3	4.9	4.5	4.6
BC	6.9	6.9	7.0	6.2	7.4	6.6

Table 2.2: Unemployment rates, Canada and Provinces, monthly 2012, seasonally adjusted

Source: Statistics Canada CANSIM Table 282-0087

Cross-section data: values for different variables recorded at a point in time.

Repeated cross-section data: cross-section data recorded at regular or irregular intervals.

Longitudinal data: follow the same units of observation through time.

Index numbers

It is important in economic analysis to discuss and interpret data in a meaningful manner. **Index numbers** help us greatly in doing this. They are values of a given variable, or an average of a set of variables expressed relative to a base value. The key characteristics of indexes are that they are *not dependent upon the units of measurement of the data in question, and they are interpretable easily with reference to a given base value*. To illustrate, let us change the price data in column 2 of Table 2.1 into index number form.

Index number: value for a variable, or an average of a set of variables, expressed relative to a given base value.

The first step is to choose a base year as a reference point. This could be any one of the periods. We will simply take the first period as the year and *set the price index value equal to 100 in that year*. The value of 100 is usually chosen in order to make comparisons simple, but in some cases a base year value of 1.0 is used. If the base year value of 100 is used, the value of index in any year t is:

$$\text{Value of index} = \frac{\text{Absolute value in year } t}{\text{Absolute value in base year}} \times 100 \quad (2.2)$$

Suppose we choose 1999 as the base year for constructing an index of the house prices given in Table 2.1 House prices in that year were \$330,000. Then the *index for the base year* has a value:

$$\text{Index in 1999} = \frac{\$330,000}{\$330,000} \times 100 = 100$$

Applying the method to each value in column 2 yields column 3, which is now in index number form. For example, the January 2003 value is:

$$\text{Index in 2003} = \frac{\$395,000}{\$330,000} \times 100 = 119.7$$

Each value in the index is interpreted relative to the value of 100, the base price in January 1999. The beauty of this column lies first in its *ease of interpretation*. For example, by 2003 the price increased to 119.7 points relative to a value of 100. This yields an immediate interpretation: The index has increased by 19.7 points *per hundred* or *percent*. While it is particularly easy to compute a percentage change in a data series when the base value is 100, it is not necessary that the reference point have a value of 100. By definition, a **percentage change** is given by the change in values relative to the initial value, multiplied by 100. For example, the percentage change in the price from 2006 to 2007, using the price index is: $(190.91 - 175.76)/175.76 \times 100 = 8.6$ percent.

Percentage change = (change in values)/original value \times 100.

Furthermore, index numbers enable us to make *comparisons with the price patterns for other goods* much more easily. If we had constructed a price index for wireless phones, which also had a base value of 100 in 1999, we could make immediate comparisons without having to compare one set

of numbers defined in dollars with another defined in tens of thousands of dollars. In short, index numbers simplify the interpretation of data.

Composite index numbers

Index numbers have even wider uses than those we have just described. Suppose you are interested in the price trends for all fuels as a group in Canada during the last decade. You know that this group includes coal, natural gas, and oil, but you suspect that these components have not all been rising in price at the same rate. You also know that, while these fuels are critical to the economy, some play a bigger role than others, and therefore should be given more importance, or weight, in a general fuel price index. In fact, the official price index for these fuels is a *weighted average of the component price indexes*. The fuels that are more important get a heavier weighting in the overall index. For example, if oil accounts for 60 percent of fuel use, natural gas for 25 percent, and coal for 15 percent, the price index for fuel could be computed as follows:

$$\text{Fuel price index} = (\text{oil index} \times 0.6) + (\text{natural gas index} \times 0.25) + (\text{coal index} \times 0.15) \quad (2.3)$$

To illustrate this, Figure 2.4 presents the price trends for these three fuels. The data come from Statistics Canada's CANSIM database. In addition, the overall fuel price index is plotted. It is frequently the case that components do not display similar patterns, and in this instance the composite index follows oil most closely, reflecting the fact that oil has the largest weight.

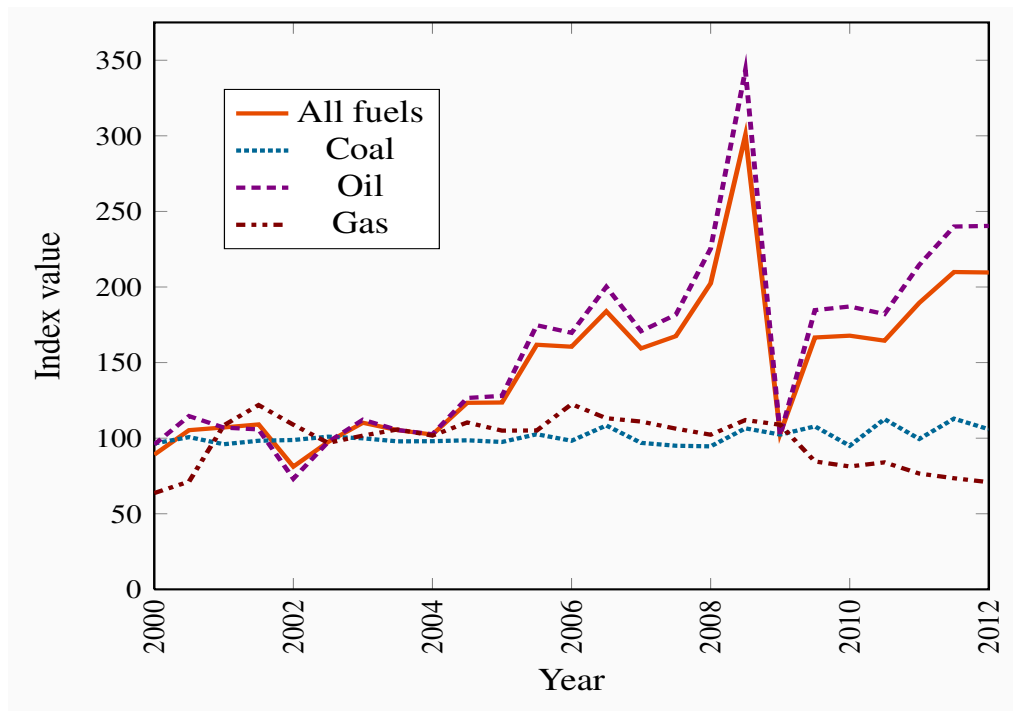


Figure 2.4: Composite fuel price index

Source: Statistics Canada. Table 330-0007 – Raw materials price indexes, monthly (index, 2002=100), CANSIM.

Other composite price indexes

The fuels price index is just one of many indexes constructed to measure a composite group of economic variables. There are also published indexes of commodity prices, including and excluding fuels, agricultural prices, average hourly earnings, industrial production, unit labour costs, Canadian dollar effective exchange rate (CERI), the S&P/TSX stock market prices and consumer prices to list just a few. All these indexes are designed to reduce the complexity of the data on key sectors of the economy and important economic conditions.

The **consumer price index (CPI)** is the most widely quoted price index in the economy. It measures the average price level in the economy and changes in the CPI provide measures of the rate at which consumer goods and services change in price—**inflation** if prices increase, **deflation** if prices decline.

The CPI is constructed in two stages. First, a consumer expenditure survey is used to establish the importance or weight of each of eight categories in a ‘basket’ of goods and services. Then the cost of this basket of services in a particular year is compared to its cost in the chosen base year. With this base year cost of the basket set at 100 the ratio of the cost of the same basket in any other year

to its cost in the base year multiplied by 100 gives the CPI for that year. The CPI for any given year is:

$$\text{CPI}_t = \frac{\text{Cost of basket in year } t}{\text{Cost of basket in base year}} \times 100 \quad (2.4)$$

Consumer price index: the average price level for consumer goods and services

Inflation rate: the annual percentage increase in the consumer price index

Deflation rate: the annual percentage decrease in the consumer price index

Using price indexes

The CPI is useful both as an indicator of how much prices change in the aggregate, and also as an indicator of *relative price* changes. Column 4 of Table 2.1 provides the Vancouver CPI with the same base year as the North Vancouver house price index. Note how the two indexes move very differently over time. The price of housing has increased considerably *relative to the overall level of prices* in the local economy, as measured by the CPI: Housing has experienced a *relative price increase*, or a **real price index**. This real increase is to be distinguished from the **nominal price index**, which is measured without reference to overall prices. The real price index for housing (or any other specific product) is obtained by dividing its specific price index by the CPI.

$$\text{Real house price index} = \frac{\text{nominal house price index}}{\text{CPI}} \times 100$$

Real price index: a nominal price index divided by the consumer price index, scaled by 100.

Nominal price index: the current dollar price of a good or service.

The resulting index is given in column 5 of Table 2.1. This index has a simple interpretation: It tells us by how much the price of Vancouver houses has changed relative to the general level of prices for goods and services. For example, between 1999 and 2004 the number 119.55 in column 5 for the year 2004 indicates that housing increased in price by 19.55 percent *relative to prices in general*.

Here is a further simple example. Table 2.3 reports recent annual data on indexes of **nominal earnings**, measured in current dollars, both average weekly and hourly rates, over the 2003-2011 time period. The table also reports the consumer price index for the same time period. To simplify the illustration all indexes have been *re-based* to 2003=100 by dividing the reported value of the index in each year by its value in 2003 and multiplying by 100.

The table shows the difference between changes in nominal and real earnings. **Real earnings** are measured in constant dollars adjusted for changes in the general price level. The adjustment is made by dividing the indexes of nominal earnings in each year by the consumer price index in that year and multiplying by 100.

Nominal earnings: earnings measured in current dollars.

Real earnings: earnings measure in constant dollars to adjust for changes in the general price level.

As measured by the nominal weekly and hourly indexes, nominal earnings increased by 26 to 27 percent over the eight year period 2003-2011. However, the general price level as measured by the consumer price index (CPI) increased by close to 17 percent over the same period. As a result, real earnings, measured in terms of the purchasing power of nominal earnings increased by only about 9 percent, notable less than in 26 percent increase in nominal earnings.

Nominal earnings			Real earnings		
Year	Average weekly earnings	Average hourly earnings	CPI	Average weekly earnings	Average hourly earnings
2003	100.0	100.0	100.0	100.0	100.0
2004	102.7	102.7	101.8	100.8	100.9
2005	106.7	106.2	104.2	102.4	101.9
2006	109.4	108.8	106.1	103.0	102.5
2007	114.1	113.8	108.5	105.2	104.9
2008	117.4	117.7	111.0	105.7	106.1
2009	119.2	121.3	111.3	107.1	109.0
2010	123.5	125.0	113.3	109.0	110.3
2011	126.6	127.5	116.6	108.6	109.4

Table 2.3: Nominal and real earnings in Canada 2003-2011

Source: Statistics Canada, CANSIM Series V1558664, V1606080 and V41690914 and author's calculations

These observations illustrate two important points. First the distinction between real and nominal values is very important. If the general price level is changing, changes in real values will differ from changes in nominal values. Real values change by either less or more than changes in nominal values. Second, in addition to tracking change over time, index numbers used in combination simplify the adjustment from nominal to real values, as shown in both Table 2.1 and 2.3.

However, a word of caution is necessary. Index numbers can be used to track both nominal and real values over time but they do not automatically adjust for change in the quality of products and services or the changing patterns of output and use in the cases of composite indexes. Index number bases and weights need constant adjustment to deal with these issues.

2.3 Testing economic models & analysis

Let us now investigate the interplay between models and data by means of a couple of examples.

The first simple economic model we proposed related house prices and mortgage rates. That

model argued that an important cause of the recently observed rise in house prices was the decline in mortgage interest rates. Figure 2.1 illustrated that relationship with a diagram and Equation 2.1 put the model in terms of basic algebra.

The logic of the model is based on the effects of the costs of financing on prices and specifically on house prices. Lower mortgage rates make financing house purchases more affordable and lower the income criteria that mortgage lenders apply to mortgage approvals. Potential buyers can afford higher priced houses and potential sellers may expect to get more for their properties. As a result, our model argues that lower mortgage rates push up house prices.

There is also an important policy issue here. On several occasions the federal government minister of finance has expressed concerns about low mortgage rates and long mortgage terms as a potential cause of a house price ‘bubble’. Experience with house price increases in other countries leading up to the financial crisis of 2008 provides a solid basis for this concern. As a result starting in 2008 and as recently as 2012 the federal government has taken action to discourage competitive reductions in mortgage rates, to limit the terms and amortization periods and to increase down payment requirements for new mortgage. The underlying rationale for these actions is the belief that higher mortgage rates, shorter terms and higher down payments will relieve upward pressure on house prices.

Let us now formalize the above ideas into an economic model of house prices. Several factors influence house prices and mortgage rates are one; another is the income of the potential buyers; a third is the number of houses or condominiums that come on the market – either new or not; a fourth could be the growth in population in the area where we are exploring house prices. If we think these are the main determinants of house prices then we could formalize this theory in the following model:

$$\text{House prices} = f(\text{mortgage rate, incomes, supply of housing offered on the market, population growth, } \dots)$$

The notation $f(\dots)$ means that the variable on the left-hand side of the equation is *a function of* the variables inside the parentheses. This equation is, therefore, an economic model that links behaviour to its main determinants.

Evidence

To support or reject the above models, we need to confront them with data. Unlike natural sciences, economics is a social science; therefore we rarely have data that come from laboratory experiments. Most of our research uses data collected over periods of time during which many relevant factors change simultaneously. A basic challenge in testing is how to disentangle the separate influences of these changing factors.

Table 2.4 contains data on the 5-year conventional mortgage interest rate and an index of resale-housing prices, quarterly for the period from the first quarter of 2007 to the fourth quarter of 2011. The house price index has a base value of 100 in the last quarter of 2006, and reflects a weighted average of detached bungalows, executive and detached two-story houses. Figure 2.5 is a **scatter diagram** of the data in Table 2.4.

A **Scatter diagram** plots pairs of values simultaneously observed for two variables.

A clear negative relationship between the two variables is evident in Figure 2.5. A higher mortgage rate is associated with lower house prices.

Fitting lines through the scatter plot

A line through the scatter of points in Figure 2.5 shows the average relationship between mortgage rates and house prices. A challenge is to define the line that most accurately characterizes the relationship. This task is the job of **econometricians**, who practice **econometrics**. Econometrics is the science of examining and quantifying relationships between economic variables. It attempts to determine the separate influences of each variable, in an environment where many things move simultaneously.

Econometrics is the science of examining and quantifying relationships between economic variables.

Econometricians are individuals who study econometrics.

In two dimensions, the line drawn through the scatter is chosen to minimize the sum of distances (or distances squared) between the line and the various points. It is called a **regression line** or a trend line if the data are in time-series form. Computer algorithms that do this are plentiful, and fortunately computers can work in many dimensions in order to capture the influences of *all* the variables simultaneously¹.

Regression line: representation of the average relationship between two variables in a scatter diagram.

¹Note in Figure 2.5 that the vertical axis begins at the value of 4, and the horizontal axis begins at a value of 100.



Figure 2.5: House prices and the mortgage rate

Year, quarter	5-year conventional mortgage rate	Resale house price index 2006q4 = 100
2007Q1	6.5	108.4
2007Q2	7.2	118.4
2007Q3	7.2	128.7
2007Q4	7.5	139.4
2008Q1	7.2	150.5
2008Q2	7.2	157.1
2008Q3	6.9	160.9
2008Q4	6.8	157.2
2009Q1	5.8	149.2
2009Q2	5.8	143.4
2009Q3	5.5	142.2
2009Q4	5.5	149.9
2010Q1	5.9	167.3
2010Q2	5.9	183.7
2010Q3	5.4	195.4
2010Q4	5.2	207.5
2011Q1	5.3	218.5
2011Q2	5.4	231.0
2011Q3	5.2	246.9
2011Q4	5.3	262.5

Table 2.4: Mortgage rates and house prices Canada 2007-2011

Source: Mortgage rate: Statistics Canada, CANSIM Series V122521; Resale Housing Price index: www.royallepage.com, and authors' calculations.

2.4 Diagrams and economic analysis

Much of our economic analysis can be developed with the help of simple two-dimensional linear diagrams. Such diagrams and graphics contain economic information – information that can be obtained by examining the properties of the regression lines that we fit through scatter plots. Consider another linear example: Imagine that we survey a group of economics students on their car use and how it would vary with a tax imposed on gasoline. Such a tax might be a carbon tax designed to reduce greenhouse gases. Our survey involves asking them how many liters of gas they would purchase at different tax rates. Evidently, at high rates they purchase less and at low rates they purchase more.

Having performed the survey, and plotted the scatter of points that represent their answers, we again fit a regression line through the points and project this regression line to meet each axis. The outcome to our experiment is represented in Figure 2.6. The line meets the vertical axis at a value of \$4 and the horizontal axis at 20 liters. The \$4 intercept value means that if the tax, which goes on top of the distributor's price, becomes this high, no student will drive their car (gasoline purchases are zero). In contrast, if the tax falls towards zero and only the distributor's price is payable, students will use 20 liters of gas per week. And the downward slope of the line tells us that more gasoline is purchased at lower tax rates.

When the function is a straight line, two pieces of information fully describe the relationship: the **intercept** and the **slope**. The vertical intercept is the height of the line when the variable on the horizontal axis has a zero value – in Figure 2.6 it has a value of 4.

Intercept of a line: height of the line on one axis when the value of the variable on the other axis is zero.

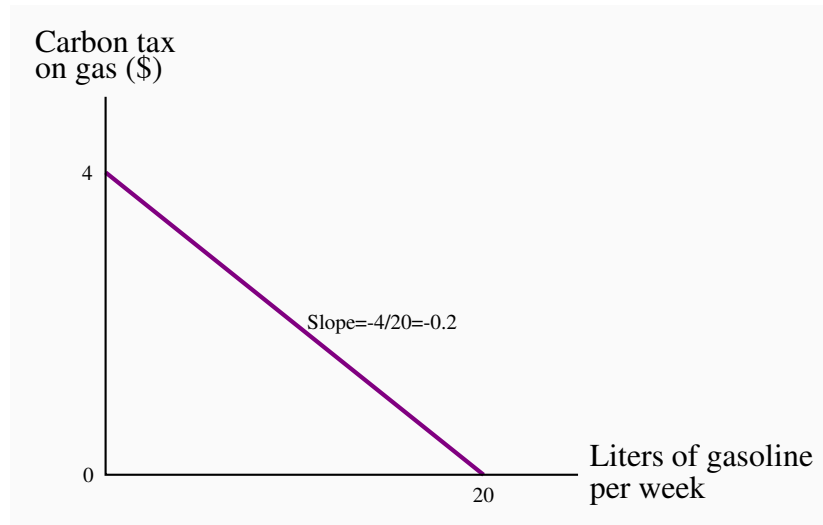


Figure 2.6: A negative linear relationship

A straight line is defined totally by the intercept – where the line meets one of the axes, and the slope – the ratio of the vertical to horizontal distances over any line segment. Downward sloping lines have negative slope; upward sloping lines have positive slope.

The slope of the line indicates the amount by which the variable on the vertical axis increases in response to a change in the value of the variable on the horizontal axis. Since this is a straight line, the slope is constant throughout. It is measured as the ratio of the vertical distance divided by the horizontal distance for any segment of the line.

Slope of a line: ratio of the change in the value of the variable measured on the vertical axis to the change in the value of the variable measured on the horizontal axis (i.e.: rise/run).

In this example, that ratio is given by $-4/20 = -1/5 = -0.2$. It is negative, since an increase in one variable is associated with a decrease in the other. We can now define a linear equation for this regression line:

$$T = 4 - 0.2 \times L.$$

T denotes the tax and L defines the liters of gas. To verify that this indeed represents the line, remember that the (vertical) intercept reflects the value of T when L is zero. In this equation a zero value of L yields:

$$T = 4 - 0.2 \times 0 = 4.$$

Second, the number 0.2 is the slope. It indicates that, for every unit change in L , the T variable changes by 0.2 points. Since there is a negative sign governing the term, an increase in L is associated with a *decline* in T . In geometric terms; the line is negatively sloped.

It is worth repeating that this line is an average representation of the relationship between the two variables; it does not go through every point in the scatter diagram. For any value of one of the variables we feed into this equation, we obtain a corresponding value for the other variable. The prediction therefore always lies on the line, whereas the actual value seldom does. When the predictions and the actual values are very close to one another, i.e., where the scatter is closely concentrated around the regression line, we say that the line is a *good fit*.

Finally note that economic relationships need not be linear; we could imagine fitting a slightly curved function through the scatter in Figure 2.5. Such a curved function might result in the points being slightly closer to such a line on average. But to maintain simplicity we will work with linear functions and lines throughout. Furthermore, economic relationships are not unchanging. Had we constructed a scatter plot for earlier or later years in Figure 2.5, the slope and intercepts of the regression line that best represented the extended data set might well have been different.

2.5 Ethics, efficiency and beliefs

Positive economics studies objective or scientific explanations of how the economy functions. Its aim is to understand and generate predictions about how the economy may respond to changes and policy initiatives. In this effort economists strive to act as detached scientists, regardless of political sympathies or ethical code. Personal judgments and preferences are (ideally) kept apart. In this particular sense, economics is similar to the natural sciences such as physics or biology.

In contrast, **normative economics** offers recommendations based partly on value judgments. While economists of different political persuasions can agree that raising the income tax rate would lead to a general reduction in the number of hours worked, they may yet differ in their views on the advisability of such a rise. One may believe that the additional revenue that may come in to government coffers is not worth the disincentives to work; another may think that, if such monies can be redistributed to benefit the needy or provide valuable infrastructure, the negative impact on the workers paying the income tax is worth it.

Positive economics studies objective or scientific explanations of how the economy functions.

Normative economics offers recommendations that incorporate value judgments.

Scientific research can frequently resolve differences that arise in positive economics—not so in normative economics. For example, if we claim that “the elderly have high medical bills, and the government should cover all of the bills”, we are making both a positive and a normative statement. The first part is positive, and its truth is easily established. The latter part is normative, and individuals of different beliefs may reasonably differ. Some people may believe that the money would be better spent on the environment and have the aged cover at least part of their own medical costs. Economics cannot be used to show that one of these views is correct and the other false. They are based on value judgments, and are motivated by a concern for **equity**. Equity is a vital guiding principle in the formation of policy and is frequently, though not always, seen as being in competition with the drive for economic growth. Equity is driven primarily by normative considerations. Few economists would disagree with the assertion that a government should implement policies that improve the lot of the poor and dispossessed—but to what degree?

Economic equity is concerned with the distribution of well-being among members of the economy.

Most economists hold normative views, sometimes very strongly. They frequently see their role as not just to analyze economic issues from a positive perspective, but also to champion their normative cause in addition. Conservative economists see a smaller role for government than left-leaning economists. A scrupulous economist will distinguish her positive from her normative analysis.

Many economists see a conflict between equity and the efficiency considerations that we developed in Chapter 1. For example, high taxes may provide disincentives to work in the marketplace and therefore reduce the efficiency of the economy: plumbers and gardeners may decide to do their own gardening and their own plumbing because, by staying out of the marketplace where monetary transactions are taxed, they can avoid the taxes. And avoiding the taxes may turn out to be as valuable as the efficiency gains they forgo.

In other areas the equity efficiency trade-off is not so obvious: if taxes (that may have disincentive effects) are used to educate individuals who otherwise would not develop the skills that follow education, then economic growth may be higher as a result of the intervention.

Data are an integral part of policy making in the public domain. A good example of this is in the area of road safety. Road fatalities have fallen dramatically in recent decades in Canada, in large measure due to the introduction of safety measures such as speed limits, blood-alcohol limits, seat belt laws, child-restraint devices and so forth. Safety policies are directed particularly strongly towards youth: they have a lower blood-alcohol limit, a smaller number of permitted demerit points before losing their license, a required period of learning (driver permit) and so forth. While fatalities among youth have fallen in line with fatalities across the age spectrum, they are still higher than for other age groups. Figure 2.7 presents data on fatalities per licensed driver by age group in Canada relative to the youngest age group. Note the strong non-linear pattern to the data – fatalities decline quickly, then level off and again increase for the oldest age group.

In keeping with these data, drivers are now required to pass a driving test in most provinces once they attain a certain age – usually 80, because the data indicate that fatalities increase when drivers age.

See:

CANADIAN MOTOR VEHICLE TRAFFIC COLLISION STATISTICS 2009, Transport Canada.

Application Box 2.1: Statistics for policy makers

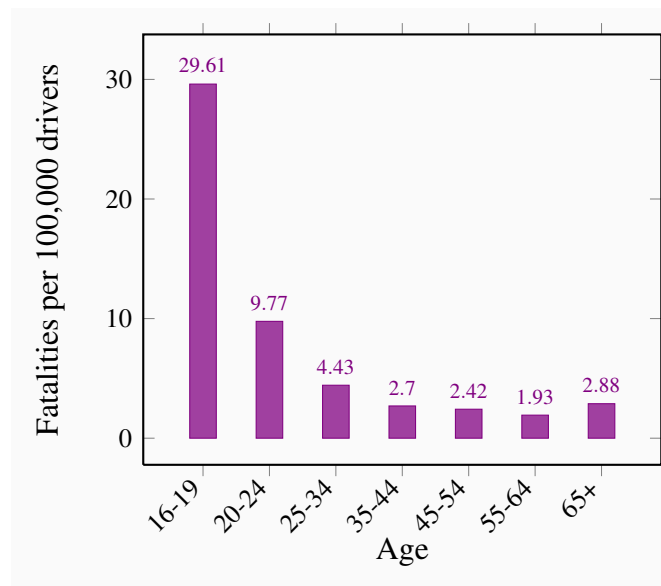


Figure 2.7: Non-linearity: Driver fatality rates Canada, 2009

Fatality rates vary non-linearly with age: at first they decline, then increase again, relative to the youngest age group.

Revisiting the definition of economics

This is an appropriate point at which to return to the definition of economics in Chapter 1 that we borrowed from Nobel Laureate Christopher Sims: economics is a set of ideas and methods for the betterment of society.

If economics is concerned about the betterment of society, clearly there are ethical as well as efficiency considerations at play. And given the philosophical differences among scientists (including economists), can we define an approach to economics that is shared by most of the economics profession? Most economists would answer that the profession shares a set of beliefs, and that differences refer to the extent to which one consideration may collide with another.

First of all we believe that *markets are critical* because they facilitate exchange and therefore encourage efficiency. Before the arrival of Man Friday, Robinson Crusoe had to hunt, cook, make fire, and sustain shelter. The arrival of Man Friday enabled Crusoe to *specialize* in the tasks where he was relatively more productive. More generally, trade creates benefits for the trading parties. For example, Canada has not the appropriate climate for growing coffee beans, and Colombia has not the terrain for wheat. If Canada had to be self-sufficient, we might have to grow coffee beans in green-houses—a costly proposition. But with trade we can simply exchange some of our wheat for Colombian coffee. Similar benefits arise for the Colombians.

A frequent complaint against globalization is that it does not benefit the poor. For example, workers in the Philippines may earn only a few dollars per day manufacturing clothing for Western markets. What these voices are really trying to say is that, in their opinion, most of the gains from trade go to the Western consumers, and a lesser part to the Asian worker.

A corollary of the centrality of markets is *that incentives matter*. If the price of business class seats on your favourite airline is reduced, you may consider upgrading. Economists believe strongly that the price mechanism influences behaviour, and therefore favour the use of price incentives in the marketplace and public policy more generally. Environmental economists, for example, frequently advocate the use of tradable pollution permits—a type of permission slip that can be traded (at a price) between users, or carbon taxes on the emission of greenhouse gases such as carbon dioxide. We will develop such ideas in *Microeconomics* Chapter 5 more fully.

In saying that economists believe in incentives, we are not proposing that human beings are purely mercenary. People have many motivations: a sense of public duty, kindness, *noblesse oblige*, etc. Acting out of a sense of self-interest does not imply that people are morally empty or have no sense of altruism. It is just recognition of one important motivating factor in an individual's life.

Whether conservative or liberal, economists believe universally in the *importance of the rule of law*, and a set of legal institutions that govern contracts. If goods and services are to be supplied in a market economy, the suppliers must be guaranteed that they will be remunerated. And this requires a developed legal structure with penalties imposed on individuals or groups who violate contracts. Markets alone will not function efficiently.

The development of markets in less developed economies was viewed as essential by many development economists in the nineteen eighties. The focus on ‘freeing up’ productive resources from the hand of the state was a central idea in what became known as the ‘Washington Consensus’. This emphasis represented a turning point in development philosophy – away from believing in the efficacy of the mega project, protectionism and state-led development. While the latter approach rarely produced the desired result on account of the missing incentives, the Washington Consensus did not produce the hoped-for results either. This was because the supposed ‘free markets’ were not always accompanied by property rights, or enforceable contracts – markets and contracts do not work well in a legal vacuum. Oxford economist Marcel Fafchamps has described these supposed ‘free markets’ as ‘flea markets’.

Not surprisingly, economists have found a high correlation between economic growth and national wealth on the one hand and the rule of law on the other. The consequence on the world stage is fascinating: numerous ‘economic’ development projects now focus upon training jurists, police officers and bureaucrats in the rule of law!

Finally economists believe in the importance of government policy. Governments can solve a number of problems that arise in market economies that cannot be addressed by the private market place. For example, governments can best address the potential abuses of monopoly power. Monopoly power, as we shall see in *Microeconomics* Chapter 10, not only has equity impacts it may also reduce economic efficiency. Governments are best positioned to deal with what economists term externalities – the impact of economic activity on sectors of the economy that are not directly involved in the activity under consideration. A good example is environmental policy. Governments may also wish to impose standards on products – consumers might not know if a bicycle helmet is effective unless safety standards are put in place.

In summary, governments have a variety of roles to play in the economy. These roles apply not only to making the economy a more equitable place (which governments achieve by their tax and redistribution policies), governments can also make the marketplace more efficient.

KEY CONCEPTS

Variables: measures that can take on different sizes.

Data: recorded values of variables.

Time series data: a set of measurements made sequentially at different points in time.

High (low) frequency data series have short (long) intervals between observations.

Cross-section data: values for different variables recorded at a point in time.

Longitudinal data follow the same units of observation through time.

Index number: value for a variable, or an average of a set of variables, expressed relative to a given base value, as seen in Equation 2.2:

$$\text{Value of index} = \frac{\text{Absolute value in year } t}{\text{Absolute value in base year}} \times 100.$$

Percentage change = $\frac{(\text{change in values})}{\text{original value}} \times 100.$

Consumer price index: the average price level for consumer goods and services.

Inflation rate: the annual percentage increase in the consumer price index.

Deflation rate: the annual percentage decrease in the consumer price index.

Real price index: a nominal price index divided by the consumer price index, scaled by 100.

Nominal price index: the current dollar price of a good or service.

Nominal earnings: earnings measured in current dollars.

Real earnings: earnings measure in constant dollars to adjust for changes in the general price level.

Scatter diagram plots pairs of values simultaneously observed for two variables.

Econometrics is the science of examining and quantifying relationships between economic variables.

Regression line represents the average relationship between two variables in a scatter diagram.

Positive economics studies objective or scientific explanations of how the economy functions.

Normative economics offers recommendations that incorporate value judgments.

Economic equity is concerned with the distribution of well-being among members of the economy.

EXERCISES FOR CHAPTER 2

Exercise 2.1. An examination of a country's recent international trade flows yields the data in the table below.

Year	National Income (\$b)	Imports (\$b)
2011	1,500	550
2012	1,575	573
2013	1,701	610
2014	1,531	560
2015	1,638	591

- Based on an examination of these data do you think the national income and imports are not related, positively related, or negatively related?
- Draw a simple two dimensional line diagram to illustrate your view of the import/income relationship. Measure income on the horizontal axis and imports on the vertical axis.

Exercise 2.2. The average price of a medium coffee at *Wakeup Coffee Shop* in each of the past ten years is given in the table below.

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
\$1.05	\$1.10	\$1.14	\$1.20	\$1.25	\$1.25	\$1.33	\$1.35	\$1.45	\$1.49

- Construct an annual 'coffee price index' for the 2005 time period using 2006 as the base year.
- Based on your price index, what was the percentage change in the price of a medium coffee from 2006 to 2013?
- Based on your index, what was the average annual percentage change in the price of coffee from 2010 to 2013?

Exercise 2.3. The table below gives unemployment rates for big cities and the rest of the country. Two-thirds of the population lives in the big cities, and one-third in other areas. Construct a national unemployment index, using the year 2000 as the base.

Unemployment (%)		
Year	Big Cities	Other Areas
2007	5	7
2008	7	10
2009	8	9
2010	10	12
2011	9	11

Exercise 2.4. The prices in the following table below are for three components in a typical consumer's budget: transportation, rent, and food. You must construct an aggregate price index based on these three components on the assumption that rent accounts for 55 percent of the weight in this index, food for 35 percent, and transport for 10 percent. You should start by computing an index for each component, using year 1 as the base period.

	Year 1	Year 2	Year 3	Year 4	Year 5
Transport \$	70	70	75	75	75
Rent \$	1000	1000	1100	1120	1150
Food \$	600	620	610	640	660

Exercise 2.5. The price of carrots per kilogram is given in the table below for several years, as is the corresponding CPI.

	2000	2002	2004	2006	2008	2010
Nominal						
Carrot Price \$	2.60	2.90	3.30	3.30	3.10	3.00
CPI	110	112	115	117	120	124

- Compute a nominal price index for carrots using 2000 as the base period.
- Re-compute the CPI using 2000 as the base year.
- Construct a real price index for carrots.

Exercise 2.6. The following table shows hypothetical consumption spending by households and income of households in billions of dollars.

Year	Income	Consumption
2006	476	434
2007	482	447
2008	495	454
2009	505	471
2010	525	489
2011	539	509
2012	550	530
2013	567	548

- Plot the scatter diagram with consumption on the vertical axis and income on the horizontal axis.
- Fit a line through these points.
- Does the line indicate that these two variables are related to each other?
- How would you describe the *causal relationship* between income and consumption?

Exercise 2.7. Using the data from Exercise 2.6, compute the percentage change in consumption and the percentage change in income for each pair of adjoining years between 2006 and 2013.

Exercise 2.8. You are told that the relationship between two variables, X and Y , has the form $Y = 10 + 2X$. By trying different values for X you can obtain the corresponding predicted value for Y (e.g., if $X = 3$, then $Y = 10 + 2 \times 3 = 16$). For values of X between 0 and 12, compute the matching value of Y and plot the scatter diagram.

Exercise 2.9. Perform the same exercise as in Exercise 2.8, but use the formula $Y = 10 - 0.5X$. What do you notice about the slope of the relationship?

Exercise 2.10. For the data below, plot a scatter diagram with variable Y on the vertical axis and variable X on the horizontal axis.

Y	40	33	29	56	81	19	20
X	5	7	9	3	1	11	10

- Is the relationship between the variables positive or negative?
- Do you think that a linear or non-linear line better describes the relationship?

Chapter 3

The classical marketplace – demand and supply

In this chapter we will explore:

- 3.1 The role of the marketplace – trading
- 3.2 The market's building blocks
- 3.3 Demand curves and supply curves
- 3.4 Demand curves shifts
- 3.5 Supply curve shifts
- 3.6 Simultaneous demand and supply movements
- 3.7 Free and managed markets – interventions
- 3.8 From individuals to markets

3.1 Trading

The marketplace in today's economy has evolved from earlier times. It no longer has a unique form – one where buyers and sellers physically come together for the purpose of exchange. Indeed, supermarkets require individuals to be physically present to make their purchases. But when purchasing an airline ticket, individuals simply go on line and interact with perhaps a number of different airlines (suppliers) simultaneously. Or again, individuals may simply give an instruction to their broker, who will execute a purchase on their behalf – the broker performs the role of a middleman, who may additionally give advice to the purchaser. Or a marketing agency may decide to subcontract work to a translator or graphic artist who resides in Mumbai. In pure auctions (where a single work of art or a single residence is offered for sale) buyers compete one against the other for the single item supplied. These institutions are all different types of markets; they serve the purpose of facilitating exchange and trade.

We should also keep in mind that not all goods and services in the modern economy are obtained through the marketplace. Schooling and health care are allocated in Canada primarily by gov-

ernment decree. In some instances the market plays a supporting role: Universities and colleges may levy fees, and most individuals must pay for their pharmaceuticals. In contrast, broadcasting services may carry a price of zero – as with the Canadian Broadcasting Corporation.

The importance of the marketplace springs from its role as an allocating mechanism. Elevated prices effectively send a signal to suppliers that the buyers in the market place a high value on the product being traded; conversely when prices are low. Accordingly, suppliers may decide to cease supplying markets where prices do not remunerate them sufficiently, and redirect their energies and the productive resources under their control to other markets – markets where the product being traded is more highly valued, and where the buyer is willing to pay more.

Whatever their form, the marketplace is central to the economy we live in. Not only does it facilitate trade, it also provides a means of earning a livelihood. Suppliers must hire resources – human and non-human in order to bring their supplies to market and these resources must be paid a return – income is generated.

In this chapter we will examine the process of price formation – how the prices that we observe in the marketplace come to be what they are. We will illustrate that the price for a good is inevitably linked to the quantity of a good; price and quantity are different sides of the same coin and cannot generally be analyzed separately. To understand this process more fully, we need to *model* a typical market. The essentials are demand and supply.

3.2 The market's building blocks

In economics we use the terminology that describes trade in a particular manner. Non-economists frequently describe microeconomics by saying “it’s all about supply and demand”. While this is largely true we need to define exactly what we mean by these two central words. Let’s start with demand. **Demand** is the quantity of a good or service that buyers wish to purchase at each conceivable price, with all other influences on demand remaining unchanged. It reflects a multitude of values, not a single value. It is not a single or unique quantity such as two cell phones, but rather a full description of the quantity of a good or service that buyers would purchase at various prices.

Demand is the quantity of a good or service that buyers wish to purchase at each possible price, with all other influences on demand remaining unchanged.

As an example, the first column of Table 3.1 shows the price of natural gas per cubic foot. The second column shows the quantity that would be purchased in a given time period at each price. It is therefore a schedule of prices.

Supply is interpreted in a similar manner. It is not a single value; it is a schedule of the quantity that sellers would want to sell at each price. Hence we say that **supply** is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged. Such a supply schedule is defined in the third column of the table. It is assumed that no supplier can make a profit (on account of their costs) unless the price is at least \$2 per unit, and therefore a zero quantity is supplied below that price. The higher price is more profitable, and therefore induces a greater quantity supplied, perhaps by attracting more suppliers.

Price (\$)	Demand (thousands of cu feet)	Supply (thousands of cu feet)	Excess
10	0	18	
9	1	16	
8	2	14	Excess Supply
7	3	12	
6	4	10	
5	5	8	
4	6	6	Equilibrium
3	7	4	
2	8	2	Excess Demand
1	9	0	
0	10	0	

Table 3.1: Demand and supply for natural gas

Supply is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged.

We can now identify a key difference in terminology – between the words demand and quantity demanded, and between supply and quantity supplied. While the words demand and supply refer to the complete schedules of demand and supply, the terms **quantity demanded** and **quantity supplied** each define a single value of demand or supply at a particular price.

Quantity demanded defines the amount purchased at a particular price.

Quantity supplied refers to the amount supplied at a particular price.

Thus while the non-economist may say that when some fans did not get tickets to the Stanley Cup it was a case of demand exceeding supply, as economists we say that the quantity demanded exceeded the quantity supplied *at the going price of tickets*. In this instance, had every ticket been offered at a sufficiently high price, the market could have generated an excess supply rather than an excess demand. A higher ticket price would reduce the *quantity demanded*; yet would not change *demand*, because demand refers to the whole schedule of possible quantities demanded at different prices.

Other things equal – *ceteris paribus*

The demand and supply schedules rest on the assumption that all other influences on supply and demand remain the same as we move up and down the possible price values. We use the expression *other things being equal*, or its Latin counterpart *ceteris paribus*, to describe this constancy of other influences. For example, we assume on the demand side that the prices of other goods remain constant, that tastes and incomes are unchanging, that the size of the market is given, and so forth. On the supply side we assume, for example, that there is no technological change in production methods.

Market equilibrium

Let us now bring the demand and supply schedules together in an attempt to analyze what the market place will produce – will a single price emerge that will equate supply and demand? We will keep other things constant for the moment, and explore what materializes at different prices. At low prices, the data in Table 3.1 indicate that the quantity demanded exceeds the quantity supplied – for example, verify what happens when the price is \$3 per unit. The opposite occurs when the price is high – what would happen if the price were \$8? Evidently, there exists an intermediate price, where the quantity demanded equals the quantity supplied. At this point we say that the market is in equilibrium. The **equilibrium price** equates demand and supply – it clears the market.

The **equilibrium price** equilibrates the market. It is the price at which quantity demanded equals the quantity supplied.

In Table 3.1 the equilibrium price is \$4, and the equilibrium quantity is 6 thousand cubic feet of gas (we will use the notation ‘k’ to denote thousands). At higher prices there is an **excess supply**—

suppliers wish to sell more than buyers wish to buy. Conversely, at lower prices there is an **excess demand**. Only at the equilibrium price is the quantity supplied equal to the quantity

Excess supply exists when the quantity supplied exceeds the quantity demanded at the going price.

Excess demand exists when the quantity demanded exceeds the quantity supplied at the going price.

Does the market automatically reach equilibrium? To answer this question, suppose initially that the sellers choose a price of \$10. Here suppliers would like to supply 18k cubic feet, but there are no buyers—a situation of extreme excess supply. At the price of \$7 the excess supply is reduced to 9k, because both the quantity demanded is now higher at 3k units, and the quantity supplied is lower at 12k. But excess supply means that there are suppliers willing to supply at a lower price, and this willingness exerts continual downward pressure on any price above the price that equates demand and supply.

At prices below the equilibrium there is, conversely, an excess demand. In this situation, suppliers could force the price upward, knowing that buyers will continue to buy at a price at which the suppliers are willing to sell. Such upward pressure would continue until the excess demand is eliminated.

In general then, above the equilibrium price excess supply exerts downward pressure on price, and below the equilibrium excess demand exerts upward pressure on price. This process implies that the buyers and sellers have information on the various elements that make up the marketplace.

Note that, if sales do take place at prices above or below the equilibrium price, the quantity traded always corresponds to the short side of the market: At high prices the quantity demanded is less than supply, and it is the quantity demanded that is traded because buyers will not buy the amount suppliers would like to supply. At low prices the quantity demanded exceeds quantity supplied, and it is the amount that suppliers are willing to sell that is traded. In sum, when trading takes place at prices other than the equilibrium price it is always the lesser of the quantity demanded or supplied that is traded. Hence we say that at non equilibrium prices the **short side** dominates. We will return to this in a series of examples later in this chapter.

The **short side of the market** determines outcomes at prices other than the equilibrium.

Supply and the nature of costs

Before progressing to a graphical analysis, we should add a word about costs. The supply schedules are based primarily on the cost of producing the product in question, and we frequently assume that all of the costs associated with supply are incorporated in the supply schedules. In *Microeconomics* Chapter 6 we will explore cases where costs additional to those incurred by producers may be relevant. For example, coal burning power plants emit pollutants into the atmosphere; but the individual supplier may not take account of these pollutants, which are costs to society at large, in deciding how much to supply at different prices. Stated another way, the private costs of production would not reflect the total, or full social costs of production. For the moment the assumption is that no such additional costs are associated with the markets we analyze.

3.3 Demand and supply curves

The **demand curve** is a graphical expression of the relationship between price and quantity demanded, holding other things constant. Figure 3.1 measures price on the vertical axis and quantity on the horizontal axis. The curve *D* represents the data from the first two columns of Table 3.1. Each combination of price and quantity demanded lies on the curve. In this case the curve is *linear*—it is a straight line. The demand curve slopes downward (technically we say that its slope is negative), reflecting the fact that buyers wish to purchase more when the price is less.

The **demand curve** is a graphical expression of the relationship between price and quantity demanded, with other influences remaining unchanged.

The **supply curve** is a graphical representation shows the relation between price and quantity supplied, holding other things constant. The supply curve *S* in Figure 3.1 is based on the data from columns 1 and 3 in Table 3.1. It, too, is linear, but has a positive slope indicating that suppliers wish to supply more at higher prices.

The **supply curve** is a graphical expression of the relationship between price and quantity supplied, with other influences remaining unchanged.

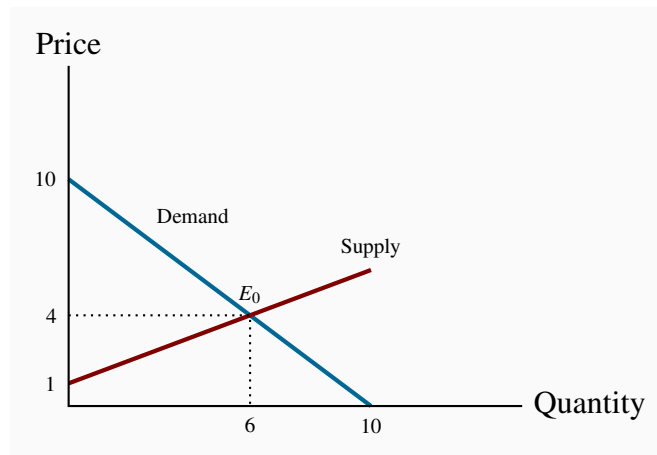


Figure 3.1: Supply, demand, equilibrium

The demand and supply curves intersect at point E_0 , corresponding to a price of \$4 which, as illustrated above, is the equilibrium price for this market. At any price below this the horizontal distance between the supply and demand curves represents excess demand, because demand exceeds supply. Conversely, at any price above \$4 there is an excess supply that is again measured by the horizontal distance between the two curves. Market forces tend to eliminate excess demand and excess supply as we explained above.

Computing the market equilibrium

It is not difficult to represent the supply and demand functions underlying Table 3.1 in their mathematical form:

$$\text{Demand: } P = 10 - Q$$

$$\text{Supply: } P = 1 + (1/2)Q$$

In the previous chapter we stated that a straight line is represented completely by the intercept and slope. Let us first verify that these equations do, indeed, represent the data in Table 3.1. On the demand side, we see that a zero quantity is demanded at a price of \$10, and this is therefore the intercept with the price (vertical) axis. To see this just set $P = 10$ in the demand equation. As for the slope, each unit change in quantity demanded (measured in thousands) is associated with a \$1 change in price. For instance, when the price is increased by \$2, the quantity demanded declines by

2 units. In reverse, if the price is lowered by \$2, the quantity demanded increases by 2 units. Since the price is on the vertical axis, it follows that the slope is given by $-\$1/1 = -1$. It is negative because an increase in quantity demanded is associated with a decrease in price.

On the supply side, column 3 in Table 3.1 indicates that at a quantity of zero the price is \$1. Therefore, \$1 is the price intercept. As for the slope, each 2-unit change in quantity is associated with a change in price of \$1. Consequently, the slope is given by $\$1/2 = 1/2$. In this case the slope is positive, since both the price and quantity move in the same direction.

We have now obtained the two defining characteristics of the demand and supply curves, which enable us to write them as above. Next we must find where they intersect – the market equilibrium. Since, at their intersection point, the price on the demand curve equals the price on the supply curve, and the quantity demanded equals the quantity supplied, this unique price-quantity combination is obtained by equating the two curves:

$$D = S \Rightarrow 10 - Q = 1 + (1/2)Q \Rightarrow 10 - 1 = Q + (1/2)Q \Rightarrow 9 = 1.5Q^1$$

Therefore,

$$Q = 9/1.5 = 6$$

The *equilibrium solution* for Q is therefore 6 units. What about an equilibrium price? It is obtained by inserting the equilibrium Q value into *either the supply or the demand function*. Either function can be used because, where $Q = 6$, the supply and demand functions intersect – they have equal P values:

$$\text{Demand price at } Q=6: P = 10 - 1 \times 6 = 10 - 6 = 4$$

$$\text{Supply price at } Q=6: P = 1 + 1/2 \times 6 = 1 + 3 = 4$$

We have just solved a mathematical model of a particular market! It was not so difficult, but the method is very powerful and we will use it many times in the text.

In the demand and supply equations above the price appeared on the left hand side and quantity on the right. Normally this format implies a causation running from the right to the left hand side variable, while in economic markets we normally think of the quantity demanded and supplied depending upon the price in the market place. But the supply and demand equations can be rearranged so that quantity appears on the left and price on the right. For example the demand equation can be rewritten as follows:

¹The \Rightarrow symbol is used in mathematics to denote “implication”. For example, $A \Rightarrow B$ translates to “If A , then B .”

$$P = 10 - Q \Rightarrow Q = 10 - P,$$

or: $Q = 10 - P \Rightarrow Q = 10 - P.$

Writing the demand curve this way illustrates that the quantity intercept is 10 – the quantity demanded when the price becomes zero. The supply curve can be rearranged similarly.

3.4 Other influences on demand

We have emphasized several times the importance of the *ceteris paribus* assumption when exploring the impact of different prices on the quantity demanded: we assume all other influences on the purchase decision are unchanged (at least momentarily). These other influences fall into several broad categories: the prices of related goods; the incomes of buyers; buyer tastes; and expectations about the future. Before proceeding, note that we are dealing with *market* demand rather than demand by one *individual* (the precise relationship between the two is developed later in this chapter).

The prices of related goods

We expect that the price of other forms of energy would impact the price of natural gas. For example, if electricity, oil or coal becomes less expensive we would expect some buyers to switch to these other products. Alternatively, if gas-burning furnaces experience a technological breakthrough that makes them more efficient and cheaper we would expect some users of other fuels to move to gas. Among these examples, it is clear that oil and electricity are substitute fuels for gas; in contrast the efficient new gas furnace complements the use of gas. We use these terms, **substitutes** and **complements**, to describe products that influence the demand for the primary good.

Substitute goods: when a price reduction (rise) for a related product reduces (increases) the demand for a primary product, it is a substitute for the primary product.

Complementary goods: when a price reduction (rise) for a related product increases (reduces) the demand for a primary product, it is a complement for the primary product.

Clearly electricity is a substitute for gas whereas the gas furnace is a complement for gas as a fuel. The words substitutes and complements immediately suggest the nature of the relationships. Every product has complements and substitutes. As another example: electronic readers are substitutes for paper-form books; a rise in the price of paper books should increase the demand for electronic

readers at any price for electronic readers. In graphical terms, the demand curve *shifts* in response to changes in the prices of other goods – an increase in the price of paper-form books will shift the demand for electronic readers outward, because more electronic readers will be demanded at any price.

Buyer incomes

The demand for most goods increases in response to income increases. Given this, the demand curve for gas will shift outward if household incomes in the economy increase. Household incomes may increase either because there are more households in the economy or because the incomes of the existing households grow.

Most goods are demanded in greater quantity in response to higher incomes at any given price. But there are exceptions. For example, public transit demand may decline at any price when household incomes rise, because some individuals move to cars. Or the demand for laundromats may decline in response to higher incomes, as households purchase more of their own consumer durables – washers and driers. We use the term **inferior good** to define these cases: An inferior good is one whose demand declines in response to increasing incomes, whereas a **normal good** experiences an increase in demand in response to rising incomes.

An **inferior good** is one whose demand falls in response to higher incomes.

A **normal good** is one whose demand increases in response to higher incomes.

There is a further sense in which consumer incomes influence demand, and this relates to how the incomes are *distributed* in the economy. In our discussion above we stated that higher total incomes shift demand curves outwards when goods are normal. But think of the difference in the demand for electronic readers between Portugal and Saudi Arabia. These economies have roughly the same average per-person income, but incomes are distributed more unequally in Saudi Arabia. It does not have a large middle class that can afford electronic readers or *iPads*, despite the huge wealth held by the elite. In contrast, Portugal has a relatively larger middle class that can afford such goods. Consequently, the *distribution of income* can be an important determinant of the demand for many commodities and services.

Tastes and networks

While demand functions are drawn on the assumption that tastes are constant, in an evolving world they are not. We are all subject to peer pressure, the fashion industry, marketing, and a desire to maintain our image. If the fashion industry dictates that lapels or long skirts are *de rigueur*

for the coming season, some fashion-conscious individuals will discard a large segment of their wardrobe, even though the clothes may be in perfectly good condition: Their demand is influenced by the dictates of current fashion.

Correspondingly, the items that other individuals buy or use frequently determine our own purchases. Businesses frequently decide that all of their employees will have the same type of computer and software on account of *network economies*: It is easier to communicate if equipment is compatible, and it is less costly to maintain infrastructure where the variety is less.

Expectations

In our natural gas example, if households expected that the price of natural gas was going to stay low for many years – perhaps on account of the discovery of large deposits – then they would be tempted to purchase a gas burning furnace rather than an oil burning furnace, particularly if they anticipated that the price of oil would increase. In this example, it is more than the current price that determines choices; *the prices that are expected to prevail in the future* also determine current demand.

Expectations are particularly important in stock markets. When investors anticipate that corporations will earn high rewards in the future they will buy a stock today. If enough people believe this, the price of the stock will be driven upward on the market, even before profitable earnings are registered.

Shifts in demand

The demand curve in Figure 3.1 is drawn for a given level of other prices, incomes, tastes, and expectations. Movements along the demand curve reflect solely the impact of different prices for the good in question, holding other influences constant. But changes in any of these other factors will change the position of the demand curve. Figure 3.2 illustrates a shift in the demand curve. This shift could result from a rise in household incomes that increase the quantity demanded *at every price*. This is illustrated by an outward shift in the demand curve. With supply conditions unchanged, there is a new equilibrium at E_1 , indicating a greater quantity of purchases accompanied by a higher price. The new demand curve reflects a *change in the quantity demanded*.

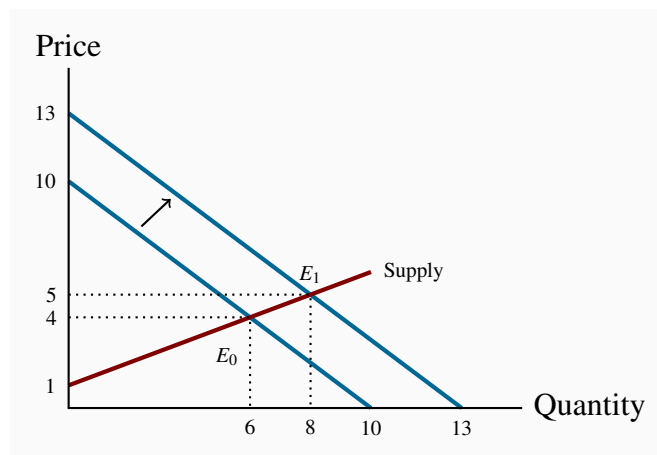


Figure 3.2: Demand shift and new equilibrium

The outward shift in demand leads to a new equilibrium E_1 .

In the middle of its second mandate, the Bush Administration in the US decided to encourage the production of ethanol – a fuel that is less polluting than gasoline. The target production was 35 billion for 2017 – from a base of 1 billion gallons in 2000. Corn is the principal input in ethanol production. It is used primarily as animal feed, as a sweetener and a food for humans. The target was to be met with the help of a subsidy to producers and a tariff on imports of Brazil’s sugar-cane based ethanol.

The impact on corn prices was immediate; from a farm-gate price of \$2 per bushel in 2005, the price reached the \$4 range two years later, despite a significant increase in production. In 2012 the price is \$7. While other factors, such as growing incomes, have stimulated the demand for corn; ethanol is seen as the main price driver.

The wider impact of these developments was that the prices of virtually all grains increased in tandem with corn. For example, the prices of sorghum and barley increased because of a switch in land use towards corn. Corn was seen as more profitable, less acreage was allocated to other grains, and the supply of these other grains fell.

While producer benefited from the price rise, consumers – particularly those in less developed economies – experienced a dramatic increase in their basic living costs. Visit the site of the United Nations’ Food and Agricultural Organization for an assessment.

In terms of supply and demand shifts, the demand side has dominated. The ethanol drive, combined with secular growth in the demand for food, means that the demand for grains shifted outward faster than the supply, as illustrated in Figure 3.4 below.

Application Box 3.1: Corn prices and demand shifts

Modelling other influences

How are such changes reflected in our *economic model*? Let us say that market research quantifies the degree to which the demand curve shifts: Market analysis indicates that the new demand curve is given by $P = 13 - Q$. Note that the intercept is greater while the slope is unchanged, so the demand curve in this instance shifts outward while maintaining the same slope; it is parallel to the original demand curve.

The new market equilibrium can be established by solving for the intersection of the new demand curve with the existing supply curve. Let us do it.

$$\text{Demand: } P = 13 - Q$$

$$\text{Supply: } P = 1 + (1/2)Q$$

Equating the two yields:

$$13 - Q = 1 + (1/2)Q \Rightarrow 13 - 1 = Q + (1/2)Q \Rightarrow 12 = 1.5Q$$

Therefore,

$$Q = 12/1.5 = 8$$

Eight units of gas are now traded, rather than 6. The new equilibrium price is obtained as before, by estimating the price at which 8 units of gas will be supplied or demanded. Inserting $Q = 8$ in either the supply or (new) demand function yields a value of \$5. As a result of the demand increase, therefore, both the equilibrium quantity traded and the equilibrium price in the market increase (see Figure 3.2).

We may well ask why so much emphasis in our diagrams and analysis is placed on the relationship between *price* and quantity, rather than on the relationship between quantity and its other determinants. The answer is that we could indeed draw diagrams with quantity on the horizontal axis and a measure of one of these other influences on the vertical axis. But the price mechanism plays a very important role. *Variations in price are what equilibrate the market.* By focusing primarily upon the price, we see the self-correcting mechanism by which the market reacts to excess supply or excess demand.

In addition, this analysis illustrates the method of **comparative statics**—examining the impact of changing one of the other things that are assumed constant in the supply and demand diagrams.

Comparative static analysis compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the other things that lie behind the demand curve or the supply curve.

Comparative obviously denotes the idea of a comparison, and static means that we are not in a state of motion. Hence we use these words in conjunction to indicate that we compare one outcome with another, without being concerned too much about the transition from an initial equilibrium to a final equilibrium. The transition would be concerned with dynamics rather than statics. In Figure 3.2 we explain the difference between the points E_0 and E_1 by indicating that there has been a change in incomes or in the price of a substitute good. We do not attempt to analyze the details of this move or the exact path from E_0 to E_1 .

3.5 Other influences on supply

To date we have drawn supply curves with an upward slope. Is this a reasonable representation of supply in view of what is frequently observed in markets? We suggested earlier that the various producers of a particular good or service may have different levels of efficiency. If so, only the more efficient producers can make a profit at a low price, whereas at higher prices more producers or suppliers enter the market – producers who may not be as lean and efficient as those who can survive in a lower-price environment. This view of the world yields an upward-sloping supply curve, although there are other perspectives on the supply curve's slope.

Frequently producers simply choose a price and let buyers purchase as much as they want at that price. This is the practice of most retailers. For example, the price of Samsung's *Galaxy* is typically fixed, no matter how many are purchased – and tens of millions are sometimes sold at a fixed price when a new model is launched. Apple sets a price, and buyers purchase as many as they desire at that price.

In yet other situations *supply* is fixed. This happens in auctions, and bidders at the auction simply determine the price to be paid. At a real estate auction a fixed number of homes are put on the market and prices are determined by the bidding process.

Regardless of the type of market we encounter, however, it is safe to assume that supply curves do not slope downward. So, for the moment, we adopt the stance that supply curves are generally upward sloping – somewhere between the extremes of being vertical or horizontal – as we have drawn them to this point.

Next, we examine those other influences that underlie supply curves. Technology, input costs, the prices of competing goods, expectations and the number of suppliers are the most important.

Technology

A technological advance may involve an idea that allows more output to be produced with the same inputs, or an equal output with fewer inputs. A good example is *just-in-time* technology. Before the modern era, auto manufacturers kept large stocks of components in their production facilities, but developments in communications and computers at that time made it possible for manufacturers to link directly with their input suppliers. Nowadays assembly plants place their order for, say, seat delivery to their local seat supplier well ahead of time. The seats swing into the assembly area hours or minutes before assembly—just in time. The result is that the assembler reduces his seat inventory (an input) and thereby reduces production cost.

Such a technology-induced cost saving is represented by moving the supply curve downward or outward: The supplier is willing to supply the same quantity at a lower price because of the technological innovation. Or, saying the same thing slightly differently, suppliers will supply more at a given price than before. This is but one example of how “supply chains” are evolving in the modern globalized world. Computer assemblers are prime examples of the same developments.

Input costs

Input costs can vary independently of technology. For example, a wage negotiation that grants workers an increase above the general inflation rate will increase the cost of production. This is reflected in a leftward, or upward, supply shift: Any quantity is now priced higher; alternatively, suppliers are willing to supply less at the going price.

As a further example, suppose the government decrees that power-generating companies must provide a certain percentage of their power using ‘green’ sources – from solar power or windmills. Since such sources are not yet as cost efficient as more conventional power sources, the electricity they generate comes at a higher cost.

Competing products

If competing products improve in quality or fall in price, a supplier may be forced to follow suit. For example, Hewlett-Packard and Dell are constantly watching each other’s pricing policies. If Dell brings out a new generation of computers at a lower price, Hewlett-Packard will likely lower its prices in turn—which is to say that Hewlett-Packard’s supply curve will shift downward. Likewise, Samsung and Apple each responds to the other’s pricing and technology behaviours.

These are some of the many factors that influence the position of the supply curve in a given market.

Technological developments have had a staggering impact on many price declines. Professor William Nordhaus of Yale University is an expert on measuring technological change. He has examined the trend in the real price of lighting. Originally, light was provided by whale oil and gas lamps and these sources of lumens (the scientific measure of the amount of light produced) were costly. In his research, Professor Nordhaus pieced together evidence on the actual historic cost of light produced at various times, going all the way back to 1800. He found that light in 1800 cost about 100 times more than in 1900, and light in the year 2000 was a fraction of its cost in 1900. A rough calculation suggests that light was five hundred times more expensive at the start of this 200-year period than at the end.

In terms of supply and demand analysis, light has been subject to very substantial downward supply shifts. Despite the long-term growth in demand, the technologically-induced supply changes have been the dominant factor in its price determination.

For further information, visit Professor Nordhaus's website in the Department of Economics at Yale University.

Application Box 3.2: The price of light

Shifts in supply

Whenever technology changes, or the costs of production change, or the prices of competing products adjust, then one of our *ceteris paribus* assumptions is violated. Such changes are generally reflected by shifting the supply curve. Figure 3.3 illustrates the impact of the arrival of just-in-time technology. The supply curve shifts, reflecting the ability of suppliers to supply the same output at a reduced price. The resulting new equilibrium price is lower, since production costs have fallen. At this reduced price more gas is traded at a lower price.

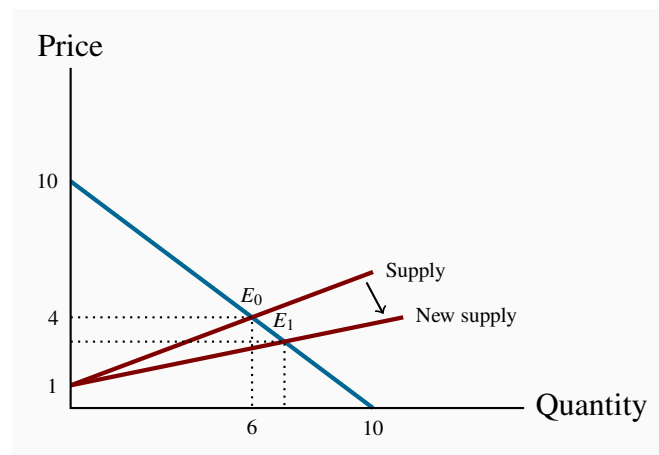


Figure 3.3: Supply shift and new equilibrium

The supply curve shifts due to lower production costs. A new equilibrium E_1 is attained in the market at a lower price.

3.6 Simultaneous supply and demand impacts

In the real world, demand and supply frequently shift at the same time. We present two very real such cases in Figures 3.4 and 3.5.

Figure 3.4 is a development of the gas market already discussed. In 2003/04 the price of oil sat at about \$30 US per barrel. By the end of the decade it had climbed to \$100 per barrel. During the same period the price of natural gas dropped from the \$8 per unit range to \$3 per unit. A major factor in generating this decline was the development of new ‘fracking’ technologies – the retrieval of gas from shale formations. These technologies are not widespread in Canada due to concerns about their environmental impact, but have been adopted on a large scale in the US. Cheaper production has led to a substantial shift in supply, at the same time as users were demanding more gas due to the rising price of oil. Figure 3.4 illustrates a simultaneous shift in both functions, with the dominant impact coming from the supply side.

Our second example comes from data on a small Montreal municipality. Vertical curves define the supply side of the market. Such vertical curves mean that a fixed number of homeowners decide to put their homes on the market, and these suppliers just take whatever price results in the market. In this example, fewer houses were offered for sale in 2002 (less than 50) than in 1997 (more than 70).

During this time period household incomes increased substantially and, also, mortgage rates fell. Both of these developments shifted the demand curve upward/outward: buyers were willing to pay more for housing in 2002 than in 1997. The higher price in 2002 was therefore due to *both* demand

and supply side shifts in the marketplace.

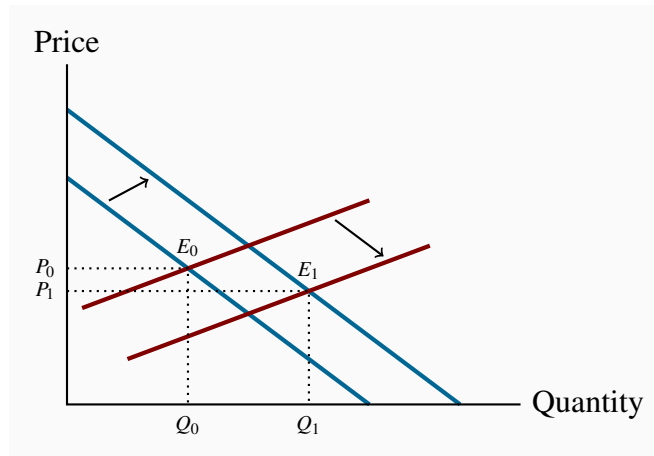


Figure 3.4: Simultaneous demand and supply shifts

The outward shift in supply dominates the outward shift in demand, leading to a new equilibrium E_1 at a lower price and higher quantity.

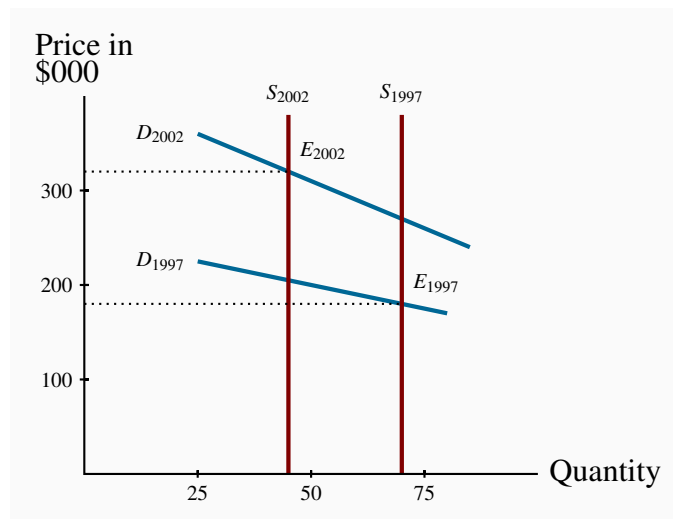


Figure 3.5: A model of the housing market with shifts in demand and supply

The vertical supply denotes a fixed number of houses supplied each year. Demand was stronger in 2002 than in 1997 both on account of higher incomes and lower mortgage rates. Thus the higher price in 2002 is due to both a reduction in supply and an increase in demand.

3.7 Market interventions

The freely functioning markets that we have developed certainly do not describe all markets. For example, minimum wages characterize the labour market, most agricultural markets have supply restrictions, apartments are subject to rent controls, and blood is not a freely traded market commodity in Canada. In short, price controls and quotas characterize many markets. **Price controls** are government rules or laws that inhibit the formation of market-determined prices. **Quotas** are physical restrictions on output.

Price controls are government rules or laws that inhibit the formation of market-determined prices.

Quotas are physical restrictions on output.

Price controls come in the form of either *floors* or *ceilings*.

Price ceilings

Ceilings mean that suppliers cannot legally charge more than a specific price. Limits on apartment rents are one form of ceiling. In times of emergency – such as flooding or famine, price controls are frequently imposed on foodstuffs, in conjunction with rationing, to ensure that access is not determined by who has the most income. The problem with price ceilings, however, is that they leave demand unsatisfied, and therefore they must be accompanied by some other allocation mechanism.

Consider an environment where, for some reason – perhaps a sudden and unanticipated growth in population – rents increase. Let the resulting equilibrium be defined by the point E_0 in Figure 3.6. If the government were to decide that this is an unfair price because it places hardships on low- and middle-income households, it might impose a price limit, or ceiling, of P_c . The problem with such a limit is that excess demand results: Individuals want to rent more apartments than are available in the city. In a free market the price would adjust upward to eliminate the excess demand, but in this controlled environment it cannot. So some other way of allocating the available supply between demanders must evolve.

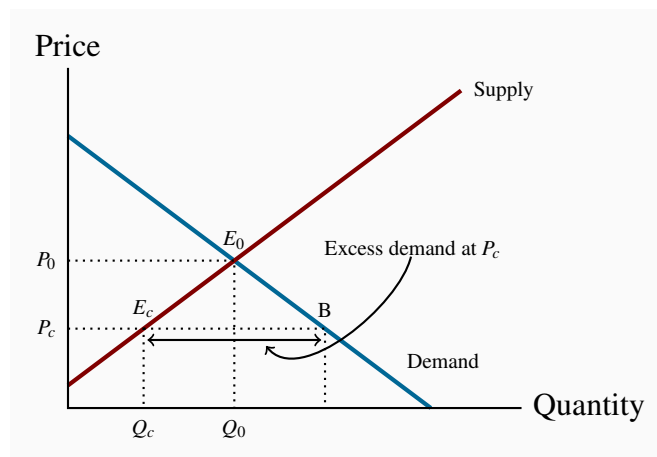


Figure 3.6: The effect of a price ceiling

The free market equilibrium occurs at E_0 . A price ceiling at P_c holds down the price but leads to excess demand E_cB , because Q_c is the quantity traded. A price ceiling above P_0 is irrelevant since the free market equilibrium E_0 can still be attained.

In reality, most apartments are allocated to those households already occupying them. But what happens when such a resident household decides to purchase a home or move to another city? It holds a valuable asset, since the price/rent it is paying is less than the free-market price. Rather than give this surplus value to another family, it might decide to sublet at a price above what it currently pays. While this might be illegal, the family knows that there is excess demand and therefore such a solution is possible. A variation on this outcome is for an incoming tenant to pay money, sometimes directly to an existing tenant or to the building superintendent, or possibly to a real estate broker who will “buy out” existing tenants. This is called “key money.”

Rent controls are widely studied in economics, and the consequences are well understood: Landlords tend not to repair or maintain their rental units and so the residential stock deteriorates. Builders realize that more money is to be made in building condominium units, or in converting rental units to condominiums. The frequent consequence is a *reduction* in supply and a reduced quality. Market forces are hard to circumvent because, as we emphasized in Chapter 1, economic players react to the incentives they face. This is an example of what we call the *law of unintended consequences*.

Price floors

An effective price floor sets the price *above* the market-clearing price. A minimum wage is the most widespread example in the Canadian economy. Provinces each set their own minimum, and it is seen as a way of protecting the well-being of low-skill workers. Such a floor is illustrated

in Figure 3.7. The free-market equilibrium is again E_0 , but the effective market outcome is the combination of price and quantity corresponding to the point E_f at the price floor, P_f . In this instance, there is excess supply equal to the amount E_fC .

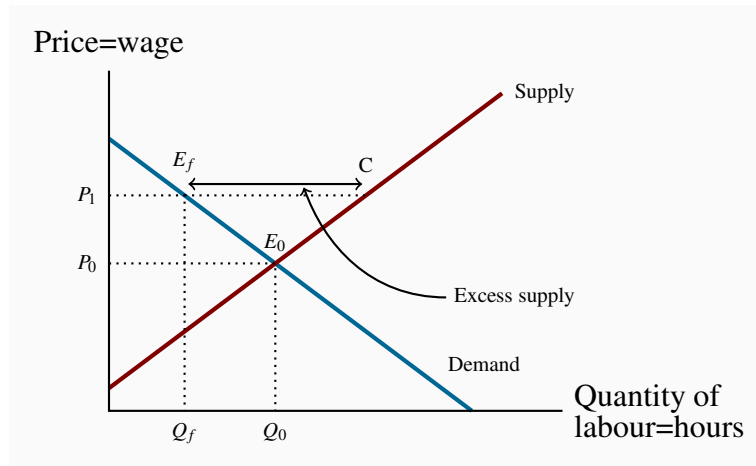


Figure 3.7: Price floor - minimum wage

In a free market the equilibrium is E_0 . A minimum wage of P_f raises the hourly wage, but reduces the hours demanded to Q_f . Thus E_fC is the excess supply.

Note that there is a similarity between the outcomes defined in the floor and ceiling cases: The quantity actually traded is *the lesser of the supply quantity and demand quantity at the going price: the short side dominates*.

Quotas

A quota represents the right to supply a specified quantity of a good to the market. It is a means of keeping prices higher than the free-market equilibrium price. As an alternative to imposing a price floor, the government can generate a high price by restricting supply.

Agricultural markets abound with examples. In these markets, farmers can supply only what they are permitted by the quota they hold, and there is usually a market for these quotas. For example, in several Canadian provinces it currently costs in the region of \$30,000 to purchase a quota granting the right to sell the milk of one cow. The cost of purchasing quotas can thus easily outstrip the cost of a farm and herd. Canadian cheese importers must pay for the right to import cheese from abroad. Restrictions also apply to poultry. The impact of all of these restrictions is to raise the domestic price above the free market price.

In Figure 3.8, the free-market equilibrium is at E_0 . In order to raise the price above P_0 , the govern-

ment restricts supply to Q_q by granting quotas, which permit producers to supply a limited amount of the good in question. This supply is purchased at the price equal to P_q .

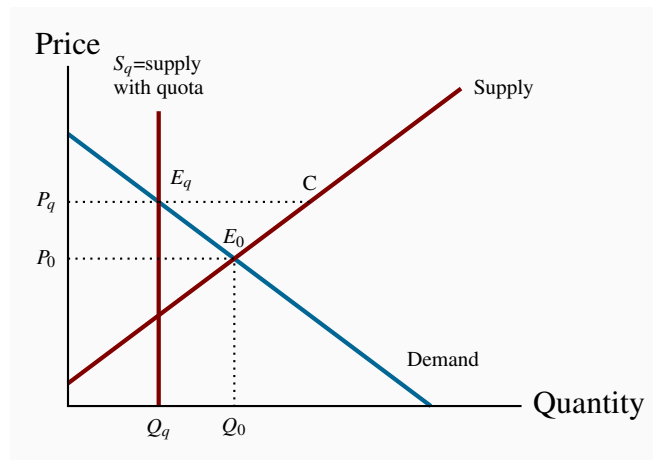


Figure 3.8: The effect of a quota

The government decides that the equilibrium price P_0 is too low. It decides to boost price by reducing supply from Q_0 to Q_q . It achieves this by requiring producers to have a production quota. This is equivalent to fixing supply at S_q .

Modelling market interventions

To illustrate the impact of these interventions on our numerical market model for natural gas, let us suppose that the government imposes a minimum price of \$6 – above the equilibrium price obviously. We can easily determine the quantity supplied and demanded at such a price. On the supply side:

$$P = 1 + (1/2)Q.$$

Hence at $P = 6$ it follows that $6 = 1 + (1/2)Q$; that is $5 = (1/2)Q$. Thus Q must take a value of 10, which is to say that suppliers *would like to supply* 10 units at this price.

Correspondingly on the demand side:

$$P = 10 - Q,$$

At $P = 6$, it follows that $6 = 10 - Q$; that is $Q = 4$. So buyers *would like to buy* 4 units at that price:

there is excess supply. But we know that the short side of the market will win out, and so the actual amount traded at this restricted price will be 4 units.

3.8 Individual and market functions

Markets are made up of many individual participants on the demand and supply side. The supply and demand functions that we have worked with in this chapter are those for the total of all participants on each side of the market. But how do we arrive at such market functions when the economy is composed of individuals? We can illustrate how, with the help of Figure 3.9.

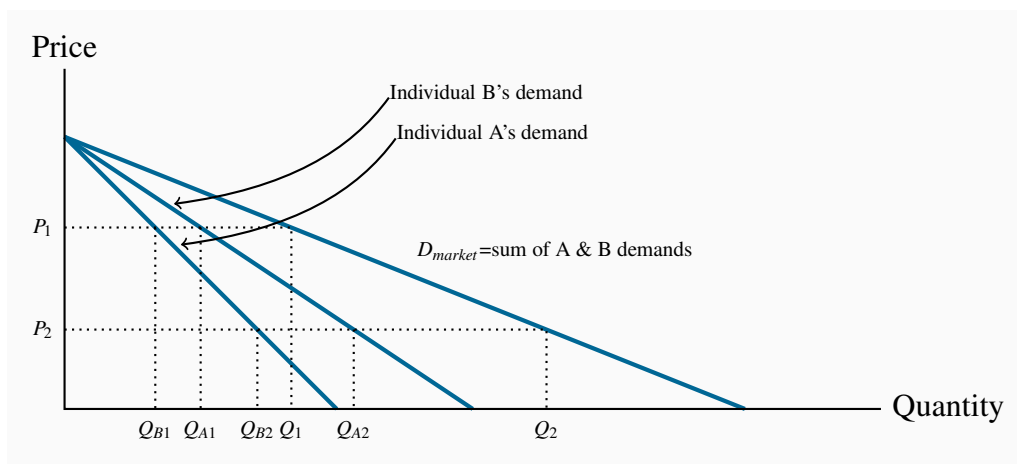


Figure 3.9: Summing individual demands

At P_1 individual A purchases Q_{A1} and B purchases Q_{B1} . The total demand is the sum of these individual demands at this price (Q_1). At P_2 individual demands are summed to Q_2 . Since the points Q_1 and Q_2 define the demands of the market participants it follows that market demand is the horizontal sum of these curves.

To concentrate on the essentials, imagine that there are just two buyers of gasoline in the economy. A has a bigger car than B, so his demand is greater. To simplify, let the two demands have the same intercept on the vertical axis. The curves D_A and D_B indicate how much gasoline A and B, respectively, will buy at each price. The market demand indicates how much they buy *together* at any price. Accordingly, at P_1 , A and B purchase the quantities Q_{A1} and Q_{B1} respectively. At a price P_2 , they purchase Q_{A2} and Q_{B2} . The **market demand** is therefore the horizontal sum of the individual demands at these prices. In the figure this is defined by D_{market} .

Market demand: the horizontal sum of individual demands.

Conclusion

We have covered a lot of ground in this chapter. It is intended to open up the vista of economics to the new student in the discipline. Economics is powerful and challenging, and the ideas we have developed here will serve as conceptual foundations for our exploration of the subject. Our next chapter deals with measurement and responsiveness.

KEY CONCEPTS

Demand is the quantity of a good or service that buyers wish to purchase at each possible price, with all other influences on demand remaining unchanged.

Supply is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged.

Quantity demanded defines the amount purchased at a particular price.

Quantity supplied refers to the amount supplied at a particular price.

Equilibrium price: equilibrates the market. It is the price at which quantity demanded equals the quantity supplied.

Excess supply exists when the quantity supplied exceeds the quantity demanded at the going price.

Excess demand exists when the quantity demanded exceeds quantity supplied at the going price.

Short side of the market determines outcomes at prices other than the equilibrium.

Demand curve is a graphical expression of the relationship between price and quantity demanded, with other influences remaining unchanged.

Supply curve is a graphical expression of the relationship between price and quantity supplied, with other influences remaining unchanged.

Substitute goods: when a price reduction (rise) for a related product reduces (increases) the demand for a primary product, it is a substitute for the primary product.

Complementary goods: when a price reduction (rise) for a related product increases (reduces) the demand for a primary product, it is a complement for the primary product.

Inferior good is one whose demand falls in response to higher incomes.

Normal good is one whose demand increases in response to higher incomes.

Comparative static analysis compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the other things that lie behind the demand curve or the supply curve.

Price controls are government rules or laws that inhibit the formation of market-determined prices.

Quotas are physical restrictions on output.

Market demand: the horizontal sum of individual demands.

EXERCISES FOR CHAPTER 3

Exercise 3.1. Supply and demand data for concerts are shown below.

Price	\$20	\$24	\$28	\$32	\$36	\$40
Quantity demanded	10	9	8	7	6	5
Quantity supplied	1	3	5	7	9	11

- Plot the supply and demand curves to scale and establish the equilibrium price and quantity.
- What is the excess supply or demand when price is \$24? When price is \$36?
- Describe the market adjustments in price induced by these two prices.
- The functions underlying the example in the table are linear and can be presented as $P = 18 + 2Q$ (supply) and $P = 60 - 4Q$ (demand). Solve the two equations for the equilibrium price and quantity values.

Exercise 3.2. Illustrate in a supply/demand diagram, by shifting the demand curve appropriately, the effect on the demand for flights between Calgary and Winnipeg as a result of:

- Increasing the annual government subsidy to *Via Rail*.
- Improving the Trans-Canada highway between the two cities.
- The arrival of a new budget airline on the scene.

Exercise 3.3. A new trend in U.S. high schools is the widespread use of chewing tobacco. A recent survey indicates that 15 percent of males in upper grades now use it – a figure not far below the use rate for cigarettes. Apparently this development came about in response to the widespread implementation by schools of regulations that forbade cigarette smoking on and around school property. Draw a supply-demand equilibrium for each of the cigarette and chewing tobacco markets before and after the introduction of the regulations.

Exercise 3.4. In Exercise 3.1, suppose there is a simultaneous shift in supply and demand caused by an improvement in technology and a growth in incomes. The technological improvement is represented by a lower supply curve: $P = 10 + 2Q$. The higher incomes boost demand to $P = 76 - 4Q$.

- Draw the new supply and demand curves on a diagram and compare them with the pre-change curves.

- (b) Equate the new supply and demand functions and solve for the new equilibrium price and quantity.

Exercise 3.5. The market for labour can be described by two linear equations. Demand is given by $P = 170 - (1/6)Q$, and supply is given by $P = 50 + (1/3)Q$, where Q is the quantity of labour and P is the price of labour – the wage rate.

- (a) Graph the functions and find the equilibrium price and quantity by equating demand and supply.
- (b) Suppose a price ceiling is established by the government at a price of \$120. This price is below the equilibrium price that you have obtained in part a. Calculate the amount that would be demanded and supplied and then calculate the excess demand.

Exercise 3.6. In Exercise 3.5, suppose that the supply and demand describe an agricultural market rather than a labour market, and the government implements a price floor of \$140. This is greater than the equilibrium price.

- (a) Estimate the quantity supplied and the quantity demanded at this price, and calculate the excess supply.
- (b) Suppose the government instead chose to maintain a price of \$140 by implementing a system of quotas. What quantity of quotas should the government make available to the suppliers?

Exercise 3.7. In Exercise 3.6, suppose that, at the minimum price, the government buys up all of the supply that is not demanded, and exports it at a price of \$80 per unit. Compute the cost to the government of this operation.

Exercise 3.8. Let us sum two demand curves to obtain a ‘market’ demand curve. We will suppose there are just two buyers in the market. The two demands are defined by: $P = 42 - (1/3)Q$ and $P = 42 - (1/2)Q$.

- (a) Draw the demands (approximately to scale) and label the intercepts on both the price and quantity axes.
- (b) Determine how much would be purchased at prices \$10, \$20, and \$30.

Exercise 3.9. In Exercise 3.8 the demand curves had the same price intercept. Suppose instead that the first demand curve is given by $P = 36 - (1/3)Q$ and the second is unchanged. Graph these curves and illustrate the market demand curve.

Exercise 3.10. Here is an example of a demand curve that is not linear: $P = 5 - 0.2\sqrt{Q}$. The final term here is the square root of Q .

- (a) Draw this function on a graph and label the intercepts. You will see that the price intercept is easily obtained. Can you obtain the quantity intercept where $P = 0$?

- (b) To verify that the shape of your function is correct you can plot this demand curve in a spreadsheet.
- (c) If the supply curve in this market is given simply by $P = 2$, what is the equilibrium quantity traded?

Exercise 3.11. The football stadium of the University of the North West Territories has 30 seats. The demand for tickets is given by $P = 36 - (1/2)Q$, where Q is the number of ticket-buying fans.

- (a) At the equilibrium admission price how much revenue comes in from ticket sales for each game?
- (b) A local fan is offering to install 6 more seats at no cost to the University. Compute the price that would be charged with this new supply and compute the revenue that would accrue each game. Should the University accept the offer to install the seats?
- (c) Redo part (b) of this question, assuming that the initial number of seats is 40, and the University has the option to increase capacity to 46 at no cost to itself. Should the University accept the offer in this case?

Exercise 3.12. Suppose farm workers in Mexico are successful in obtaining a substantial wage increase. Illustrate the effect of this on the price of lettuce in the Canadian winter.

Part Two

Introduction to Macroeconomics

4. Economic activity and performance
5. Output, business cycles and employment
6. Aggregate expenditure & aggregate demand
7. The government sector

The four chapters in this part of the text introduce and develop the expenditure side of a basic traditional macroeconomic model. Chapter 4 explains the measurement of macroeconomic activity and performance. Then Chapter 5 introduces an aggregate demand and supply model to national output, the general price level and business cycles. Market based aggregate expenditure components that determine aggregate demand, when prices, interest rates and exchange rates are constant, are modelled in Chapter 6. Chapter 7 extends the expenditure model to include Government expenditure, taxes, budgets, public debt and basic fiscal policy.

Chapter 4

Economic activity and performance

In this chapter we will explore:

- 4.1 Indicators of macroeconomic activity and performance
- 4.2 Recent Canadian economic performance
- 4.3 National accounts and economic structure
- 4.4 Measuring GDP
- 4.5 Nominal GDP, real GDP and the GDP deflator
- 4.6 Per capital real GDP, productivity and standards of living

Macroeconomic performance and policy continue to dominate the media, political debates, and public discussion in Canada, the U.S. and Europe. The 2008 economic crisis in the American financial and housing markets had profound and lasting effects on U.S. banks and households.

Major financial institutions collapsed on an international scale. Output and employment fell sharply and continuously in the midst of the most dramatic recession since the 1980s. Recession spread quickly and widely to other countries through international capital markets and financial flows, trade flows, commodity prices, and exchange rates. The crisis triggered unprecedented government intervention in U.S and European financial markets and calls for large and innovative changes in both monetary and fiscal policy stimulus.

The after-effects of the crisis and policy responses continue to dominate the financial news. Financial institution bailouts in many countries combined with initial fiscal stimulus to fight recession create large government budget deficits in North America and Europe. These deficits drew attention to an underlying concern about government debt to GDP ratios.

Markets reacted negatively to increased risks of default on the sovereign debt of weaker countries in the euro zone like Portugal, Ireland, Greece and Spain, (the PIGS). New European policy initiatives to provide financial support for these and other troubled EU countries included requirements for strong fiscal austerity to reduce government budget deficits. To the extent that austerity

programs cut economic growth and caused deeper recessions, the deficit and debt problems intensified. Larger support programs were needed. This process continues in 2013 as France, Germany, Italy and Spain discuss the design of an effective stabilization program to sustain the euro.

Macroeconomic theory and models emerged from an earlier major financial collapse and crisis followed by the depression years of the 1930s. Although today's economies are larger and more complex they still behave by the same basic principles.

Macroeconomics studies the national economy as a system. It starts with carefully developed measures of the economy's total output of goods and services, and expenditures on current output by households, businesses, national governments, and residents of other countries. Expenditures generate incomes for households and businesses and, through taxation, revenues for governments. Money, banking, financial markets, and foreign exchange markets play key roles in financing these expenditure flows. Macroeconomics explains the ways in which different parts of the economy interact to determine outputs, incomes, prices, and employment in the whole economy.

Macroeconomic theory, models and institutions also provide for the design and evaluation of national monetary and fiscal policies. Most countries have a central bank charged with designing and pursuing monetary policies to control inflation while supporting high levels of national income and employment.

Similarly, national governments, and in many cases junior governments as well, have fiscal policy responsibilities. Fiscal policies fund a set of public services by designing government budgets that control deficits and government debt while at the same time contributing to stability and growth in national income and employment. The media report regularly on the monetary and fiscal policy announcements of the Governor of the Bank of Canada, Stephen Poloz and the Federal Minister of Finance, the Honorable Joe Oliver.

To understand the different dimensions of economic activity, economic conditions and macroeconomic policies we need a framework that captures how they are related and how they interact. Macroeconomics provides that framework, based on a consistent and comprehensive system of definitions for the measurement of economic activity in the national economy.

4.1 Macroeconomic performance

Output, price, and employment are three main indicators of macroeconomic activity and performance. Output is a measure of the total quantity of goods and services produced in the economy. It is also a measure of the incomes generated by that production. Price or the price level in macroeconomics is the weighted average of the market prices of all final goods and services produced. The price level reflects the costs of production in the economy. Employment is a measure of the number of jobs involved in the production of goods and services, or, in more refined terms, the number of hours of labour input required to produce the economy's output.

Real gross domestic product (real GDP) measures output and income. Real GDP is the quantity of final goods and services produced in the economy in a specific time period, say, one year, measured in the market prices of a base year, 2007, for example. (It may also be called GDP in constant 2007 dollars.) As we will see later in this chapter, the production of goods and services generates incomes equal to the value of those goods and services. As a result, real GDP is also the real income in the economy and the quantity of goods and services the economy can afford to buy.

Real GDP: the quantity of final goods and services produced by the economy in a specified time period.

When we look at the economy over time we see that real GDP changes from year to year. Because we measure real GDP in the prices of a base year, the changes we see in real GDP are the result of changes in the quantities of goods and services produced and not the result of changes in prices. This distinction is important. Increased quantities of goods and services provide for increased standards of living in the economy. Increases in prices do not. As a result, we define **economic growth** as an increase in real GDP, and the annual **rate of economic growth** is the annual percentage change in real GDP. The rate of growth in real GDP is calculated as follows:

$$\text{Rate of growth of real GDP} = \frac{\text{Real GDP}_{\text{year 2}} - \text{Real GDP}_{\text{year 1}}}{\text{Real GDP}_{\text{year 1}}} \times 100 \quad (4.1)$$

Economic growth: an increase in real GDP.

Rate of economic growth: the annual percentage change in real GDP.

Recent measures of real GDP in Canada provide an example of economic growth and the calculation of the rate of economic growth. In the year 2013, real GDP in Canada measured in 2007 dollars was \$1,681 billion. In 2012, real GDP in 2007 dollars was \$1,654 billion. Using these data:

$$\text{Rate of growth of real GDP in 2013} = \frac{\$1,681 - \$1,654}{\$1,654} \times 100 = 1.6\%$$

The **price level** in the economy is a measure of the weighted average of prices of a wide variety of goods and services. Section 2.3 in Chapter 2 explained how a **price index** is constructed and used to provide a measure of prices in one year compared with prices in a base year. The **Consumer Price Index (CPI)**, for example, compares the cost of a fixed basket of goods and services bought by the typical household at a specific time with the cost of that same basket of goods and services in the base year. It is the most widely used indicator of prices in Canada and is often referred to as the “cost of living.”

Price level: a measure of the average prices of all goods and services produced in the economy.

Price index: a measure of the price level in one year compared with prices in a base year.

Consumer Price Index (CPI): a measure of the cost of living in any one year to the cost of living in a base year.

The Consumer Price Index is a more comprehensive measure of the change in prices from one year to the next, but the simple example in Example Box 4.1 illustrates the how such an index is constructed and what it tells us.

A simple example illustrates the construction of a price index. Suppose a survey of expenditures by university students in the year 2006 gives the information reported in the first three columns in the following table:

University student weekly expenditure basket (Base year 2006)

	Quantity	2006 Price	2006 Cost	2011 Price	2011 Cost
Pizza	5	\$7.50	\$37.50	\$8.50	\$42.50
Hamburger	5	\$2.50	\$12.50	\$2.25	\$11.25
Coffee	10	\$1.00	\$10.00	\$1.25	\$12.50
Movies	1	\$10.00	\$10.00	\$8.00	\$8.00
Bus fare	7	\$1.50	\$10.50	\$1.85	\$12.95
Total			\$80.50		\$87.20

This table gives us the cost of weekly expenditures on a basket of five items and the weight of each item in the total expenditure. If we chose 2006 as our base year then the cost of the basket in 2006 prices, \$80.50, has an index value of 100 $[(\$80.50/\$80.50) \times 100]$. In other words we have a Student Price Index:

$$\text{SPI}_{2006} = 100.0$$

Now we see in the last two columns of the table that this same basket of goods and services in *the prices of 2011* would cost \$87.20. Then our SPI in 2011 would be:

$$\frac{\text{Cost of basket in 2011}}{\text{Cost of basket in 2006}} \times 100 = \frac{\$87.20}{\$80.50} \times 100 = 108.3$$

The index tells us that even though the prices of some things went up and others went down the Student Price Index increased by 8.3%. This was the weighted average increase in prices and the increase in the cost of student expenditures.

Example Box 4.1: Constructing a price index

Today, the base year for the consumer price index is 2002 with a value of 100. Statistics Canada uses a fixed basket classified under eight consumer expenditure categories. The weight or importance of each category is its share of expenditure as determined by consumer expenditure surveys. By visiting the Statistics Canada website, www.statcan.gc.ca, and selecting Consumer Price Index in the *Latest Indicators* table on the right side of the home page, you can scroll down to a table showing the components of the CPI.

For 2012 Statistics Canada reported a CPI of 121.7 compared to a CPI of 100.0 in 2002. That meant the cost of the basket of goods in 2012 was 21.7 per cent higher than it was in 2002. Prices and the cost of living increased over the 10-year period. At the end of 2013 the CPI was 122.8. Prices had increased again. **Inflation** is defined as a persistent rise in the general price level as indicated by these increases in the change, as a percentage, in the price level.

Inflation: a persistent rise in the general price level.

The inflation rate is calculated using the same method used for calculating the growth rate in real GDP. For example:

$$\text{Inflation rate for 2013} = \frac{\text{CPI}_{2013} - \text{CPI}_{2012}}{\text{CPI}_{2012}} \times 100 \quad (4.2)$$

Statistics Canada reported the 2013 CPI at 122.8 and the 2012 CPI at 121.7. The inflation rate for 2013 was:

$$\text{Inflation rate for 2013} = \frac{122.8 - 121.7}{121.7} \times 100 = 0.9$$

Statistics Canada also collects and publishes information on the Canadian labour market. It uses a monthly Labour Force Survey of approximately 50,000 Canadian individuals 15 years of age or over living in the provinces of Canada, excluding full-time members of the armed forces, those persons living on Indian reserves, and those in institutions such as penal institutions, hospitals, and nursing homes. The survey provides the data used to estimate the size of the labour force, employment, and unemployment.

Employment is defined as the number of adults (15 years of age and older) employed full-time and part-time and self-employed. **Unemployment** covers those not working but available for and seeking work. The civilian **labour force** is those adults who are employed plus those not employed but actively looking for jobs. Based on these concepts, and data on the surveyed population, Statistics Canada reports three key labour market indicators, namely: the participation rate, the unemployment rate, and the employment rate. Employment and unemployment receive most of the media attention and have become familiar indicators of economic conditions. There are, however, two other underlying labour market measures that deserve attention when interpreting the employment and unemployment rates.

Labour force: adults employed plus those not employed but actively looking for work.

Employment: number of adults employed full-time and part-time and self-employed.

Unemployment: number of adults not working but actively looking for work.

The **participation rate** is the proportion of the surveyed population that is either working or unemployed. It measures the size of the labour force relative to the surveyed population. The participation rate changes as people become more optimistic about finding employment, or discouraged by periods without employment. Discouraged workers want to work but are no longer looking for work because they believe suitable work is not available. As a result they are excluded from the measurement of the labour force and reduce the participation rate. Changes in the participation rate change the size of the labour force and the unemployment rate even if employment and the population are constant.

Participation rate: percent of the population that is either working or unemployed.

$$\text{Participation Rate} = \frac{\text{Labour force}}{\text{Population 15+ yrs}} \times 100 \quad (4.3)$$

In Canada in 2013 Statistics Canada reported the population 15 years and older was 28.690 million persons and the labour force was 19.079 million persons. These data give:

$$\text{Participation rate in 2013} = \frac{19.079}{28.690} \times 100 = 66.5\%$$

The **unemployment rate** is the number of unemployed persons as a percentage of the labour force. However, because the size of the labour force depends on the participation rate, the choices people make about looking for work, the unemployment rate will rise if people become more optimistic about job prospects and begin to look for work, increasing the participation rate and the labour force. On the other hand, the unemployment rate will decline if some people become discouraged and give up looking for work, reducing the participation rate and the labour force.

Unemployment rate: the number of unemployed persons as a percentage of the labour force.

The unemployment rate is calculated as follows:

$$\text{Unemployment Rate} = \frac{\text{Labour force} - \text{employment}}{\text{Labour force}} \times 100 \quad (4.4)$$

Statistics Canada reported labour force participation rate of 66.5 percent, a labour force of 19.079 million persons in 2013 and total employment of 17.731 million persons. In that year, 1.348 million

persons were unemployed and the unemployment rate was:

$$\text{Unemployment rate for 2013} = \frac{19.079 - 17.731}{19.079} \times 100 = 7.1\%$$

Unemployment as measured by the broad unemployment rate has three important components. **Cyclical unemployment** is unemployment that would be eliminated by a higher level of economic activity without putting increased pressure on wage rates and inflation. **Frictional unemployment** comes from the dynamics of the labour market as changing labour force participation and employment opportunities mean that it takes time to match job openings with job candidates. **Structural unemployment** reflects differences in labour force characteristics and employment opportunities as the structure of the economy changes. In combination, frictional and structural unemployment make up the “full employment” level of unemployment. The corresponding unemployment rate is defined as the **natural unemployment rate**. In recent years in Canada, estimates of frictional and structural unemployment suggest a natural unemployment rate of about 6.0 percent. An unemployment rate persistently below 6.0 percent would create inflationary pressure in the labour market and the economy.

Cyclical unemployment: would be eliminated by higher levels of economic activity.

Frictional unemployment: a result the time involved in adjusting to changing labour force and employment opportunities.

Structural unemployment: caused by changes in economic structure relative to labour characteristics.

Natural unemployment rate: the unemployment rate at “full employment”.

The **employment rate** is the percentage of the population 15 years of age and over that is employed. Employment rates provide a different perspective on labour market conditions because they are not affected by changes in the participation rate, which can change unemployment rates. If some people become discouraged and stop looking for work the participation rate, the labour force and the unemployment rate decline, but the employment rate is unchanged. The employment rate is calculated as:

$$\text{Employment Rate} = \frac{\text{Employment}}{\text{Population 15+ yrs}} \times 100 \quad (4.5)$$

Employment rate: percent of the population 15 years of age and over that is employed.

In 2013 the population 15 years of age and over was 28.111 million and employment was 17.327 million and the employment rate was:

$$\text{Employment rate in 2013} = \frac{17.731}{28.690} \times 100 = 61.8\%$$

The employment rate was lower than the participation rate because some members of the labour force were unemployed.

Table 4.1 gives recent data on the Canadian labour force and labour market conditions using these concepts.

1. Non-institutional population 15+ yrs	28,894
2. Labour force	19,133
3. Employment	17,790
4. Unemployment [(2) – (3)]	1,343
5. Participation rate [(2)/(1) × 100]	66.2%
6. Employment rate [(3)/(1) × 100]	61.6%
7. Unemployment rate [(4)/(2) × 100]	7.0%

Table 4.1: The Canadian labour market, February 2014 (thousands of persons and percent)

Source: Statistics Canada, Labour Force Characteristics, Seasonally Adjusted, by Province. Table 282-0087.

Almost every day the media discuss some aspects of economic growth, inflation, and employment. Often these discussions ignore the requirement that employment must grow faster than the growth in the labour force if unemployment is to decline. Good news about ‘job creation’ needs to be tempered by news on labour force growth. These issues often play large roles in elections and discussions of economic policy. In the chapters that follow, we will study causes of changes in output, income, prices and inflation, and employment and unemployment. As a background to that work, consider recent Canadian economic performance.

4.2 Canadian economic performance

The positive relationship between economic performance and standards of living motivates the study of macroeconomics and macroeconomic policy. Table 4.2 provides a summary of performance in Canada and the U.S. based on the three main indicators defined above. It examines and compares Canada and U.S. real GDP growth, inflation and unemployment in the 2000-2011 time period. To recognize the dramatic shift in economic conditions brought on by the 2008 financial crisis, the data are presented as annual averages for the 2000-2008 period and then as annual averages for 2009-2011.

	Canada	United States
	%	%
Real GDP growth rate		
2000-2008	2.4	2.1
2009	-2.8	-3.5
2010	3.2	3.0
2011	2.2	2.1
Inflation rate		
2000-2008	2.3	2.8
2009	0.3	-0.3
2010	1.8	1.7
2011	2.7	3.2
Unemployment rate		
2000-2008	6.8	5.1
2009	8.3	9.3
2010	8.0	9.6
2011	7.4	9.0

Table 4.2: Real GDP growth, inflation & unemployment

Sources: Statistics Canada, CANSIM series V1992067, V41690914, V2062815; US Department of Commerce, BEA series GDPC1 Department of Labour, BLS series CPI AUSL, UNRATE.

Before the financial crisis in 2008 the average performances of both economies were equally strong. GDP growth rates in the 2.0 to 2.6 range were sufficient to maintain relatively low unemployment rates without serious inflationary pressures. In Canada, the inflation rate was comfortably within the Bank of Canada's 1%-3% target range. Similar U.S. inflation and lower unemployment were also consistent with implicit policy targets. These were generally good economic times despite wars in Iraq and Afghanistan and persistent anxiety over terrorism.

The financial crisis of 2008 created a sharp recession and prolonged recovery that is still fragile. In terms of the indicators of performance, economic growth rates collapsed to negative values in 2009 as outputs of goods and services declined in both Canadian and US economies. Inflation rates fell and unemployment rates increased as reduced production led to employee layoffs. Growth rates did recover in 2010 but not sufficiently to increase output and employment to previous levels as population and labour force continued to grow. Over the four years period 2009-2013, unemployment rates were higher in both Canada and the US than they were in 2000-2008 and economic prospects in Europe are even more uncertain.

Figures 4.1 to 4.4 provide a more detailed look at real GDP growth, inflation, and unemployment in Canada over these time same periods. They show the trends and annual variations in these measures of economic performance that lie behind the averages in Table 4.2. Understanding the causes of these short-term fluctuations in economic performance, their effects on standards of living and the economic policy questions they raise, are major reasons for studying macroeconomics.

Figure 4.1 shows the substantial growth in real GDP over the 2000-2013 period. It also shows that growth was not steady. Real GDP did increase from 2000-2008 with annual growth rates ranging from 1.5-3.0. Then the real GDP declined sharply by 3.0 percent in 2009. This and other times of negative growth in real GDP are called **recessions**. Indeed the fall in real GDP in 2009, the largest since such decline since the 1930's, is now called the 'Great Recession'.

Recession: decline in economic activity, often defined as two consecutive quarters of negative growth in real GDP.

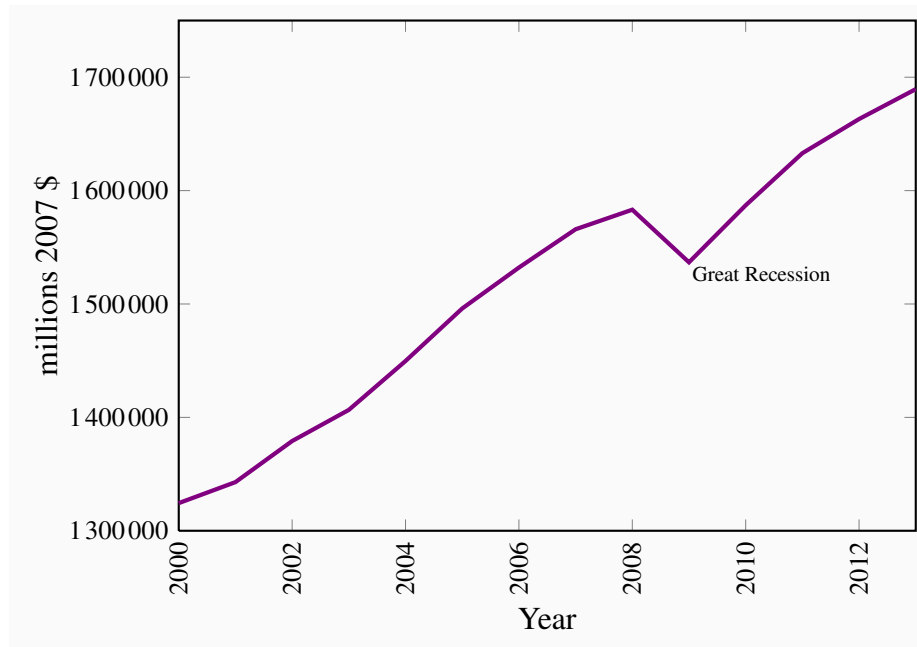


Figure 4.1: Real GDP in Canada 2000-2013

Source: CANSIM Table 380-0106

Figure 4.2 shows more clearly the considerable fluctuations in real GDP annual growth rates and the negative growth rate of the Great Recession. Annual growth rates varied from about 1.1 percent in 2008 to 3.3 percent in 2010. Even when the trend in growth is positive, fluctuations in growth rates can have negative effects on standards of living. We study macroeconomics to find explanations for the causes and effects of these fluctuations in economic activity that will guide stabilization policies.

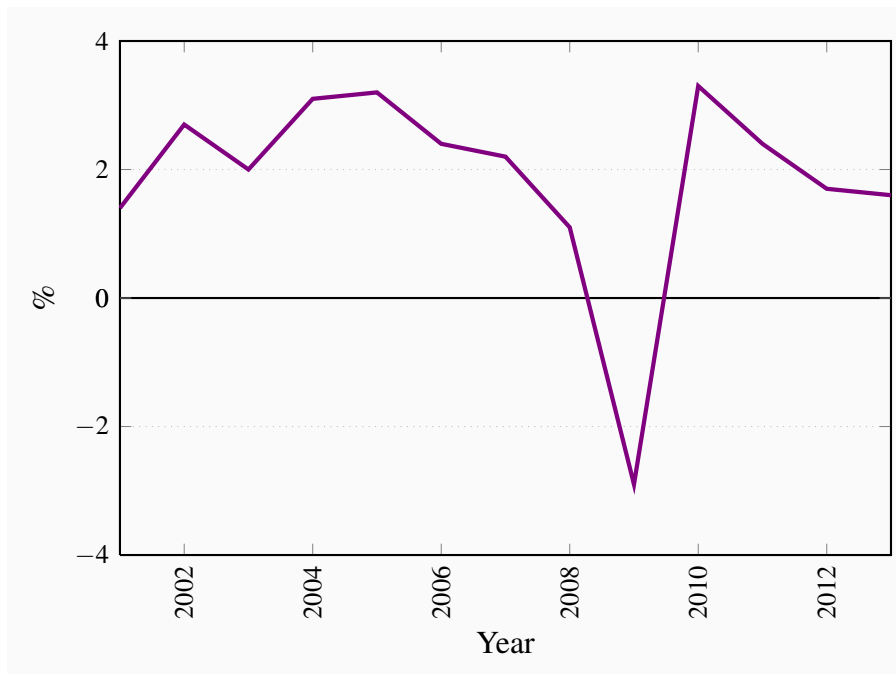


Figure 4.2: Annual real GDP growth in Canada, 2001-2013

Source: CANSIM Table 380-0106 and author's calculations

The period averages of inflation rates in Table 4.2 also hide the volatility of annual inflation rates in Canada. Figure 4.3 shows annual inflation rates in Canada since 2000. These annual values show the relative stability of Canadian inflation in the years leading up to the Great Recession. That pattern changed after 2008 with the effects of lower output growth and higher unemployment on prices and wage rates.

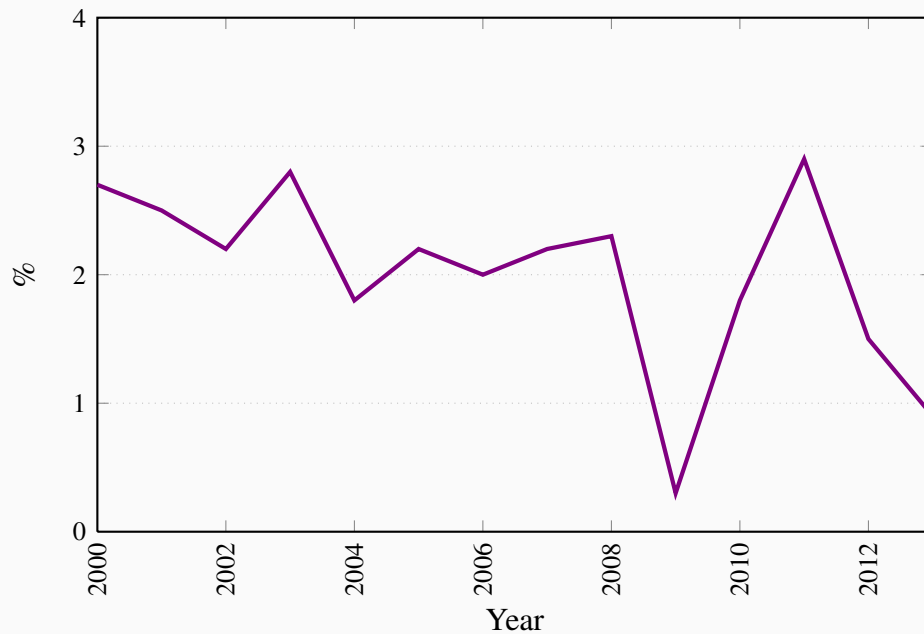


Figure 4.3: Annual inflation rates in Canada, 2000-2013

Source: Statistics Canada, CANSIM series V41690914

Our recent experience with low and stable inflation rates in the 2000-2014 period, is quite different from past experience.

We will examine the roles that monetary policies and recessions played in these changes in inflation rates.

Fluctuations in growth rates and inflation rates are also accompanied by fluctuations in unemployment rates. Annual unemployment rates plotted in Figure 4.4 have fluctuated between 6 percent and 8.3 percent. Although employment in the has grown over time, when job creation has at times fallen short of the growth in the labour force unemployment rates rise. At other times, strong real GDP growth and job creation have lowered the unemployment rate. The falling unemployment rates from 2002 to 2007 coincided in time with the continuous growth in real GDP we saw in Figure 4.1.

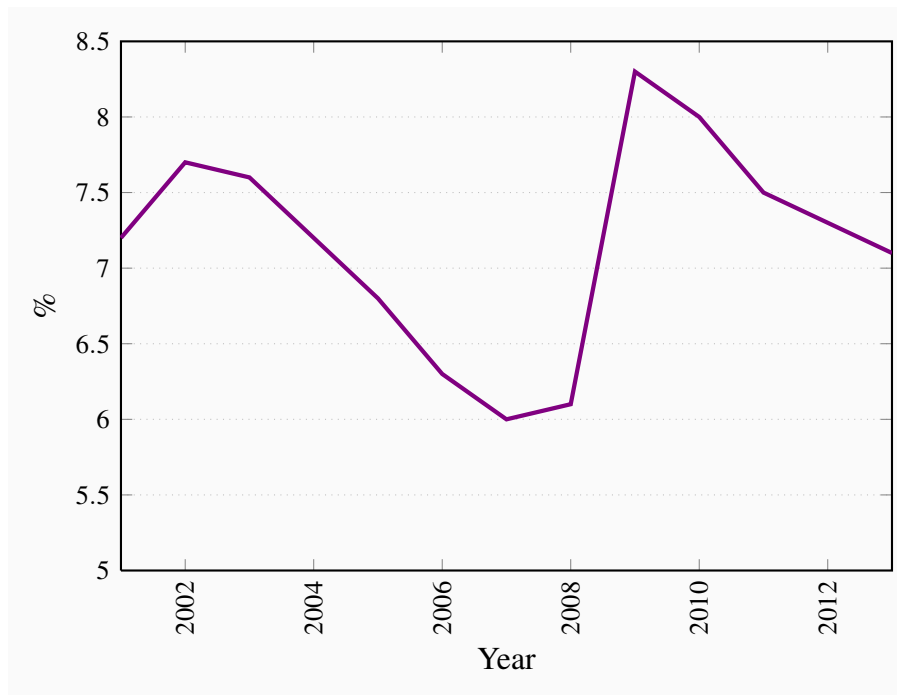


Figure 4.4: Annual Unemployment Rates in Canada 2001-2013

Source: Statistics Canada CANSIM series V2062815

The sharp rise in unemployment in 2009 and the persistence of unemployment rates higher than those in earlier years give us an example of the way growth in real GDP and employment are tied together. The recovery of GDP growth after the Great Recession has not been strong enough to offset modest growth in the labour force and lower unemployment rates to pre-recession levels.

Table 4.3 provides an international perspective on unemployment rates. It shows that measured unemployment rates differ quite widely among countries. Furthermore, unemployment rates change over time in different ways across countries. Most but not all countries experienced sharply higher unemployment after 2008 as the financial U.S. crisis spread internationally. Korea and Germany were the exceptions based strong domestic and export demand. There was some moderation in unemployment rates in the following two years for all countries except Greece. In that case the government debt crisis, aggravated by the recession, led to strong fiscal austerity as a condition of financial support from other European countries. The result was a deeper recession and continued growth in public debt. High unemployment rates in other European countries also reflect difficult economic conditions and government deficit and debt problems.

Country	2008	2010	2012
Canada	6.1	8.0	7.2
US	5.8	9.6	8.1
Japan	4.0	5.1	4.3
Korea	4.0	3.7	3.4
France	7.4	9.4	n/a
Italy	6.7	8.4	10.7
Germany	7.5	7.1	5.9
Greece	7.7	12.5	24.2

Table 4.3: Unemployment rates selected countries 2008, 2010, 2012 (percent of labour force)

Source: International Labour Office: ILOSTAST Database 2013.

4.3 National accounts

National accounts provide the framework that is essential for consistent definitions and measurement of spending, output, and incomes. However, it is important to recognize that this is an accounting system that *describes* the economy, not an economic model that *explains* the economy's behaviour. That comes later.

The national economy involves all households, businesses, and governments that make decisions about employment, output and expenditures. The results of individual decisions made by these economic units are measured by the economy's total spending, output, and income. The **circular flow diagram** in Figure 4.5 shows the relationship between spending, output, and income.

Circular flow diagrams: show the flows of money payments real resources, and goods and services between households and businesses.

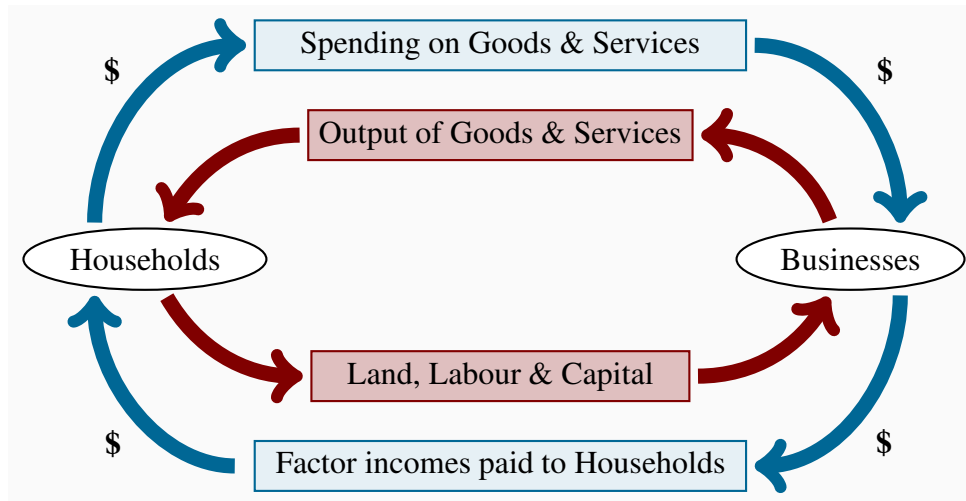


Figure 4.5: Circular Flows in the Economy

We start with the simplest of economies. There are only households and businesses; no government and no trade with other countries. Households own the factors of production: labour, land, capital, and entrepreneurship. Businesses use these factors of production to produce outputs of goods and services. Businesses pay households for the factor services they use and recover these costs by selling their output to the households.

Figure 4.5 shows the circular flow of inputs to production, outputs of goods and services, costs of the inputs to production, and receipts from sales. The upper half of the diagram, above the horizontal line, shows the outputs of goods and services supplied by business to households and household expenditures on those goods and services. The lower half of the diagram shows the factor services of labour, land capital, and entrepreneurship supplied by households to business in exchange for the factor incomes: wages, rent, interest, and profit.

The figure also suggests an alternative way to look at activity in the aggregate economy. The inner loop in the diagram shows the *flows of real factor services* between households and businesses. Households provide factor services to business and get goods and services in return. In modern economies this exchange of factor services for goods and services is facilitated by the use of money as a means of payment. The outer loop in the diagram illustrates the *flows of money payments* made by business to buy factor services, and by households to buy goods and services produced by business. Business pays wages, rent, interest, and profits to households and finances those costs with their receipts from sales to households. To keep the example simple, we assume that households spend all the income they receive from the business sector on goods and services produced by the business sector.

Figure 4.5 illustrates four ways to measure economic activity, namely:

1. the output of goods and services at market prices;
2. the total expenditure on goods and services at market prices;
3. the inputs to the production of goods and services costed at market prices; and
4. the incomes received by households for providing factor inputs to production.

The four rectangles in the diagram show these four alternative but equal measurements.

The accounting framework gives the same measure of total economic activity whether we use the market value of output, total spending on that output, inputs to production, or the factor incomes received by households in return for those inputs.

This circular flow model is kept very simple to illustrate the basic accounting principle:

$$\begin{aligned}
 \text{Market value of output} &= \text{total expenditure} \\
 &= \text{market value of factor services} \\
 &= \text{household income.}
 \end{aligned}$$

While the principle illustrated by the circular flow is sound, the economy in Figure 4.5 is too simple. It does not allow households to save or businesses to invest. It leaves out government expenditures and taxes, and transactions between households and businesses with the rest of the world. Including those aspects of economic activity would make our model more complex, and we would need a comprehensive system of national accounts to describe and measure it. But the basic accounting principle would be the same: the four ways to measure total activity in the economy give, *by definition*, the same answer.

4.4 Measuring GDP

Nominal GDP is measured using market prices and a specific time period. It is not possible to add up the final physical outputs of many different businesses and arrive at a meaningful result. Instead, because we have a ‘money economy’, we let current market prices determine the money values of these different outputs. Then the total market value can be found by adding up the money values. Nominal GDP is the market value at current prices of all final goods and services.

Furthermore, the outputs of goods and services occur over time, not all at once. They flow over time and must be measured relative to time. GDP measured over three-month and one-year time periods are reported as quarterly GDP and annual GDP. Annual nominal GDP for any year is the value of the **final goods and services** produced in that year at the prices of that year.

Final goods and services: goods and services are purchased by the ultimate users.

In Canada, Statistics Canada uses the Canadian System of National Accounts (CSNA) to measure GDP. This framework is based on the circular flow concept we have discussed, but is applied to the complexity of the actual economy.

Although we defined and discussed *real GDP*, measured at prices of a base year, earlier in this chapter, national accounting measures **nominal GDP** at current prices. The CSNA produces three measurements of nominal GDP:

1. *Output-based GDP* is the sum of value added (output less the cost of goods and services purchased from other business) by all industries in Canada;
2. *Income-based GDP* records the earnings generated by the production of goods and services; and
3. *Expenditure-based GDP* is equal to expenditure on final goods and services produced.

Nominal GDP: the output of final goods and services, the money incomes generated by the production of that output, and expenditure on the sale of that output in a specific time period.

These three alternative measures of GDP provide importantly different perspectives on the level of national economic activity. The output and income measures describe the *supply side* of the economy in terms of goods and services produced, and cost of production. The expenditure measure of GDP describes the *demand side* of the economy.

Output-based GDP

To measure output in the economy, and the contribution of particular businesses or industries to that output, we use the **value-added** approach to GDP. Value added measures the *net* output of each industry. To find the value added (net output) of a particular business or industry, the costs of the goods and services purchased from other businesses and industries are deducted from the value of the final product. National, or all-industry GDP, is then the sum of GDP by industry.

Value added: the difference between the market value of the output of the business and the cost of inputs purchased from other businesses.

This method recognizes that businesses buy inputs to production from other businesses as well as from households. Automakers like General Motors and Honda buy parts and components like tires and windshields from other businesses, and include the costs of those inputs in the prices of the finished cars they sell. They also buy services like accounting, advertising, and transportation from service producers. Similarly, pizza makers buy cheese and pepperoni from cheese factories and meat processors. If we were to add up the outputs of auto parts manufacturers, cheese makers, meat processors, pizza makers, General Motors, and Honda in our measurement of nominal GDP, we would overstate GDP by *double counting*. The cheese would be counted once at the cheese factory and again in the pizza. The same applies to the tires and windshields of the new cars. To avoid double counting, we use value added, the increase in the value of goods and services as measured by the difference between market value of output and the cost of **intermediate inputs** bought from other businesses. Or we could count only the outputs sold to *final* users. Notice that total GDP by our definition measures the output of final goods and services.

Intermediate inputs: services, materials, and components purchased from other businesses and used in the production of final goods.

Consider a simple example. A coffee shop sells 100 cups of coffee an hour at a price, before tax, of \$1.50. To make 100 cups of coffee the shop uses 2 kilos of ground coffee costing \$10.00 per kilo, 25 litres of pure spring water costing \$0.40 a litre, and electricity and dairy products costing, in total \$20. The coffee shop's sales per hour are \$150 using inputs costing \$50. Its value added is $\$150 - \$50 = \$100$. As we will see shortly, this value added, or \$100, covers the labour costs, rent, interest expenses, and management costs of the business, for producing 100 cups of coffee an hour.

Table 4.4 shows the industrial structure of output in Canada in 2013, based on the percentage shares of selected industries in Canadian GDP. Industry outputs are measured by value added. The data illustrate the importance of service-producing industries to economic activity in Canada. This industrial structure is typical of today's high-income economies and raises many interesting questions about the relationship between economic structure, performance, and growth. However, when our main interest is in the total level of economic activity rather than its industrial structure, the expenditure-based and income-based measures of GDP are used.

All Industries	100.0
Goods producing industries	29.9
Service producing industries	70.1
Agriculture, forestry, fishing, etc.	1.8
Mining, oil and gas extraction	8.3
Construction	7.0
Manufacturing	10.3
Wholesale and retail trade	10.8
Transportation	4.2
Finance, insurance and real estate	19.5
Professional and educational	10.6
Health and social assistance	6.8
Public administration	6.9
All other	13.9

Table 4.4: Outputs of selected industries in GDP, Canada 2013 (percent shares)

Source: Statistics Canada, CANSIM Table 379-0031 and author's calculations.

Expenditure-based GDP

The expenditure-based measurement of nominal GDP adds up the market value of all the final goods and services produced and bought in a given time period, say one year. The national accounts classify this *final expenditure* into five main categories: consumption, investment, government expenditure, exports, and imports. This classification system is essential for our study of macroeconomic activity for two reasons. First, the classification scheme covers final expenditure in the economy completely; nothing is omitted. Second, the categories represent expenditure decisions made for different reasons in different parts of the economy. Understanding expenditure decisions is critical to the work that lies ahead. Defining the *expenditure* categories is the first step.

Consumption expenditure is expenditure by the household sector on currently produced final goods and services in one year. It includes expenditures on food, clothing, housing, home ap-

pliances, transportation, entertainment, personal services, financial services, and so forth. The total of these expenditures is aggregate consumption. We will use C to indicate these household expenditures.

Consumption expenditure (C): spending by households on currently produced final goods and services.

Investment is expenditure by the business sector on currently produced final goods and services to be used in the future production of goods and services. Investment adds to the *buildings, machinery, and inventories* that business uses for the production of goods and services. This is the country's capital stock. It was included in our discussion of the factors of production and factor incomes. By national accounts conventions, investment also includes expenditure on newly constructed residential housing, another component of the nation's capital stock, one that produces housing services.

Investment (I): spending by business on currently produced final goods and services.

The investment defined here is *gross investment*. It does not take account of the decline or *depreciation* of the capital stock through wear and tear and obsolescence. Net investment is gross investment minus depreciation. *Net investment* measures the change in capital stock from one year to the next. Notice that net investment will be smaller than gross investment and could even be negative if the current level of investment expenditure is not enough to cover the depreciation of the capital stock. The key concept for our work is gross investment expenditure by business on currently produced final goods and services. We will use I to indicate this expenditure.

Government expenditure is the purchase of currently produced final goods and services by the government sector of the economy. It includes the wages and salaries of government employees and the military, and thus the government-provided services like health care, education, the courts, foreign embassies, and national defense. Governments also spend on office equipment, buildings, roads, and military equipment. This public sector capital stock is also used to provide government services to the economy. We use G to indicate government expenditure on final goods and services.

Government expenditure (G): spending by government on currently produced final goods and services.

Governments also make payments to households and business that are not expenditure directly on current final output. These include payments made under government programs like Old Age Security, Employment Insurance Benefits, and Social Assistance, as well as the interest payments the government makes to holders of government bonds. These are *transfer payments* that do not

require the provision of any goods or services in return. They are not included in GDP because there is no corresponding output. We will see in later chapters that government taxes and transfer payments redistribute existing income and spending power away from those taxed and towards those receiving transfer payments.

Exports and **Imports** measure the expenditures arising from international trade in goods and services. Our **exports** are the result of expenditures by residents of other countries on the final goods and services produced in this country. These expenditures provide incomes to domestic factors of production. Our **imports** are our expenditures on goods and services produced in other countries. They do not give rise to incomes for domestic factors of production. However, some part of household consumption expenditures, business investment expenditures, and government expenditures are for goods and services produced in other countries. Furthermore, many of our exports of goods and services have imports included in them; for example, the new cars we assemble in Ontario and sell in the United States have components made in other countries. We could subtract the import component separately from the other expenditure categories and measure only expenditure on domestically produced final goods and services, but it is easier to continue to measure that final expenditure in total and then subtract imports from that total.

Exports (X): purchases of our domestic goods and services by residents of other countries.

Imports (IM): purchases of goods and services produced by other countries.

The effect of international trade on domestic incomes is the result of the difference between exports and imports. **Net exports**, exports minus imports, measure this effect even though they are not directly related. We will use X to represent exports, IM to represent imports, and $NX (= X - IM)$ to represent net exports.

Net exports (NX): the difference between exports and imports.

Gross domestic product measured by the expenditure approach is the sum of expenditures by households, businesses, governments, and residents of other countries on domestically produced final goods and services. Using the expenditure categories and notation we have discussed gives:

$$\text{GDP} = \text{consumption} + \text{investment} + \text{government expenditure} + \text{exports} - \text{imports}$$

or

$$\text{GDP} = C + I + G + X - IM \quad (4.6)$$

This approach to the measurement of GDP corresponds to the output and expenditure in the upper part of Figure 4.5. The left-hand columns of Table 4.5 show Canadian GDP in 2013 measured by

the expenditure approach, in terms of the absolute values of expenditure categories and the percent share of each category in GDP measured by expenditure. Shares of consumption and exports are important structural aspects of the Canadian economy that are important for the model of the economy developed in later chapters.

Expenditure Measures			Incomes Measures		
At market price	\$	%	Income source	\$	%
<i>C</i> by households ¹	1,045.9	56.7	Employee compensation	956.8	50.9
<i>I</i> by business ²	380.0	20.2	Net corporate surplus	239.5	12.7
<i>G</i> by government	485.6	25.8	Net mixed income	167.7	8.9
<i>X</i> exports	565.7	30.1	Capital consumption	325.0	17.3
<i>IM</i> imports	-597.6	-31.8	Net indirect taxes	190.3	10.1
Statistical discrepancy	-0.2	0.0	Statistical discrepancy	0.2	0.0
GDP at market price	1,879.5	100.0	GDP at market price	1,879.5	100.0

1. Includes expenditure by non-profit institutions serving households

2. Includes investment in inventories

Table 4.5: Canadian national accounts 2013 (\$ billions at current prices and % GDP)

Source: Based on Statistics Canada CANSIM Tables 380-0063 and 380-0064 and author's calculations.

Income-based GDP

The income-based measurement of nominal GDP follows from the lower part of the circular flow diagram in Figure 4.5. By the national accounts definition, the income-based approach to measuring GDP must give the same value as the expenditure approach. A comparison of the left hand and right hand columns of Table 4.5 illustrates this accounting identity.

National accounts classify incomes roughly in terms of the factors of production used to produce the goods and services in the economy in a year or a quarter of a year. The income categories in Table 4.5 are based on the latest Statistics Canada revisions to the national accounts. Other costs and taxes are then added to include all the things that enter into the final market prices of goods and services. We begin our measurement of the income-based GDP by defining each of these income sources and components of price.

Employment compensation is the income earned by labour from its contribution to the production of goods and services. It includes the wages and salaries paid by businesses to employees. It also includes supplementary income, the costs of benefits like pensions, employment insurance premiums, supplemental health care, and dental insurance plans. This is the total cost of the labour services supplied by households to businesses. It reflects the money wage rates and salaries multiplied by total employment. We will use the W to represent total employment income.

Employment compensation (W): the sum of all wages, salaries, and benefits paid to labour.

Net corporate surplus is the sum of the profits of corporations before tax.

Net corporate surplus (NCS): corporate profits before tax.

Net mixed income is in part the sum of the incomes and rents earned by unincorporated business, which include many small owner-operated businesses, professional practices, and farm operations. It measures the costs of management and entrepreneurship, and the cost of owners' labour and capital used in the production of goods and services. Net mixed income also includes interest and investment income earned on bank deposits, holdings of corporate bonds, and other incomes from financial assets, excluding government bonds.

Net mixed income (NMI): unincorporated business income plus investment income.

We will sum up net corporate surplus and net mixed income and use **BI**, for **business income**, to represent this type of income.

Business income (BI): the sum of net corporate surplus and net mixed income.

Adding together the incomes earned by labour, by businesses, and by holders of investment assets gives the total of incomes earned by the factor inputs to the production of goods and services in the domestic economy. This total is called **Domestic Income (DI)** at factor cost.

Domestic Income: total income earned by factors of production.

Domestic Income = employee compensation + net corporate surplus + net mixed income:

$$DI = W + BI \quad (4.7)$$

Canadian Domestic Income for the year 2013 is reported in the right-hand side of Table 4.5. It is the sum of the first three factor incomes reported in the lines recording income by source, namely, \$1,364.0 billion. Employee compensation was the largest component of this domestic income at about 70 percent, and accounted for about 51 percent of GDP at market price. This income distribution and cost structure is important for the modeling the short run fluctuations in aggregate output and prices, and for later work on models of economic growth.

Factor incomes are the largest part of the income flow resulting from the production of goods and services, but they do not cover all the components of the market prices by which expenditures are measured. Two things are missing. The first is an allowance for the depreciation of the capital stock used for production. The second is the effect of taxes and government subsidies. We include both of these to measure GDP by the income approach.

Even with expenditures on repair and maintenance, the reliability and productive capacity of the capital stock declines over time. The ability of business to produce goods and services declines with it. A car or a bicycle or a computer depreciates and loses its reliability in the same way. Business recognizes “consumption” of the capital stock as a cost of production over and above the factor cost. As with factor costs, businesses cover depreciation and the replacement costs of capital with part of the revenue received from sales of goods and services. National accounts capture depreciation by including a **Capital Consumption Allowance (CCA)** in the measurement of the income.

Capital Consumption Allowance (CCA) measures depreciation of the capital stock.

Adding the Capital Consumption Allowance to Domestic Income gives **GDP at basic price**. That is the price before indirect tax or subsidy.

GDP at basic price = Domestic Income + Capital Consumption Allowance.

$$\text{GDP at basic price} = DI + CCA \quad (4.8)$$

Net indirect taxes (T_{IN}) are the sales and excise taxes imposed by government on products and services, or on expenditure more generally, minus the subsidies governments give to some production. The GST, the HST, provincial retail sales taxes, taxes on liquor and tobacco products, and gasoline taxes are all indirect taxes. You pay if you buy. Sellers of these products collect the tax revenue for the government and remit it to the government. As a result, the expenditures on

goods and services at market price exceed production cost and generate a flow of income to the government in addition to the flow of income going to business and households.

Net indirect taxes (T_{IN}): sales and excise taxes minus subsidies.

Subsidies are payments made by governments to producers to cover some of the costs of production. A producer who receives such a payment does not have to recover all factor and depreciation costs from the market price of the product. As a result, the market price is less than the full cost. Subsidies are subtracted from indirect taxes to give the net effect. GDP at basic price plus net indirect tax equals **GDP at market price**, measured by the income approach.

GDP at market price: Domestic Income + Capital Consumption Allowance + Net Indirect Tax.

$$\text{GDP at market price} = DI + CCA + T_{IN} \quad (4.9)$$

The economy as described by the concepts of national accounts is more complex than the simple economy of the circular flow in Figure 4.5. But the basic principle remains. The final output of the economy is, by definition, equal to the sum of expenditures on final goods and services at market price or by the flows of income to households, business, and government. GDP is the same by either approach if we measure correctly.

There are two important concepts we have not yet discussed. The household and business sectors may *save* some of their incomes or *borrow* to finance expenditure. The government sector may also *save* or *borrow*, and operate with either a budget deficit or a budget surplus. These are topics we will examine carefully as we *explain* the determinants of expenditure decisions in Chapter 6 and government budgets in Chapter 7.

To construct a macroeconomic theory and model the economy we must explain the linkages, feedbacks and interactions among the elements of the economy defined by national accounting conventions. These linkages, feedbacks and interactions are the important relationships that work together to explain how this economic system determines GDP, business cycle fluctuations in GDP, inflation, and employment.

4.5 Nominal GDP, real GDP & the GDP deflator

We have discussed *real GDP* briefly in the beginning of this chapter, and then nominal GDP in some detail. Now we need to look carefully at both concepts and the relationship between them,

which is the GDP deflator.

Nominal GDP measures output and incomes based on *current market prices* for goods and services and factors of production. As a result, changes in nominal GDP from one period to the next might be the result of changes in prices of final outputs and factor inputs, or the result of changes in the quantities of final outputs and factor inputs, or some combination of the two.

Since it is physical quantities of goods and services that yield satisfaction or utility, it can be misleading to judge the economy's performance by looking at nominal GDP. For that purpose we need real GDP, as we discussed earlier in this chapter. *Real GDP*, or *GDP in constant prices*, measures the value of goods and services produced in any given year using the *prices of a base year*. In this way, real GDP adjusts changes in GDP for changes in prices by measuring GDP in different years in constant prices.

To illustrate this important point, Table 4.6 shows a simple economy that produces both consumer goods, blue jeans, and capital goods, solar panels. In this economy nominal GDP rises from \$300,000 to \$570,000 between 2000 and 2014, a 90 percent increase measured in current prices as a result of changes in both quantities and prices. If we take 2000 as the base year, we can measure *real GDP* in 2014 by valuing output quantities in 2014 using 2000 prices. This gives real GDP in 2014 of \$525,000 in prices of the base year. In the example in the table, quantities of both products rise over the period but the price of blue jeans rises while the price of solar panels falls. As a result the rise of about 75 percent in real GDP gives a truer picture of the extra quantity of goods available in the economy in 2014 compared with 2000. It eliminates the change in GDP that was the result of the changes in prices by 8.6 percent between 2000 and 2011.

		2000	2014	% Change
Quantity	blue jeans	4,000	5,000	25
	solar panels	2,000	4,000	100
Price in \$	blue jeans	25	50	100
	solar panels	100	80	-20
Current value	blue jeans	100,000	250,000	150
	solar panels	200,000	320,000	60
Nominal GDP		300,000	570,000	90
Value in 2000 \$	blue jeans	100,000	125,000	25
	solar panels	200,000	400,000	100
Real GDP		300,000	525,000	75
GDP deflator		100	108.6	8.6

Table 4.6: Nominal and real GDP

The GDP deflator

The Canadian economy is obviously more complex than this economy. We have seen that GDP includes expenditures by households, governments, businesses, and residents of other countries who supply us with imports and buy our exports. To convert nominal GDP to real GDP we need to use an index that includes what is happening to the prices of all these different goods and services. This index is called the **GDP deflator**.

GDP deflator: index of current final output prices relative to base year prices.

If we have data for both nominal and real GDP, we can calculate the GDP deflator as the ratio of nominal GDP to real GDP expressed as an index with a value of 100 in the base year.

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100 \quad (4.10)$$

The GDP deflator differs from the consumer price index (CPI) illustrated in Example Box 4.1 and used to measure inflation in consumer prices and the cost of living. First, the CPI is based on a “representative basket” of goods and services that consumers buy, while the GDP deflator is comprehensive and covers all the goods and services included in national accounts. Second, the CPI changes over time with changes in the prices of the basket of consumer goods and services. The GDP deflator, by contrast, is built on the base year prices. It changes over time as the current prices change relative to base year prices. In other words the GDP deflator is used to “deflate” the dollar value of current 2011 output to what it would be in value would be in 2000 prices, while the CPI measures the *increase in the cost* of the “basket” of consumer goods and services.

But why does the GDP deflator change over time? The accounting data on nominal and real GDP do not provide an explanation. From our earlier discussion of the national income accounting framework, we can see that *costs of production* and *net indirect taxes* are include in the general level of market prices measured by the GDP deflator. Nominal GDP measured by the income approach is reported in Table 4.5. It is the sum of incomes paid to factor inputs to production, plus depreciation allowances and net indirect taxes. These components of nominal GDP are the costs of production, gross profits, and taxes that are built into the market prices of the goods and services. We can write:

Nominal GDP = employment income + profit, business, and investment income + capital consumption allowance + net indirect taxes

or

$$\text{Nominal GDP} = W + BI + CCA + T_{IN} \quad (4.11)$$

Alternatively, using the expenditure approach as illustrated in Table 4.5, using Y to denote *real* GDP and P for the weight average price level we have:

$$\text{Nominal GDP} = P \times Y = P \times (C + I + G + X - IM) \quad (4.12)$$

Our national accounting framework and procedures tell us that nominal GDP will be the same whether measured by the income approach or the expenditure approach. This means we can define the general price level as:

$$P = \frac{W}{Y} + \frac{BI + CCA}{Y} + \frac{T_{IN}}{Y} \quad (4.13)$$

The general price level in the economy, in accounting terms is equal to the sum of:

1. employee compensation per unit of output, W/Y ;
2. gross business income per unit of output, $(BI + CCA)/Y$; and
3. net indirect tax per unit of output T_{IN}/Y .

Changes in the sum of these three components of the price level must change *both* price and nominal GDP, whether we measure nominal GDP by the income or the expenditure approach. The GDP deflator is an index of this price level in any particular year relative to a chosen base year. However, the accounting framework does not explain the causes of change in the price level. That requires explanations of changes in unit labour costs, of producer output and pricing decisions and information on the net indirect tax rate. Those explanations are parts of an economic model of the supply side of the economy.

Now consider the empirical importance of the distinction between real and nominal GDP. Table 4.7 gives Canadian data over the period 2001 to 2013. Nominal GDP rose from 1,134.8 billion in 2001 to \$1879.5 billion in 2013. Without knowing what happened to prices of goods and services in general, we cannot judge what happened to the quantity of output over that period. To answer this question we use the GDP deflator to convert nominal GDP to real GDP in the prices of the base year 2007 as follows:

$$\text{Real GDP}_{\text{year } t} = \frac{\text{GDP}_t}{\text{GDP deflator}} \times 100 \quad (4.14)$$

	2001	2005	2009	2013
Nominal GDP (bill \$)	1,134.8	1,410.7	1,567.0	1,879.5
GDP deflator (2007=100)	84.6	94.3	101.6	110.9
Real GDP (bill 2007 \$)	1,341.5	1,496.0	1,542.3	1,694.8

Table 4.7: Canadian nominal and real GDP 2001-2013

Source: Statistics Canada CANSIM Tables 380-0064 and 380-0066 and author's calculations.

For example, in 2013, nominal GDP was \$1,879.5 billion and the GDP deflator (2007=100) was 110.9. Real GDP measured in constant 2007 dollars was then:

$$\text{Real GDP}_{2013} = \frac{1879.5}{110.9} \times 100 = 1694.8 \text{ in 2007 dollars}$$

When converted to constant dollars, the change in real GDP is much smaller than the change in nominal GDP. Over the 2001-2013 period, real GDP increased by 26.3 percent compared to a 65.6 percent increase in nominal GDP. On average, prices in 2013 were 31.1 percent higher than in 2001. Clearly, it is important to distinguish between nominal and real GDP.

4.6 Per capita real GDP

Real GDP is a simple measure of the total real income and output of an economy. The percentage change in real GDP we saw in Figure 4.1, 4.2 and 4.3 shows how fast the economy is growing. But we are also interested in what is happening to *productivity*, the *standard of living* in the economy and how they change over time. For a given real GDP, the larger the population, the lower is productivity and the smaller is the quantity of goods and services per person. To get a simple measure of the standard of living enjoyed by a person in the economy it is better to look at **per capita real GDP**, which adjusts for population. Whether or not growth in total GDP improves standards of living depends also on what is happening to the size of the population. To find per capita real GDP for a country, which is real GDP per person, we simply divide real GDP by population.

Per capita real GDP: real GDP per person.

$$\text{Per capita real GDP} = \frac{\text{Real GDP}}{\text{Population}} \quad (4.15)$$

The study of short run macroeconomics is strongly motivated by the negative effects of recessions on national standards of living. Figure 4.6 shows the negative effects of recessions on per capita GDP in 1982, 1991 and 2009.

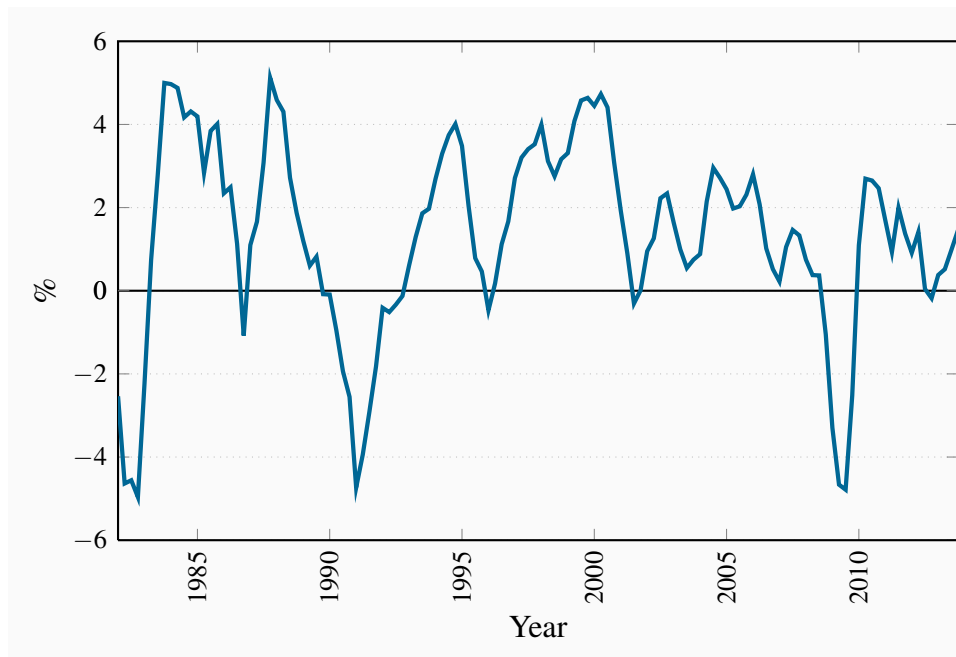


Figure 4.6: Quarterly rates of growth in per capita real GDP in Canada, 1982-2013

Source: Statistics Canada, CANSIM Table 380-0064 and Series V1

Macroeconomic models are built to help us understand the causes of fluctuations in real GDP, employment, and the price level. Understanding the workings of the economy is essential for the design and implementation of monetary and fiscal policies that contribute to economic stability and protect standards of living.

In longer time horizons macroeconomics seeks to understand and explain the growth of real GDP that is essential to protect and improve standards of living as population grows. Growth also increases the capacity of the economy to direct its resources to a wider range of activities that may include improvements in the quality of goods and services produced or reductions in the effects of growth on social and environmental conditions.

Limitations of real GDP

Because we use GDP to measure the output and income of an economy, the coverage should be as comprehensive as possible. We should also recognize that the composition of GDP and the distribution of income are important to a country's standard of living.

In practice, we encounter several problems when including all production in GDP. First, some production causes noise, pollution, and congestion, which do not contribute to economic welfare. Current national and international concern about greenhouse gases and climate change is a clear

and obvious example of the issues involved. We should adjust GDP for these costs to evaluate standards of living more accurately. This is sensible but difficult to do. Recent policy changes by governments to impose carbon taxes on fuels and fuel efficiency targets for automobiles aim to reduce some greenhouse gases. But most such nuisance goods are not traded through markets, so it is hard to quantify their output or decide how to value their costs to society.

Similarly, many valuable goods and services are excluded from GDP because they are not marketed and therefore are hard to measure. These include the home cleaning, maintenance, and improvements households carry out for themselves, and any unreported jobs and incomes in the economy. Deducting nuisance outputs and adding the value of unreported and non-marketed incomes would make GDP a more accurate measure of the economy's production of goods and services.

Furthermore, high GDP and even high per capita GDP are not necessarily good measures of economic well-being. The composition of that output also affects standards of living. Health care services are likely to have different effects than military expenditures. The United Nations prepares an annual Human Development Index (HDI) to provide a more comprehensive measure of a country's achievements. The HDI provides a summary measure based on life expectancy, adult literacy, and real GDP per capita.

Table 4.8 shows HDIs for the top ten countries in 2011, according to the *Human Development Report, 2011*. The second last and last columns in the table are of particular interest. The second last column shows the HDI adjusted for national inequalities in the distributions of income, life expectancy and education on country standards of living. The underlying argument is that more equal distributions of income, life expectancy and education contribute to higher standards of living. The last column in the table records the effects of inequality on a country's ranking according to the HDI. By these data, distributional inequalities reduce the ranks of three countries: the Netherlands by 1 place, Canada by 7 places and United States by 19 places. By Inequality Adjusted HDI's the Netherlands would rank 4th in 2011, Canada would rank 13th and the United States would rank 23rd. Clearly per capita real GDP is not the only indicator of standard of living.

Country Ranked by 2011 HDI	2000 Index	2005 Index	2011 Index	2011 HDI Inequality Adjusted Index	Change in HDI Rank*
1. Norway	0.893	0.938	0.943	0.890	0
2. Australia	0.906	0.918	0.929	0.856	0
3. Netherlands	0.882	0.890	0.910	0.846	-1
4. United States	0.897	0.902	0.910	0.771	-19
5. New Zealand	0.878	0.899	0.908	—	—
6. Canada	0.879	0.892	0.908	0.829	-7
7. Ireland	0.869	0.898	0.908	0.843	0
8. Germany	0.864	0.895	0.905	0.842	0
9. Sweden	0.894	0.896	0.904	0.851	5
10. Switzerland	—	—	0.903	—	—

* A positive value indicates a country HDI rank higher than its per capita GDP rank.

Table 4.8: Top ten countries based on the United Nations human development index

Source: Human Development Report 2011, Statistical Tables, Table 3, p. 135. New York: United Nations Development Programme, hdr.undp.org/en/reports/global/hdr2011/, and *Regional and National trends in Human Development Indicators 1980-2011*.

Do these limitations of GDP matter for our study of macroeconomics? Probably not. We will be examining changes in real GDP from year to year, for the most part. As long as the importance of nuisance and non-marketed outputs, life expectancy, literacy and inequalities do not change dramatically in that time frame, changes in measured real GDP will provide good measures of changes in economic activity and performance. Changes in per capita real GDP will also provide measures of changes in standards of living.

Conclusion

In this chapter we have looked at indicators of macroeconomic activity and performance, and the measurement of macroeconomic activity using the national accounts. We have not examined the conditions that determine the level of economic activity and fluctuations in that level. An economic model is required for that work. In the next chapter we introduce the framework of a basic macroeconomic model.

KEY CONCEPTS

Macroeconomics studies the whole national economy as a system. It examines expenditure decisions by households, businesses, and governments, and the total flows of goods and services produced and incomes earned.

Real Gross Domestic Product (GDP), prices and **inflation rates**, and employment and **unemployment rates** are indicators of macroeconomic activity and performance.

Fluctuations in the growth rate of real GDP, in inflation rates, and in unemployment rates are important aspects of recent economic performance in Canada.

The expenditures by households, production of goods and services by business, and the incomes that result are illustrated by the **circular flow** of real resources and money payments.

The **National Accounts** provide a framework for the measurement of the output of the economy and the incomes earned in the economy.

Nominal GDP measures the output of final goods and services at market prices in the economy, and the money incomes earned by the factors of production.

Real GDP measures the output of final goods and services produced, and incomes earned at constant prices.

The **GDP deflator** is a measure of the price level for all final goods and services in the economy.

Real GDP and **per capita real GDP** are crude measures of national and individual welfare. They ignore non-market activities, the composition of output, and the distribution of income among industries and households.

EXERCISES FOR CHAPTER 4

Exercise 4.1.

You have the following annual data for an economy:

Year	Real GDP (2002 \$)	Consumer Price Index (2002=100)	Labour Force	Employment
2010	1,282	109.1	17,593	16,537
2011	1,307	111.9	17,857	16,696
2012	1,288	138.9	18,125	16,856

- What was the rate of growth of real GDP from 2010 to 2011, and 2011 to 2012?
- What was the rate of inflation in 2011 and in 2012?
- What were the rates of growth of the labour force and employment from 2010 to 2011, and 2011 to 2012?
- What happened to the unemployment rate between 2010 and 2011, and between 2011 and 2012?

Exercise 4.2. Suppose the economy represented by the table in Exercise 4.1 above had a population of 27.885 thousand in 2011.

- What were the participation and employment rates in the economy in those years?
- Suppose a mild recession in that year discouraged some unemployed workers and they stop looking for work. As a result the participation rate fell to 64.5 per cent. How would the unemployment rate and the employment rate be affected? Why?

Exercise 4.3. If brewers buy barley and hops from agricultural producers, natural gas to fire their brew kettles from gas companies and bottles from glass manufacturers as in the following table, what is the value added of the brewing industry? If brewers also wholesale some of their output to pubs, is that output counted in GDP? Explain your answer.

Costs (Millions of Current \$) of:			
Brewery Retail Sales	Barley and Hops	Natural Gas	Bottles
1000	350	125	150

Exercise 4.4. The economy has two main industries. One produces services and the other produces goods. The services industries produce services for households and businesses with a total market value of \$10,000. The goods industries produce goods for the use of both households and businesses with a total market value of \$5,000. The service industries spend \$1000 on computers and paper and envelopes supplied by the goods industries. The goods industries spend \$1000 to buy financial, insurance, advertising and custodial supplied by the service industries. Explain how you measure nominal GDP in this economy and the value of output you find?

Exercise 4.5. Suppose you are given the following data on incomes and expenditures for the economy of Westland, in current prices for factors of production and outputs.

Consumption expenditures	2500
Employment income	2800
Government expenditure	800
Net indirect taxes	150
Exports	1200
Business income	700
Capital consumption allowance	200
Investment expenditure	600
Imports	1100
Investment income	150

- What is the value of nominal GDP measured by expenditures?
- What is net domestic income?
- What is the value of nominal GDP measured by the income approach?

Exercise 4.6. Suppose GDP is \$2,000, consumption expenditure is \$1,700, government expenditure is \$50, and net exports are \$40.

- What is business investment expenditure?
- If exports are \$350, what are imports?
- If the capital consumption allowance for depreciation is \$130 and net indirect taxes are \$100, what is net domestic income?
- In this example, net exports are positive. Could they be negative?

Exercise 4.7. Consider the following information about a hypothetical economy:

Year	Nominal GDP (Billion \$)	GDP Deflator (2000=100)	Population (Millions)
2012	750	104.0	25.0
2013	825	112.0	30.0

- Calculate the growth (percentage change) in nominal GDP from 2012 to 2013.
- What was real GDP in 2007 and 2008? How much did real GDP grow?
- If changes in the standard of living can be measured by changes in real per capita GDP, did growth in nominal and real GDP raise the standard of living in this economy from 2012 to 2013?
- Explain the reasons for the change in standard of living that you have found.

Chapter 5

Output, business cycles, growth & employment

In this chapter we will explore:

- 5.1** Aggregate demand and aggregate supply
- 5.2** Equilibrium output and potential output
- 5.3** Growth in potential output
- 5.4** Business cycles and output gaps
- 5.5** Output gaps and unemployment
- 5.6** Adjustments to output gaps?
- 5.7** The role of macroeconomic policy

Macroeconomic analysis has important time dimensions. In the long run, over periods of several years and decades, real GDP in most industrial economies grows and per capita real GDP grows as well, raising standards of living. We have seen the data for Canada on this long-run performance in Chapter 4. We have also seen that growth rates fluctuate over short time periods of a few months or a few years. At some times real output declines and at other times it grows very rapidly. Economists describe these short-run fluctuations as business cycles, using the words recession, recovery, boom, and slump to describe different stages of the business cycle. These words are also part of the everyday language of the news media, which often engages in a debate over current economic conditions as they foretell continuing stability, a recession, or recovery from a recession. The financial crises and recession of 2008–2009 and ongoing public debt and unemployment problems in Europe and North America are the most recent examples.

An aggregate demand and aggregate supply model is the workhorse of macroeconomics. It illustrates the determination of real GDP and the GDP deflator, and changes in those measures of output and prices. In this chapter we introduce a basic aggregate demand and supply model and use it to illustrate the causes and effects of business cycle fluctuations in real output and prices. This provides the framework for most of what comes later, the development of the economic theory on which aggregate demand and supply are based.

5.1 Aggregate demand & aggregate supply

The **short run** in macroeconomics is defined by assuming a specific set of conditions in the economy. These are:

1. There are constant prices for factors of production, especially money wage rates for labour.
2. The supply of labour, the stock of capital, and the state of technology are fixed.
3. The money supply is also fixed.

Short run: a time frame in which factor prices, supplies of factors of production, and technology are fixed by assumption.

In the short run, changes in output involve changes in the employment of labour and in the use of plant and equipment, but these changes are not sustainable over longer time periods. Furthermore, because supplies of factor inputs and technology are fixed, there is no sustained growth in real GDP. We leave that topic for a later chapter.

The national accounts we studied in Chapter 4 describe and measure economic activity in terms of an accounting framework used to measure aggregate expenditures, outputs, and incomes. But the accounting framework simply measures what has happened in the recent past. It does not *explain* the level of economic activity and prices or the reasons for changes in output and prices from time to time.

For that we need an analytical framework that looks at cause and effect. An **aggregate demand (AD)** and **aggregate supply (AS) model** is such an analytical framework. It helps us understand the conditions that determine output and prices, and changes in output and prices over time.

AD/AS model: a framework used to explain the behaviour of real output and prices in the national economy.

The short-run AD/AS model builds on the national accounts framework. Aggregate demand is the relationship between aggregate expenditure on final goods and services and the general price level. Real GDP by the expenditure approach measures this expenditure at the price level given by the GDP deflator. Aggregate supply is the relationship between the output of goods and services produced by business and the general price level. Real GDP by the income approach measures this output, and the corresponding real incomes. The price level is again the GDP deflator. National accounts tell us that, by definition, these *measured* outputs and incomes are equal. AD and AS

functions describe *expenditure plans, outputs, and prices* using the national accounts framework. This distinction between measured and planned expenditure and output is important. Planned expenditure is the current output households and businesses would *want to buy* at different levels of income and price. Output is what businesses actually produce. Planned expenditure and the actual output produced by business may not be the same.

Figure 5.1 gives us a first look at output, real income, and prices for a specific year using an aggregate demand and aggregate supply diagram. The price level as measured by the GDP deflator is measured on the vertical axis. Real output and income are measured on the horizontal axis. The point of intersection of the AD and AS lines shows that real output by the expenditure approach, Y_0 , is equal to real income by the income approach at the price level P_0 , as required by national accounts. It also shows planned aggregate expenditures equal to the current output of goods and services. However, we need to explain the aggregate demand and aggregate supply relationships indicated by the slopes and positions of the AD and AS lines in the diagram before we use the model to study output and prices.

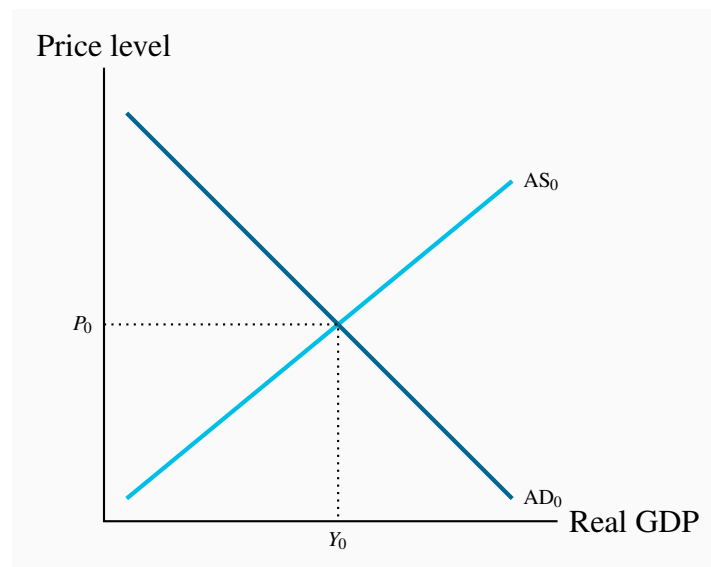


Figure 5.1: A Basic Aggregate Demand and Supply Model

The AD and AS lines show planned expenditures on and output of final goods and services at different aggregate price levels *all other conditions held constant*. At the intersection of AD_0 and AS_0 planned expenditures on final goods and services are equal to real GDP at P_0 .

Aggregate Demand (AD) is **planned aggregate expenditure** on final goods and services ($C + I + G + X - IM$) at different price levels when all other conditions are constant. We will examine this relationship in detail in the chapters that follow. A downward sloping AD curve means the relationship between planned aggregate expenditure and the general price level is negative. A higher price level reduces the expenditures planned by households, businesses, and residents of other countries. Lower price levels increase those expenditure plans.

Aggregate Demand: planned aggregate expenditure on final goods and services at different price levels, all other conditions remaining constant.

Aggregate Supply (AS) is the output of final goods and services business produces at different price levels when other conditions are constant. As the upward sloping AS curve in Figure 5.1 assumes that the relationship between the quantity of goods and services produced and the price level is positive. Prices and output rise or fall together. We will examine this relationship in more detail below and in later chapters.

Aggregate Supply: the output of final goods and services businesses would produce at different price levels, all other conditions held constant.

Aggregate demand

Aggregate Demand and the market demand for an individual product are different. In our discussion of the market for an individual product in Chapter 3, demand is based on the assumptions that incomes and prices of other products are constant. Then a rise in the price of the product makes the product more expensive relative to income and relative to other products. As a result, people buy less of the product. Alternatively, if price falls people buy more.

The link between the *general* price level and aggregate demand is different. We cannot assume constant incomes and prices of other products. In the aggregate economy a rise in the price level raises money incomes by an equal amount. A 10 percent rise in the general price level is also a 10 percent rise in money incomes. Changes in the price level do not make goods and services either more or less affordable, *in terms of incomes*. There is no direct price incentive to change aggregate expenditure.

Furthermore, if prices of individual goods and services do not rise or fall in the same proportion as the general price level, the distribution of aggregate expenditure among goods and services may change without a change in aggregate expenditure. If, for example, the general price level is pushed up because oil and commodity prices rise, and expenditure on those products rises in the short run because there are no alternatives, expenditures on other goods and services fall. Aggregate expenditure is unchanged.

As a result, we cannot explain the negative relationship between the general price level and aggregate expenditure as we would explain demand for an individual good or service. Nor can we simply add up all the demands for individual products and services to get aggregate demand. The assumptions of constant incomes and other product prices that underlie market demand do not hold in the aggregate. Different explanations are needed.

Money and financial markets play key roles in the explanation of the price-quantity relationship in aggregate demand. The traditional AD function is based on a fixed nominal money supply and a demand for real money balances. The interplay between the supply of money balances and the demand for money balances in financial markets determine the interest rates and foreign exchange rates that are important to aggregate expenditure decisions. Chapters 8, 9 and 10 examine these financial markets and their effects on expenditure.

In broad terms, changes in price levels change the supply and demand for money and other assets in financial markets. Change interest rates and foreign exchange rates follow. A rise in the price level causes a rise in interest rates that increases the cost of financing expenditures. It may also change the foreign exchange rate making imports cheaper relative to domestic products and exports less competitive in foreign markets, reducing net exports. In combination these changes reduce aggregate expenditure. The result is a negative relationship between the price level and aggregate expenditure and a negatively sloped AD curve.

In Figure 5.2, the negatively sloped AD line shows planned aggregate expenditures at different price levels, on the assumption that the money supply and anything other than price that might affect expenditure plans are held constant. If the price level falls from P_0 to P_1 , the movement along AD from A to B shows the negative relationship between planned aggregate expenditure and price. A rise in price would reduce planned expenditure as shown by moving up the AD curve.

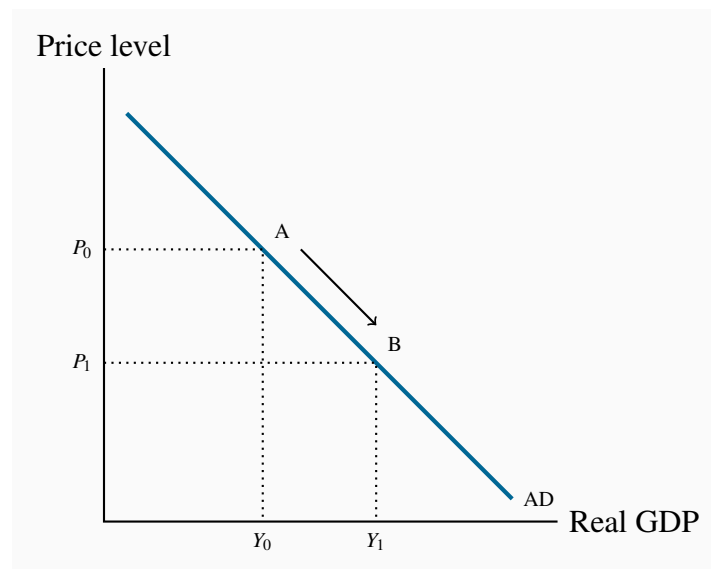


Figure 5.2: The Aggregate Demand Curve

The AD curve shows planned expenditures at different aggregate price levels all things other than price held constant. *A change in the price level causes movement along the AD curve* as from A to B if price falls from P_0 to P_1 .

The *position of the AD curve* depends on all the conditions other than price that affect aggregate

expenditure plans. We study these other conditions in detail in later chapters.

Aggregate supply

Aggregate Supply (AS) is the output of final goods and services businesses would produce at different price levels. The aggregate supply curve is based on the following key assumptions:

1. Prices of the factors of production—the money wage rate for labour in particular—are constant.
2. The stock of capital equipment—the buildings and equipment used in the production process—and the technology of production are constant.

From national accounts we know that the costs of production include labour costs, business and investment incomes and depreciation. Market prices depend on those *costs per unit of output* and the output and price setting decisions by producers. Aggregate supply is usually described as a positive relationship between quantities of goods and services businesses are willing to produce and prices. Higher outputs of final goods and services and higher prices go together.

This relationship between aggregate output, costs and prices reflects two different market conditions on the supply side. In some markets, particularly those for commodities and standardized products, supply and demand in international markets establish price. Producers of those products are price takers. They decide how much labour and plant capacity to employ to produce based on market price.

Broadly speaking, in these industries cost per unit of output are increasing with increasing output. Employing more labour and plant capacity means expanding into less productive land and natural resource inputs. Mining gold or extracting bitumen from oil sands are good examples. A rise in price justifies expanding the output of higher cost mines and oil wells. However, many raw material markets are like this including those for agricultural products, forestry products, base metals and natural gas. When market price changes these producers respond by changing their outputs.

In other parts of the economy producers are price setters. Major manufacturing and service industries like auto producers, banks and wireless phone companies face market conditions that are different from those of commodity producers. They set prices based on costs of production and sales and profit targets, and supply the number of cars or bank services or cell phone accounts that are in demand at those prices.

In these industries costs per unit of output are constant over a wide range of current outputs. Money wage rates are fixed, the capacity to produce output is flexible and productivity is constant. If demand for their product or service increases they can supply more by hiring more employees

at existing wage rates and selling more output at existing prices. Industries like major manufacturing, retail services, financial services, hospitality services, and professional services are some examples. Output and changes in output are determined by demand.

The upward-sloping aggregate supply curve in Figure 5.3 captures both market conditions to show the output producers are willing to produce and the price level. The aggregate supply curve is drawn based on the assumptions that money wage rates and all other conditions except price that might affect output decisions are constant. As we will see in later chapters, money wage rates and productivity are the most important of these conditions. They determine the *position* of the AS curve.

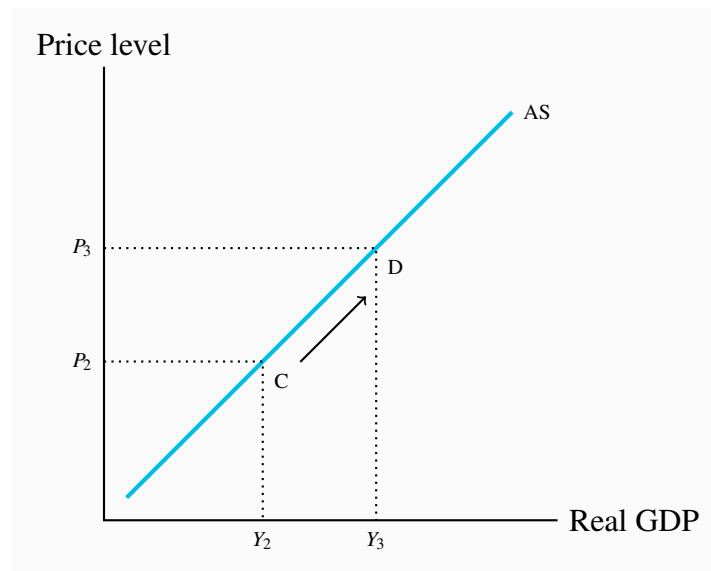


Figure 5.3: The Aggregate Supply Curve

The AS curve shows the relationship between price level and real GDP, assuming the prices of factors of production are constant. The position of the curve is determined by factor prices and productivity. The slope is determined by changes in costs of production and producer price decisions as output changes.

The *slope* of the AS curve depends on changes in cost per unit of output and price changes if aggregate output changes. As a result it reflects the structure of industry. In Canada, for example Table 4.4 shows that about 70 percent of real GDP comes from service producing industries. Consequently we would expect a smaller positive slope in the AS curve than in Figure 5.3.

In Figure 5.3, if price were P_2 the AS curve shows that business would be willing to produce aggregate output Y_2 , which would generate an equal flow of real income. A rise in aggregate output from Y_2 to Y_3 would mean a rise in price to P_3 to meet the increased costs and profits associated with output at this level. Changes in output or price, holding all other conditions constant, move the economy along the AS curve. Moving from point C to point D in the diagram shows this

relationship.

On the other hand, a change in any of the conditions assumed to be constant will shift the entire AS curve. A rise in money wage rates, for example, would increase labour costs per unit of output (W/Y) at every level of output. The AS curve would shift up vertically as prices rose in order to cover the increased unit labour costs.

Equilibrium real GDP and price

Aggregate demand and aggregate supply together determine **equilibrium real GDP** and the general price level. Figure 5.4 illustrates equilibrium. Aggregate demand is planned aggregate expenditure at different prices. Aggregate supply is aggregate output at different prices. The circular flow diagram and national accounts show how aggregate expenditure provides the flow of revenue business needs to cover its costs of production, and that those costs of production are income flows to households. When planned aggregate expenditure is equal to output, we have equilibrium real GDP. The revenues businesses receive from aggregate expenditure are just what they require to cover their costs, including expected profit. As long as conditions affecting expenditure and output plans are constant, business has no incentive to change output. This *equilibrium* between aggregate expenditure, outputs, and income and the general price level is illustrated by the intersection of the AD and AS curves in Figure 5.4.

Equilibrium real GDP: $AD=AS$, planned expenditure equals current output and provides business revenues that cover costs including expected profit.

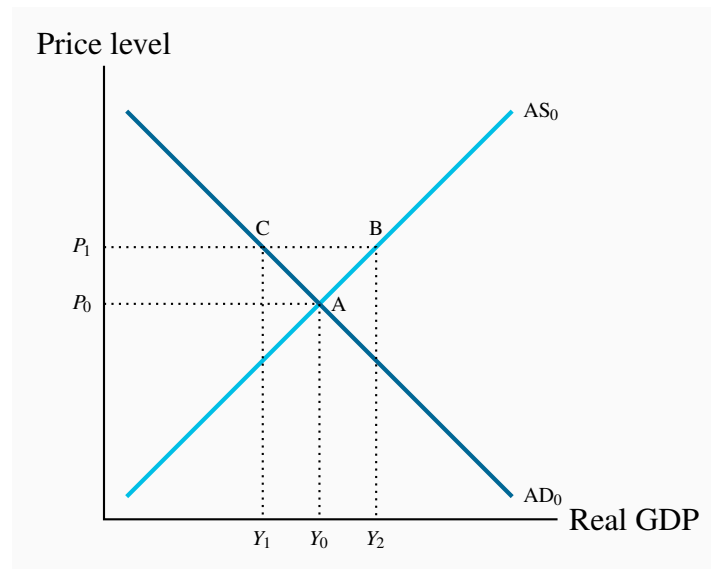


Figure 5.4: Equilibrium Real GDP and Price

The intersection of AD_0 and AS_0 gives equilibrium Y_0 and P_0 at point A. Any other Y such as Y_1 or Y_2 would result in *unwanted changes in inventories* and changes in output.

To understand what equilibrium means we consider what would happen if the economy were not at point A in the diagram. Suppose, for example, business produced output and paid costs greater than Y_0 , as would be the case at point B on the AS curve. Output would be Y_2 , but planned expenditure at P_1 is only Y_1 , less than business needs to cover its costs. Aggregate demand is lower than expected, output $Y_1 Y_2$ is not sold. Costs of production are not recovered and *unwanted inventories build up*. In response, business would cut output, moving back to point A. Alternatively, if output were less than Y_0 higher demand and *unwanted reductions in inventories* would provide strong incentives to increase output. Market conditions push the economy to equilibrium, the point where AD equals AS.

The equilibrium determined by aggregate demand and aggregate supply at point A is the result of the economic conditions at a moment in time, and the expenditure and output decisions in the economy. It is a short-run equilibrium. The aggregate supply curve is based on the assumption that money wage rates, other factor prices, capital stock and technology are constant. However, any change in the conditions that affect expenditure and output plans would change the AD and AS curves and lead to a new short-run equilibrium real GDP and price.

5.2 Equilibrium output and potential output

The distinction between equilibrium output and **potential output** is very important to our study of the economy. In the short run, AD and AS determine *equilibrium output*. *Potential output* is determined by the size of the labour force, the stock of capital, and the state of technology. The general level of prices and short-run aggregate demand and supply conditions do not affect potential output.

Potential output: the real GDP the economy can produce on a sustained basis with current labour force, capital and technology without generating inflationary pressure on prices.

Short-run equilibrium real GDP is determined by AD and AS conditions. Fluctuations in real GDP and price are a result of short-run changes in economic conditions. To evaluate the economy's performance and understand how it behaves over time, we need a benchmark. Potential output is the output the economy can produce on a sustained basis using the current labour force, capital, and technology without putting continuous upward pressure on the price level or the inflation rate.

In the short run, the labour force, the capital stock, and technology are fixed by assumption. Potential output is the economy's output based on "full employment" of these inputs, but it is not the maximum output an economy can conceivably make. For short periods of time we could make more by using labour for longer hours and factories for extra production shifts. Just as a marathon runner can sprint from time to time but cannot sustain the sprint over the whole race, the economy can operate for short time periods at levels of output above potential. Potential output is the output the economy can produce on a sustained basis.

When the economy is at potential output, every worker wanting a job at the equilibrium wage rate can find a job, and every machine that can be profitably used at the equilibrium cost for capital is in use. Thus, potential output includes an allowance for "equilibrium unemployment" or structural unemployment and some excess capacity. Some people, who would work at higher wage rates, do not want to work at the equilibrium wage rate. Moreover, in a constantly changing economy, some people are joining the labour force, others are leaving, and still others are temporarily between jobs. Today, Canadian potential output means an unemployment rate of about 6 to 7 percent. This is usually called the **natural unemployment rate**.

Natural unemployment rate: the unemployment rate that corresponds to potential GDP.

Actual output can also fall below potential output. Workers who want jobs may be unemployed, and producers may have idle plant and equipment or excess capacity. The unemployment rate rises above the 6 percent "full employment" rate.

A key issue in macroeconomics is the way differences between actual output and potential output affect unemployment rates, wage rates, and inflation rates. These effects are important to how the economy adjusts equilibrium output to potential output, as we will see later in this chapter.

Figure 5.5 illustrates potential real GDP (Y_P) with a vertical line. Changes in price from P_0 to P_1 , for example, have no effect on Y_P . Changes in the supply of labour, the stock of capital, or the state of technology would increase potential output and shift the this vertical Y_P line to the right or to the left.

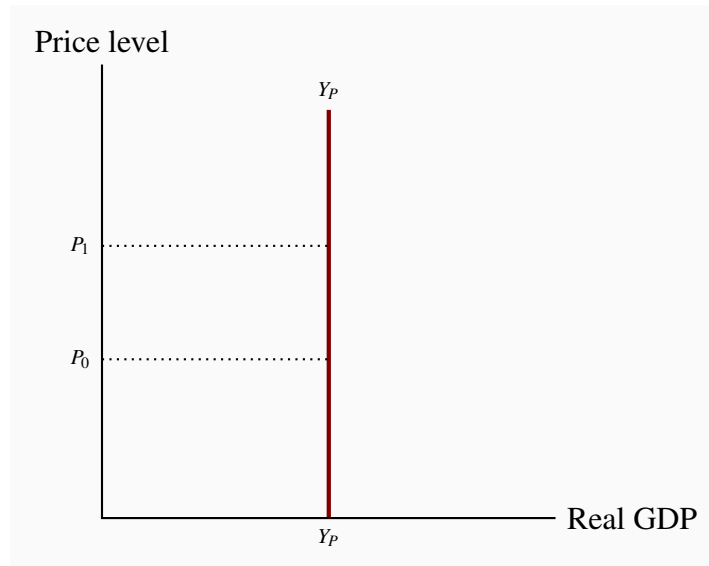


Figure 5.5: Potential GDP

Potential GDP (Y_P) is the real GDP the economy could produce on a sustained basis without putting pressure on costs and prices. Y_P is independent of P .

5.3 Growth in potential output

Growth in the labour force and improvements labour productivity increase the economy's potential output over time. Labour productivity grows as a result of advances in technology and knowledge coming from investments in capital equipment, education and training. Figure 5.6 shows growth rates for potential and actual real GDP each year in Canada over the period from 1990 to 2011. Potential GDP grew over this period, reflecting the underlying growth in labour force, the stock of capital, and improved technology. But annual growth rates were not constant and in the period since 2000 have tended to decline. Part of this decline is attributed to lower rates of productive growth in recent years as compared to earlier periods.

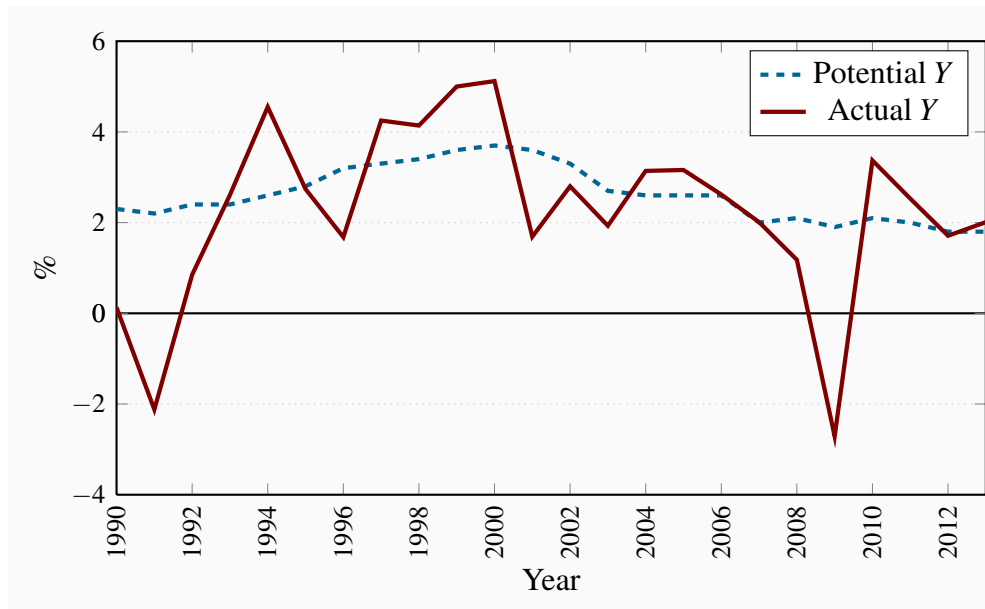


Figure 5.6: Annual growth in potential and actual real GDP in Canada, 1990-2013

Sources: Statistics Canada, CANSIM Table 380-0064, Office of the Parliamentary Budget Officer and author's calculations.

Growth rates in actual GDP were more volatile relative to growth rates in potential output. The negative growth rates in 1991 and 2009 mark the recessions of those years. Fluctuations in AD and AS cause business cycles in real GDP and employment. Unemployment rises when output growth is less than the growth in potential output and falls when it is greater.

5.4 Business cycles and output gaps

Figure 5.6 shows us that actual real GDP does not grow smoothly. In some years GDP grows very rapidly, and in other years it actually falls. Growth of potential GDP is also variable but it is consistently positive. These up and down fluctuations in the growth of real GDP are described as **business cycles** in economic activity.

Business cycles: short-term fluctuations of actual real GDP.

Business cycles cause differences between actual and potential GDP. **Output gaps** measure these differences. In a short-run aggregate demand and supply model with a constant potential output, the gap is:

$$\text{Output Gap} = Y - Y_P \quad (5.1)$$

Output gap: the difference between actual output and potential output.

In an economy that grows over time the absolute output gap $Y - Y_P$ is usually measured relative to potential output. This recognizes that a gap of \$10 million is a more serious matter in an economy with a potential output of \$1,000 million than in an economy with a potential output of \$5,000 million.

Figure 5.7 plots the Bank of Canada's estimates of the differences between actual and potential GDP for Canada for each year from 1990 to 2011, expressed as a percentage of potential GDP, calculated as:

$$\text{Output Gap}(\%) = \frac{Y - Y_P}{Y_P} \times 100 \quad (5.2)$$

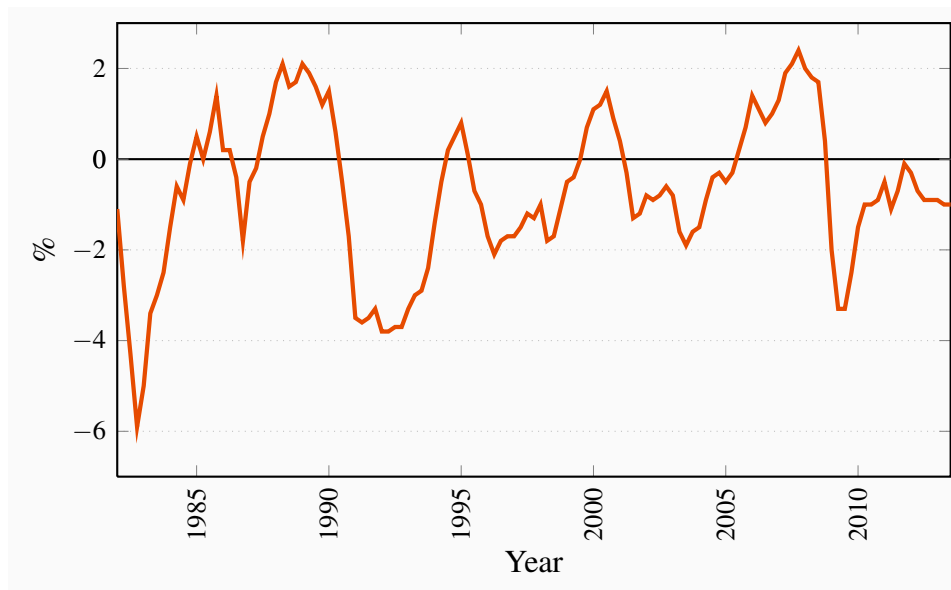


Figure 5.7: The output gap in Canada, 1982-2013

Source: Bank of Canada, Indicators of Capacity and Inflation Pressures for Canada, www.bankofcanada.ca.

When we compare growth in actual real GDP and potential GDP in Canada from 2007 to 2011, we see an example of the business cycle caused by the 2008-2009 financial crisis and the output gap it

created. Real GDP declined in 2009, and actual GDP fell below potential GDP in Figure 5.6. This was a *recession*. It created the negative output gap in Figure 5.7 that starts in the first quarter of 2009 and persists in the second quarter of 2012.

Output gaps describe and measure the short-run economic conditions, and indicate the strength or weakness of the economy's performance. High growth rates in the boom phase of the cycle create positive output gaps, which are called **inflationary gaps** because they put upward pressure on costs and prices. Low or negative growth rates that result in negative output gaps and rising unemployment rate are called **recessionary gaps**. They put downward pressure on costs and prices. As economic conditions change over time, business cycle fluctuations move the economy through recessionary and inflationary gaps. However, you will notice in Figure 5.7 that recessionary gaps in Canada have been deeper and more persistent than inflationary gaps over the past 30 years.

Inflationary gap: a measure of the amount by which actual GDP is greater than potential GDP.

Recessionary gap: a measure of the amount by which actual GDP is less than potential GDP.

We can show output gaps in diagrams using the aggregate demand and supply curves and the potential output line. Figure 5.8 provides an example. Panel a) illustrates a recessionary gap. Panel b) shows an inflationary gap.

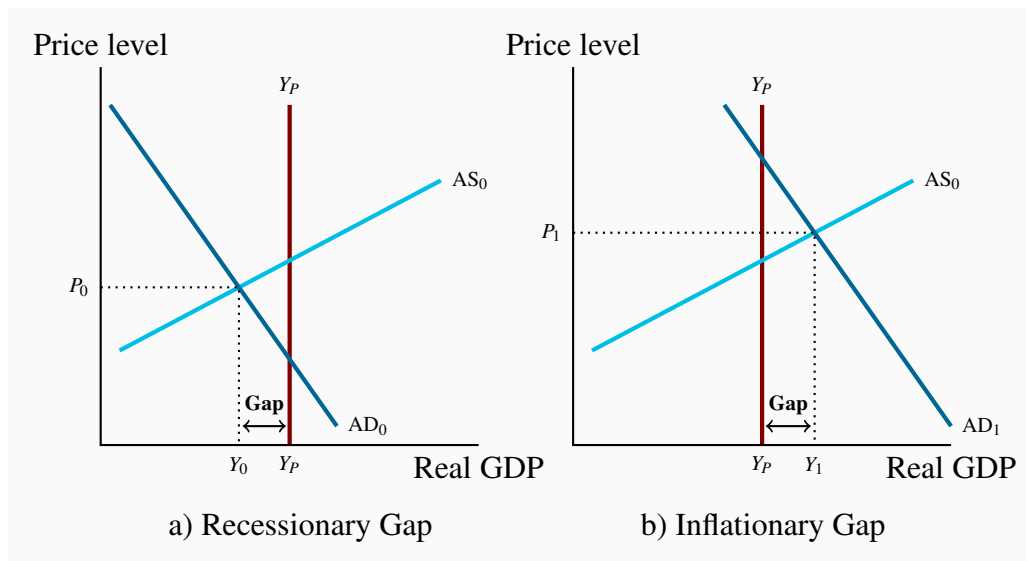


Figure 5.8: Output Gap

- a) AD is too weak to support equilibrium at Y_P .
- b) AD is too strong and pushes equilibrium past Y_P .

The AD and AS model provides a basic explanation of the differences we see between actual real GDP and potential real GDP. Short-run AD and AS conditions determine equilibrium real GDP, which may be either greater or less than potential GDP. Furthermore, the business cycles are the results of changes in the short-run AD and AS conditions.

We have made an important first step in our study of the performance of the macro economy. Now we need to ask more questions:

1. What is the relationship between output gaps and unemployment?
2. How would the economy react to a persistent output gap?
3. Why do short-run AD and AS conditions change from time to time?

The first two questions are considered in the remainder of this chapter. Chapter 6 starts on the third question.

5.5 Output gaps and unemployment rates

Output gaps and unemployment rates are tied together. Output gaps measure the difference between actual real GDP and potential GDP. When the economy is producing potential output, employment is at the ‘natural employment’ rate. Any output other than potential output therefore involves an employment rate other than the full employment rate and a corresponding level of unemployment that differs from the approximately 6 to 7 percent natural unemployment rate.

Figures 5.6 and 5.7 show the relationship between growth rates in actual and potential GDP and the output gap. Negative growth rates in actual GDP in recessions, while potential GDP continues to grow, create recessionary gaps. Indeed any time *growth* in actual GDP differs from *growth* in potential GDP the output gap changes and the unemployment rate changes.

Differences between the rates of growth in actual and potential output explain the persistence of high rates of unemployment in western industrial countries in the years since the 2008 financial crisis. Real GDP and employment in both Canada and the United States have been growing since 2009. However, potential output has been growing at the same time. As a result growth in actual GDP has not been strong enough to eliminate output gaps and restore full employment.

Figure 5.9 shows the relationship between output gaps and unemployment rates in Canada. Clearly a rise in the output gap also involves a fall in the unemployment rate, and vice versa. Business cycle fluctuations in actual output result in predictable changes in output gaps and unemployment rates.

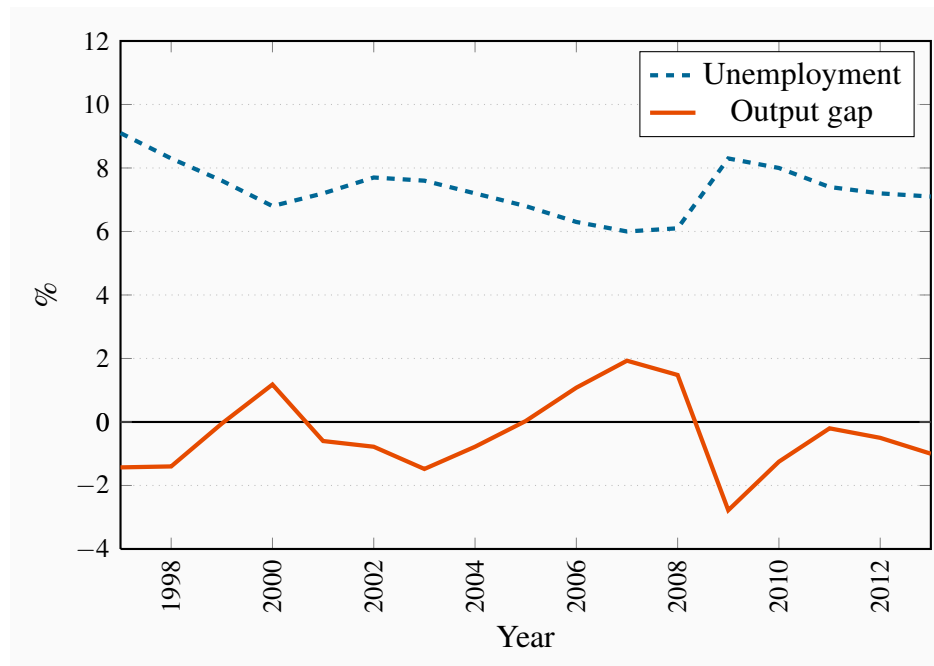


Figure 5.9: Output gaps and unemployment rates in Canada, 1997-2013

Source: Bank of Canada, Indicators of Capacity and Inflation Pressures for Canada. Statistics Canada, CANSIM series V2062815 and author's calculations.

5.6 Adjustments to output gaps?

Potential output is real GDP when all markets are in equilibrium. Output gaps indicate disequilibrium in some markets. If we leave the short run and drop the assumption that factor prices are constant, we can ask:

How does the economy react to persistent output gaps?

The answer to this question depends in part on the *flexibility of wage rates and prices* and in part on how *planned expenditure* responds to the flexibility in wage rates and prices.

Figure 5.9 shows that the labour market is one of the markets not in equilibrium when there is an output gap. We also know from national accounts that labour costs are the largest part of factor costs of production, and labour costs per unit of output are the largest part of prices. If the labour market is not in equilibrium—which means unemployment rates not equal to the natural rate—result in changes in money wage rates, persistent output gaps will change wage rates and other factor prices and costs. Changes in costs will change prices, shifting the short-run AS curve. The economy may have an adjustment mechanism that tries to eliminate output gaps over time.

Figure 5.10 illustrates the changes in real output as the economy adjusts over time to output gaps. In Panel (a), the high unemployment of a recessionary gap at Y_0 lowers wage rates and other factor prices. A change in factor costs changes the entire AS curve. In this case it shifts down to AS'_0 . With lower costs, producers are willing to produce and sell at lower prices. The change in factor costs and AS conditions continues, moving the economy along the AD curve until the recessionary gap is eliminated and output is at Y_P .

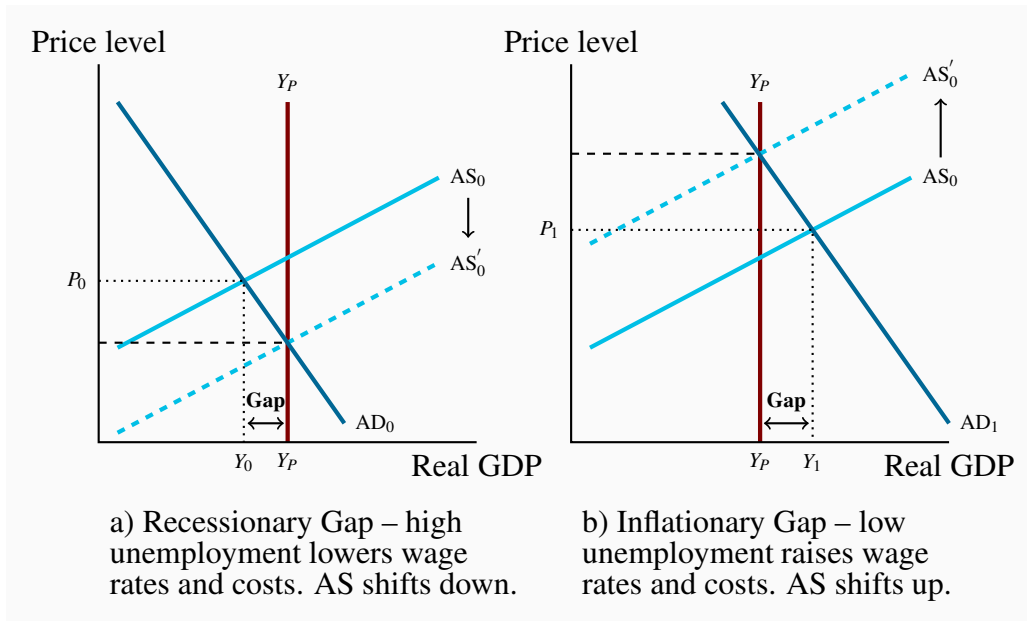


Figure 5.10: Adjustments to output gaps

This adjustment process assumes that the AD curve is not changed by the fall in wage rates that shifts the AS curve. There are good reasons for skepticism here. In a money economy, with debt and financial contracts denominated in nominal terms, a general fall in money incomes can cause financial distress, extensive insolvencies and reductions in AD. As a result, economists generally agree that *deflation*, a persistent fall in the general *price level*, is *contractionary*, not expansionary as the simple adjustment process suggests. This is reflected in the current concerns that deflation may return to Japan and emerge in Europe as growth stagnates and inflation rates have fallen persistently below 1 percent.

5.7 The role of macroeconomic policy

In Chapter 4, performance of the economy was evaluated based on the standard of living, measured as the real GDP per capita, it provided. Recessionary gaps reduce the standard of living in the

economy by reducing employment, real GDP, and per capita real GDP.

Inflationary gaps reduce standards of living in more subtle ways. They push up the price level, raising the cost of living. But the rise in the cost of living affects different people in different ways. Those on fixed money incomes suffer a reduction in their standards of living. People holding their wealth in fixed price financial assets like bank deposits and bonds suffer a loss in their real wealth. On the other hand, inflation reduces the real value of debt, whether it is mortgage debt used to finance the purchase of a house, or a student loan used to finance education. The money repaid in the future has a lower purchasing power than the money borrowed. In these and other ways, the costs of inflation are distributed unevenly in the economy, making decisions about employment, household expenditure, and investment more difficult.

Using Figure 5.10, we have described the self-adjusting mechanism within the AD/AS model that might eliminate output gaps and move the economy to equilibrium at potential output. We have also seen, in Figure 5.7, that output gaps have been persistent in the Canadian economy despite the possibility that flexible wages and prices might automatically eliminate gaps. These observations raise two questions:

1. Why are output gaps, especially recessionary gaps, persistent?
2. Can government policy work to eliminate output gaps?

To answer the first question, we need to think about two issues. The first is the *flexibility or rigidity of wages and prices both up and down*. The second is *strong possibility of asymmetry between adjustment effects of absolute increases and absolute decreases in wages and prices*.

In any case the economy's reaction to output gaps takes time, because wage rates and prices are sticky and slow to adjust to changed economic circumstances. But, there is reason to doubt that absolute reductions in money wage rates and prices would help to eliminate a recessionary gap in an economy with fixed nominal financial contracts.

In the modern economy, wage rates for labour are often fixed by contract or custom for finite periods of time. Labour contracts often set wage rates for periods of several years. Even without explicit contracts, employers are unlikely to change the wages they pay on an hour-by-hour or day-to-day basis. Custom may suggest an annual adjustment. Minimum wage laws prevent cuts in the lowest wage rates. These institutional arrangements mean that the money wage rates paid to labour adjust slowly to changes in economic conditions. Cuts to money wage rates are particularly difficult and controversial, although they have occurred in particular industries, like the airline industry and the auto industry under very difficult market conditions. The macroeconomic adjustment process calls for a change in the average money wage rate across the entire economy. That is a more complex process and uncertain.

Contracts and custom also affect the speed of price adjustment to economic conditions. Producers in many cases have supply contracts with their customers that fix prices for a finite time period.

Sellers may be reluctant to change prices frequently, in part because they are uncertain about how their competitors will react to their price changes, and in part to avoid alienating their customers. Retailers often issue catalogues in which prices are fixed for a specified period. The result is slow price adjustment to changing economic conditions in many parts of the economy.

Nevertheless, if the economy experiences a persistent output gap, that gap will lead eventually to changes in factor prices, costs, and market prices for goods and services. Indeed, the adjustment to inflationary gaps may come more quickly than to recessionary gaps because it is easier to raise money wage rates than to cut them. The important policy question is: When wages and prices are sticky, should government wait for the self-adjustment process to work, accepting the costs of high unemployment or rising inflation that it produces? This was a very serious and widely debated question since 2008 in the face of growing international recessions as a consequence of serious sovereign debt problems and continued international financial market uncertainty.

Government has policies it can use to reduce or eliminate output gaps. In Chapter 7 we will examine **fiscal policy**, the government expenditures and tax policy that establish the government's budget and its effect on aggregate demand. Government can use its fiscal policy to change the AD curve and eliminate an output gap without waiting for the economy to adjust itself. Chapters 9 and 10 discuss **monetary policy**, actions by the monetary authorities designed to change aggregate demand and eliminate output gaps by changing interest rates, money supply, and the availability of credit. Both fiscal and monetary policy work to change aggregate demand and eliminate output gaps, which reduce the standard of living the national economy provides for its citizens.

Fiscal policy: government expenditure and tax changes designed to influence AD.

Monetary policy: changes in interest rates and money supply designed to influence AD.

KEY CONCEPTS

The **Aggregate Demand and Supply** model provides a framework for our study of the operation of the economy.

Aggregate Demand is the negative relationship between planned aggregate expenditure on final goods and services and the price level, assuming all other conditions in the economy are constant.

Aggregate Supply is the positive relationship between outputs of goods and services and the price level, assuming factor prices, capital stock, and technology are constant.

Short-Run Equilibrium Real GDP and Price are determined by short-run Aggregate Demand and Aggregate Supply, illustrated by the intersection of the AD and AS curves.

Potential Output is the output the economy can produce on an ongoing basis with given labour, capital, and technology without putting persistent upward pressure on prices or inflation rates.

The **Natural Unemployment Rate** is the ‘full employment’ unemployment rate observed when the economy is in equilibrium at potential output.

Growth in potential output comes from growth in the labour force and growth in labour productivity coming from improvements in technology as a result of investment in fixed and human capital.

Business Cycles are the short-run fluctuations in real GDP and employment relative to Potential Output (GDP) and full employment caused by short-run changes in Aggregate Demand and Supply.

Output Gaps are the differences between actual real GDP and potential GDP that occur during business cycles.

Unemployment rates fluctuate with output gaps.

Inflationary Gaps and Recessionary Gaps are the terms used to describe positive and negative output gaps based on the effects the gaps have on factor prices.

Actual output adjusts to Potential Output over time *if factor input and final output prices are flexible* and changes in prices shift the Aggregate Supply curve to equilibrium with Aggregate Demand at Y_p .

Fiscal and monetary policy are tools governments and monetary authorities can use to stabilize real output and employment or speed up the economy's adjustment to output gaps.

EXERCISES FOR CHAPTER 5

Exercise 5.1. Suppose we have the following information for an economy:

GDP Deflator	Planned Aggregate Expenditure	Planned Aggregate Output
90	550	150
100	500	300
110	450	450
120	400	600
130	350	750

- Plot the AD and AS curves in a carefully labeled diagram.
- What are the short-run equilibrium values of real GDP and the price level?

Exercise 5.2. Suppose we learn that potential output is 500 for the economy in Exercise 5.1.

- Add a line to your diagram for Exercise 5.1 to illustrate potential GDP.
- What is the size of any output gap you see in the diagram?
- What is the size and sign of the output gap?

Exercise 5.3. Potential GDP is determined by the size of the labour force, the stock of capital and the state of technology used in the production process. Assume the labour force grows over time, and research and development lead to improvements in technology, and productivity. Use an AD/AS diagram to illustrate potential GDP both before and after the growth in labour force and the improvement in technology.

Exercise 5.4. Consider an economy described by the following: AD: $Y = 2250 - 10P$, AS: $P = 125 + 0.1Y$.

- What are the short run equilibrium values for real GDP and the price level?
- Assume potential output is 500 and draw an AD/AS/ Y_P diagram to show the initial short run equilibrium real GDP, price level and potential output.

- (c) Changes in international market conditions drive up prices for crude oil and base metals. Increased production costs driven by these higher input prices raise the general price level by 5 at every level of output. Write the equation of the new AS curve. What are the new short run equilibrium real GDP and price level?
- (d) Draw the new AS curve in your diagram for b). What is the size of the output gap?

Exercise 5.5. Growth in potential output is determined by growth in the labour force and growth in labour productivity. Suppose the labour force grows by 1.5 percent a year and labour productivity, based on increased capital and improved technology, grows by 1.0 percent a year.

- (a) What is the annual growth in potential output?
- (b) Illustrate the growth in potential output in an AD/AS diagram.
- (c) Aggregate demand is not changed by the change in potential output. Indicate any output gap caused by the change in potential output.

Exercise 5.6. Suppose we have the following data for an economy:

Year	Potential Output (billions 2002\$)	Real GDP (billions 2002\$)
2006	1,038	1,017
2007	1,069	1,030
2008	1,101	1,101
2009	1,134	1,160
2010	1,168	1,139
2011	1,203	1,130
2012	1,240	1,187
2013	1,277	1,163

Calculate the output gap for each year in this economy. Plot the output gap in a time series diagram. Date the timing of the phases of any business cycles you see in your plot of the output gap.

Exercise 5.7. Suppose employment in the economy is proportional to output based on the output function $Y = 100N$, where N is employment in person years. If a recessionary gap reduced output (Y) by 1.0 percent what change in employment would result?

Chapter 6

Aggregate expenditure & aggregate demand

In this chapter we will explore:

- 6.1 Short run aggregate demand and output
- 6.2 Consumption, saving and investment
- 6.3 Exports and imports
- 6.4 Aggregate expenditure & equilibrium output
- 6.5 The multiplier
- 6.6 Equilibrium output and the AD curve

In Chapter 5 we saw that real output and employment are sometimes smaller, and at other times larger, than potential output Y_p . According to our aggregate demand and aggregate supply model, short-run changes in AD and AS conditions cause these fluctuations in output. But why do AD and AS conditions fluctuate? To answer this question, we begin with a simple short-run model of the economy.

6.1 Short run aggregate demand and output

We concentrate first on the private market sector. Assume there are households and businesses in our simple economy, but no government. The households and businesses buy domestically produced and imported goods and services. Businesses also sell some output in export markets to residents of other countries. This model will help us to understand the mechanics that determine real output and employment and the main causes of fluctuations in real GDP. Chapter 7 will add a government sector and introduce fiscal policy. These additions will begin to make the model more realistic, but the internal mechanics will be the same. Understanding how this simple model works is key to understanding how the actual economy works.

This initial *short run* model has a number of crucial properties:

- All prices and wages are fixed at a given level.
- At these prices and wages, businesses produce the output that is demanded and labour accepts opportunities to work.
- Money supply, interest rates and foreign exchange rates are fixed because at this stage we ignore the financial sector

Holding prices constant we can postpone the detailed analysis of the supply side of the economy. Total output is demand-determined. Figure 6.1 uses an AD/AS diagram like those developed in Chapter 5 to illustrate these conditions and the *expenditure function* we will develop.

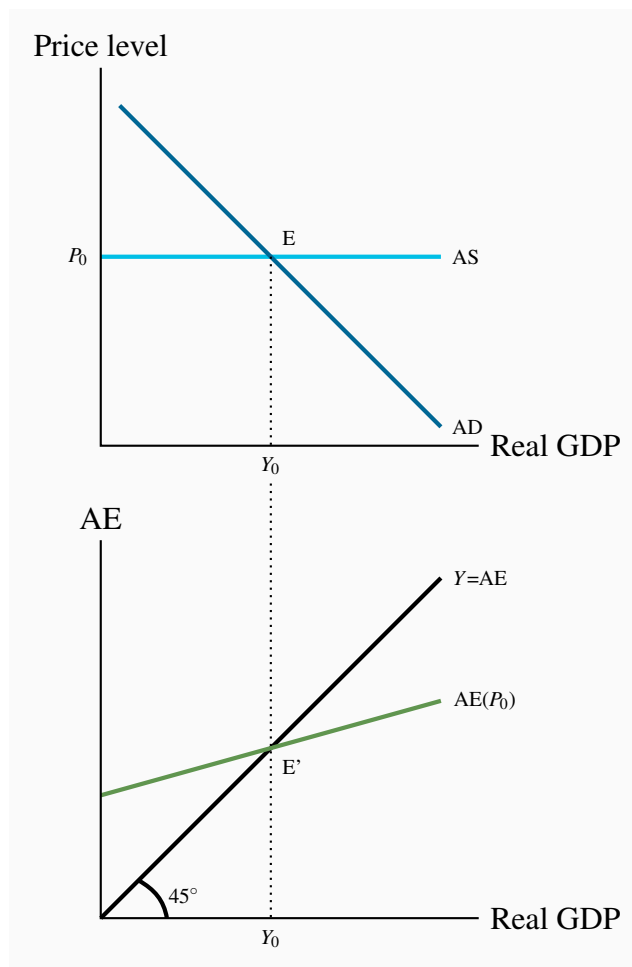


Figure 6.1: Aggregate Demand, aggregate expenditure and output when the price level is constant

The horizontal AS curve in the upper part of Figure 6.1 shows that the price level is fixed at P_0 ,

as we have assumed. As a result, the equilibrium real GDP in this example is determined by the *position of the AD curve*. Changes in the position of the AD curve would cause changes in real output and real income, and corresponding changes in employment. But what determines the position of the AD curve? Those things, *other than price*, that affect expenditure decisions. Understanding these expenditure decisions and their effects are the focus of this and the next several chapters.

The lower part of Figure 6.1 offers the first answer. It shows the relationship between planned aggregate expenditure and *income* when the price level is fixed. It also shows that, if the aggregate expenditure function (AE) has the right position and slope, there is a level of output at which planned expenditure and output are equal. This equality between planned expenditure and output determines the *position* of the AD curve. We begin our study of the interactions of expenditure, output, and income under simple conditions in this chapter. The relationships in the lower part of Figure 6.1 are the starting point.

Later we will introduce financial markets and relax the assumption that prices, wages, interest rates, and exchange rates are fixed. Not only do we want to study inflation; we also want to ask if market forces acting through changes in prices and wages would eliminate unemployment and spare capacity and move the economy to potential output. We had a first look at that process in Chapter 5, and will examine it in detail in Chapter 11.

6.2 Consumption, saving, and investment

Chapter 4 introduced the circular flow of income payments between households and business. Business pays incomes to households to buy factor inputs. Households use income to buy the output of business, providing business revenue. Business revenue is ultimately returned to households as factor incomes. We now build a simple model of this interaction between households and business.

Aggregate expenditure is the sum of *planned* consumption expenditure by households, investment expenditure by business, and expenditure by residents of other countries on exports of domestic output, minus the imports contained in all these planned expenditures on goods and services. Using AE to denote aggregate expenditure, *C* for consumption expenditure, *I* for investment expenditure, *X* for exports, and *IM* for imports,

$$AE = C + I + X - IM \quad (6.1)$$

Aggregate expenditure (AE): the sum of *planned* expenditure in the economy.

Consumption expenditures, investment expenditures, and expenditures on exports of domestic output and imported goods and services are made by different groups and depend on different things. To establish the underlying sources of aggregate expenditure we examine each of its components in more detail.

Consumption expenditure

Households buy goods and services such as food, cars, movie tickets, internet services and downloads of music and video. Annual consumption expenditures averaged about 90 percent of disposable income and were about 60 percent of GDP in 2013. **Disposable income** is the income households receive from employment, plus transfer payments received from governments, minus direct taxes they pay to governments. Households decide to either spend or save their disposable incomes.

Disposable income is income net of taxes and transfers.

The scatter diagram of annual data in Figure 6.2 illustrates the relationship between real disposable income and real consumption expenditure in Canada. We know from Chapter 4 that consumption expenditure is the largest component of real GDP measured by the expenditure approach. The slope of the line drawn in the diagram, which passes close to the data points, shows us that a \$1 increase in real disposable income results in an increase in real consumption expenditure of about \$0.90.

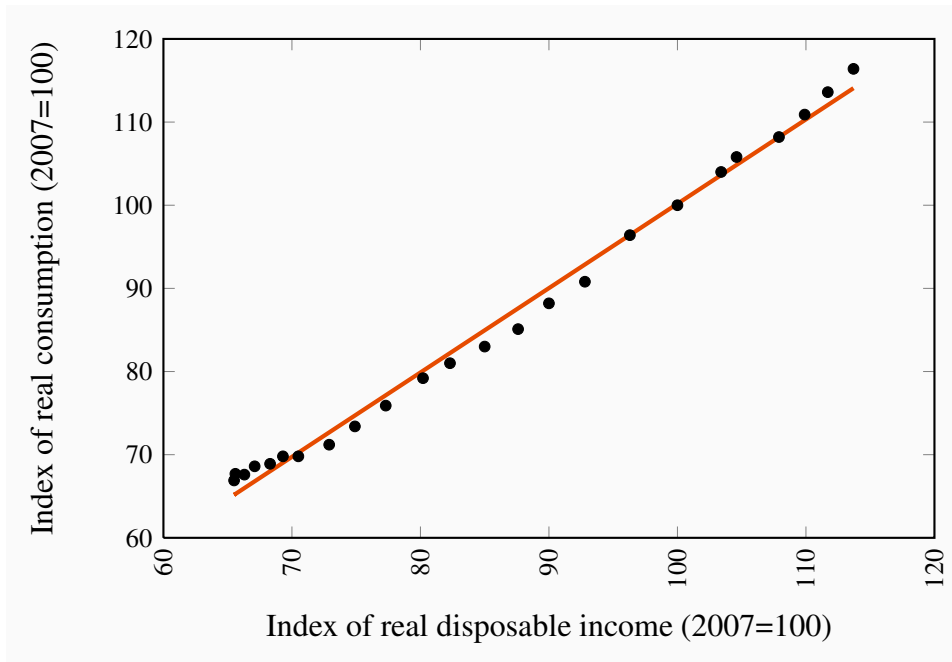


Figure 6.2: A consumption function for Canada, 1990-2013

Source: Statistics Canada, CANSIM Tables 380-0064 and 380-0065.

Because we have assumed there is no government, disposable income is simply the income households receive from employment in business firms. Each household decides how to allocate its disposable income between spending and saving. Some families save part of their disposable income and accumulate wealth; others spend more and borrow, incurring debt. While consumption and saving decisions depend on many factors, we start with a simple, basic argument. *Aggregate* consumption expenditure is determined by *aggregate* disposable income. It rises or falls when disposable income rises or falls, but it does not rise or fall by as much as disposable income rises or falls.

Figure 6.2 shows this positive relationship in the annual data for real consumption expenditure and real disposable income in Canada. Because the scatter of points lies close to an upward sloping line summarizing this relationship, our basic argument is reasonable. Nevertheless, the points do not lie exactly along the line. The simplification we start with omits some other influences on consumption expenditure that we take up later.

The relationship between disposable income and consumption expenditure we see in Figure 6.2 is called the **consumption function**.

Consumption function: planned consumption expenditure at each level of disposable income.

The consumption function tells us how disposable income Y and consumption expenditure C are related. If C_0 is a positive constant, and c is a positive fraction between zero and one,

$$C = C_0 + cY \quad (6.2)$$

We have assumed for simplicity there is no government that might impose taxes or make transfer payments. As a result disposable income equals national income. Equation 6.2 then relates planned consumption expenditure to national income Y . With c a constant fraction, the consumption function is a straight line.

The intercept C_0 is *autonomous* consumption expenditure. **Autonomous expenditure** is not related to current income. Households wish to consume C_0 based on things other than income.

Autonomous expenditure: expenditure not related to current income.

The slope of the consumption function is the **marginal propensity to consume**. The marginal propensity to consume is the change in consumption expenditure *caused* by a change in income¹. We call this **induced expenditure**, and write,

$$\frac{\Delta C}{\Delta Y} = MPC$$

Marginal propensity to consume (MPC): the change in consumption expenditure caused by a change in income.

Induced expenditure: expenditure determined by national income that changes if national income changes.

Table 6.1 and Figure 6.3 illustrate these relationships. Autonomous consumption expenditure, $C_0 = 20$ in the numerical example, determines the vertical intercept of the function in the diagram. The marginal propensity to consume, $c = 0.8$, is the slope of the function. You can see in the table that an increase in income by 50 *induces* an increase in consumption expenditure by 40, which is 0.8×50 . A change in autonomous consumption expenditure would shift the entire function, changing consumption at every level of income.

¹The Greek letter Δ (*Delta*) means ‘change in’. For example, ΔC means ‘change in C ’.

Consumption function:	$C = C_0 + cY$			
Saving function:	$S = -C_0 + (1 - c)Y$			
For example:	$C = 20 + 0.8Y$	$S = -20 + 0.2Y$		
Y	C	$\Delta C/\Delta Y$	$S = Y - C$	$\Delta S/\Delta Y$
0	20	–	–20	–
50	60	0.8	–10	0.2
100	100	0.8	0	0.2
150	140	0.8	10	0.2
200	180	0.8	20	0.2

Table 6.1: The consumption and saving functions: a numerical example

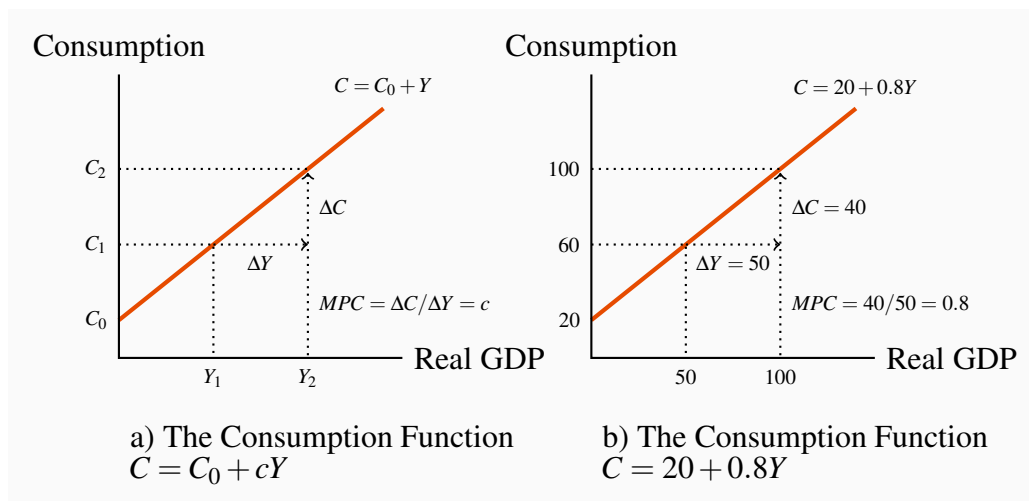


Figure 6.3: The Consumption Function

Saving

Saving is income not spent to finance consumption. Figure 6.3 in Panel a) and Equation 6.2 imply that when income Y is zero, saving is $-C_0$. Households are not saving, borrowing, or selling their assets.

Because just a fraction c of any change in income is spent on consumption, the remaining fraction $(1 - c)$ of any change in income is saved. The **marginal propensity to save** ($MPS = \Delta S / \Delta Y$) is $(1 - c)$. Accordingly a change in income changes planned consumption and planned saving, and $MPC + MPS = 1$. Figure 6.4 shows the **saving function** corresponding to the consumption function in Figure 6.3.

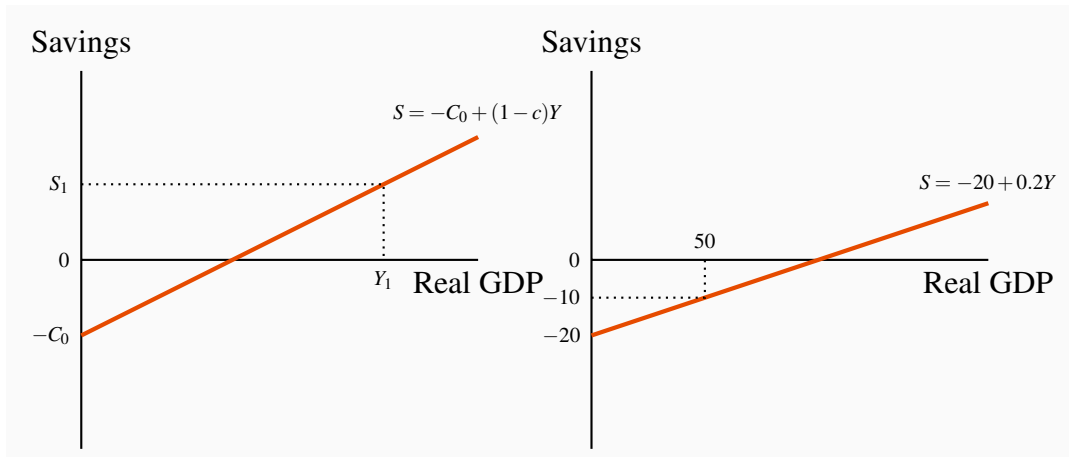


Figure 6.4: The Saving Function

Marginal propensity to save (MPS): the change in saving caused by a change in income.

Saving function: planned saving at each level of income.

Based on Equation 6.2 and the absence of government and foreign sectors, households can either spend income on consumption or save it. This means $Y = C + S$, and $S = Y - C$ so the saving function shown in Figure 6.4 is:

$$S = -C_0 + (1 - c)Y \quad (6.3)$$

Adding Equations 6.2 and 6.3, the left-hand side gives planned consumption plus planned saving, and the right-hand side gives income, Y , as it should.

When using diagrams, we make an important distinction between events that move the economy along the consumption and saving functions as opposed to events that shift the consumption and saving functions. A change in income causes a *movement along* the consumption and saving functions, and changes in consumption expenditure and saving are determined by the MPC and the MPS . These are changes in expenditure and saving plans *induced* by changes in income. Any

change other than a change in income that changes consumption and saving at every income level causes a *shift* in the consumption and saving functions. These changes in expenditure and saving plans are *autonomous*, caused by something other than changes in income.

The economic crisis and recession of 2008-2009 is explained in part by *shifts in household consumption expenditure* caused by changes in confidence and expectations about the future of the economy. Canadians watched as banks and financial institutions collapsed in many countries. Pessimism and uncertainty about households' income and finances increased with losses in household financial wealth as equity markets declined sharply on an international scale, and the house price bubble collapse in the United States. Households cut back, reducing autonomous expenditure.

Even in the relatively tranquil economic times increases in household indebtedness, changes in demographics, or changes in government monetary and fiscal policies will change autonomous consumption and shift the consumption function.

We also identify a limited number of changes in the economy that will change the slopes of the consumption and saving functions. These events are of special interest because, as we will see shortly, the slope of the consumption function—and the household expenditure behaviour it describes—is one key to our understanding of fluctuations in real output.

Consumption expenditure plays a special role in our model because it is the largest and most stable component of expenditure.

Investment expenditure

Investment expenditure (*I*) is planned expenditure by business intended to change the fixed capital stock, buildings, machinery, equipment and inventories they use to produce goods and services. In 2011 investment expenditures were about 21 percent of GDP. Business capacity to produce goods and services depends on the numbers and sizes of factories and machinery they operate and the technology embodied in that capital. Inventories of raw materials, component inputs, and final goods for sale allow firms to maintain a steady flow of output and supply of goods to customers. Firms' investment expenditure on fixed capital depends chiefly on their current *expectations* about how fast the demand for their output will increase and the *expected profitability* of higher future output. Sometimes output is high and rising; sometimes it is high and falling. Business expectations about *changes* in demand for their output depend on many factors that are not clearly linked to current income. As a result we treat investment expenditure **I** as autonomous, independent of current income.

Investment expenditure (*I*): business expenditure on current output to add to stock of capital used to produce current goods and services.

However, the interest rates determined by conditions in financial markets do affect investment decisions. For the moment we are assuming interest rates are constant. But it will be important to understand that interest rates are the *cost of financing* investment expenditure and of carrying inventories and they are important in the market valuation of the current capital stock.

Higher interest rates reduce investment expenditure and lower interest rates raise investment expenditure. After we study financial markets and interest rates in Chapter 9 we will drop the assumption of constant interest rates and bring interest rates into the investment decision.

For now, with interest rates constant at i_0 , we can write the investment function as:

$$I = I_0 - bi_0 \quad (6.4)$$

Figure 6.5 shows this investment function. For a given level of interest rates and business expectations about future markets and profits, it is a horizontal line that intersects the vertical axis at I_0 . Any change in business firms' expectations about future markets, or profits or interest rates or any other conditions that cause a change in their investment plans would *shift* the investment line in Figure 6.5 up or down, but leave its slope unchanged at zero.

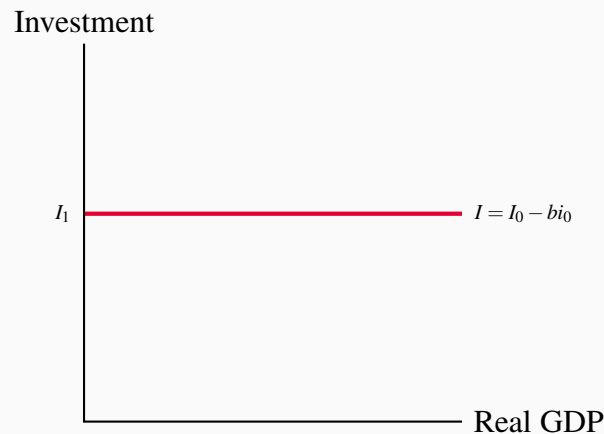


Figure 6.5: The Investment Function

Planned investment expenditure is independent of current GDP. A change in the interest rate would shift the line.

Investment, unlike consumption, is a volatile component of expenditure. Changes in business expectations about future markets and profits happen frequently. New technologies and products, like hybrid automobiles, “clean” diesel engines, biofuels, LED televisions, advanced medical diagnostic processes, renewable energy products and “green” building materials lead to the investment in factories to produce these products and the infrastructure to use them. Investment expenditures

increase. A sudden uncertainty about safety reduces demand for plastic products in food and beverage packaging. Investment in new capacity to produce these products drops and a search for new packaging begins. Increased gasoline prices reduce the demand for large cars and trucks, leading some auto manufacturers to close plants and cut investment spending. More recently, sharp drops in prices for conventional energy and difficult financial market conditions have led to the postponement and cancellation of large investments in both conventional and alternative energy projects.

Fluctuations in investment in Canada caused by these and other factors are illustrated in Figure 6.6. The steep drop in investment expenditure in 2008 and 2009 is of particular note. This was a major cause of the recession that followed the financial crisis of 2009. The coincident drop in exports also contributed to that recession. Volatility in these expenditure components over the period covered by Figure 6.6 are major causes of business cycles in Canadian real GDP and employment.

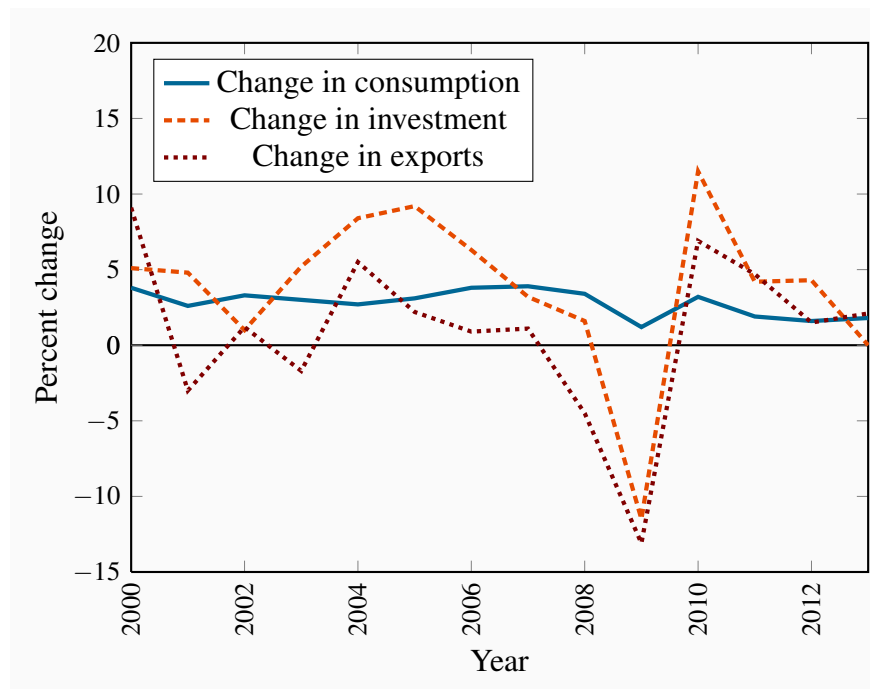


Figure 6.6: Annual percent change in real consumption, investment and exports, Canada 2000-2013

Source: Statistics Canada, CANSIM Table 380-0064

6.3 The export and import functions

Our **exports** (X) are the goods and services produced at home but sold to residents of other countries. Our **imports** (IM) are goods and services produced in other countries but bought by domestic

residents. Exports and imports each amounted to between 30 and 35 percent of GDP in 2013. **Net exports** ($NX = X - IM$), is the difference between exports and imports, which is the net effect of international trade on aggregate expenditure.

Exports (X): domestic goods and services sold to residents of other countries.

Imports (IM): goods and services bought from other countries.

Net exports (NX): measure the difference between exports and imports.

Canada is a very open economy. In the United States, by comparison, exports and imports make up only 10 to 15 percent of GDP. International trade is much more important to aggregate expenditure in Canada and most European countries than in a very large country with diverse regions like the United States, which trades mostly internally.

Exports are a part of *autonomous* aggregate expenditure. Canadian exports are not determined by Canadian national income. Instead they depend on income levels in other countries, price levels here and in those countries, and the foreign exchange rate.

The **foreign exchange rate** is the domestic currency price of a unit of foreign currency. This is the price people pay to buy the U.S. dollars they want to cover travel costs in the U.S. It is also the amount of Canadian dollar revenue a Canadian exporter receives for each \$1.00U.S. of exports sales to U.S. buyers. In mid-2012 our exchange rate, the Canadian dollar price of the United States dollar, was about \$1.01Cdn/\$1.00U.S. In late 2014 our exchange rate was \$113.6/\$1.00US. Exporter revenues per dollar of sales to the US were about 12 percent higher and imports from the US cost about 12 percent more.

Foreign exchange rate: the domestic currency price of foreign currency.

Assuming that prices and exchange rates are constant, the price competitiveness and profitability of Canadian exports is fixed. Changes in national incomes in export markets will cause changes in our exports. A recession in the United States, for example, reduces demand for Canadian exports of raw materials, energy, and manufactured goods like automobiles, as was the case in 2008 and 2009. Previously, strong growth in U.S. real GDP created strong demand for Canadian exports. Canadian exports to other parts of the world, such as China and India, are driven by GDP and GDP growth in those countries.

However, as we will see in later chapters, changes in economic and financial conditions change exchange rates. The competitiveness and profitability of exports change as a result. In Canada between 2002 and 2007 the exchange rate fell, lowering the Canadian dollar price of the United States dollar from \$1.58Cdn to \$0.98Cdn for \$1.00U.S. A U.S. dollar of sales revenue from exports

that provided \$1.58 in Canadian dollar revenue in 2002 brought just \$0.98 in Canadian dollar revenue in 2007. In the earlier period, 1995 to 2001, the rise in the exchange rate made Canadian exports very competitive and profitable, supporting strong export growth. Subsequently, the fall in the exchange rate caused a difficult market and competitive conditions for manufactured exports.

For now, assuming exchange rates are constant and letting X_0 be autonomous exports, the export function is:

$$X = X_0 \quad (6.5)$$

Exports, like investment, can be a volatile component of aggregate expenditure. Changes in economic conditions in other countries, changes in tastes and preferences across countries, changes in trade policies, and the emergence of new national competitors in world markets all impact on the demand for domestic exports. To illustrate this volatility in exports and in investment, Figure 6.6 shows the year-to-year changes in investment, exports, and consumption expenditures in Canada from 1987 to 2012. You can see how changes in investment and exports were much larger than those in consumption. This volatility in investment and exports appears as up and down shifts in the functions in Figures 6.5 and 6.7.

Imports are part of domestic expenditure. Like consumption expenditure, imports rise when national income rises and fall when national income falls. Goods and services bought by households and business are a mix of domestic output and imports. Exports of goods and services embody imported components and services. Some imports are *autonomous*; that is, independent of current income. Changes in autonomous consumption, investment, and exports include changes in autonomous imports. Some changes in imports are *induced* by changes in income through the **marginal propensity to import** ($MPM = m$). The MPM is a positive fraction, reflecting the fact that a rise in income causes an increase in induced expenditure, including induced imports.

Marginal propensity to import ($MPM = m$): the change in imports caused by a change in national income.

Imports also depend on domestic and foreign prices and the foreign exchange rate. The recent fall in the Canada–United States exchange rate resulted in strong increases in cross-border shopping and travel by Canadian residents. In earlier years the high exchange rate raised prices of imports to Canada. Higher costs in Canadian dollars for U.S. goods, travel, and tourist services reduced cross-border travel by Canadians and imports from the United States.

Using IM_0 for autonomous imports and m for the marginal propensity to import ($\Delta IM/\Delta Y$), and assuming constant exchange rates, the import function is:

$$IM = IM_0 + mY \quad (6.6)$$

Figure 6.7 shows expenditure on exports and imports at different levels of national income. Assume for purposes of illustration that $X_0 = 100$. The export function with a vertical intercept of 100 is a horizontal line because exports are autonomous. Autonomous imports are $IM_0 = 40$ when national income is zero, and rise as national income rises. The slope of the import function is the marginal propensity to import (MPM) with $m = 0.2$. A change in national income of \$1 changes imports by \$0.20.

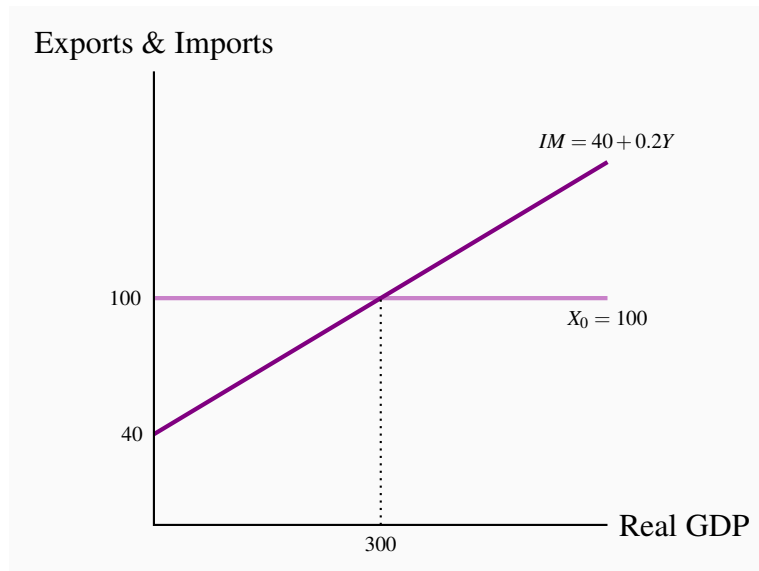


Figure 6.7: Exports and Imports

Exports are autonomous at $X = 100$. Imports increase from an autonomous level of 40 as income increases, according to the marginal propensity to import m . Net exports vary inversely with real GDP.

The difference between exports and imports at each level of national income is the net export level. At low income levels, imports are low and net exports are positive. At higher income levels, higher imports result in negative net exports. The marginal propensities to import and consume play very important roles in the operation of the economy through the induced changes in aggregate expenditure they generate.

6.4 Aggregate expenditure and equilibrium output in the short run

Aggregate expenditure is *planned expenditure* by firms and households on currently produced final goods and services at each level of current national income. The **aggregate expenditure function (AE)** is the relationship between planned expenditure in the total economy and real national income

or GDP. Table 6.2 and Figure 6.8 together show the aggregate expenditure function in terms of numerical examples and diagrams.

Aggregate expenditure function (AE): the relationship between planned expenditure in the total economy and real national income or GDP.

Consumption function:	$C = 20 + 0.8Y$				
Investment function:	$I = 20$				
Export function:	$X = 50$				
Import function:	$IM = 10 + 0.2Y$				
Aggregate expenditure:	$AE = C + I + X - IM = 80 + 0.6Y$				
Y	C	I	X	IM	$AE = C + I + X - IM$
0	20	20	50	10	80
100	100	20	50	30	140
150	140	20	50	40	170
200	180	20	50	50	200
250	220	20	50	60	230

Table 6.2: The aggregate expenditure function: a numerical example

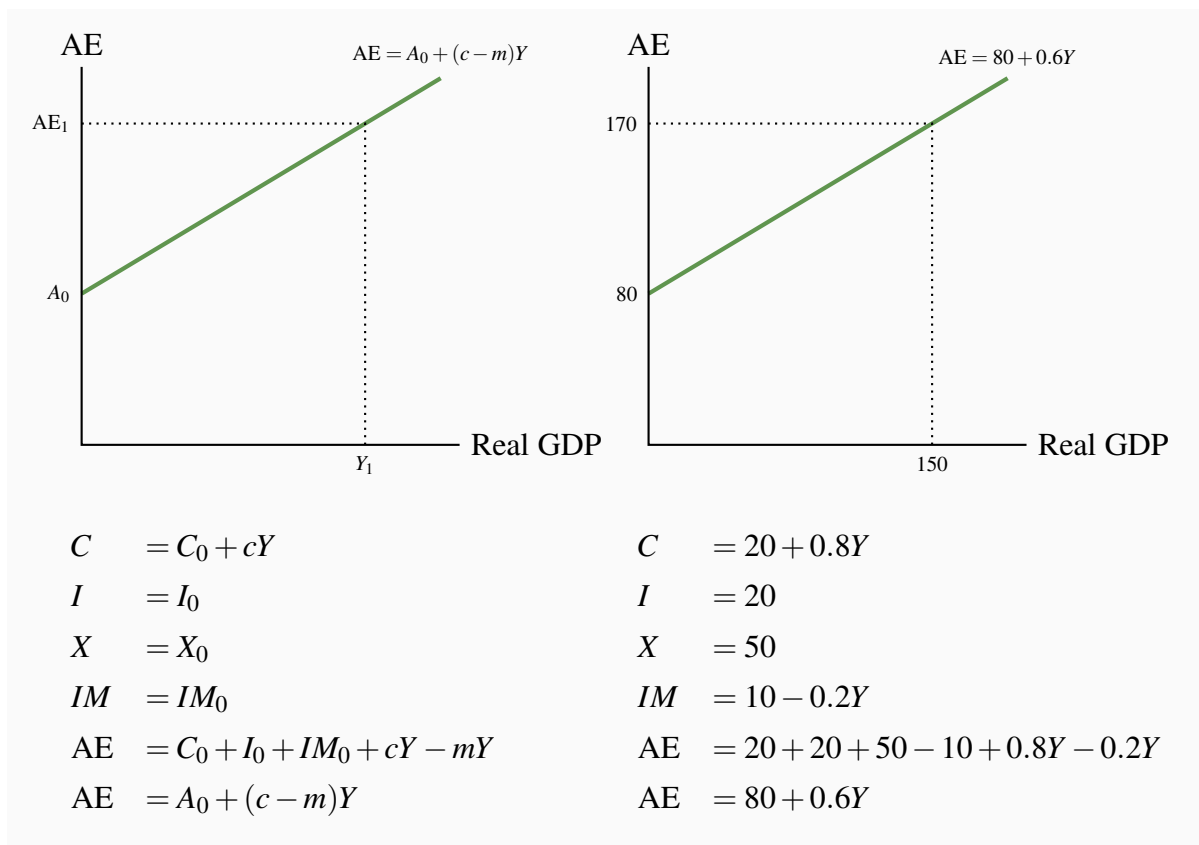


Figure 6.8: Aggregate Expenditure

Aggregate expenditure AE , as defined above and earlier by Equation 6.1, is:

$$AE = C + I + X - IM$$

In Table 6.2 and Figure 6.8, the *aggregate expenditure function* is derived using this equation. Aggregate expenditure is different at different income levels because of induced expenditure on consumption and imports. Aggregate expenditure changes by $(c - m)$ times any change in income. ($\Delta AE = \Delta C - \Delta IM = c\Delta Y - m\Delta Y$). In the Figure the vertical intercept of AE is the sum of autonomous expenditure. The slope of AE is $(c - m)$, the marginal propensity to consume minus the marginal propensity to import.

Many things other than income influence autonomous expenditure. It is not fixed, but it is independent of income. The AE function separates the change in expenditure directly induced by changes in income from changes caused by other sources. All other sources of changes in aggregate expenditure are shown as *shifts* of the AE line. If firms get more optimistic about future demand and profit and invest more, autonomous expenditure rises. The new AE line is parallel to, but higher

than, the old AE line. A financial crisis like that in the US in 2008 or the ongoing sovereign debt crisis in Europe shifts the AE line down. A change in exports shifts the AE line up or down without changing its slope as exports either increase or decrease.

Equilibrium output

Output is said to be in **short-run equilibrium** when planned aggregate expenditure (AE) equals the current output of goods and services (Y). Spending plans are not frustrated by a shortage of goods and services. Nor do business firms make more output than they can sell. In short-run equilibrium, output equals the total of goods and services that households, businesses, and residents of other countries want to buy. Real GDP is determined by aggregate expenditure.

Short-run equilibrium output: Aggregate expenditure equals current output.

In Figure 6.9 real GDP is measured on the horizontal axis and aggregate spending on the vertical axis. The 45° line labeled $Y=AE$, illustrates the equilibrium condition. At every point on the line, AE measured on the vertical axis equals current output, Y , measured on the horizontal axis. This 45° line has a slope of 1.

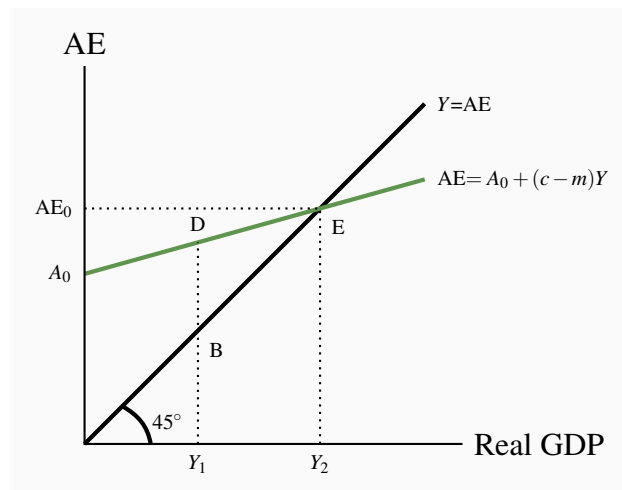


Figure 6.9: The 45° Diagram and Equilibrium GDP

The 45° line gives $Y = AE$ the equilibrium condition. At point E the AE line crosses the 45° line and $AE_0 = Y_2$. This is the equilibrium. At Y_1 , $AE > Y$ and unplanned reductions in inventories provide the incentive to increase Y .

The AE function in Figure 6.9 starts from a positive intercept on the vertical axis to show autonomous aggregate expenditure, and has a slope which is less than one and equal to $(c - m)$. This

positive intercept and slope less than 1 means that the AE line crosses the 45° line at E. On the 45° line, the value of output (and income) on the horizontal axis equals the value of expenditure on the vertical axis, as required by the national accounts framework. Since E is the only point on the AE line also on the 45° line, it is the only point at which output and *planned* expenditure are equal. It is the equilibrium point.

This is the only aggregate expenditure that just buys all current output. For example, assume as shown in the diagram, that output and incomes are only Y_1 . Aggregate expenditure at D is not equal to output as measured at B. Planned expenditure is greater than current output. Aggregate spending plans cannot all be fulfilled at this current output level. Consumption and export plans will be realized only if business fails to meet its investment plans as a result of an *unplanned fall in inventories* of goods.

In Figure 6.9 all outputs less than the equilibrium output Y_2 , are too low to satisfy planned aggregate expenditure. The AE line is above the 45° line along which expenditure and output are equal. Conversely, if real GDP is greater than Y_2 aggregate expenditure is not high enough to buy all current output produced. Businesses have unwanted and *unplanned increases in inventories* of unsold goods.

We can also find equilibrium output using the consumption function (Equation 6.2), the investment function (Equation 6.4), the export function (Equation 6.5), the import function (Equation 6.6), and the equilibrium condition $Y = AE$. We have:

$$AE = C + I + X - IM$$

$$C = C_0 + cY$$

$$I = I_0$$

$$X = X_0$$

$$IM = IM_0 + mY$$

Using the equilibrium condition $Y = AE$ and solving for Y gives:

$$Y = C + I + X - IM$$

$$Y = C_0 + cY + I_0 + X_0 - IM_0 - mY$$

$$Y - cY + mY = C_0 + I_0 + X_0 - IM_0$$

$$Y(1 - c + m) = C_0 + I_0 + X_0 - IM_0$$

This gives:

$$Y_e = \frac{(C_0 + I_0 + X_0 - IM_0)}{(1 - c + m)} = \frac{A_0}{1 - c + m} \quad (6.7)$$

This is the equilibrium output Y_2 we found using the diagram in Figure 6.9. From the numerical example in Table 6.2 we have:

$$\begin{aligned} C &= 20 + 0.8Y \\ I &= 20 \\ X &= 50 \\ IM &= 10 + 0.2Y \\ AE &= 20 + 0.8Y + 20 + 50 - 10 - 0.2Y \\ AE &= 80 + 0.6Y \end{aligned}$$

Using the equilibrium condition $Y = AE$ and solving for Y gives:

$$\begin{aligned} Y &= 80 + 0.6Y \\ Y - 0.6Y &= 80 \\ Y &= \frac{80}{(1 - 0.6)} \\ Y_2 &= 200 \end{aligned}$$

When we look back at Table 6.2 we do see that aggregate expenditure and income are equal when income is 200. You can construct a diagram like Figure 6.9 using the numerical values for aggregate expenditure in Table 6.2 and a 45° line to show equilibrium $Y_e = 200$.

Adjustment towards equilibrium

Unplanned changes in business inventories cause adjustments in output that move the economy to equilibrium output. Suppose in Figure 6.9 the economy begins with an output Y_1 , below equilibrium output Y_e . Aggregate expenditure is greater than output Y_1 . If firms have inventories from previous production, they can sell more than they have produced by running down inventories for a while. Note that this fall in inventories is unplanned. Planned changes in inventories are already included in planned investment and aggregate expenditure.

If firms cannot meet planned aggregate expenditure by unplanned inventory reductions, they must turn away customers. Either response—unplanned inventory reductions or turning away customers—is a signal to firms that aggregate expenditure is greater than current output, markets are strong, and output and sales can be increased profitably. Hence, at *any* output below Y_e , aggregate expenditure exceeds output and firms get signals from unwanted inventory reductions to raise output.

Conversely, if output is initially above the equilibrium level, Figure 6.9 shows that output will exceed aggregate expenditure. Producers cannot sell all their current output. *Unplanned and unwanted additions to inventories* result, and firms respond by cutting output. In recent years,

North American auto producers found demand for their cars and trucks was less than they expected. Inventories of new cars and trucks built up on factory and dealer lots. Producers responded by lowering production to try to reduce excess inventory. In general terms, when the economy is producing more than current aggregate expenditure, unwanted inventories build up and output is cut back.

Hence, when output is below the equilibrium level, firms raise output. When output is above the equilibrium level, firms reduce output. At the equilibrium output Y_e , firms sell their current output and there are no unplanned changes to their inventories. Firms have no incentive to change output.

Equilibrium output and employment

In the examples of short-run equilibrium we have discussed, output is at Y_e with output equal to planned expenditure. Firms sell all they produce, and households and firms buy all they plan to buy. But it is important to note that nothing guarantees that equilibrium output Y_e is the level of potential output Y_P . When wages and prices are fixed, the economy can end up at a short-run equilibrium below potential output with no forces present to move output to potential output. Furthermore, we know that, when output is below potential output, employment is less than full and the unemployment rate u is higher than the natural rate u_n . The economy is in recession and *by our current assumptions* neither price flexibility nor government policy action can affect these conditions.

6.5 The multiplier: changes in aggregate expenditure and equilibrium output

In our model the slope of the AE line depends on the marginal propensity to consume and the marginal propensity to import. For any given MPC and MPM , the level of autonomous expenditure ($C_0 + I_0 + X_0 - IM_0$) determines the height of the AE line. Recall that autonomous expenditure is expenditure that is not related to national income.

Changes in autonomous expenditure cause parallel vertical shifts in the AE function. Investment expenditure depends chiefly on firms' current expectations about future demand for their output and future profits. These expectations about the size and strength of future markets can fluctuate significantly, influenced by current pessimism or optimism about the future. We saw this volatility in investment in Figure 6.6. Similarly, changes in conditions in export markets change exports and changes in consumer confidence change autonomous consumption expenditure.

Suppose firms become very optimistic about future demand for their output. They want to expand their factories and add new equipment to meet this future demand. Planned investment rises. If

other components of aggregate expenditure are unaffected, AE will be higher at each income than before. Figure 6.10 shows this upward shift in AE to AE_1 . Before we go into detail, think about what is likely to happen to output. It will rise, but by how much?

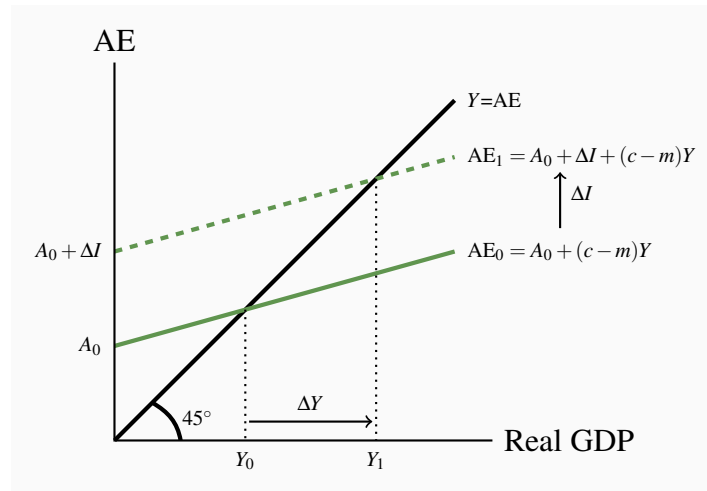


Figure 6.10: The Effect of a Rise in Investment

A rise in investment ΔI shifts AE up to AE_1 . Equilibrium GDP rises by a larger amount from Y_0 to Y_1 .

When investment rises, firms increase output, increasing their payments for factor inputs to production. Households have higher income and increase their consumption expenditure ($c\Delta Y$) and imports ($m\Delta Y$). Firms increase output again to meet this increased demand, further increasing household incomes. Consumption and imports rise further. What brings this process of rising output and income to an end?

Figure 6.10 shows that an upward shift in the AE function increases equilibrium income by a finite amount, but by a larger amount than the vertical rise in the AE line. This is because $(c - m)$, the slope of AE, is less than unity, giving the AE line a lower slope than the 45° line. Households increase their expenditure when incomes rise, but they increase expenditure by less than the rise in income. Equilibrium moves from Y_0 to Y_1 . Equilibrium output rises more than the original rise in investment, $\Delta Y_e > \Delta I$, but does not rise without limit.

We can also show the change in equilibrium output caused by a rise in autonomous investment expenditure using the simple algebra we used earlier. As before, start with:

$$\text{Consumption:} \quad C = 20 + 0.8Y$$

$$\text{Investment:} \quad I = 20$$

$$\text{Exports:} \quad X = 50$$

$$\text{Imports:} \quad IM = 10 + 0.2Y$$

$$\text{Aggregate expenditure:} \quad AE = 80 + 0.6Y$$

Then, equilibrium requires output (Y) equal to aggregate expenditure (AE):

$$\begin{aligned} Y &= 80 + 0.6Y \\ (1 - 0.6)Y &= 80 \\ Y &= \frac{80}{(1 - 0.6)} \\ Y &= 200 \end{aligned}$$

Now suppose investment increases by 10 to $I = 30$ and AE increases to $AE = 90 + 0.6Y$.

Equilibrium still requires output (Y) equal to aggregate expenditure (AE), but now:

$$\begin{aligned} Y &= 90 + 0.6Y \\ (1 - 0.6)Y &= 90 \\ Y &= \frac{90}{(1 - 0.6)} \\ Y &= 225 \end{aligned}$$

A rise in autonomous investment expenditure by 10 has increased equilibrium output and income by 25, from 200 to 225. This is an algebraic example of the effect of the increase in investment illustrated by Figure 6.10. The algebra gives us the equilibrium output under two different levels of autonomous investment expenditure. But it does not show us the adjustment process. The key to that process is the induced expenditure coming from the marginal propensities to consume and import.

A rise of 10 in investment expenditure causes a rise of 25 in equilibrium output. Higher investment expenditure *induces a rise in output and income that induces a further rise in consumption expenditure and imports*. Total expenditure rises by more than the original rise in investment, but the process does not spiral out of control because the marginal propensities to spend are less than 1. Expenditure increases in diminishing steps until equilibrium output is 225.

The **multiplier** is a concept used to define the change in equilibrium output and income *caused by* a change in autonomous expenditure. If A is autonomous expenditure:

$$\text{The multiplier} = \frac{\Delta Y}{\Delta A} \quad (6.8)$$

Multiplier ($\Delta Y/\Delta A$): the ratio of the change in equilibrium income Y to the change in autonomous expenditure A that caused it.

In our example, the initial change in autonomous expenditure $\Delta I = \Delta A$ is 10, and the final change in equilibrium output ΔY is 25. The multiplier is $\Delta Y/\Delta A = 25/10 = 2.5$. That is why in Figure 6.10, a small upward shift in the AE line leads to a much larger increase in equilibrium output and income.

The size of the multiplier

The multiplier is a number that tells us how much equilibrium output changes as a result of a change in autonomous expenditure. The multiplier is bigger than 1 because a change in autonomous expenditure changes income and sets off further changes in induced expenditure. The marginal propensities to consume and import determine the induced expenditure.

The size of the multiplier depends on the sizes of the marginal propensities to consume and import. The initial effect of a unit rise in autonomous investment expenditure is to raise output and income by one unit. If the $(MPC - MPM)$ is large, this rise in income causes a large rise in induced expenditure, and the multiplier is large. If the $(MPC - MPM)$ is small, a given change in autonomous expenditure and output induces only small changes in expenditure, and the multiplier is small.

To find the multiplier, add all the increases in aggregate expenditure and output from each step in Table 6.3 below, based on $c = 0.8$ and $m = 0.2$ as follows:

$$\text{Multiplier} = 1 + (0.8 - 0.2) + (0.8 - 0.2)^2 + (0.8 - 0.2)^3 + \dots$$

The dots at the end mean we keep adding terms such as $(0.8 - 0.2)^4$ and so on. The right-hand side of the equation is a geometric series. Each term is $(0.8 - 0.2)$ times the previous term. Fortunately, mathematicians have shown that there is a general formula for the sum of all terms in such a series, which gives:

$$\text{Multiplier} = \frac{1}{(1 - (0.8 - 0.2))} = \frac{1}{(1 - 0.6)}$$

The formula applies whatever the (constant) values of c and m , the marginal propensities to consume and import, as follows:

$$\text{Multiplier} = \frac{1}{(1 - c + m)} \quad (6.9)$$

	Y	I	$C = 20 + 0.8Y$	X	$IM = 10 + 0.2Y$	AE
Initial equilibrium	200	20	180	50	50	200
Step 1: $\Delta I = 10$	200	30	180	50	50	210
Step 2	210	30	188	50	52	216
Step 3	216	30	192.8	50	54	222
New equilibrium	225	30	200	50	55	225

Table 6.3: The multiplier effects of an increase in investment ($\Delta I = 10$) on equilibrium GDP

For the particular values of $c = 0.8$ and $m = 0.2$, Equation 6.9 confirms that the multiplier is $1/(1 - 0.6)$, which is $1/0.4 = 2.5$. Hence, a rise in investment expenditure by 10 causes a rise in equilibrium output by 25, as we know from Table 6.3. Similarly, the multiplier allows us to predict that a fall in investment expenditure by 10 would lower equilibrium output and income by 25, if $c = 0.8$ and $m = 0.2$. Indeed, you will probably have guessed this from Equation 6.9. Equilibrium output is simply autonomous expenditure multiplied by the multiplier!

In more general terms, because $MPC - MPM = c - m$ is the slope of the AE function, we can write:

$$\text{Multiplier} = \frac{1}{(1 - \text{slope of AE})} \quad (6.10)$$

In the model we have here, the slope of AE is $MPC - MPM$, but this formula for the multiplier will still be useful when we introduce the tax system in the government sector in Chapter 7.

Leakages, injections & equilibrium output

Equilibrium output equals planned expenditure on consumption, investment, and exports net of imports. This also means that planned investment and exports equal planned saving and imports. If $Y = C + I + X - IM$, then $Y - C + IM = I + X$. From Equation 6.3, $Y - C = S$, and thus,

$$S + IM = I + X \quad (6.11)$$

This condition holds only when aggregate expenditure is at the right level to achieve equilibrium.

Savings and imports are leakages from the expenditure stream that do not pass current income on to business through expenditure on current output. On the other hand, autonomous investment and exports are injections into expenditure and a flow of funds to business that is independent of current income. When these injections just offset the leakages, aggregate expenditure equals output and the economy is in equilibrium.

In modern economies, business managers make investment decisions and residents of other countries make decisions about expenditure on domestic exports. Household expenditure plans depend on their income. Since planned saving and imports depend on income but planned investment and exports do not, Equation 6.11 means that *output and income adjust to establish equilibrium* by making savings and import plans by households (leakages) equal to the investment plans of firms and export plans of non-residents (injections). Figure 6.11 illustrates this equilibrium condition.

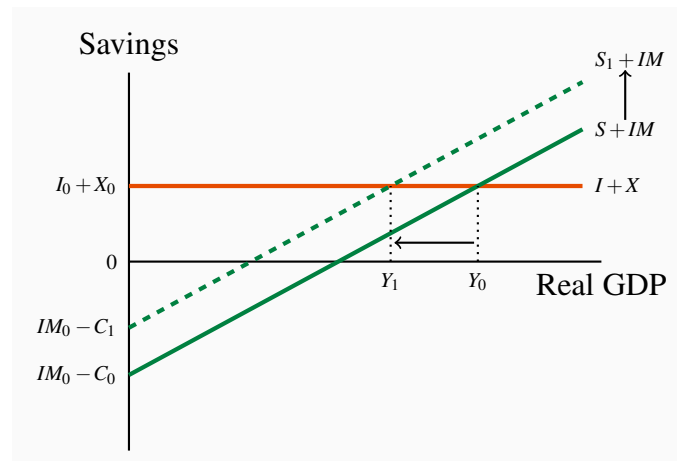


Figure 6.11: Equilibrium when Planned Leakages Equal Planned Injections

At equilibrium Y_0 planned saving plus imports equal planned investment plus exports. An increase in saving to S_1 lowers equilibrium Y to Y_1 .

This equilibrium condition also reveals the **paradox of thrift** whereby an attempt to increase aggregate saving in the economy results in a lower equilibrium GDP but unchanged aggregate saving. In Figure 6.11 the increase in the rate of saving (S/Y) shifts the $S + M$ up to $S_1 + IM$. This increase in leakages lowers aggregate expenditure at Y_0 and output falls to Y_1 . The paradox is that the attempt to increase savings causes a decrease in national income and leaves leakages $S + IM$ unchanged. $S_1 + IM$ at Y_1 equals $S + IM$ at Y_0 .

Paradox of thrift: attempts to increase aggregate national saving cause changes in equilibrium GDP that leave saving unchanged.

Interest in this paradox has returned following the financial crisis and recession of 2008-09 as households in many countries tried to reduce their debt loads by raising the saving rate. Aggregate expenditure was further reduced by reduced consumption expenditures, adding to the recession. As we will see in Chapter 7 the paradox can also frustrate government attempts to eliminate budget deficits by austerity programs when economies are in recession.

6.6 Equilibrium output and the AD curve

In Chapter 5 and at the beginning of this chapter, we used an Aggregate Demand and Aggregate Supply model to explain business cycle fluctuations in real GDP and employment. In this chapter we have developed a basic explanation for the *shifts in AD* that cause changes in real output. In the short run:

- wages, prices, money supply, interest rates and exchange rates are assumed to be constant;
- distinction between autonomous and induced expenditures is important; and
- equilibrium real GDP requires output equal to planned aggregate expenditure.

In this model, investment and exports are the main sources of fluctuations in autonomous expenditures. The marginal propensities to consume and import describe the changes in aggregate expenditure caused by changes in income. These induced expenditures are the source of the multiplier. When business changes its investment plans in response to predictions and expectations about future markets and profits, or exports change in response to international trade conditions, the multiplier translates these changes autonomous expenditure into shifts in the AD curve. Shifts in the AD curve cause changes in equilibrium output and employment.

Figure 6.12 shows how this works. Equilibrium real GDP in the upper panel determines the position of the AD curve in the lower panel.

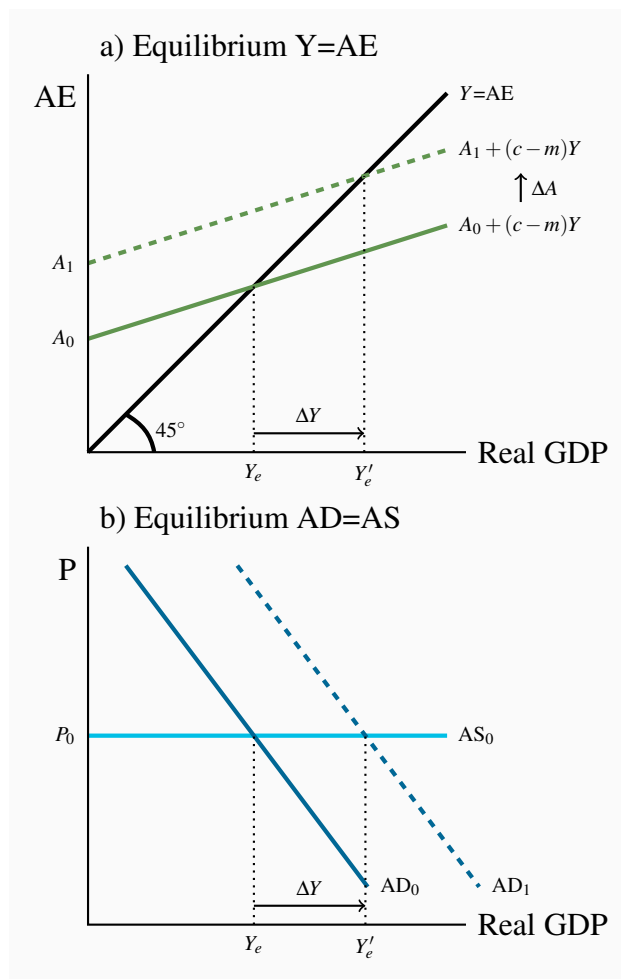


Figure 6.12: Equilibrium GDP and Aggregate Demand

Equilibrium in a) determined the *position* of the AD curve in b). A *change in autonomous expenditure* in a) changes equilibrium Y and *shifts AD* by the change in autonomous expenditure times the multiplier.

Initially, equilibrium real GDP at the price level P_0 is determined by the equilibrium condition $Y_0 = A_0 + (c - m)Y$ in the upper panel and by the equilibrium condition $AD_0 = AS_0$ in the lower panel.

Changes in autonomous expenditure shift the AD curve. If autonomous expenditure increased from A_0 to A_1 as shown in Panel a), equilibrium output would increase from Y_0 to Y'_e . The change in equilibrium output would be $(\Delta A \times \text{multiplier})$. The AD curve would shift to the right to AD_1 as a result of the increase in autonomous expenditure. The size of the horizontal shift would be $(\Delta A \times \text{multiplier})$.

This model provides an important first insight into the sources of business cycles in the economy. However, it is a pure private household/private business sector economy. Autonomous consump-

tion, investment, exports and imports, and the multiplier drive real GDP and income and fluctuations in those measures of economic activity. There is no government, and thus no way for government policy to affect real output and employment. There is no financial sector to explain the interest rates and foreign exchange rates that affect expenditure decisions, and thus no monetary policy. In the next few chapters we extend our discussion of aggregate expenditure and aggregate demand to include the government sector and financial sectors, as well as fiscal and monetary policy. The framework becomes a bit more complicated and realistic, but the basic mechanics are still those we have developed in this chapter.

KEY CONCEPTS

Aggregate demand determines real output and national income in the short run when prices are constant.

Equilibrium between **aggregate expenditure (AE)** and output determines aggregate demand.

Aggregate expenditure (AE) is planned spending on goods and services. The AE function $AE = C + I + X - IM$ shows aggregate expenditure at each level of income and output.

This chapter assumes an economy without a government sector. It concentrates on the **consumption expenditure (C)** by households, the **investment expenditure (I)** by business (planned additions to plant, equipment, and inventories), **exports** of goods and service to foreign countries (X), and **imports** of goods and services from those countries (IM). We assume wages, prices, interest rates, and exchange rates are constant.

Consumption expenditure is closely though not perfectly related to **disposable income**. Without a government sector, there are no taxes or transfer payments. Disposable income is equal to national income.

Autonomous consumption expenditure is planned consumption, even at zero income. The **marginal propensity to consume** is the change in planned consumption expenditure caused by a change in income ($MPC = \Delta C / \Delta Y$). The MPC is positive but less than unity.

The **marginal propensity to save** is the change in planned saving caused by a change in income ($MPS = \Delta S / \Delta Y$). Since income must be either spent or saved, $MPC + MPS = 1$.

Investment and exports are **autonomous expenditures**. Business's plans to add to their factories, machinery, and inventories lead to investment expenditure. Demand from residents of other countries for domestic goods and services lead to exports.

Imports are that part of consumption, investment, and exports supplied by goods and services produced in other countries. A change in national income causes a change in imports according to the **marginal propensity to import**, ($MPM = \Delta IM / \Delta Y$).

For given prices and wages, the economy is in **equilibrium** when output equals planned spending or aggregate expenditure ($Y = AE$). Equivalently, the economy is in equilibrium when leakages equal injections ($S + IM = I + X$).

Equilibrium output and income does not mean that output equals potential output. Equilibrium output might be either lower or higher than potential output.

Because we assume that prices and wages are fixed, **equilibrium output is determined by aggregate expenditure and aggregate demand**. Firms and workers supply the output and labour services that are demanded.

Adjustment to equilibrium is a response to unplanned changes in inventories. When aggregate expenditure exceeds actual output, there is an **unplanned fall in inventories**. Unplanned decreases in inventory are a signal to producers to increase output. Similarly, **unplanned increases in inventories** mean output is greater than aggregate expenditure. Producers will reduce output.

Starting from an equilibrium income, an **increase in autonomous expenditure** causes an increase in output and income. The initial increase in income to meet the increased autonomous expenditure leads to further increases in consumption expenditure through the *MPC*, and imports through the *MPM*.

The multiplier determines the change in equilibrium income caused by a change in autonomous expenditure (multiplier = $\Delta Y/\Delta A$). In the model of this chapter, the multiplier is determined by the *MPC* and the *MPM*. The multiplier = $1/(1 + MPC + MPM)$ = $1/(1 - \text{slope of AE})$. The multiplier is greater than 1 because the *MPC* and *MPM* are positive fractions and the *MPC* is larger than the *MPM*.

The **equilibrium output** determined by the equality of aggregate expenditure and output determines the **position of the AD** curve in the AD/AS model. Changes in equilibrium output caused by **changes in autonomous expenditure and the multiplier shift the AD curve** horizontally, changing the equilibrium level of output and employment.

Business cycle fluctuations in output and employment are caused by fluctuations in autonomous expenditure magnified by the multiplier.

EXERCISES FOR CHAPTER 6

Exercise 6.1. Suppose that in an economy with no government the consumption function is: $C = 50 + 0.75Y$.

- Draw a diagram showing the consumption function, and indicate the level of consumption expenditure when income is 150.
- In this same diagram, show what would happen to consumption expenditure if income increased to 200.
- Write the equation for the saving function and draw the saving function in a diagram.
- In this diagram show what would happen to savings if income increased from 200 to 250.

Exercise 6.2. (a) Suppose the media predicts a deep and persistent economic recession. Households expect their future income and employment prospects to fall. They cut back on expenditure, reducing autonomous expenditure from 50 to 30. Re-draw the consumption and saving functions you have drawn in your diagrams for Exercise 6.1 to show the effects, if any, of this change in household behaviour.

- Suppose households also reduce the amount by which they are willing to spend out of any increase in income. In a diagram show the effect would this have on the consumption and savings functions you have drawn?

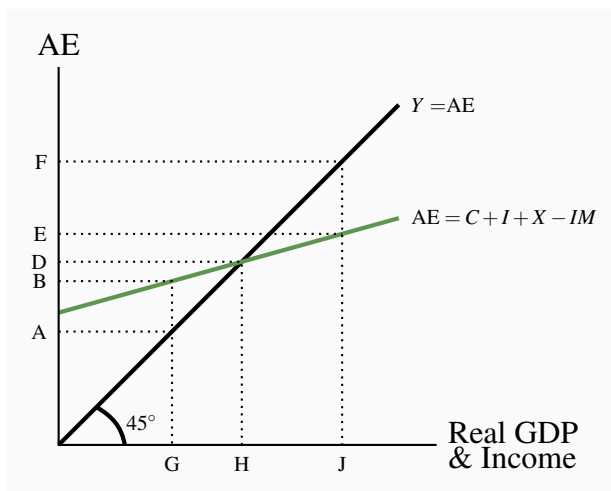
Exercise 6.3. The consumption function is $C = 50 + 0.75Y$ and investment is $I = 50$, exports are $X = 25$ and the import function is $IM = 20 + 0.25Y$.

- Write the equation for the aggregate expenditure function for this economy?
- Draw a diagram showing the aggregate expenditure function AE. What is the intercept of this function on the vertical axis?
- What is the slope of the AE function, and what does the slope measure?

Exercise 6.4. Output and income are in equilibrium when planned expenditures $C + I + X - IM$ are equal to national income, in other words, meaning $Y = AE$.

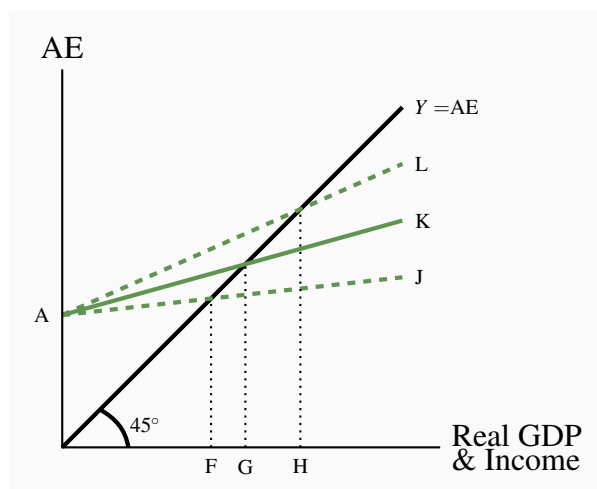
- Suppose the consumption function is $C = 100 + 0.8Y$, investment is 25, exports are 30 and imports are $IM = 10 + 0.05Y$. Draw a diagram showing the aggregate expenditure function.
- In your diagram draw the 45° line that shows all points at which national income and aggregate expenditures are equal ($Y = AE$).
- Using your diagram, or a numerical example, or an algebraic solution, find equilibrium output and income in this example and show it in the diagram.

Exercise 6.5. The diagram below shows the aggregate expenditure schedule for the economy and the equilibrium condition on the 45° line.



- Suppose output is OG . What is the level of planned aggregate expenditure? Is planned expenditure greater or less than output?
- What is the size of the unplanned change in inventories at output OG ?
- How will business firms respond to this situation?
- What is the equilibrium income and expenditure?
- Suppose output is at OJ : What is there an unplanned change in inventories?

Exercise 6.6. The following diagram shows an economy that initially has an aggregate expenditure function AK .



- (a) What is the initial equilibrium real GDP?
- (b) Suppose there is an increase in the marginal propensity to import. What is the new aggregate expenditure function?
- (c) What is the new equilibrium real GDP and income?
- (d) Suppose, instead, the marginal propensity to consume has increased. What is the new aggregate expenditure function? What is the new equilibrium real GDP and income?

Exercise 6.7. The distinction between autonomous and induced expenditure is important for the determination of equilibrium real GDP. Assume that the marginal propensity to consume is 0.80, the marginal propensity to import is 0.10 and autonomous aggregate expenditure is zero.

- (a) What is the equation for the aggregate expenditure function under these assumptions?
- (b) Draw the aggregate expenditure function in an income-expenditure 45° line diagram.
- (c) What is the equilibrium level of real GDP illustrated by your diagram?
- (d) Explain why this is the equilibrium level of real GDP.

Exercise 6.8. Suppose the marginal propensities to consume and import are 0.75 and 0.25. Starting from equilibrium, suppose planned investment increases by 10.

- (a) By how much and in what direction does equilibrium income change?
- (b) How much of that change in equilibrium income is the result of the change in consumption expenditure?
- (c) How would your answers to (b) differ if the marginal propensity to consume were 0.85 rather than 0.75?

Exercise 6.9. Research by a team of expert economists has uncovered the consumption and import functions and produced a forecast of planned investment and exports for the economy of Wonderland as reported below.

Real GDP	Consumption	Investment	Exports	Imports
Y	C	I	X	IM
0	100	100	75	25
800	920	100	75	145
900	1010	100	75	160
1000	1100	100	75	175
1100	1190	100	75	190
1200	1280	100	75	205

- What equilibrium real GDP would Wonderland produce?
- What are the marginal propensities to consume and import in Wonderland?
- What is the size of the multiplier?
- If actual GDP were 900, what difference between planned and actual investment would result? Why?
- If planned investment increased by 50 to 100, what would happen to equilibrium income?

Exercise 6.10. Planned investment is 100, exports are 50 and saving is $S = -25 + 0.2Y$ and imports are $IM = 25 + 0.3Y$.

- Draw a diagram showing the initial equilibrium level of income.
- Now households decide to increase their saving at every level of income, but do not change their marginal propensity to save. Using the diagram show what happens to equilibrium income and to household saving?

Exercise 6.11. Suppose there is no autonomous expenditure in the economy. The aggregate expenditure function is $AE = 0.75Y$.

- Draw the aggregate expenditure function and the 45° line in a diagram.
- What is the equilibrium level of real output and income?
- How would you explain your answer to part b).

Chapter 7

The government sector

In this chapter we will explore:

- 7.1 Government in Canada
- 7.2 Government expenditures, taxes, and equilibrium real GDP
- 7.3 The government's budget and budget balance
- 7.4 Fiscal policy and government budgets
- 7.5 Automatic and discretionary fiscal policy
- 7.6 The public debt and the budget balance
- 7.7 Aggregate demand and equilibrium GDP

Canadian governments directly buy about 25 percent of GDP according to the national accounts data in Table 4.5. They also spend about 17 percent on transfer payments to persons and business (old age security, childcare allowances and subsidies) including interest payments to holders of government bonds. Governments in most industrial economies make purchases on about the same scale. Government spending is financed mainly by taxes and, when governments run budget deficits, by borrowing through bond sales. In this chapter, we extend our model to include the government sector.

The government sector adds an important new dimension to our model, namely fiscal policy. A government can use its taxing and spending powers to provide public services. But it can also structure and manage its budget to stabilize aggregate demand and reduce business cycle fluctuations in real GDP and employment.

In late 2008 and early 2009 strong recessionary conditions led to an international call for fiscal stimulus. Many countries, including Canada, introduced substantial increases in government expenditures and reductions in tax rates to offset broad-based declines in aggregate demand. This was an important revival of fiscal policy.

However, over time, governments must also manage their budgets in ways that control the size of their debt relative to GDP. Until very recently, Canadian governments have been more concerned about government budget surpluses, deficits, and debt than about demand management when designing fiscal policy.

To explain the role of government in macroeconomic analysis and policy, we start with a brief look at the data on the size of the government sector in Canada.

7.1 Government in Canada

The total government sector in Canada includes the federal, provincial, and municipal governments, as well as hospitals. Table 7.1 shows total outlays by the government sector in 2012. These totaled \$738 billion. Of this total, 31 percent was expenditure on government employees and 22.4 percent for the goods and services that provided government services to Canadians. The remaining 46.6 percent was transfer payments to persons, business, and non-residents, and interest paid on the outstanding public debt.

Total Expense	Compensation employees	Use of Goods & Services	Consumption of Fixed Capital	Subsidies & Grants	Social Benefits	Interest
(\$ millions)	%	%	%	%	%	%
738	31.0	22.4	8.3	10.5	19.5	8.3

Table 7.1: Total government expense in Canada, 2012

Source: Department of Finance, Fiscal Reference Tables 2012, Table 34.

Table 7.2 makes a comparison of the sizes of the government sectors relative to GDP in the G7 group of industrial countries (Canada, the United States, Japan, the United Kingdom, Germany, France, and Italy) in 2007 and 2013. These data illustrate two aspects of recent government budget activity that are of particular interest. The first is the size of the government sector in each country as measured by revenue, expenditure, budget balance and net public debt, all reported as a percent of GDP. The second is the change in government sector finances from 2007 to 2013, the period of the financial crisis, recession and prolonged recovery.

	Total Revenues		Total Outlays		Budget Balance		Net Public Debt	
	% GDP		% GDP		% GDP		% GDP	
	2007	2013	2007	2013	2007	2013	2007	2013
Canada	40.1	38.1	38.6	41.1	1.5	−3.0	27.0	40.4
United States	33.4	33.8	37.1	39.0	−3.7	−5.2	44.3	81.2
Japan	33.7	41.2	35.8	43.1	−2.1	−1.9	80.5	137.5
United Kingdom	40.5	40.6	43.4	47.1	−2.9	−6.5	26.2	65.4
Germany	43.7	44.6	43.5	44.6	0.2	0.0	42.6	49.7
France	49.8	52.8	52.6	57.0	−2.8	−4.2	35.7	73.6
Italy	46.0	47.7	47.6	50.6	−1.6	−2.9	90.8	116.5
G7 Average	37.3	37.3	39.9	42.9	−2.6	−5.6	49.7	84.3

Table 7.2: The general government sector in G7 countries: 2007-2013

Source: Canada: Department of Finance, Fiscal Reference Tables 2014, Tables 51-54.

On the first point the 2007 data show expenditures by Canada's government sector—the combined federal, provincial, and local governments—on goods, services, and transfers were just under 40 percent of GDP. This is about average for the G7 countries, although you will notice that some spend quite a bit more and others less than this average. The differences reflect national political choices about the role the government sector plays in the economy.

In 2007, Canada and Germany differed from other G7 countries in terms of their government sector budget balances. Both operated with a budget surplus (revenues were greater than expenditures), while the other countries had budget deficits. Canada's budget surplus was the latest in a series of annual government-sector budget surpluses over the period from 1997 to 2007. These budget surpluses reduced the outstanding public debt and reduced Canada's ratio of net public debt to GDP to the lowest in the G7.

The shift in fiscal conditions in the G7 from 2007 to 2013 was dramatic. The recession that followed the financial crisis of 2008 reduced employment, incomes and government revenues in all countries. At the same time governments increased expenditures to stimulate demand and provided financial bailouts support in some cases to banks to limit the impact of the financial crisis on bank balance sheets. In combination, these fiscal policy actions increased government outlays by about 5 percent of GDP on average, pushed budget deficits up to 8.6 percent and, combined with slow growth in GDP, raised the average net public debt ratio more than 20 percentage points.

The government debt crisis that followed in several countries has dominated European economic conditions and policy debates and remained unsolved in 2014.

7.2 Government expenditure, taxes, and equilibrium real GDP

Since it is time-consuming to keep distinguishing between market prices and basic prices as we did in Chapter 4, we will assume that all taxes are direct taxes. With no indirect taxes, measurement at market prices and basic prices coincide. We continue to assume fixed wages, prices, interest rates and exchange rates.

Aggregate expenditure AE is now consumption expenditure (C), investment expenditure (I), and **government expenditure** (G) on goods and services, including the public services provided to households and business at zero price, valued at cost, exports (X) minus imports (IM). Direct taxes and transfer payments do not enter directly into aggregate expenditure. Thus we have:

$$AE = C + I + G + X - IM \quad (7.1)$$

Government expenditure (G): government spending on currently produced goods and services.

In the short run, government expenditure (G) does not vary automatically with output and income. We assume G is fixed, or at least autonomous and independent of income. It reflects government policy decisions on how many hospitals to build, how many teachers to hire, and how large the armed forces should be. This means we now have five autonomous components of aggregate expenditure independent of current output and income: the autonomous consumption expenditure (C_0), investment expenditure (I), exports (X), autonomous imports (IM_0), and government expenditure (G).

We illustrate autonomous government expenditure in the same way we did with other autonomous expenditures, using a simple equation. For a specific level of government expenditure:

$$G = G_0 \quad (7.2)$$

In a diagram with income on the horizontal axis and government expenditure on the vertical axis, we would draw a horizontal line intersecting the vertical axis at G_0 . Any change in government expenditure would shift this line up or down in a parallel way.

The government also levies taxes and pays out transfer payments. The difference between taxes

collected and transfers paid is **net taxes** (NT), the net revenue collected by government from households.

Net taxes: taxes on incomes minus transfer payments.

With no indirect taxes, net taxes (NT) are simply direct taxes T_d minus transfer payments T_r . Net taxes reduce disposable income—the amount available to households for spending or saving—relative to national income. Thus, if t is the *net tax rate*, the total revenue from net taxes is:

$$NT = tY \quad (7.3)$$

For simplicity, we assume that net taxes are proportional to national income. If **YD is disposable income**, Y national income and output, and NT net taxes,

$$YD = Y - NT = Y - tY = (1 - t)Y \quad (7.4)$$

Disposable income (YD): national income minus net taxes.

Suppose taxes net of transfers are about 15 percent of national income. We can think of the net tax rate as 0.15. If national income Y increases by \$1, net tax revenue will increase by \$0.15, so household disposable income will increase by only \$0.85.

Household planned consumption expenditure is still determined largely by household disposable income. For simplicity, suppose, as before, the marginal propensity to consume out of disposable income is 0.8. The consumption function is as before:

$$C = 20 + 0.8YD$$

With a net tax rate t , Equation 7.4 says disposable income is only $(1 - t)$ times national income. Thus, to relate consumption expenditure to *national income*:

$$C = 20 + 0.8(1 - t)Y$$

A change in national income of \$1 changes consumption expenditure by only 0.8 times $(1 - t)$ of a dollar. If the net tax rate is 0.15, consumption expenditure changes by only $\$1 \times (0.8 \times$

0.85) = \$0.68. Each extra dollar of national income increases disposable income by \$0.85, out of which households plan to spend 68 cents and save 17 cents. A numerical example and Figure 7.1 illustrate.

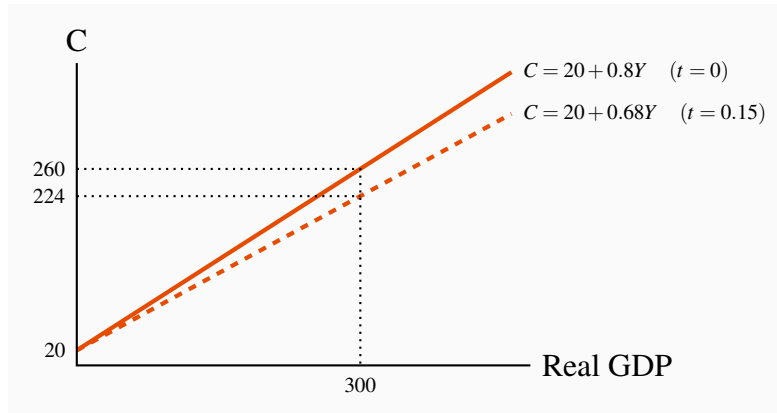


Figure 7.1: Net Taxes and Consumption

The net tax rate reduces disposable income relative to national income. The marginal propensity to consume relative to national income falls, lowering the slope of the C function from 0.8 to 0.68.

<p>a) $C = 20 + 0.8YD$ $NT = 0$ $YD = Y$</p>	<p>b) $C = 20 + 0.8YD$ $NT = 0.15Y$ $YD = (1 - 0.15)Y$ $C = 20 + 0.8(1 - 0.15)Y$</p>																																								
<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> <td style="width: 15%;">Y</td> <td style="width: 10%;">NT</td> <td style="width: 15%;">YD</td> <td style="width: 10%;">C_1</td> </tr> <tr> <td>a)</td> <td>100</td> <td>0</td> <td>100</td> <td>100</td> </tr> <tr> <td></td> <td>300</td> <td>0</td> <td>300</td> <td>260</td> </tr> <tr> <td></td> <td>500</td> <td>0</td> <td>500</td> <td>420</td> </tr> </table>		Y	NT	YD	C_1	a)	100	0	100	100		300	0	300	260		500	0	500	420	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> <td style="width: 15%;">Y</td> <td style="width: 10%;">NT</td> <td style="width: 15%;">YD</td> <td style="width: 10%;">C_2</td> </tr> <tr> <td>b)</td> <td>100</td> <td>15</td> <td>85</td> <td>88</td> </tr> <tr> <td></td> <td>300</td> <td>45</td> <td>255</td> <td>224</td> </tr> <tr> <td></td> <td>500</td> <td>75</td> <td>425</td> <td>360</td> </tr> </table>		Y	NT	YD	C_2	b)	100	15	85	88		300	45	255	224		500	75	425	360
	Y	NT	YD	C_1																																					
a)	100	0	100	100																																					
	300	0	300	260																																					
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	Y	NT	YD	C_2																																					
b)	100	15	85	88																																					
	300	45	255	224																																					
	500	75	425	360																																					

Example Box 7.1: A numerical example

In the absence of taxation, in example (a), national income Y and disposable income YD are the same. The consumption function C_1 shows how much households wish to consume at each level of national income, based on the numerical example.

With a proportional net tax rate of 0.15, households still consume \$0.80 of each dollar of disposable income. Since as example (b) shows YD is now only 0.85 of Y , households consume only $0.8 \times 0.85 = 0.68$ of each extra dollar of national income, the effect of net taxes is to rotate the consumption function from C_1 to C_2 as in Figure 7.1. The slope of the consumption function is reduced.

A comparison of the numbers in examples (a) and (b) shows the effect of the tax rate at each income level. These numerical effects are also shown in the Figure 7.1.

Clearly, spending \$0.68 of each extra dollar of national income implies a flatter consumption function, when plotted against national income, than spending \$0.80 of each extra dollar of national income. The marginal tax rate t lowers disposable income at every level of national income and as a result lowers *induced* consumption expenditure. In a diagram the net tax rate *lowers the slope of the expenditure function*.

Aggregate expenditure and equilibrium output do not depend on whether the leakage is through saving (as when the MPC is low) or through imports or through taxes (as when the MPC multiplied by $(1 - t)$ is low). Either way, the leakage prevents income from being recycled as expenditure on the output of producers.

If MPC is the marginal propensity to consume out of disposable income, and there is a proportional tax rate t , then the slope of the consumption function, the *marginal propensity to consume out of national income*, is given by:

$$\frac{\Delta C}{\Delta Y} = MPC \times (1 - t) = c(1 - t) \quad (7.5)$$

Government taxes and expenditure affect equilibrium national income and output and the position of the AD curve. To show this we start with an example in which investment expenditure is I_0 , exports are X_0 , imports are $IM_0 + mY$ and the consumption function in terms of disposable income is $C = C_0 + cYD$.

With the addition of government expenditure and taxes, aggregate expenditure equilibrium real GDP still determines *equilibrium real GDP*. The aggregate expenditure equation is:

$$AE = C + I + G + X - IM$$

Equilibrium real GDP is:

$$Y = C + I + G + X - IM \quad (7.6)$$

Then $Y = C_0 + c(1 - t)Y + I_0 + G_0 + X_0 - IM_0 - mY$, and

$$Y = \frac{C_0 + I_0 + G_0 + X_0 - IM_0}{1 - c(1 - t) + m}$$

As before, equilibrium real GDP equals autonomous aggregate expenditure multiplied by the multiplier. With government added there is a new autonomous expenditure component G_0 and a new factor $(1 - t)$ in the multiplier, which lowers the slope of the AE function and the size of the multiplier. Table 7.3 illustrates.

The effects of both government expenditure and taxation

Suppose the economy begins with no government and equilibrium output of 200. Assume autonomous consumption, investment and exports minus imports combined are $(20 + 20 + 50 - 10) = 80$. With a marginal propensity to consume out of disposable income of 0.80 and marginal propensity to import of 0.20, aggregate expenditure is $(80 \times \text{multiplier}) = 80/[1 - (0.8 - 0.2)] = 80 \times 2.5 = 200$, which is equal to output. Panel a) of Table 7.3 shows this equilibrium.

a) Equilibrium with no net taxes ($NT = 0$)						
$Y = C + I + X - IM$						
$C = 20 + 0.8Y$						
$I = 20$						
$X = 50$						
$IM = 10 + 0.2Y$						
Y	C	I	X	IM	AE	
100	100	20	50	30	140	
150	140	20	50	40	170	
200	180	20	50	50	200	
250	220	20	50	60	230	

b) Equilibrium with net taxes at 12.5% ($t = 0.125$)							
$Y = C + I + X - IM$							
$C = 20 + 0.8(1 - 0.125)Y$							
$I = 20$							
$X = 50$							
$IM = 10 + 0.2Y$							
$NT = 0.125Y$							
Y	NT	YD	C	I	X	IM	AE
120	15	105	104	20	50	34	140
140	17.5	122.5	118	20	50	38	150
160	20	140	132	20	50	42	160
180	22.5	157.5	146	20	50	46	170

Table 7.3: The effects of net taxes on equilibrium GDP

a) This panel begins the illustration with an economy that does not have a government sector. Autonomous expenditure of 80 and the multiplier of 2.5 gives equilibrium income $Y_e = 200$.

b) This panel adds a government sector that imposes a net tax rate of 12.5% giving $t = 0.125$. Autonomous expenditure is still 80 but the net tax rate lowers the slope of AE from 0.6 to 0.5, lowers the multiplier from 2.5 to 2.0. The new equilibrium income is $Y'_e = 160$.

Raising the net tax rate reduces equilibrium output because it reduces consumption expenditure, lowers the slope of the AE function and reduces the size of the multiplier. You will recall from Chapter 6 that the multiplier comes from the induced expenditure that is driven by autonomous expenditure. In the absence of net taxes, disposable income and national income are the same. Then the MPC is the change in consumption caused by a change in national income, slope of the AE function is $MPC - MPM = c - m$, and the multiplier is $1/(1 - (c - m)) = 1/(1 - \text{slope of AE})$. A net tax rate $t > 0$, or a change, $\Delta t > 0$, reduces disposable income relative to national income, lowers the slope of the consumption function to $c(1 - t) - m$, lowers the slope of AE, lowers the multiplier, lowers equilibrium output, and lowers aggregate demand. A cut in t , $\Delta t < 0$, has the opposite effect.

Now introduce new autonomous expenditure $G = 25$ from the government, taking total autonomous expenditure to 105. Also introduce a net tax rate $t = 0.125$. The marginal propensity to consume out of national income (MPC) falls from 0.8 to 0.7, $(0.8 \times (1 - 0.125))$, and the multiplier falls from 2.5 to $1/(1 - (0.70 - 0.20)) = 1/0.5 = 2.0$. Multiplying autonomous expenditure of 105 by 2.0 gives equilibrium output of 210, higher than the original equilibrium output of 200. Panel b) in Table 7.4 and Panel b) of Figure 7.2 illustrate this result.

a) Equilibrium with no government ($G = 0$) and no net taxes ($NT = 0$)						
$Y = C + I + X - IM$						
$C = 20 + 0.8Y$						
$I = 20$						
$X = 50$						
$IM = 10 + 0.2Y$						
Y	C	I	X	IM	AE	
100	100	20	50	30	140	
150	140	20	50	40	170	
200	180	20	50	50	200	

b) Equilibrium with government ($G = 25$) and net taxes ($NT = 0.125Y$)								
$Y = C + I + G + X - IM$								
$C = 20 + 0.8(1 - 0.125)Y$								
$I = 20$								
$G = 25$								
$X = 50$								
$IM = 10 + 0.2Y$								
$NT = 0.125Y$								
Y	NT	YD	C	I	G	X	IM	AE
190	23.75	166.25	153	20	25	50	48	200
200	25	175	160	20	25	50	50	205
210	26.25	183.75	167	20	25	50	52	210
220	27.5	192.5	174	20	25	50	54	215

Table 7.4: The effects of government expenditure & taxes on equilibrium GDP

a) This panel begins with equilibrium in an economy without taxes of government expenditure. Autonomous expenditure is 80, the multiplier is 2.5 and equilibrium GDP is $Y = 200$.

b) This panel introduces government expenditure of $G = 25$ and net tax revenue $NT = 0.125Y$. Government expenditure increases autonomous expenditure to 105 while net taxes reduce induced expenditure and the multiplier to 2.0. Equilibrium GDP is $Y = 210$. This combination of increased government expenditure and taxes has a small positive effect on equilibrium.

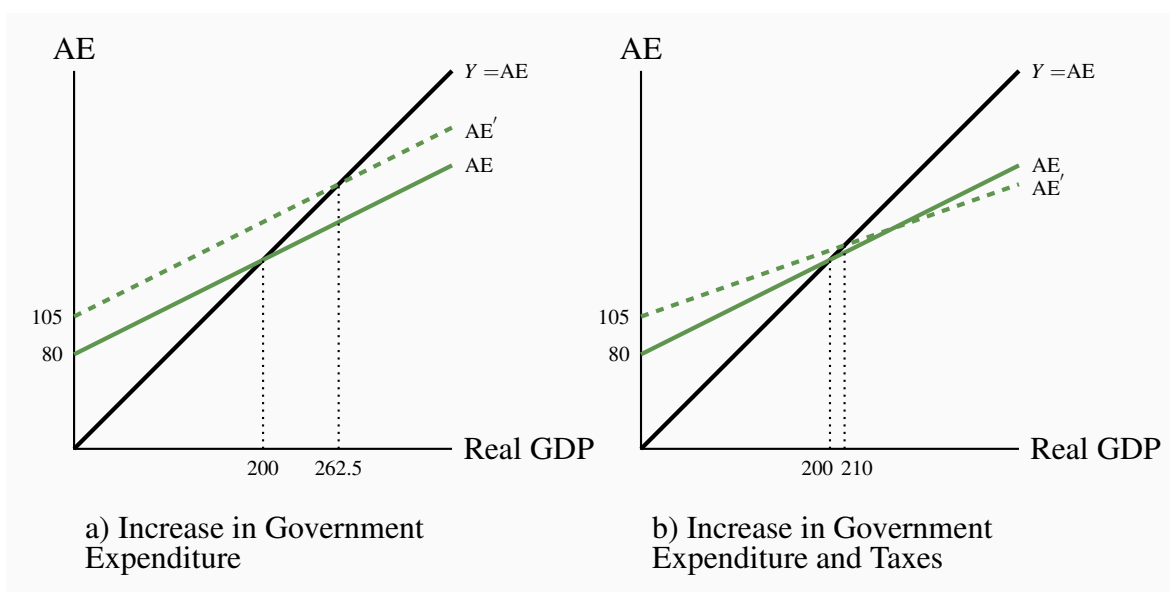


Figure 7.2: Government Expenditure, Taxes, and Equilibrium Real GDP

- a) An increase in G of 25 with a multiplier of 2.5 increases equilibrium GDP by 62.5.
- b) An increase in G of 25 and a tax rate of $g = 0.125$ increase equilibrium GDP by 10. The tax rate reduced the multiplier from 2.5 to 2.0.

The multiplier revisited

The multiplier relates changes in equilibrium national income to the changes in autonomous expenditures that cause them. The formula in Chapter 6 still applies.

$$\text{The multiplier} = \frac{1}{1 - \text{slope of AE}}$$

Without government and taxes, disposable income and national income are the same and when the marginal propensity to import is included and the multiplier is:

$$\frac{\Delta Y}{\Delta A} = \frac{1}{1 - MPC + MPM} = \frac{1}{1 - c + m}$$

With government and taxes proportional to income, the *slope of the AE function* is reduced.

$$\frac{\Delta AE}{\Delta Y} = c(1 - t) - m$$

The multiplier is smaller as a result, namely:

$$\frac{\Delta Y}{\Delta A} = \frac{1}{1 - c(1 - t) + m}$$

Table 7.4 provides numerical examples of these multipliers.

Now that we have seen that government expenditure and net tax taxes have effects on aggregate expenditure and equilibrium income, it is time to examine the effects of government budgets on AE, AD, and real GDP. The government implements fiscal policy through its budget.

7.3 The government's budget and budget balance

A budget is the revenue and spending plan of an individual, a company, or a government. The **government budget** describes what goods and services the government will buy during the coming year, what transfer payments it will make, and how it will pay for them. Most spending is financed by taxes, but some revenue comes from charges for services. When revenues and spending are equal, the budget is balanced. When revenues exceed spending, there is a budget surplus. When revenues fall short of spending, there is a budget deficit, which is financed by borrowing through the sale of government bonds.

Government budget: planned government spending and revenue.

Continuing to use G for government expenditure on goods and services, and NT for net tax revenue or taxes minus transfer payments (ignoring other sources of revenue, for simplicity),

$$\text{Government budget balance } (BB) = NT - G$$

$$BB = tY - G \tag{7.7}$$

The government budget balance is the difference between revenues and expenditures. Figure 7.4 shows government purchases G and net tax revenue $NT = tY$ in relation to real GDP and income.

As a numerical example assume G is fixed at $G = 200$. Also assume a net tax rate of $t = 0.20$, net tax revenue is $NT = 0.2Y$. The tax function has a positive slope. Taxes are zero when income is zero, 100 when income is 500, and 200 when income is 1000. At incomes and outputs below

1000, NT is less than G and the budget balance is a deficit, $BB < 0$. At income and output of 1000, it is balanced, $BB = 0$. At any output and income above 1000, the budget balance shows a surplus, $BB > 0$. Thus, for any fiscal plan like the *fiscal plan* that sets $G = 200$ and $t = 0.20$, the budget balance depends on the level of output and income.

The budget balance, whether deficit, surplus or zero, is determined by three things:

1. the *net tax rate* t set by the government;
2. the level of *expenditure* G set by the government; and
3. the level of *output* Y determined by AE and AD.

We can summarize the relationship between national income and the government's budget balance in a way we will find useful for discussing fiscal policy. Table 7.4 shows the numbers in more detail, and Figures 7.3 and 7.4 show the budget and the **the budget function** that gives the budget balance for this fiscal program at different incomes.

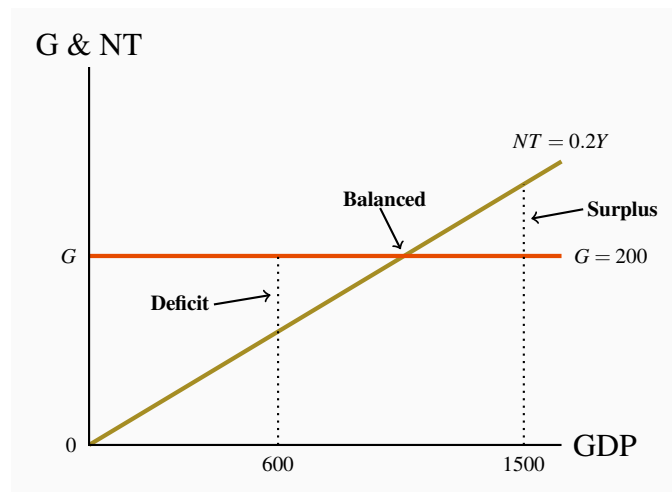


Figure 7.3: A Government Budget

The government's budget plan sets $G = 200$ and $t = 0.2Y$. The budget balance is determined by the level of GDP.

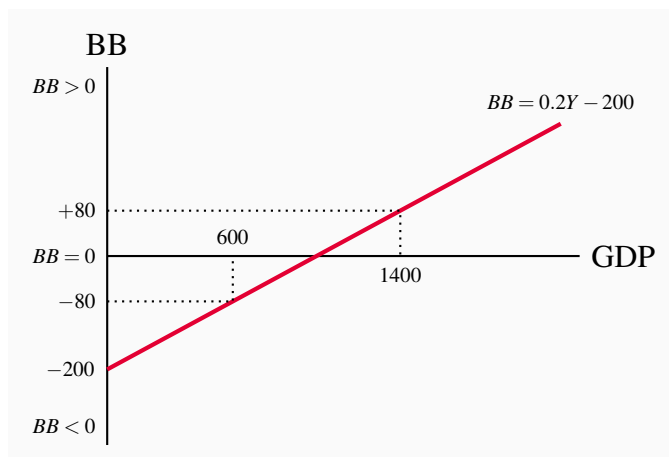


Figure 7.4: The Government Budget Function

Budget function positioned by $G = 200$ with a slope $NT = 0.2Y$. The budget balance is determined by the level of GDP.

The Minister of Finance sets the fiscal program by setting the net tax rate and level of planned government expenditure in a budget statement presented to parliament. A budget function shows us the different budget balances for one fiscal policy program at different levels of national income.

Once that fiscal program is set, the budget function is set, but the budget balance is not. The budget balance depends on the performance of the economy in terms of national income. In presenting the budget, the minister gives a forecast of the budget balance based on a forecast of national income. If the income forecast is wrong, the budget program will result in either a larger or smaller budget balance than initially predicted.

For many years before the financial crisis of 2008 and the recession that followed the Canadian federal government ran budget surpluses that frequently exceeded predictions, while many provincial government budget deficits were smaller than predicted. Economic growth during those years was stronger than forecast when the budgets were designed. Clearly the difficulties in making accurate income forecasts have important effects on the actual government budget balances.

The recession of 2009 led to a shift in the federal government budget to provide fiscal stimulus through increased government expenditure and tax incentives. This 'Action Plan' involved a current budget deficit along with a plan to eliminate that deficit over a period of years in the future. Forecasts for growth in real GDP were a key part of the deficit elimination plan. As of mid-2014, economic growth slightly stronger than predicted has helped to cut the deficit slightly faster than planned.

Finally, notice that because a budget function describes one fiscal plan, any change in the fiscal plan will change the BB line to show a new budget function.

7.4 Fiscal policy & government budget balances

Fiscal policy is the government's use of its taxing and spending powers to affect aggregate expenditure and equilibrium real GDP. The main objective of fiscal policy is to stabilize output by managing aggregate demand, keeping output close to potential output, and reducing the size and duration of business cycle fluctuations. This requires changes in the government's expenditure plans and tax policy to offset changes in autonomous consumption, investment and exports that would otherwise push the economy away from equilibrium at potential output.

In 2008 and 2009, for example, the international financial crises and the recession that followed led to fiscal stimulus programs in most industrial countries, like Canada's federal '*Economic Action Plan*', and calls for international coordination of fiscal stimulus. This fiscal stimulus led in turn to increased budget deficits and national debts and, especially in Europe, to sovereign debt crises. We return to this important issue in Section 7.7.

Fiscal policy: government use of taxes and spending to affect equilibrium GDP.

Figure 7.5 illustrates the use of fiscal policy to eliminate output gaps. In the diagram on the left, the economy has a recessionary gap at $Y_0 < Y_P$ because aggregate expenditure is not high enough to give equilibrium at Y_P .

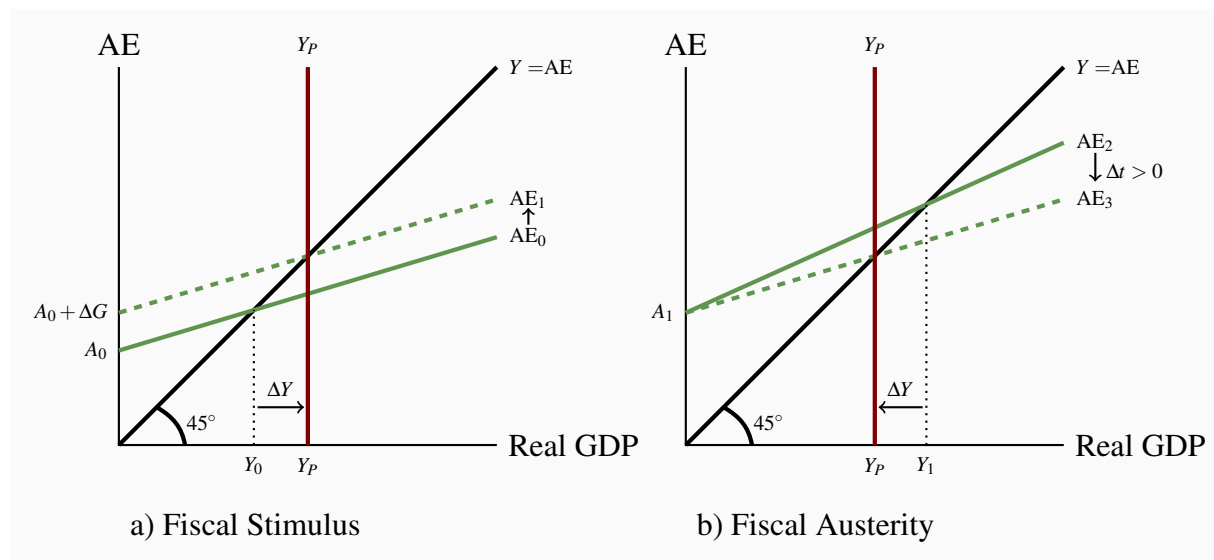


Figure 7.5: Fiscal Policies to Eliminate Recessionary and Inflationary Gaps

- An increase in government spending increases Y and closes recessionary gap.
- Increase in the tax rate reduces spending and the multiplier to close inflationary gap.

Government can intervene to raise AE to AE_1 by increasing government expenditures or by lowering the net tax rate or a combination of the two. In this case, the government chooses to increase G . Working through the multiplier the increase in G moves the economy to equilibrium at potential output.

The right-hand diagram in Figure 7.5 shows a fiscal policy response to an inflationary gap. Again the government can choose between changing expenditures and changing the tax rate. In this example, an increase in the net tax rate reduces the slope of AE and moves the economy to equilibrium at Y_P .

Fiscal policy makes changes in net tax rates and government spending that are intended to change aggregate expenditure and aggregate demand and stabilize equilibrium output at potential output. These changes also change the government's budget function. An important question we need to consider is if the *observed budget balance*—whether surplus, balanced, or deficit—is a good measure of the government's policy intention or fiscal stance.

Does the budget balance show whether fiscal policy is *expansionary*, aiming to raise national income, or *contractionary*, trying to reduce national income?

In itself, the budget balance may be a poor measure of the government's fiscal stance, because the budget balance can change for reasons unconnected to fiscal policy. Even if G and t are unaltered, a fall in investment or exports will reduce national income and output. In turn, this reduces net tax revenue and reduces the budget balance. Indeed, any change in non-government autonomous expenditure changes equilibrium income, net tax revenue, and the government's budget balance.

For given levels of government expenditure and tax rates, the budget function shows us that the budget balance is smaller in recessions, when national income is low, than in booms, when income is high. Suppose autonomous aggregate expenditure and demand fall suddenly. The budget may go into deficit. Someone looking only at that deficit might conclude that fiscal policy had shifted toward expansion with an increase in expenditure or a cut in the net tax rate, and no further fiscal stimulus was needed. That might be wrong. The deficit may be caused by the recession, not by a change in policy.

Recent Canadian experience provides a good example. The Minister of Finance in his budget of February 2008, provided a fiscal plan based on a projected rate of growth in nominal GDP in 2008 of 3.5 percent and in 2009 of 4.3 percent. Under this plan and these growth rates, the projected budget surplus for the fiscal year 2008-2009 was \$2.3 billion. However, the financial crisis in the U.S. and the U.S. recession that developed in the last quarter of 2008 along with the drop in energy and commodities prices undermined the Minister's GDP growth projections. By the time of his Economic and Financial Statement of November 2008 he was projecting much smaller budget surpluses of \$0.8 billion in fiscal 2008-2009 and \$0.1 billion in fiscal 2009-2010. In terms of the budget function in Figure 7.4, the budget balance had moved to the left and down the budget function.

The structural budget balance

To use a budget balance as an indicator of fiscal stance, we calculate the **structural budget balance (SBB)**. This is an estimate of what the budget balance would be if the economy were operating at potential output. By evaluating the budget at a fixed level of income, namely potential GDP, the structural budget balance does not change as a result of business cycle fluctuations in output. In terms of the budget function we used above, the structural balance is:

$$SBB = tY_p - G \quad (7.8)$$

Structural budget balance (SBB): the government budget balance at potential output.

Notice that this structural budget function differs from the general budget function of Equation 7.7 by calculating net tax revenue at Y_p rather than at any Y .

Using the previous numerical example, suppose government expenditure is 200 and the tax rate is 0.20. As in Figure 7.5, the budget balance is a deficit at any income below 1000 and a surplus at any income above 1000. If, given other components of aggregate expenditure, the equilibrium output is 800, the actual budget balance will be a deficit. Net tax revenue will be $NT = 0.2 \times 800 = 160$. With government expenditure of $G = 200$, $BB = 160 - 200 = -40$.

Conversely, suppose higher AE makes equilibrium output 1200. With a tax rate of 0.20 and government expenditure of 200, the budget balance would be a surplus of 40. The important point of these examples is that we cannot tell the stance of fiscal policy, or a change in the stance of fiscal policy, by looking at the actual budget balance. We need to look at a *structural budget balance*, calculated at potential output (Y_p) that is not changed by business fluctuations in actual output around potential output.

Changes in the government's *fiscal policy program* change the structural budget balance and shift the budget function. An increase in government expenditure on goods and services, for example, would *shift the BB* line in Figure 7.6 down and lower the structural budget balance. The AE line would shift up and increase equilibrium income and aggregate demand. This would be an expansionary fiscal policy.

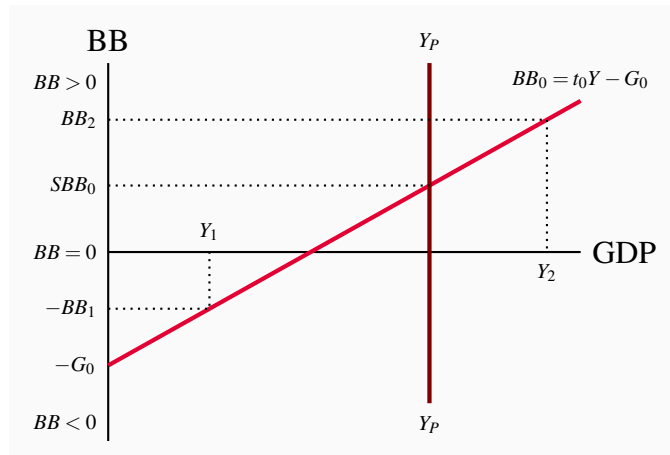


Figure 7.6: Actual and Structural Budget Balances

Structural budget balance $SBB_0 = t_0Y_p - G_0$. Actual budget balance $BB_1 = tY_1 - G_0$.

A change in the net tax rate would also change the structural budget balance and the budget line BB in the diagram. In this case, the *slope of the line* would increase with an increase in the tax rate or fall with a cut in the tax rate. In either case it would be the change in the structural budget balance that would tell us that fiscal policy had changed and whether the change would increase or reduce aggregate expenditure.

Figure 7.7 shows the difference between actual and structural budget balances for one fiscal policy program and budget. The budget program BB_0 would give a structural budget deficit BB_1 if the economy were in equilibrium at Y_1 .

However, if higher autonomous investment or exports increased AE to give equilibrium at potential output Y_p the budget program would have its structural balance SBB_0 . Still higher AE would give equilibrium output greater than Y_p , at Y_2 for example, and create a larger budget surplus, BB_2 .

7.5 Automatic and discretionary fiscal policy

Automatic fiscal policy

Automatic stabilizers have a great advantage. They are built into the budget program by setting the net tax rate, and work automatically. There is no need to determine if the shift in autonomous expenditure is transitory or persistent. By reducing the sensitivity of the economy to expenditure shocks, automatic stabilizers are always at work reducing the size of output and employment fluctuations.

Automatic stabilizers: tax and transfer programs that reduce the size of the multiplier and the effects of *transitory* fluctuations in autonomous expenditures on equilibrium GDP.

Income taxes and transfers, such as unemployment benefits, are important automatic stabilizers. At given net tax rates, a fall in national income, output, and employment raises payments of unemployment benefits and reduces tax collections. Both effects mean that disposable income changes by less than the change in national income. The slope of the aggregate expenditure function ($c(1 - t) - m$) is lower, and so is the multiplier. Conversely, in a boom, net tax revenues rise and disposable income rises by less than the rise in national income, which helps dampen the boom.

However, automatic stabilizers only serve to moderate the fluctuations in real GDP caused by fluctuations in autonomous expenditure. They do not offset those autonomous expenditure disturbances. There is no automatic change in autonomous government expenditure or tax rates. Those changes usually come from discretionary fiscal policy.

Discretionary fiscal policy

But automatic fiscal stabilizers only reduce the impact of changes in autonomous expenditure. They do not offset them. For that governments can also use **discretionary fiscal policies** to offset *persistent* changes in autonomous expenditures. A persistent drop in investment or exports would be offset by an increase in government spending and by cutting taxes, or both as for example the Canadian government's *Economic Action Plan* in response to the recession of 2009. Alternatively an export or investment boom might be offset by higher tax rates or reduced government expenditures.

Discretionary fiscal policy: changes in net tax rates and government expenditure intended to offset *persistent* autonomous expenditure shocks and stabilize aggregate expenditure and output.

The budget function and the structural budget balance we discussed earlier provide a good illustration of automatic and discretionary fiscal policy. Figure 7.7 shows a government budget function $BB_0 = t_0Y - G_0$ and a structural budget balance SBB_0 at potential output Y_p . This budget function represents a fiscal program designed by the Minister of Finance and approved by parliament.

Automatic stabilization is a part of this program. It comes from the *slope of the budget function*, the net tax rate t_0 in this case. Any fluctuations in private sector autonomous expenditures cause changes in income Y . These changes in Y for example, down to Y_1 or up to Y_2 , *cause movements along the budget function* and a change in the budget balance, as shown in Figure 7.7. The effect of the change in the budget balance is stabilizing. A larger net tax rate would mean larger automatic changes in the budget balance in response to changes in income and more automatic stabilization.

When we use the budget function to show fiscal policy changes, we can also consider more complex programs that change both the slope of the function and the structural balance.

It is quite easy to present fiscal policy in theory and illustrate it in diagrams but does it work in the real world? Why, if governments have fiscal tools to stabilize and offset fluctuations in aggregate expenditure and demand do we still experience business cycles, including the recession of 2009 and the prolonged recovery?

The answer has several dimensions. While automatic stabilizers moderate the severity of fluctuations in autonomous expenditures they do not offset those fluctuations. That calls for discretionary fiscal policy, namely a change in the budget plan involving changes in autonomous government expenditures and net tax rates. The process is partly economic and partly political and can take time.

The timelines involved are frequently defined in terms of recognition lags, decision lags, implementation lags and impact lags. It takes time to recognize a *persistent* shift in aggregate expenditure and identify its source. This involves the availability of economic data and economic analysis to establish the size and source of shift in economic conditions. That in turn provides the basis for the design of the new budget program required. The implementation of the new budget is a political process. It may involve substantial the time and changes to the budget before it passes. Once the budget passes and new expenditure plans and tax rate are in effect it takes time for them to work through the economy and have their full impact on aggregate expenditure and national income. As a result, economic fluctuations are well underway before discretionary fiscal policies can shift to offset them. Discretionary policies may still provide stabilization but they do not completely eliminate business cycle fluctuations.

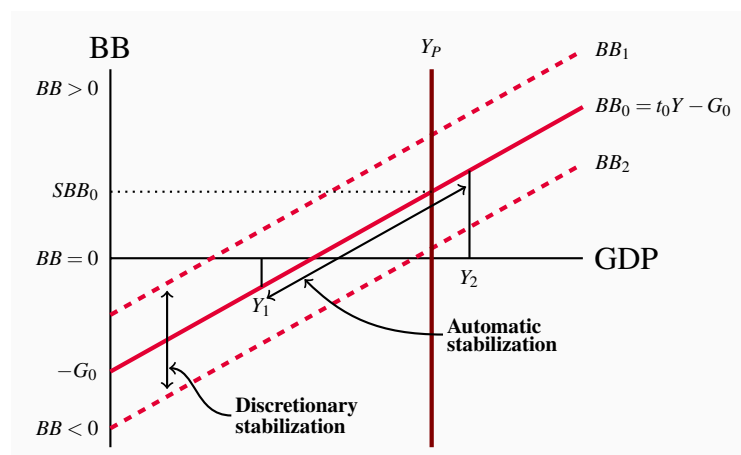


Figure 7.7: Automatic and Discretionary Fiscal Policies

Automatic stabilization comes from changes in the budget balance along the BB_0 line as Y fluctuates between Y_1 and Y_2 . *Discretionary stabilization* shifts the budget function as a result of changes in government expenditure or taxes.

7.6 The public debt and the budget balance

Budget balances and outstanding debt are closely related. A student's debt at the time of graduation is the sum of her budget balances during years of study. In any year in which her income is less than her expenses, she finances the difference by borrowing. In another year, if income is greater than expenses, she can repay some previous borrowing. In the end, the sum of borrowings minus the sum of repayments is her outstanding student debt (loan). This debt is a result of borrowing to finance investment in education.

Similarly, the outstanding **public debt** (PD) at any point in time is simply the sum of past government budget balances. Governments borrow to finance budget deficits by selling government bonds to households and businesses. Budget surpluses reduce the government's financing requirements. Some bonds previously issued mature without being refinanced. In simple terms, the budget balance in any year changes the outstanding public debt by an equal amount but with the opposite sign. A positive balance, a surplus ($BB > 0$), reduces the public debt ($\Delta PD < 0$). A negative balance, a deficit ($BB < 0$), increases the public debt ($\Delta PD > 0$). Using PD to represent the outstanding public debt, we can express the link between the public debt and the government's budget balance as:

$$\Delta PD = -BB \quad (7.9)$$

Public debt (PD): the outstanding stock of government bonds issued to finance government budget deficits.

Figures 7.8 and 7.9 show the relationship between the government budget balance and the change in the public debt relative to GDP based on Canadian data for the 1988-2012 period. Recognizing that growth in the economy makes absolute numbers for deficits and debt hard to evaluate, the budget balance and the change public debt are presented as percentages of nominal GDP. The effects of budget balances on the public debt are illustrated clearly in the diagrams.

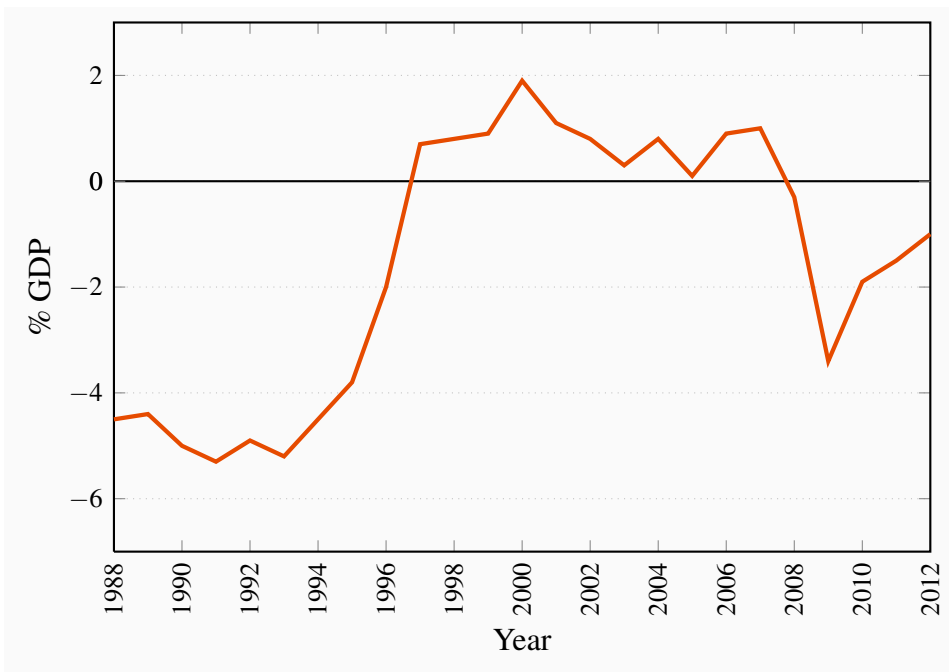


Figure 7.8: Canadian federal government BB % GDP

Source: Department of Finance, Fiscal Reference Tables 2013

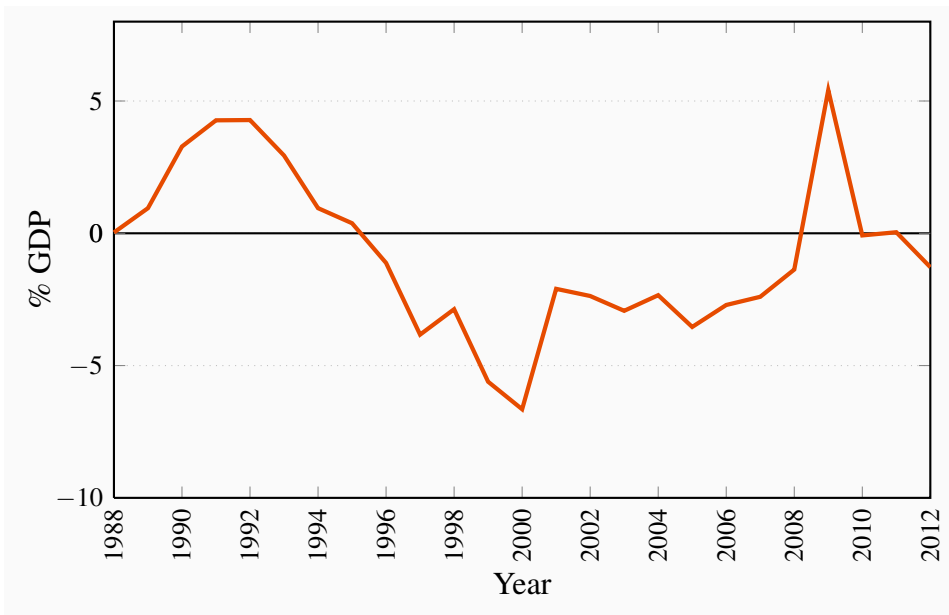


Figure 7.9: Change in federal government public debt ratio

Source: Department of Finance, Fiscal Reference Tables 2013. Bank of Canada, Banking and Financial Statistics Feb 2014 and author's calculations.

In the years from 1995 to 2007 the Government of Canada had budget surpluses. Things were different in the years before 1995. Large budget deficits, averaging more than 5 percent of GDP, were the norm in the late 1980s and early 1990s. As a result, the outstanding federal government public debt increased, and increased faster than GDP, pushing the ratio of public debt to GDP up from 38 percent of GDP in 1983 to 68 percent of GDP in 1996. The cost of the interest payments the government had to make to the holders of its bonds increased from \$3.9 billion to \$42.4 billion. These costs accounted for almost 30 percent of budgetary expenses in 1995.

As a result, Canadian fiscal and budgetary policy shifted in 1995 to focus much more on deficit and debt control than on income stabilization. As Figure 7.8 shows, the federal budget was in surplus from 1997 until 2007. This reduced the debt to GDP ratio each year until 2008 as in Figure 7.9.

The financial crisis and recession of 2008-2009 and the federal government's *Economic Action Plan* changed this focus and pattern of fiscal policy. Fiscal stimulus through increased government expenditures and modest tax credits together with the recession in income created budget deficits in 2008-2013. These deficits added directly to the federal government debt. Larger debt combined with little or no growth in nominal GDP in 2009 and 2010 caused a sharp increase in the debt ratio shown in Figure 7.9. The focus of Federal Budget plans for recent years, as the recovery from recession seems to be underway, has shifted back to budget deficit control and reduction and a return to lower public debt ratios.

Although cumulative deficits can raise the public debt dramatically, it is not the absolute value of the outstanding debt that should be of interest or concern. If, at the same time as the debt is rising, the economy is growing and tax revenues are rising as a result of a growing tax base, the government may be able to service a growing debt without having to raise taxes. The **public debt ratio** (PD/Y) is then the appropriate measure of the debt situation. A rise in the outstanding debt is not in itself a source of concern. However, the government cannot allow the debt ratio to rise without limit.

Public debt ratio (PD/Y): the ratio of outstanding government debt to GDP.

Recent sovereign debt crises in Portugal, Ireland, Greece and Spain provide clear examples of the difficulties high and rising public debt ratios cause. In those countries and others in Europe, and in the US, the government costs of rescuing banks in financial distress after 2008 combined in many cases with already large budget deficits, compounded by the recession in economic growth raised public debt ratios sharply. Table 7.2 shows the early stages of these increases in from 2007 to 2012. The consequence was a loss of financial market confidence in the ability of some of these countries to pay interest on and subsequently retire outstanding government bonds, let alone service new bond issues to finance current deficits. Interest rates for new bond issues increased sharply and Greece and Ireland needed financial bailouts from joint EU rescue funds. This has provided time for fiscal adjustment but the economic growth required to solve sovereign debt issues remains elusive.

We will return to the relationship between fiscal policy and the public debt and examine the dynamics of the public debt ratio in Chapter 12.

This completes our introduction to the government budget, fiscal policy, aggregate expenditure, and the economy. We have seen two ways in which the government sector affects aggregate expenditure and output. Government expenditure is a part of autonomous aggregate expenditure. It affects the position of the AE function, equilibrium output, and the aggregate demand curve. The net tax rate is a leakage from the income expenditure flow. It affects induced expenditure, the slope of the AE function, the size of the multiplier, equilibrium output, and the AD curve. Government expenditure and the net tax rate are *policy levers* the government can use to influence aggregate expenditure and output. The net tax rate provides some automatic stabilization by reducing the size of the multiplier. Changes in the net tax rate or government expenditure are discretionary fiscal policy tools. Example Box 7.2 pulls this material together in a basic algebraic example.

The following example shows the determination of equilibrium output under constant prices in a general model.

Consumption	$C = C_0 + cYD$, where $YD = Y - NT$
Investment	$I = I_0$
Government expenditure	$G = G_0$
Net taxes	$NT = tY$
Exports	$X = X_0$
Imports	$IM = X_0 + mY$

The lower case letters c , t , and m indicate *induced* relationships, and the subscript 0 indicates initial values for autonomous expenditures.

Aggregate expenditure is:

$$\begin{aligned} AE &= C + I + G + X - IM, \text{ which, by substitution, is} \\ AE &= C_0 + c(1-t)Y + I_0 + G_0 + X_0 - IM_0 - mY, \text{ or} \\ AE &= C_0 + I_0 + G_0 + X_0 - IM_0 + c(c(1-t) - m)Y \end{aligned}$$

We can reduce this expression to its two key components, ***autonomous and induced expenditures***, by writing:

$$AE = A_0 + (c(1-t) - m)Y, \text{ letting } A_0 = C_0 + I_0 + G_0 + X_0 - IM_0$$

This aggregate expenditure function drawn in a diagram, would have an intercept on the vertical axis A_0 , and a slope $(c(1-t) - m)$.

National income and output are in equilibrium when national income and planned aggregate expenditure are equal. This is the condition: $Y = AE$. Using this condition and solving for Y_e we have:

$$\begin{aligned} Y &= A_0 + (c(1-t) - m)Y \\ Y - (c(1-t) - m)Y &= A_0 - 0 \\ (1 - c(1-t) + m)Y &= A_0 \\ Y_e &= \frac{A_0}{1 - c(1-t) + m} \end{aligned}$$

Equilibrium national income is determined by the total autonomous expenditure in the economy, A_0 , multiplied by the multiplier, $Y_e = \frac{A_0}{1 - c(1-t) + m}$, which is based on the changes in expenditure induced by changes in national income.

Changes in equilibrium national income come mainly from changes in autonomous expenditures A , multiplied by the multiplier. The multiplier itself might also change if households changed their expenditure behaviour relative to national income or shift between domestic and imported goods. The net tax rate t in the multiplier is a fiscal policy tool that adds automatic stability to the economy in addition to raising revenues to finance the G component of A .

Example Box 7.2: The algebra of income determination

7.7 Aggregate demand & equilibrium output

Our objective in this chapter was to extend the model of Chapter 6 to include a government sector and fiscal policy in aggregate demand. To do this we continued to assume that *wages, prices, money supply, interest rates, and foreign exchange rates are constant*. We also continued to make the important distinction between *autonomous* expenditure and *induced* expenditure, which leads to the existence of a multiplier. The equilibrium condition is still $Y = AE$ and $AD = AS$, output and income equal to planned expenditure. Even though the model is more complex, it still shows us that fluctuations in autonomous expenditures, working through the multiplier, cause fluctuations in Aggregate Demand, output, income, and employment.

In our model, there are five sources of fluctuation in autonomous expenditures. In addition to the autonomous parts of consumption and imports the model includes autonomous investment, exports and government expenditures. The link between changes in national income and the induced changes in consumption expenditure is also more complex. As a result, the multiplier is determined by the marginal propensity to consume (*MPC*), the net tax rate (*t*), and the marginal propensity to import (*MPM*). Government expenditure and the net tax rate are policy variables. Other expenditure decisions are driven by market forces. The net tax rate and the marginal propensity to import are sources of leakage from the income stream, in addition to the marginal propensity to save. They reduce the size of the multiplier.

Nevertheless, changes in autonomous expenditures are still the sources of business cycles. If business changes planned investment expenditure in response to changed expectations about future markets, or if changes in economic conditions in other countries change exports or imports, the multiplier translates these changes into larger changes or fluctuations in income and employment. Government expenditure plans and net tax rates are fiscal policy tools that could be used to moderate or offset these fluctuations through a combination of automatic and discretionary fiscal policy.

Figure 7.10 shows the relationship between equilibrium income and output, and the link between changes in aggregate expenditure, aggregate demand, and equilibrium income. In the upper diagram a fall in autonomous expenditure from A_0 to A_1 reduces AE and equilibrium Y from Y_{e_0} to Y'_e , which is the fall in A times the multiplier.

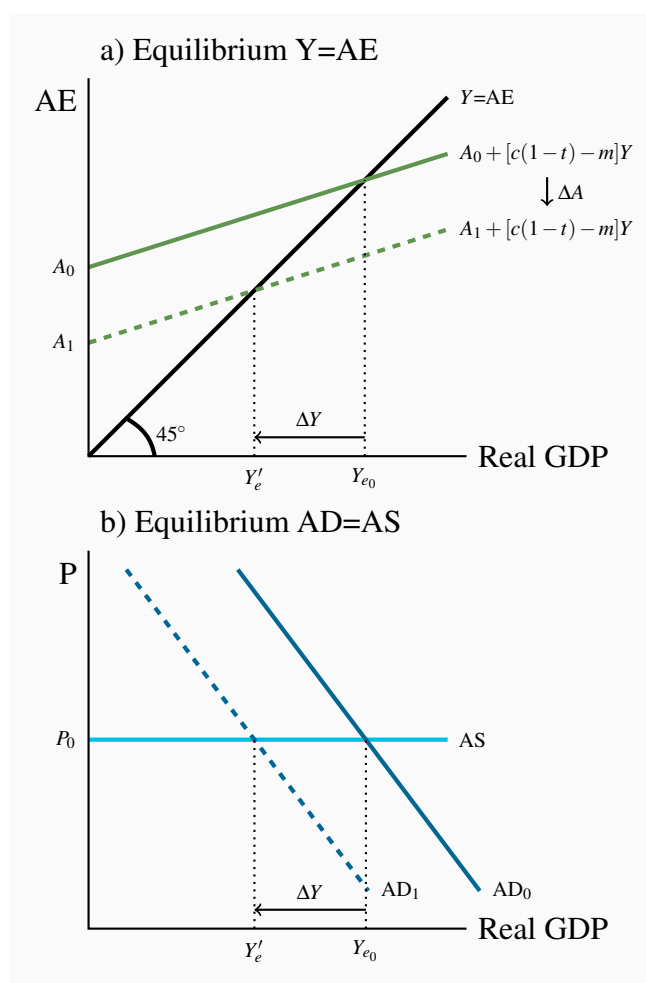


Figure 7.10: AE, AD and Equilibrium Output

The fall in autonomous expenditure and equilibrium is a leftward shift in the AD curve in the lower diagram. The size of that shift in AD is the change in equilibrium income in the upper diagram, namely the fall in A times the multiplier. Because the price level is constant, giving a horizontal AS curve at P_0 , the fall in equilibrium determined by AD/AS is the same as the horizontal shift in AD.

The multiplier in Canada

The multiplier plays a key role in the AE and AD/AS model of the economy. But what is the size of the multiplier in Canada? A simple statistical estimate, using Statistics Canada annual data for real GDP and consumption expenditures, gives a Canadian marginal propensity to consume

out of national income $c(1 - t) = 0.54$, and marginal propensity to import $m = 0.34$. Using these estimates, we get a multiplier for Canada:

$$\frac{\Delta Y}{\Delta A} = \frac{1}{(1 - 0.54 + 0.34)} = \frac{1}{1 - 0.2} = 1.25$$

If you recall, in Chapter 6 we had an estimate of the Canadian marginal propensity to consume out of disposable income of $MPC = 0.88$. If there were no taxes or imports, an $MPC = 0.88$ would mean a multiplier of about 8.33. The difference between the multipliers 1.25 and 8.33 shows clearly the automatic stabilization coming from the net tax rate and marginal propensity to import.

KEY CONCEPTS

Canadian governments directly buy about 25 percent of GDP according to the national accounts data. They also spend about 17 percent on transfer payments to persons and business, including interest payments to holders of government bonds.

Government expenditure G on goods and services, including the public services provided to households and business is a policy variable and an autonomous component of aggregate expenditure.

Net taxes ($NT = tY$), the revenue collected by government from households, are difference between taxes collected and transfers paid.

Disposable income is national income minus net taxes. Changes in disposable income cause changes in household consumption expenditure based on the MPC .

The **net tax rate** (t) reduces changes in disposable income relative to national income and reduces the marginal propensity to consume out of national income to $c(1 - t)$. This lowers the slope of AE and the size of the multiplier.

Government expenditure and net taxes affect equilibrium national income by changing both autonomous expenditure and the multiplier.

The **government budget** describes what goods and services the government plans to buy during the coming year, what transfer payments it will make, and how it will pay for them. Most spending is financed by taxes, but some revenue comes from charges for services.

The **government budget balance** is the difference between net revenues and government expenditures. Because net tax revenues depend on national income ($NT = tY$) the **actual budget balance** is determined by the government's budget plan and the level of national income. The actual budget balance will change with changes in national income.

Fiscal policy is the government's use of its taxing and spending powers to affect aggregate demand and equilibrium GDP.

The **structural budget balance** (SBB) is an estimate of what the budget balance would be if the economy were operating at potential output. *Changes in the structural budget balance* are indicators of changes in fiscal policy because they measure changes in expenditure and tax programs at a standardized income level.

The government's tax and transfer programs are **automatic (fiscal) stabilizers** that reduce the size of the multiplier and the effects of *transitory* fluctuations in autonomous expenditures on

equilibrium GDP.

Discretionary fiscal policies are changes in net tax rates and government's expenditure intended to offset *persistent* autonomous expenditure shocks and stabilize aggregate demand and equilibrium output at potential output.

Public debt (PD) is the outstanding stock of government bonds issued to finance past government budget deficits minus the retirement of government bonds in times of past government budget surpluses. The annual change in the public debt is $\Delta PB = -BB$.

Public debt ratio (PD/Y) is the ratio of outstanding government debt to GDP, PD/Y .

Recent **sovereign debt crises** in Portugal, Ireland, Greece and Spain provide clear examples of the difficulties high and rising public debt ratios cause.

The **government sector and fiscal policy** are important determinates of aggregate demand and equilibrium GDP. Government expenditures are an autonomous policy variable. Net tax rates and policy affect the size of the multiplier. Changes in government expenditure and tax programs through the setting of the government's budget affect AE, AD and equilibrium GDP.

EXERCISES FOR CHAPTER 7

Exercise 7.1. Suppose a government is established in a country where none previously existed. The government spends 100, financed by borrowing, to provide public services. If autonomous consumption, investment and exports minus imports are 200 and the marginal propensity to consume $MPC = 0.75$, and the $MPM = 0.15$, what are the equilibrium real GDP values before and after the government is established.

Exercise 7.2. If the government expenditure in Exercise 7.1 were financed by imposing a net tax rate on income of $t = 0.10$:

- Calculate and compare the slopes of the AE functions in Exercises 7.1 and 7.2.
- Calculate and compare the multipliers in Exercises 7.1 and 7.2.
- What is the equilibrium real GDP in Exercise 7.2 compared to Exercise 7.1.

Exercise 7.3. If government expenditure is 100 and the net tax rate is $t = 0.20$:

- Complete the following table:

Y	$NT = tY$	G	$BB = NT - G$
100			
200			
300			
400			
500			
600			
700			

- In a diagram with national income Y on the horizontal axis and government revenue and expenditure on the vertical axis, draw the government expenditure and net tax functions. Explain the intercept on the vertical axis, and the slope you have given to the NT and G functions in your diagram.
- Suppose the government cuts the tax rate to $t = 0.15$. Show the effects in your diagram.

Exercise 7.4. Draw diagrams to illustrate the initial equilibrium national income, the effect of the increase in government expenditure on equilibrium national income, and the government's budget functions and balances before and after the increase in government expenditure.

Exercise 7.5. Suppose the government raises its revenue by a net tax of 25 percent on income, $t = 0.25$, the marginal propensity to consume out of disposable income is 0.8 and the marginal propensity to import is $m = 0.15$.

- (a) What is the slope of the AE function? What is the size of the multiplier?
- (b) Autonomous expenditure by the non-government sectors ($C_0 + I_0 + X_0 - IM_0$) is 300 and government expenditure is 400. What is the equilibrium income and output? What is the government's budget balance?
- (c) The government increases its expenditures by 100 to provide additional funding for national defense. What is the effect on equilibrium income and output? What is the effect on the government's budget balance?

Exercise 7.6. An economy is in equilibrium at a real GDP of 750, but current estimates put potential output at $Y_P = 850$.

- (a) Is there an inflationary or a recessionary gap, and, if there is either, what is its size?
- (b) Research suggests that the MPC is 0.75, the MPM is 0.10, and the net tax rate is 0.20. If there is a gap, what change in government expenditure would eliminate the gap?
- (c) If the government preferred to change its net tax rate to eliminate the gap, and not change government expenditure, what new tax rate would be required to eliminate the gap?

Exercise 7.7. (a) Draw a diagram that shows the government's budget balance relative to national income. Explain briefly the vertical intercept of the budget function and its slope.

- (b) Using your diagram from (b), show the structural budget balance and a situation in which the actual balance is different from the structural balance.
- (c) Based on this diagram, show and explain the difference between the budget effects of automatic stabilization and discretionary fiscal policy.

Exercise 7.8. Suppose the $MPC = 0.8$, the tax rate $t = 0.1$, the $MPM = 0.12$ and autonomous aggregate expenditure $A = 1000$, including government expenditure $G = 20$. Further assume the government has an outstanding public debt of 1000.

- (a) What is the initial debt to GDP or debt to national income ratio?
- (b) Suppose government increased its expenditure by $\Delta G = 10$, without any increase in the tax rate. What are the new equilibrium national income and the government's new budget balance?
- (c) What is the outstanding public debt and the public debt ratio at the new equilibrium income, assuming the economy has reached its new equilibrium national income in one year?

Part Three

Financial Markets & Economic Activity

8. Money, banking & money supply

9. Financial markets, interest rates, foreign exchange rates and aggregate demand

10. Central banking and monetary policy

Three chapters in this part examine the financial sector of the economy and the important role it has in the determination of output and employment. They cover money, banks and banking, financial markets, asset prices and foreign exchange rates. When integrated, these parts of the economy provide the 'monetary transmission mechanism' and a framework for the design and implementation of central bank monetary policy. Moreover, the financial sector is the key to price level and inflation rate elasticities in the aggregate demand functions derived in later chapters.

Chapter 8

Money, banking & money supply

In this chapter we will explore:

- 8.1 Money and functions of money
- 8.2 Measures of the Canadian money supply
- 8.3 Banking in Canada today
- 8.4 Money created by banks
- 8.5 The monetary base and the money supply

This chapter and the two chapters which follow examine the financial sector of the economy. They cover money, banks, Canadian banking, financial markets, asset prices, interest rates, and foreign exchange rates.

The financial sector provides the important link between and aggregate expenditure and aggregate demand. *It is the key to understanding the slope and position of the AD curve.* It also creates the framework for central bank *monetary policy*.

8.1 Money and the functions of money

You can see the variety of things that have been used as money in Canada in James Powell's *A History of the Canadian Dollar*, available at the Bank of Canada's website: <http://goo.gl/wNUCjX>.

Our money in the seventeenth and eighteenth centuries was silver and gold coins from many countries, and playing cards. The British pound sterling, the Spanish silver dollar, and the U.S. dollar were the main moneys in Canada in the nineteenth century, followed by paper currencies issued by banks and by the government since the late nineteenth century.

It is not the commodity or token used as money that matters, but the social convention that it is accepted without question as a means of payment. Money makes it easier for everyone to buy and sell goods and services and economize on the use of scarce resources.

Money is defined by four important functions. It provides:

1. A means of payment as a medium of exchange
2. A unit of account
3. A store of value
4. A standard of deferred payments

As a **means of payment** money is involved in most exchanges. We use money to pay for the goods and services – from food and clothing to transportation, to rent, to fees and taxes. People receive wages and salaries and other types of income in money. Money is not consumed in these transactions. It is used as a medium of exchange.

Means of payment: a commodity or token generally accepted in payment for goods and services or the repayment of debt.

Exchange transactions without money are **barter exchanges**, a direct exchange of one good for another. These exchanges depend on a *double coincidence of wants*. Each party to the exchange has a good the other party wants and is willing to trade one good for another. This means exchange transactions are expensive as people must find others who have what they want and want what they have. Using a money as a medium of exchange dramatically lowers the cost and increases the efficiency of trade.

Barter exchanges: direct exchanges of goods or services for goods or services without the use of money.

Money also serves as a **unit of account**. Prices in Canada are quoted in Canadian dollars. Similarly in other countries prices are quoted in domestic currency. In much of Europe prices are in euros, in the United States in U.S. dollars and in Japan in yen. This reflects the convenience of using the same units for the means of payment and the unit of account. However, there are exceptions. Historically, in Canada, during the time of the fur trade, books were kept in “currency” but actual currency never changed hands in the barter of trade goods for furs.

Unit of account: the standard in which prices are quoted and accounts are kept.

To serve as a medium of exchange, money *must also be* a **store of value**. Money works as a time machine allowing people to separate the timing of their expenditures from the timing of their

incomes. Money is accepted today with confidence that it can be used some time in the future to make payments when buying goods and services. You would not accept money today that you thought would be unacceptable when you offered it in payment at some later date.

Money is not a unique store of value. Other assets including real estate, financial assets like corporate and government bonds, fine art and antiques all serve as stores of value. These may be better ways to store value, but people still choose to hold some of their wealth as money. This choice to hold money balances is very important to the effects money balances have on financial markets and aggregate expenditure. We will examine it in detail in the next chapter.

Store of value: an asset that carries purchasing power forward in time for future purchases.

Money provides a **standard for deferred payments**. If you take out a student loan the amounts you will repay in the future are measured in dollars. Similarly, servicing and retiring a mortgage on a property or a loan on a car calls for future payments specified in dollars. Domestic money is not essential for this function. Individuals, businesses and governments often borrow or lend in the money of other countries. In those cases the currency in which the loan transaction takes place is usually the standard for payments to settle the debt. The essential attribute of money is its general acceptance as a means of payment. For this money must also be a store of value. This works well when money is also a unit of account and a standard of deferred payments.

Standard of deferred payments: the units in which future financial obligations are measured.

The development of money

The money we use today is the product of a long and continuing evolution in the financial services industry. It is a testament to the ingenuity of people and society seeking to reduce the costs and increase the volume of trade in goods and services.

Historically, there were no banks. Money was a commodity. Gold and silver bullion are two commodities that came to be used extensively because of their relative scarcity and durability. Concerns about the purity of these metals and the inconvenience of weighing out small quantities to make payments led to coinage. The minting of gold and silver coins by heads of state offered a solution to these problems. The monarch certified the purity and quantity of the metal in the coin by having his or her likeness stamped into the metal.

Unfortunately, coinage did not completely solve the concerns about the quantity and quality of gold and silver money. The quantity of gold in a coin could be reduced by clipping its edges, or by rubbing the surfaces of the coin to wear some of the metal away. “Sweating” coins by placing them

in a leather bag and shaking them was one technique used to remove some of their precious metal. The edge designs, millings, or facets that we still see on coins today were introduced to combat clipping, and wear on the heads and tails stamped into coins provided evidence of sweating. Coins that were worn or clipped were not accepted at full value in exchange for goods and services.

A second difficulty with precious metal coinage came from the sovereign who controlled the minting process. Adding a little base metal to the gold or silver being minted resulted in coins with less precious metal content than their face value certified. A little of the precious metal was withheld and could be used to mint more coin, which was, in effect, free money for the sovereign. This “debasement” of the coinage was a serious problem at times and, like clipping and sweating, reduced the acceptability of precious metal coinage as money.

The emergence of banks and paper money was a response to the problems with gold and silver commodity money. The first banks were goldsmiths who used gold in the production of jewelry and ornaments. They were accustomed to buying and selling gold bullion, and holding stocks of gold bullion. It was a natural extension of their business to offer to hold gold for safekeeping. Those who stored their gold with goldsmiths were given paper claims or receipts (IOUs), which were convertible back into gold on demand.

When people began to use gold receipts to make payments, gold receipts became a means of payment. They were **token money**, representing a fixed amount of the precious metal.

Token money: convertible claims on commodity money.

Goldsmiths became bankers when they realized that not all their customers would show up at the same time and want their gold back. The convertibility of gold receipts made them acceptable as a medium of exchange. Gold merchants could make loans by issuing more gold receipts than they had gold in their storage vaults. They only needed gold holdings equal to a fraction of the gold receipts they had issued, as long as people used the receipts as a medium of exchange.

Banks as we know them grew out of this acceptance by society of credit (IOU) money as a medium of exchange. Banks began to accept customer deposits of token money and to issue their own bank notes (credits) as receipts. People liked the convenience and safety of storing some of their wealth with banks. As society became more comfortable with banks and confident in the safety of banks, bank deposits, which could be transferred by cheque, became widely accepted as the medium of exchange. Bank notes and deposits were no longer convertible into gold or commodity money, but they were convertible into **legal tender**. Governments established central banks to control the supply of legal tender, bank notes, or cash. Bank notes now serve as both a medium of exchange and as the **reserves** banks hold to ensure the convertibility of their customers’ deposits.

Legal tender: money that by law must be accepted as a means of payment.

Bank reserves: cash (legal tender) held by banks to meet possible withdrawals by depositors.

Unlike other financial institutions, such as pension funds and insurance companies, the key aspect of banks is that some of their liabilities are used as the medium of exchange; cheques and debit cards allow their deposits to be used as money to make payments. Bank deposits are credit money.

In Canada today, as in most industrial countries, we use a combination of **fiat money** and **credit money**. Fiat money, in contrast to commodity or token money is money that the government has declared to be legal tender. Coins and paper bank notes are fiat money in Canada. If you look carefully at a \$5, \$10, or \$20 Bank of Canada bill you will find the statement: “This note is legal tender.” By law it must be accepted as a means of payment for goods and services bought or debts repaid.

Fiat money: money the government has declared as legal tender.

Credit money: the debt of a private business or individual.

Our fiat money is supplemented by credit money. A bank deposit is credit money, and is redeemable in fiat money on demand, or in the case of some savings and time deposits, after a short waiting period. Furthermore, the bank is obliged to pay when your cheque is presented, or when you use your debit card. Bank deposits are a medium of exchange because they are generally accepted as a means of payment, even though they are not legal tender. The sum of bank deposits and fiat money in circulation outside the banks at any time is the stock of medium of exchange and the economy’s **money supply**.

Money supply: the means of payment in the economy, namely currency (notes and coin) in circulation outside the banks and bank deposits.

8.2 Measures of the Canadian money supply

The money supply is traditionally defined as cash in circulation outside the banks, plus bank deposits. But as the banking and financial system evolved so did the types of deposits issued to the non-bank public. Now there are questions about the measurement of money supply.

In the early days of banking there were demand deposits on which cheques could be written and savings deposits which often required a period of notice before funds could be withdrawn. Today banks offer a much wider spectrum of deposits to customers from demand to savings deposits that may or may not be chequable, pay interest under different terms, and some which can only

be accessed online. Not all deposits serve as means of payment. For these the balance must be transferred to another account before it is available to make a payment. Which deposits should be counted in the money supply?

The structural evolution of the financial system raises further questions. What is a ‘bank’? Today banks compete vigorously for deposits with other businesses, including trust companies and credit unions whose deposits are widely accepted as means of payment. There is no longer a reason to exclude those deposits from measures of the money supply. Different measures of the money supply illustrate the importance of different financial institutions in the industry.

The Bank of Canada now publishes data on the **monetary base** in response to continuing changes in the types of bank deposits available to households and businesses. Advances in technology, financial deregulation, and competition in the financial services sector, which have led to more types of financial assets, make it easy for customers to substitute between those assets we include in narrow definitions of money supply and other assets. But once we leave the monetary base as a measure of money supply, there is no single measure of money that is clearly the means of payment. There is however only one type of money that is legal tender namely notes and coin.

Monetary base: legal tender comprising notes and coins in circulation plus the cash held by the banks.

Table 8.1 shows the size of the money supply in Canada based on different definitions and money aggregates. These data illustrate the range of choice involved in the selection of a specific measure of the money supply. But one thing is clear. Bank deposits are the major component of money supply by any measure other than the currency component of the monetary base.

Monetary base (MB)	70.6
Currency in circulation (CR)	65.7
M1B=currency+chequable chartered bank deposits	640.6
M2 = M1B + notice and savings deposits in the banks	1,249.0
M2+ = M2 + deposits at other financial institutions	1,611.5

Table 8.1: The money supply in Canada in February 2014 (\$ billions)

Source: Statistics Canada, CANSIM Table 176-0025. Revised 26/10/2014.

Currency in circulation is only about 5 percent of M2. Deposits account for the remaining 95 percent. The importance of bank deposits as money means that understanding the operations of banks as sources of loans and deposits is the key to understanding the money supply function in

the economy

8.3 Banking in Canada today

In Canada today, and in other industrial countries, the banking system is made up of a *central bank* and a number of *commercial banks* and other deposit-taking institutions called *near banks*. Table 8.2 illustrates the structure of the banking industry in Canada. The industry is defined broadly to include deposit-taking institutions, not just those that operate under the federal Bank Act.

Banking Institution	Number
Central bank:	
The Bank of Canada	1
Number of Chartered Banks:	
Schedule I domestic banks	23
Schedule II foreign banks subsidiaries	26
Schedule III foreign bank branches	23
Total	72

Table 8.2: The Canadian banking system in 2012

Source: Canadian Bankers' Association. www.cba.ca

Banks are **financial intermediaries**. They borrow money from the public, crediting them with a deposit. The deposit is a liability of the bank. It is money owed to depositors. The money raised from depositors provides the funds to support the bank loans made to businesses, households, and governments.

Financial intermediary: a business that specializes in bringing borrowers and lenders together.

Banks are not the only financial intermediaries. Trust companies, credit unions, caisses populaires, insurance companies, securities dealers, mutual fund companies, and independent financial advisors all play a role in this industry. But banks hold more than 70 percent of the assets in the financial services sector, and the six largest Canadian banks account for over 90 percent of the assets of the banking industry. Trust companies, credit unions, and caisses populaires also accept deposits that

are used as money, but those deposits are a small fraction of the total of deposit money. As a result, bank deposits are the focus of our discussion of money in Canada.

The **Bank of Canada** is Canada's central bank. It is the source of the bank notes used to make payments and held as cash reserves by commercial banks. Established by the government in 1935, it has the responsibility to regulate the national money supply and support the operation of financial markets. The Bank's power to meet these responsibilities comes from its monopoly on the issuance of bank notes.

Bank of Canada: Canada's central bank.

The Bank of Canada also is the provider of:

- Banking services for the commercial banks in the system
- Banking services for the federal government
- Lender-of-last-resort facilities in times of liquidity crises and reserve shortfalls

Commercial banks hold some of their reserves as deposits in the Bank of Canada, and make payments among themselves using their Bank of Canada deposits. These interbank payments arise from wire transfers, direct deposits, pre-authorized debits, bill payments, point-of-sale debits, and online payments made by bank customers. For example, cheques written by customers at one bank, say Scotiabank, but paid to and deposited by customers of the Royal Bank result in transfers of deposits between these banks. To settle these transfers, Scotiabank must pay the Royal Bank. Funds held by Scotiabank on deposit in the Bank of Canada are used for this purpose. They are called "settlement balances." In 2011, the Canadian Payments Association, which co-ordinates this clearing of interbank transactions, handled more than 864 million cheques and 3.4 billion point-of-sale debits.

The government holds some deposits in the Bank of Canada. Government receipts, like income taxes paid to the Receiver General, are deposited in government accounts in the Bank of Canada. Government payments like Old Age Security, Employment Insurance benefits, bond interest, and income tax refunds are paid with government cheques or transfers drawn on its Bank of Canada account. Government funds over and above those needed to make regular payments are held on deposit in the commercial banks, and earn interest income for the government.

The key difference between a central bank and the commercial banks in the banking system is the profit motive. Central banks *do not* pursue profits. Their operations focus on the management of the cash reserves available to the public and the banks. The supply of cash reserves affects the behaviour of other banks and financial markets more generally. This is the monetary policy role of the central bank. We will examine it in detail in Chapter 10.

Commercial banks, on the other hand, are profit-oriented businesses. They operate, as we will see shortly, to maximize the profit they earn for their owners. To this end, they offer banking services to the public. Using the notes and deposits issued by the Bank of Canada as reserves, they issue bank deposits to their customers—which are widely used as the medium of exchange—and they make loans to finance purchases made by businesses and households.

To illustrate the business of these banks, Table 8.3 shows the consolidated balance sheet of Canadian chartered banks in November 2013. In the table we see that the banks held small cash balances as reserves against their deposit liabilities. Their other Canadian assets were mainly loans to households and businesses, including mortgage loans, and their holdings of financial securities. Because cash and many of their financial securities have high **liquidity**, banks can lend long and still have cash and funds available if depositors withdraw their money.

Liquidity: the cost, speed, and certainty with which asset values can be converted into cash.

Assets	\$ billion	Liabilities	\$ billion
Canadian dollars:		Canadian dollars:	
Cash	26.7	Personal deposits	791.9
Government of Canada securities	227.7	Non-personal deposits	662.4
Corporate securities	232.0	Government deposits	10.3
Personal and business loans	815.5	Advances from Bank of Canada	1.0
Mortgages	954.0	Other liabilities	542.0
Foreign currency assets	1717.9	Foreign currency liabilities	1773.0
Total assets	4006.3	Total liabilities and shareholders' equity	4006.3

Table 8.3: Balance sheet of Canadian chartered banks, November 2013

Source: Bank of Canada, Banking and Financial Statistics, February 2014, Tables C3 and C4 and author's calculations. Figures have been rounded to one decimal place.

However, many loans to businesses and households are quite *illiquid*. The bank cannot easily get its money back in a hurry. This is not really a cause for concern when people and businesses have confidence in the banks and make widespread use of bank deposits as money. Payments and receipts are both in bank deposit form, which are cleared quickly and efficiently through the cheque-clearing and transfer facilities. Banks need only small cash balances to cover the net clearings and net public demand for cash. In Table 8.3, the banks are holding only \$26.7 billion against deposit liabilities of \$1,454.3 billion.

Canadian banks also carry on important international banking operations, as do banks in many other countries. We see this business recorded on the balance sheet as foreign currency assets and liabilities. The foreign currency assets are mainly loans to customers and holdings of foreign financial securities. Foreign currency deposits of customers are the main foreign currency liabilities. These foreign currency operations are similar to the banks' domestic currency operations. The banks provide loan financing to customers needing foreign currency to make payments in other countries, and they provide deposit facilities for customers using foreign currency for international transactions.

Competition and co-operation are important to the efficient operation of the banking system. Banks compete among themselves for customer deposits and customer loans. Some of the competition for deposits is based on the location, convenience, and quality of bank branches, some on the offers of service packages including personal financial advice and wealth management, and some on the interest rates offered on deposit balances. If you watch TV, you are probably aware that some small banks like President's Choice Financial and Tangerine Bank offer you a relatively high interest rate and will make no service charges if you would put some of your funds on deposit with them. Success in attracting deposits is very important to size and growth of a bank's business.

Credit-worthy customers willing to borrow funds are equally important to a bank's operations. Interest income earned on customer loans is the major source of bank revenue. As a result, banks compete in the personal and business loan markets, using both the terms of loans and the interest rates charged on loans to attract borrowers. The market for mortgage funds is one of the most competitive areas of bank operations. Mortgage rates and terms are advertised widely in the media and in displays in bank offices and even in supermarkets.

Despite this competition for deposits and loans, the banking system depends on the co-operation among banks that makes deposits the medium of exchange. Co-operation in the cheque-clearing system and the debit card *Interac* system are two important examples of banks working jointly to provide the payments system. A cheque book or a debit card is not very useful if it can make payments only to other people or businesses that do business with the same bank you use. Joint interests in *VISA* and *MASTERCARD* are a second important part of inter-bank co-operation that makes these cards widely acceptable as a source of credit.

There are also important areas of bank co-operation on the lending side of their operations. It often happens that businesses and industries have projects that need more financing than any one bank can or wants to provide. However, several banks might agree to provide funding jointly, increasing their lending capacity and spreading the risks associated with the project among them.

These dimensions of competition and co-operation among banks, and their contribution to the efficient functioning of the money and financial sector of the economy, appear regularly in the debate over bank mergers in Canada.

Banking operations and profits

A commercial bank is a profit-oriented business. Its profits come from the difference between what it costs it to raise funds and the revenues it earns from lending. To bring deposits in, the bank offers customers a range of banking services, including safekeeping, record keeping, access to banking offices or bank machines, chequing, Internet banking and debit card facilities, and interest income on some types of deposits. Service charges or fees cover the costs of some of these services. The interest payments to depositors are the main net cost of funds to the bank.

To be profitable, banks have to find ways to lend, at acceptable levels of risk, the funds they have attracted from depositors. Table 8.3 shows how banks lend their money. In Canadian dollars, most is lent to households and businesses at interest rates established for different types of personal, business, and mortgage lending. Some is used to buy government securities and other financial assets, usually with a short time to maturity. These assets pay a lower rate of interest than loans, but they are more liquid and provide the banks with funds if people decide to withdraw a lot of money from their deposit accounts. Notice that the banks also hold some cash, on which no interest is earned, to cover the day-to-day clearing balances that come from the withdrawals, deposits, and transfers made by their customers.

Bank profits come from the difference or spread between the interest cost of raising funds from depositors and the interest income earned on bank assets. If, for example, the banks pay, on average, 4 percent on their deposit liabilities of all types and earn, on average, 6 percent on their assets of all types, their **net interest income** would be 2 percent. To take an actual example, the *Scotiabank Annual Report* for 2013 reports net interest income of 2.32 percent of average assets in 2013. *Scotiabank* net interest income was higher than the same quarter of the previous year as a result of asset growth in residential mortgages, consumer auto and commercial lending, which increased deposit to lending interest rate spreads. The other large banks report net interest income of the same order of magnitude but there are variations among them. The key to profitability is choosing the right mix of high-quality (low-risk) loans and investments while at the same time controlling the costs of raising funds.

Net interest income: the excess of loan interest earned over deposit interest paid.

As we saw in Table 8.3 Canadian banks held only \$26.7 billion in cash against \$1,454.3 billion in personal and non-personal deposit liabilities. Their cash reserve assets were about 1.8 percent of their total deposits. The skill in running a bank entails being able to judge just how much must be held in liquid assets, including cash, and how much can be lent out in less liquid forms that earn higher interest income. The profit motive pushes the bank toward riskier, higher interest paying assets and higher net interest income. **Banker's risk**, the risk that customers will withdraw their deposits and demand cash, pushes the bank toward holding higher cash balances. But cash balances earn no interest income and reduce the bank's net interest income.

Bankers risk: the risk that customers may demand cash for their deposits.

8.4 Money created by banks

Banks *create money* when they increase their deposit liabilities to pay for the loans they make to customers, or for the financial securities they buy. The public uses the deposit liabilities of the banks as money to make payments or to hold as a store of wealth. The banks' ability to create money comes from the willingness of the public to use bank deposits, the liabilities of the bank, as money. Thus, *four key conditions* that give banks the ability to create money are:

1. The non-bank public has confidence in banks and is willing to hold and use bank deposits as money.
2. The non-bank public is willing to borrow from the banks to finance expenditure or asset purchases.
3. The banks are willing to operate with cash reserves equal to some small fraction of their deposit liabilities.
4. The banks are willing to accept the risks involved in lending to the non-bank public.

If any of these is absent, the banks cannot create money, although they may provide safekeeping services.

The first condition is described and defined by the **currency ratio** (*cr*). That is the ratio of cash balances to the bank deposits that members of the non-bank public wish to hold. The banks hold the cash in the economy not held by the non-bank public. Banks acquire cash by offering customers deposit services, as we have discussed above. If the non-bank public holds all its money as cash, the banks cannot acquire the cash reserves they need to cover their deposit liabilities. There is no banking industry.

Currency ratio (*cr*): the ratio of cash balances to deposit balances the held by the non-bank public.

$$cr = \frac{\text{non-bank public cash holdings}}{\text{non-bank public bank deposits}}$$

The third condition required for the banks to create money is a bank reserve ratio that is less than one. The **reserve ratio** (rr) is the ratio of cash on hand to deposit liabilities that banks choose to hold. We defined this ratio earlier as:

$$rr = \frac{\text{reserve assets}}{\text{deposit liabilities}}$$

Reserve ratio (rr): the ratio of cash reserves to deposit liabilities held by banks.

Cash holdings are reserve assets. If banks choose to hold reserves equal to their deposit liabilities, $rr = 1$ and the banks cannot create deposits. They are simple safety deposit boxes.

To see how banks can and do create deposits, we start with a very simple case. Let's assume banks use a reserve ratio of 10 percent ($rr = 0.10$), and the public decides it does not wish to hold any cash balances ($cr = 0$). Suppose initially the non-bank public has wealth of \$1000 held in cash, before they decide to switch to bank deposit money. This cash is a private sector asset. It is a liability of the central bank or government, which issued it, but not a liability of the private banks. The first part of Table 8.4 uses simple balance sheets to show this cash as an asset of the non-bank private sector.

Banks				Non-bank public			
Assets		Liabilities		Assets		Liabilities	
1. Initial position							
Cash	0	Deposits	0	Cash	1,000	Bank loans	0
2. People deposit their cash in the banks							
Cash	1,000	Deposits	1,000	Cash	0	Bank loans	0
				Deposits	1,000		
3. Banks make loans of \$9,000 and create \$9,000 in new deposits for customers							
Cash	1,000	Deposits	10,000	Cash	0	Bank loans	9,000
				Deposits	10,000		

Table 8.4: How the banking system creates money

Then people deposit this \$1000 of cash into the banks by opening bank accounts. Banks get assets of \$1000 in cash, distributed among individual banks by their customers and issue total deposit liabilities of \$1000. These deposits are money the banks owe to their depositors. If banks were simply safety deposit boxes or storerooms, they would hold cash assets equal to their deposit liabilities. Their reserve ratio would be 100 percent of deposits, making $rr = 1.0$. Table 8.4 would end with part 2.

However, if the public uses bank deposits as money, the banks don't need all deposits to be fully covered by cash reserves. It is unlikely that all depositors will show up at the same time and demand cash for their deposits. Recognizing this, the banks decide that reserves equal to 10 percent ($rr = 0.10$) of deposits will cover all *net* customer demands for cash. In this case, the many banks have excess reserves which in total equal 90 percent of their deposit liabilities or, initially \$900.

The banks use their excess reserves to expand their lending. Each bank makes new loans equal to its excess reserves. It pays for those loans by *creating an equal amount of deposits*. If you were to borrow from bank your personal deposit would be increased by the amount of the loan. The same thing happens to other people who borrow from their banks.

In our example, all banks combined can create \$9000 of loans based on \$1000 in new cash reserves. In part 3 of Table 8.4, we see loans of \$9000, as assets on the banks' balance sheets, and \$9000 of new deposits to customers, against which they can write cheques or make payments on line or by transfers. The deposits of \$9000 are a liability on the banks' balance sheets. Because the public uses bank deposits as money, the banks can buy new loans by creating new deposits.

Now the banks have \$10,000 total deposits—the original \$1000 when cash was deposited, plus the new \$9000 created by making new loans—and \$10,000 of total assets, comprising \$9000 in loans and \$1000 in cash in the vaults. The reserve ratio is 10 percent in part 3 of Table 8.4 ($rr = \$1000 \text{ cash} / \$10,000 \text{ deposits} = 0.10$ or 10%).

It does not even matter whether the 10 percent reserve ratio is imposed by law or is merely smart profit-maximizing behaviour by the banks that balances risk and reward. The risk is the possibility of being caught short of cash; the reward is the net interest income earned.

Why were the banks able to create money? Originally, there was \$1000 of cash in circulation. That was the money supply. When paid into bank vaults, it went out of circulation as a medium of exchange. But the public got \$1000 of bank deposits against which cheques could be written. The money supply, cash in circulation plus bank deposits, was still \$1000. Then the banks created deposits *not* fully backed by cash reserves. Now the public had \$10,000 of deposits against which to write cheques. The money supply rose from \$1000 to \$10,000. *The public was willing to use bank deposits as money, willing to borrow from the banks and the banks were willing to lend.* This allowed the banks to create money by making loans based on their fractional reserve ratio.

If the currency ratio is not zero the example is a bit more complex. The banks are still able to create deposits but the extent of the deposit creation is limited by the public's withdrawal of currency to maintain the currency ratio as deposits increase. A fall in public confidence in the banks in times

of financial problems and bank failures like those in that arose in the autumn of 2008 and continue today in some European countries would result in a rise in the currency ratio. Bank deposits and lending capacity would be reduced as a result.

Financial panics

Most people know that banks operate with fractional reserve ratios and are not concerned. But if people begin to suspect that a bank has lent too much, made high risk loans or faces problems in raising funds which would make it difficult to meet depositors' claims for cash, there would be a *run on the bank* and a **financial panic**. Recognizing the bank cannot repay all depositors immediately, you try to get your money out first while the bank can still pay. Since everyone does the same thing, they ensure that the bank is unable to pay. It holds cash equal to a small percentage of its deposit liabilities and will be unable to liquidate its loans in time to meet the demands for cash.

Financial panic: a loss of confidence in banks and rush to withdraw cash.

The experience of the Northern Rock Bank in the U.K. starting in the summer of 2007 is an early example financial of panics that developed in the crisis of 2007 to 2009. Northern Rock was one of Britain's largest mortgage lenders. It financed its lending with large denomination, short term **wholesale deposits** from other financial institutions like insurance companies and pension funds, as well as a relatively small amount of retail deposits from individual customers. As the recession and falling property values emerged the financial community began to worry that homeowners would not be able to pay back their mortgages.

If that happened mortgage lenders like Northern Rock would not be able to pay back depositors money, especially the large denomination short term wholesale deposits. This loss of confidence in the value of and repayment of mortgages made current depositors unwilling to continue holding funds in Northern Rock. The risks involved were unknown. News of this collapse in its major source of funds triggered a loss of confidence among depositors, massive withdrawals and the first run on deposits in a British bank in about 140 years.

Wholesale deposits: large denomination short term 30-day and 60-day deposits that pay higher interest rates than retail deposits.

Despite substantial support from the Bank of England and government assurances that deposits were safe, depositors continued to withdraw funds and access to both commercial and retail deposits collapsed, as did the value of the bank's shares on the stock market. In the end, the government, unable to find a suitable private buyer, nationalized the bank in order to prevent a bank

failure that might spread to other financial institutions.

Fortunately, financial panics involving depositor runs on the bank are rare, particularly in Canada. A key reason for this, which we discuss in the next chapter, is that the central bank, the Bank of Canada, and other national central banks, will lend cash to banks in temporary difficulties. Furthermore, deposit insurance plans like the Canadian Deposit Insurance Corporation, CDIC, cover individual bank deposits up to \$100,000 against default. Knowledge of these institutional arrangements helps prevent a self-fulfilling stampede to withdraw deposits before the bank runs out of cash.

However, recent experience shows how financial crises can arise in other ways. Northern Rock was the first casualty of the crisis in the U.S. mortgage market and real estate sector. Once portfolio managers realized that it was difficult if not impossible to evaluate the risks of wholesale deposits, financial institutions were in difficulties if they held those deposits or relied on renewing and issuing new deposits to raise funds. Several large financial institutions in the United States required government rescue or failed. The plight of famous names like Bear Sterns, Countrywide Financial, Fannie May, and Freddie Mac became headline news.

The crisis was not limited to the U.S. financial sector. Banks in Iceland could no longer place new deposits to refinance their wholesale deposits and were taken over by the government. In late 2008 the large Swiss bank USB announced a bailout agreement with the Swiss National Bank to stabilize its financial position after continued difficulties based with its holdings of wholesale deposits. Other European lenders, including Bradford & Bingley in the U.K., and Fortis in Belgium and Luxembourg have been rescued by their governments

Banks in Canada were not immune to the financial difficulties created by the collapse of the commercial paper markets. All the major chartered banks were holding some of the commercial paper that contributed to the market collapse in 2008. They were forced to accept that without a market these assets had no value and funds tied up in them were lost. Fortunately, Canadian banks relied more heavily on strong retail depositor bases as sources of funds. The banks remained financially strong even after their commercial paper losses, and public confidence in the banks did not collapse. No Canadian bank failed or required a government bailout.

By contrast, the financial crisis and the extended real estate and credit collapse created large problems for US banks. Loan and financial asset defaults destroyed bank assets and bank liquidity. Even in the absence of panics and bank runs, many banks become insolvent without sufficient liquid assets to cover their liabilities. Failed bank data illustrates the scale of the problem. The U.S. Federal Deposit Insurance Corporation lists 457 U.S. bank failures over the period January 2008 to September 2012. In the four preceding years, January 2004 to December 2007 there were just 7 US bank failures. (<http://goo.gl/ruzAtM>)

8.5 The monetary base and the money supply

Table 8.1 showed that bank deposits are the major component of the money supply in Canada, as in most industrial countries. Bank deposits depend in turn on the cash reserves held by banks and the public's willingness hold bank deposits and borrow from the banks.

To complete our analysis of how the money supply is determined, we need to examine three things:

1. The first is the source of the cash in the economy.
2. The second is the amount of that cash that is deposited in the banking system, rather than held as cash balances by the public.
3. The third is the relationship between the cash supply to the economy and the money supply that results from public and bank behaviour.

Today, in developed countries, central banks are the source of bank reserves. The central bank, the Bank of Canada in Canada, controls the issue of token money in the form of Bank of Canada notes. These are the \$5, \$10, \$20, \$50, and \$100 bank notes you can withdraw from the bank when you wish to convert some of your bank balance to cash. Bank reserves are mainly the banks' holdings of these central bank notes in their vaults and bank machines. Our bank deposits are now convertible into Bank of Canada notes. The central bank has the responsibility to manage the supply of cash in the economy. We will examine the details of central bank operations in Chapter 10.

The cash the central bank provides to the economy is called the **monetary base (MB)** and is sometimes referred to as the stock of high-powered money. It is the legal tender into which bank deposits can be converted. It is the ultimate means of payment in transactions and the settlement of debts. Notes and coins in circulation and held by the banking system are the main part of the high-powered money issued by the central bank. As we discussed earlier, the commercial banks hold small settlement balances in the central bank to make inter-bank payments arising from cheque clearings.

Monetary base (MB): legal tender comprising notes and coins in circulation plus the cash held by the banks.

The public's decisions about the use of cash or banks deposits determine how much of the monetary base is held by the banks. In our simple example of deposit creation in Table 8.4, we assumed the public deposited all its cash with the banks. This was a useful simplification that ignores the cash people hold. We will drop this assumption in what follows.

Our main interest is the relationship between the money supply in the economy, *the total of cash in circulation plus bank deposits*, and the *monetary base* created by the central bank. Using our

earlier discussion of the fractional reserve ratio in the banking system, we can define a **money multiplier**. The money multiplier provides the link between the monetary base created by the central bank and the money supply in the economy. It also predicts the change in money supply that would result from a change in the monetary base – the money supplied by the central bank.

Money multiplier: the change in the money supply caused by a change in the monetary base.

$$\text{Money supply} = \text{money multiplier} \times \text{monetary base}$$

$$\text{Money multiplier} = \frac{\Delta \text{ money supply}}{\Delta \text{ monetary base}}$$

The value of the money multiplier depends on two key ratios:

1. rr , the banks' ratio of cash reserves to total deposits; and
2. cr , the non-bank public's ratio of cash balances to bank deposits.

Banks' choice of a ratio of cash reserves to total deposits determines how much they can expand lending and create bank deposits based on their reserve holdings. The *lower* the reserve ratio, the more deposits banks can create against given cash reserves, and the *larger* is the multiplier. We saw this relationship earlier in our discussion of Table 8.4.

Similarly, the lower the non-bank public's choice of a ratio of cash to bank deposits, the larger is the share of the monetary base held by the banks. When the banks hold more monetary base, they can create more bank deposits. The lower the non-bank public's currency ratio, the larger are bank holdings of monetary base and the larger the money supply for any given monetary base.

The money multiplier

Suppose banks wish to hold cash reserves R equal to a fraction rr of their deposits D .

$$R = rrD \tag{8.1}$$

The non-bank sector also wishes to hold some money as cash to pay for small purchases. If cash holdings outside the banks, CR , are also a fraction cr of deposits, we can write:

$$CR = crD \quad (8.2)$$

As a result, the monetary base is held either as cash in bank vaults and automatic banking machines or as cash in business cash registers and safes and cash in peoples' wallets, purses, or cookie jars. This means from Equations 8.1 and 8.2 that:

$$MB = (rr + cr)D \quad (8.3)$$

The money supply, M , is the sum of cash in circulation outside the banks and bank deposits. This gives us:

$$\begin{aligned} M &= CR + D \\ M &= (1 + cr)D \end{aligned} \quad (8.4)$$

By dividing Equation 8.4 by 8.3, we can find the ratio of M to MB :

$$\frac{M}{MB} = \frac{(1 + cr)}{(rr + cr)} \quad (8.5)$$

and the money multiplier the defines the change in money supply as a result a change in the monetary base, provided cr and rr are constants is:

$$\frac{\Delta M}{\Delta MB} = \frac{(1 + cr)}{(rr + cr)} \quad (8.6)$$

which will be greater than 1 as long as rr is less than 1.

If, for example, banks want to hold cash reserves equal to 5 percent, and the non-bank public wants to hold cash equal to 10 percent of their holdings of bank deposits, the money multiplier will be:

$$\frac{\Delta M}{\Delta MB} = \frac{(1 + 0.1)}{(0.05 + 0.1)} = \frac{1.1}{0.15} = 7.33$$

The money multiplier tells us how much the money supply in the economy would change as a result of a change in the monetary base. In this example, a \$1 change in the monetary base results in a change in the money supply equal to \$7.33.

We can see from the way we have found the money multiplier that it depends on the decisions made by the banks in terms of their reserve holdings, and the decisions made by the public in terms of their use of cash rather than bank deposits as money. If you experiment with different values for rr and cr , you will see how the money multiplier would change if these ratios were to change.

The importance of bank reserve decisions and public cash holdings decisions is illustrated by recent financial conditions in Europe. As a result of banking crisis and bailouts during and after the financial crisis of 2008, the public had concerns about the safety of bank deposits and were motivated to hold more cash. At the same time banks found it difficult to evaluate the credit worthiness of potential borrowers and the risks involved in holding commercial paper or junior government bonds. Their response was to hold more cash reserves. These shifts in behaviour would reduce the money supply, making credit conditions tighter, unless the central bank provided offsetting increases in the monetary base.

How big is the money multiplier?

Now that we have a formula for the money multiplier, we can ask: What is the size of the multiplier in Canada? Based on data in Table 8.1 above, in February 2014, the monetary base was \$70.6 billion, and the money supply defined as M1B was \$640.6 billion. These data suggest a money supply multiplier

$$\frac{\Delta M}{\Delta MB} = \frac{\$640.6}{\$70.6} = 9.1$$

Each \$100 change in monetary base would change the money supply by about \$910.

However, using a broader definition of money supply such as ‘currency outside banks and all chartered bank deposits’ gives a Canadian money supply of \$1240.9 and a money multiplier of $\$1,240.9/\$70.6 = 17.58$.

It is important to remember that a fall in either the banks’ cash reserve ratio or the private sector’s ratio of currency to bank deposits raises the money multiplier. For a given monetary base the money supply rises. A rise in either or both these ratios reduces the money multiplier and the money supply.

Figure 8.1 summarizes the relationship between the monetary base and the money supply. It shows the monetary base used either as cash in circulation or held as cash reserves by the banks. Since banks operate with fractional reserve ratios, the leverage banks have to expand the money supply through their lending and deposits creation based on their reserves RR . We also see that the money supply is heavily dependent on the size of the monetary base and currency ratios and reserve ratios determined by public willingness to hold bank deposits and bank willingness to lend.

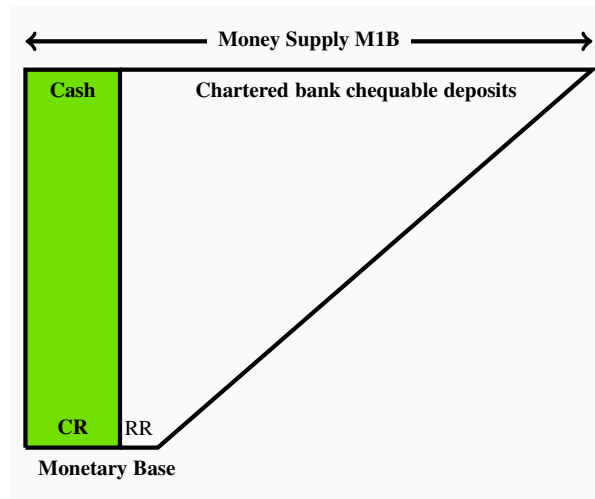


Figure 8.1: The Monetary Base and the Money Supply

The explanation of banking and the money supply in this chapter provides the money supply function we will use in the next chapter. It is combined there with a demand for money function in the money market to determine the equilibrium rate of interest. That rate of interest integrates money and financial markets with the markets for goods and services in aggregate demand.

A simple money supply function illustrates the determinants of the money supply. The three variables we have discussed enter this function, namely:

1. MB , the monetary base;
2. cr , the public's currency ratio; and
3. rr , the banks' reserve ratio.

Using Equation 8.5 above, where M is the money supply, we can write:

$$M = \frac{(1 + cr)}{(cc + cr)} \times MB \quad (8.7)$$

The central bank's control of the monetary base, MB , gives it control of the money supply, M , as long as cr and rr are constant.

Figure 8.2 uses a diagram to illustrate the money supply function and changes in the money supply. The line M_0 shows the size of the money supply for a given monetary base MB_0 and the money

multiplier $\frac{(1+cr)}{(rr+cr)}$. The money supply in this diagram is vertical, because we assume cr and rr are not affected by the interest rate. M is therefore independent of the nominal interest rate i , which is measured on the vertical axis. This is the supply size of the *money market* with quantity measured on the horizontal axis and interest rate, which is analogous to price, on the vertical axis.

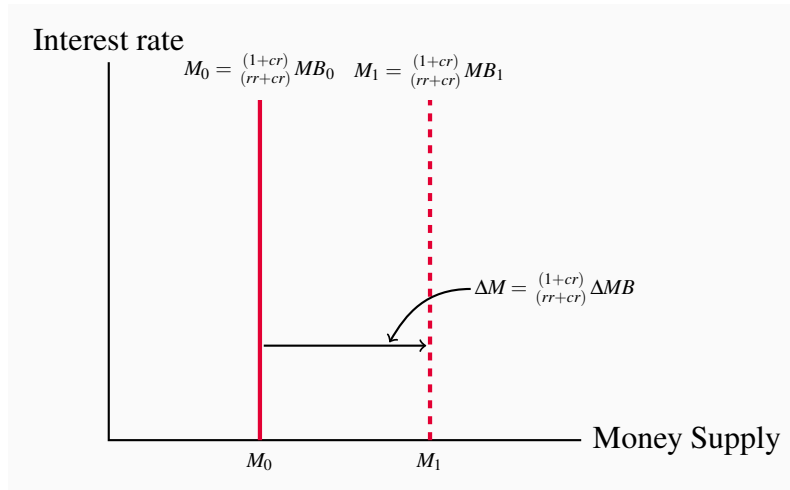


Figure 8.2: The Money Supply Function

Monetary policy

Our money supply function shows us how, *if rr and cr are constant, the central bank's control of the monetary base gives it the power to change money supply and other financial conditions in the economy.* If the central bank increases the monetary base, banks have larger cash reserves and increase their lending, offering favourable borrowing rates to attract new loans and create more deposits. In Figure 8.2 the increase in the monetary base to MB_1 causes an increase in money supply (M) by the change in MB (ΔMB), multiplied by the money multiplier. The money supply function shifts to the right to M_1 . A decrease in the monetary base would shift the M function to the left, indicating a fall in the money supply.

Next

Now that we have examined money, the banking system, and the size of the money supply, we have one important side of the *financial market* that will link money to expenditure and economic activity. This is the supply side of the market. In the next chapter, we will study the reasons why people wish to hold money balances. We also study how the portfolio choices people make

between money and other assets create the demand for money balances. The interaction between the supply of money balances and the demand for money balances determines the prices of financial assets and interest rates. Interest rates in turn provide an important link between money, financial markets, and expenditures in markets for goods and services, both directly and through the foreign exchange rate.

KEY CONCEPTS

Money has four functions: a **medium of exchange** or means of payment, a **store of value**, a **unit of account**, and a **standard of deferred payment**. The medium of exchange function distinguishes money from other assets.

In a **barter economy**, trading is costly because there must be a double coincidence of wants. Money, a medium of exchange, reduces the costs of exchange and allows resources to be used for other things.

A **token money** is a convertible claim on commodity money. Because its monetary value greatly exceeds its production costs, token money economizes on the resource costs of transactions.

Fiat money is money the government has declared **legal tender**. The **central bank** controls the supply of legal tender.

The Canadian **money supply** is the sum of currency in circulation outside the banks and bank deposits.

The **monetary base** is comprised of notes and coins in circulation plus cash held by banks.

The Canadian banking system is made up of a **central bank** and a number of **commercial banks** and other institutions called **near banks**.

Banks are **financial intermediaries**. Bank deposits, which can be transferred by cheque or debit card, provide a convenient means of payment. Bank services plus interest payments on deposits attract funds into the bank. Banks use these funds to make loans, purchase securities, and finance expenditures. The general acceptance of bank deposits as money, and well-developed financial markets, allow modern banks to operate with very low cash reserve ratios.

Banks create money by making loans and creating deposits based on a **fractional cash reserve ratio**, rr . The banks' reserve ratio involves a trade-off between earnings and **bankers' risk**.

The **monetary base** MB is currency in circulation plus banks' cash reserves. The **money multiplier** is a ratio of a change in the money supply to the change in the monetary base that caused it, $\Delta M / \Delta MB$. The money multiplier is larger (a) the smaller is the cash reserve ratio of the banks, rr , and (b) the smaller is the private sector's ratio of cash in circulation to deposits, cr .

The **money supply**, M , is currency in circulation plus bank deposits. The size of the money supply is determined by the monetary base, MB , the banks' cash reserve ratio, rr , and the private sector's currency ratio, cr , is Equation 8.5:

$$M = \frac{(1 + cr)}{(rr + cr)} \times MB$$

EXERCISES FOR CHAPTER 8

Exercise 8.1. What are the functions of money? What is money in Canada today? What is the money supply in Canada today? Are debit cards and credit cards money?

Exercise 8.2. Since both central banks and commercial banks can create money what is the key difference between a central bank, like the Bank of Canada, and the many commercial banks in the financial industry?

Exercise 8.3. Suppose the banks receive \$100 cash from a new deposit of funds previously held outside the banking system. If banks operate with a 5 percent reserve ratio, use simple balance sheets to show by how much this new cash would affect lending and deposits of all banks in the system.

Exercise 8.4. If banks have a 10 percent reserve ratio and the public has a 10 percent currency ratio how much lending and deposit creation can the undertake after they receive a new \$1,000 cash deposit. How much would the public's holding of cash increase? Would it be in the banks' interest to find ways to reduce the currency ratio? Why?

Exercise 8.5. What protection does the Canadian Deposit Insurance Corporation provide for your money if your bank is unable to pay cash to its depositors?

Exercise 8.6. Define the money multiplier and explain how it might be used.

Exercise 8.7. Suppose the banks in the banking system find it prudent to maintain holdings of cash equal to 10 percent of their deposit liabilities, and people find it convenient to hold cash balances equal to 15 percent.

- (a) If the monetary base in the economy is \$1,000, what is the size of the money supply?
- (b) Suppose the monetary base decreased by \$100, would the money supply change? If so, by how much would it change?

Exercise 8.8. Suppose a crisis in financial markets, like the collapse of the asset back commercial paper (ABCP) market in 2007 and 2008, increases the risk banks attach to lending and the non-bank public attaches to bank deposits. What are the implications for the desired reserve ratio, the currency ratio and the money supply multiplier and the money supply?

Exercise 8.9. Using a diagram illustrate and explain the determinants of the position and slope of the money supply function assuming an initial monetary base of \$1000, $rr = 5\%$ and $cr = 10\%$. If the monetary base were to increase by 10% how would the money supply and the money supply function in your diagram change?

Exercise 8.10. Suppose the currency ratio depends on the interest rate such that the non-bank public reduces their cash holdings relative to deposits (cr) as the interest rate rises. Use a diagram to illustrate what effect if any this condition would have on the money supply function.

Chapter 9

Financial markets, interest rates, foreign exchange rates & AD

In this chapter we will explore:

- 9.1 Portfolio choices between money and other assets
- 9.2 Bond prices, yields, and interest rates
- 9.3 The demand for money balances
- 9.4 Financial market equilibrium and interest rates
- 9.5 Interest rates and foreign exchange rates
- 9.6 Interest rates, exchange rates, and aggregate demand
- 9.7 The monetary transmission mechanism

This chapter continues our study of the effects of money and financial markets on economic activity. In Chapter 8, we examined money and the supply of money created by the banking system. The *money supply* was defined as the non-bank public's holdings of currency and bank deposits. In this chapter, we will see that the non-bank public's holdings of money balances arise from decisions about the management of wealth.

Money balances are one asset in a *portfolio* of assets. People choose to hold some of their financial wealth as money and some in other financial assets. These choices create a *demand for money balances*, which we will examine in detail.

The demand for money balances and the supply of money balances form the *money market*. Equilibrium between supply and demand in the money market determines *the interest rate*. That interest rate has important effects on planned expenditure, aggregate demand, output, and employment directly and through its effect on the *foreign exchange rate*.

We start with a brief discussion of portfolio choice and the prices of financial assets.

9.1 Portfolio choices between money and other assets

A financial portfolio is a collection of financial assets. It might include money balances, bonds, equities, mortgages, and mutual funds. The structure of a portfolio, the proportion held in each type of asset, reflects two main characteristics of the assets involved:

1. The *returns* paid by different financial assets
2. The *risks* arising from changes in the market prices of assets

Wealth holders and institutional portfolio managers for pension funds and insurance companies like their portfolios to pay high returns with low risk. To achieve this, they hold mixed portfolios of money and other financial assets.

Suppose you win \$10 million in a lottery. Now that you have wealth, what are you going to do with it? You will no doubt spend some and give some away. That is a wealth effect, but what about the balance of your winnings? You have to make a portfolio choice. Will you hold your wealth as money in the bank? Will you put your money in the stock market? Will you put your money in the bond market?

If you consult a financial planner, he or she will probably recommend a mixed portfolio made up of money, bonds, and equities. That recommendation will be based on your intention to increase your wealth and draw income from it while protecting it from losses in financial markets.

Money holdings are an important part of the portfolio. Money is the medium of exchange. It can be used directly to make payments for goods and services or to settle debts. Other assets, for example bonds, cannot be used as a means of payment. Furthermore, money has a fixed nominal price. It is a “safe asset.” Wealth held as money does not rise or fall with the rise or fall in financial asset prices on stock and bond markets. However, money is exposed to the risk that inflation will lower its real purchasing power.

Other financial assets differ from money in three respects. First, they cannot be used as a means of payment. To use them to make a payment you would first have to sell them for money, at their current market price, and then use the money to make the payment. Second, they offer a return in the form of an interest payment, a dividend payment, or a rise in price that provides income to the portfolio holder. Third, because the prices of financial assets like bonds or stocks fluctuate daily on financial markets, these assets carry the risk that their values may decline significantly from time to time.

Portfolio management recognizes these differences between assets by trading some return for lower risk and greater convenience in the mix of assets held. Money in the portfolio offers the convenience of the means of payment, providing low risk but zero return. Other assets offer a flow of

interest and dividend income, and possible capital gains if asset prices rise, but the risk of capital loss if prices fall.

This portfolio choice between money balances and other assets is the basis for our discussion of the demand for money balances in the remainder of this chapter.

9.2 Bond prices, yields and interest rates

Before we can discuss the demand for money that comes from portfolio decisions, we need to understand the relationship between interest rates, bond coupons, the prices of financial assets, and yields on financial assets. To keep our discussion simple, we will assume only one type of financial asset, a bond. However, the prices and yields of other financial assets are related to interest rates in the same way as bond prices.

Several concepts are important for our discussion. A **bond** is an asset that makes one or more *fixed money payments* to its holder each year until its maturity date. On its maturity date, it also repays its principal value.

Bond: a financial contract that makes one or more fixed money payments at specific dates in the future.

The **interest rate** the *current* market rate, expressed as a percentage, paid to lenders or charged to borrowers.

Interest rate: the current market rate paid to lenders or charged to borrowers.

A **bond coupon** is the *fixed money payment* made *annually* to the holders of the bond from the date of issue until the date of maturity. The coupon rate is a fixed percentage of the principal value of the bond at the time of issue.

Bond coupon: the *annual* fixed money payment paid to a bond holder.

The **price of a marketable bond** is the current price at which it can be bought or sold on the open bond market at any time between its date of issue and its maturity date.

Price of a marketable bond: the current price at which the bond trades in the bond market.

The **yield on a bond** is the return to a bond holder expressed as an annual percentage rate, which is a combination of the coupon payments and any change in the market price of the bond during the period in which it is held.

Yield on a bond: the return to a bond holder expressed as an annual percentage.

The ongoing and continuous purchases and sales of bonds on the bond market establish the equilibrium prices of bonds. At those prices, the *yields* on the bonds at that point in time are equal to the market rate of interest. Changes in bond prices with changing bond market conditions change yields and market interest rates. In late 2008, for example, uncertainty in financial markets led portfolio managers to shift to low-risk assets like Government of Canada bonds. This increased demand for bonds bid bond prices up, and yields on Government of Canada 1-to-3 year bonds fell from 3.22 percent in January 2008 to 1.11 percent in December 2008. In the same period, yields on 3-to-5 year bonds fell from 3.45 percent to 1.61 percent.

With slow recoveries from the recession that followed the 2008-09 financial crisis monetary policy shifted to low interest rates to provide economic stimulus. These low policy rates, slow economic growth continue in 2014 and the effects have spread across terms to maturity in the bond market. As of late April 2014 Government of Canada benchmark bond yields were: 3 year 1.21 percent, 5 year 1.71 percent and 10 year 2.45 percent.

Consider an example that shows the relationship between bond coupons, current market interest rates, bond prices, and yields. Suppose one such bond is listed as:

Government of Canada 4.250 June 1, 2017

This is a *marketable* 4.25 percent bond with a maturity date of June 1, 2017. It promises to pay its holder \$4.25 for each \$100 of face value on June 1 each year until June 1, 2017. The \$4.25 is the *coupon* value and \$100 is the *principal* value. On June 1, 2017, the bond matures and pays \$104.25, the coupon plus the principal.

Bond prices depend on current market interest rates. The **current price of a bond** is the present value of the future payments it will provide. **Present value** is the *discounted* value of those future payments. It recognizes that money payments in the future are worth less than money payments today. To help understand present value, ask the following question: If someone offers to give you \$1000, would you rather have it today or a year from today?

Bond price: the *present value* of future payments of interest and principal.

Present value is the *discounted* value of future payments.

Notice that \$1000 *lent* at an interest rate of 3 percent would give you a sum of:

$$\$1,000 \times (1.03) = \$1,030$$

one year from today. In the same way, the amount of money you need to lend today to have \$1000 one year from today is:

$$\begin{aligned} \$M \times (1.03) &= \$1,000 \\ \$M &= \frac{\$1,000}{(1.03)} \\ \$M &= \$970.87 \end{aligned}$$

When the market rate of interest is 3 percent, the present value of \$1000 to be received one year in the future is \$970.87.

By experimenting with different interest rate assumptions in this present value calculation you will see that the present value of \$1,000 to be paid one year from today changes with the rate of interest. Higher interest rates reduce present values while lower rates increase them.

This relationship is the key to understanding bond prices and how they fluctuate over time. A rise in market interest rates lowers the prices of outstanding bonds. A fall in market rates increases bond prices. Bond prices and interest rates move inversely. A couple of examples illustrate this relationship.

First consider the price of the 4.25 percent bond described above. *Let's assume that the 3 year market rate of interest on the date you buy the bond, say June 1, 2014 is 4.25 percent.* The price of the bond is the present value of the future payments: \$4.25 on June 1, 2015, \$4.25 on June 1, 2016, and \$104.25 on June 1, 2017. Payments to be received two years in the future are discounted twice, and three years in the future three times, to give:

$$\begin{aligned} PV &= \frac{\$4.25}{(1.0425)} + \frac{\$4.25}{(1.0425)^2} + \frac{\$104.25}{(1.0425)^3} \\ PV &= \$4.076 + \$3.911 + \$92.013 \\ PV &= \$100.00 \end{aligned}$$

If you paid \$100 for each \$100 of face value and held the bond to maturity, it would *yield* 4.25 percent, the current market rate of interest *assumed in this example*. We would say the bond is trading *at par* because the market price equals the face value.

As an alternative example *let's assume that the 3 year market rate of interest on your purchase date June 1, 2014 is 1.75 percent*, which is closer to current rates. The price of the bond is then the present value of the future payments: \$4.25 on June 1, 2015, \$4.25 on June 1, 2016, and \$104.25 on June 1, 2017. Payments to be received two years in the future are discounted twice, and three years in the future three times, to give:

$$\begin{aligned}
 PV &= \frac{\$4.25}{(1.0175)} + \frac{\$4.25}{(1.0175)^2} + \frac{\$104.25}{(1.0175)^3} \\
 PV &= \$4.177 + \$4.125 + \$98.962 \\
 PV &= \$107.26
 \end{aligned}$$

The price of this 4.25 percent bond on June 1, 2014 would be \$107.26 per \$100 of face value. The assumption that the market rate of interest is 1.75 percent, which is clearly lower than the 4.25 percent coupon on the bond, means the bond trades at a *premium*. The premium price means that buying the bond and holding it to its maturity date will give you an annualized return of 1.75 percent on your money. That is the assumed 3 year rate.

In this case the **yield on the bond**—the present value of its coupon payment plus the **capital loss** as its price falls to par at maturity—gives a rate of return equal to the market interest rate of 1.75 percent.

Yield on a bond: the coupon plus any **capital gain or loss** from the change in price between the date of purchase and the date of maturity.

In general, because the future payments offered by bonds are fixed in dollar terms, the *prices of marketable bonds vary inversely to market rates of interest*. Rising interest rates mean falling bond prices, and falling interest rates mean rising bond prices. There are many types of bonds that differ by coupon, maturity date, frequency of future payments, and in other ways. However, the relationship between prices, yields, and interest rates remains the same. Because bond prices are the present value of future payments, prices and interest rates move in opposite directions.

Furthermore, the size of the change in the price of a bond as a result of a change in the interest rate depends on the bond's term to maturity. The prices of longer-term bonds are more volatile than those of shorter-term bonds. This an important consideration for bond portfolio managers concerned with trade-offs between risk and return. To see this, rework the numerical example where the term to maturity is one year rather than three.

Bond markets in action

Asset markets like the bond market are very active. Large volumes of bonds are bought and sold every business day. If portfolio managers see bond prices that offer yields higher than current market interest rates, they buy bonds. Buying makes prices rise and yields fall until yields and current interest rates are equal. Conversely, if bondholders find yields are lower than interest rates, they sell bonds, bond prices fall, and yields rise. Table 9.1 provides a sample of the information on bond prices and yields. The first three columns define the bond. The next two give current prices and yields.

Issuer	Coupon	Maturity Date	Price	Yield
Trans Canada Pipe	5.1	11/01/2017	108.81	1.77
Saskatchewan	5.5	17/06/2019	115.59	2.28
Canada	1.5	01/06/2023	93.70	2.27

Table 9.1: Bond prices and yields, April 16, 2014

A Trans Canada Pipe 5.10 percent coupon is the first listed in Table 9.1. It matures on the 11th day of January 2017, about 32 months from the date of this quotation. The price is what sellers or buyers were willing to accept or pay for some of these outstanding bonds. The final column reports the yield to maturity from buying this bond in April 2014 and holding it until January 2017. These yields also reflect the market rate of interest for 32-month money on April 16, 2014, which is 1.77 percent.

The first two bonds reported in the table are trading at a premium. Their market prices exceed \$100 for \$100 of principal value, and their yields to maturity are lower than their coupons. The third bond is trading at a discount. The coupons paid by the bonds reflect market interest rates at the time the bonds were issued. Three and five year market interest rates at those times were higher than on April 2014. The borrowers had to offer higher coupons to sell bonds in the market conditions at the time of issue. The ten market year rate was lower than the *April 2014* ten year market rate when the 1.5% coupon Canada was issued. Consequently, it traded at a discount in April 2016.

The fall in Canadian interest rates over the past few years has been good for bondholders. As our calculation of bond prices tells us, falling interest rates raise bond prices. Bondholders enjoyed capital gains as the prices of their bonds rose, in addition to the interest income their bonds paid. We see these higher bond prices in the table.

Of course, market conditions can change. If interest rates were to rise from the 2012 levels, bond

prices would fall. Bondholders would suffer capital losses as interest rates rose and bond prices fell. This is the *market risk* that comes with holding bonds and other marketable financial assets.

Bonds are only one of the alternatives to money in a wealth portfolio. Application Box 9.1 describes some other assets, their prices and yields, in a bit more detail. To understand the demand for money balances and the operation of financial markets, we need to know how these financial assets, which are alternatives to money balances, differ from money. The choice to hold money balances, regardless of motive, is a choice between money and other forms in which wealth could be held.

There are three broad classes of financial assets that are bought and sold in financial markets. These are bills, bonds, and equities.

Bills are short-term financial assets that make no interest payment to the holder but do make specified cash payment on their maturity date. They trade at a discount. A government treasury bill or T-Bill is an example. Every second week the government sells T-Bills that promise to pay the buyer \$100 for each \$100 of face value on the date that is about three months in the future. The interest earned is the difference between the price paid and the face amount received at the maturity date.

Bonds are longer-term financial assets that pay a fixed money income payment each year and repay their face value on a fixed maturity date. Bonds are marketable, and trade on the bond market between their issue dates and maturity dates at prices determined by supply and demand. As with T-Bills, the return to the holder of a bond depends on the price paid for the bond. In this case, the calculation is more complex however, because it involves a fixed annual money payment and a fixed value at maturity.

Equities are shares in the ownership of the business. They give the holder the right to a share in the profits of the business, either in the form of dividend payments or in terms of the increase in the size of the business if profits are used for business expansion. The shares or stocks in publicly traded businesses can be bought and sold on stock markets like the Toronto Stock Exchange. The financial pages of major newspapers give you daily reports on stocks prices and stock markets. Shareholders returns from their stock holdings depend on the combination of dividend income they receive and the changes in the market price of the shares they hold. Equity prices are the expected value of the future profits of business. Because expectations of future business performance are volatile, equity prices are volatile and therefore risky. Equities do however offer the prospect of higher long-term returns.

Application Box 9.1: A basic guide to financial assets

9.3 The demand for money balances

Canadians held of M2 money balances of \$1,249 billion in April 2014. Three variables that may explain the size of these holdings are: interest rates, the price level, and real income. Together they provide a theory of the demand for money.

Why hold money?

It is important to distinguish between money and income discussing the demand for money. You might have a high income but no money, or no income and lots of money. That is because income is a flow of funds over a period of time. If you spend your income as it is received you will not accumulate a *stock of money*. Alternatively, you might have a stock of money or a money balance but no income. Then you can choose to either hold or spend your money. If you have no income you can finance a flow of expenditures by spending your money balance.

In Chapter 8, money was a means of payment and a store of value. Those two functions motivate the demand to hold at least some wealth in money balances. There are alternative stores of value. Bonds, equities, precious metals, real estate, and art are a few examples. The quantity of money people choose to hold is part of the *portfolio decision* they make about their wealth. They choose money instead of some other asset.

To develop the demand for money balances it is useful to simplify the portfolio decisions by assuming there are only two assets:

1. *Money*, which has a constant money price, pays no interest income but does serve as the means of payment.
2. *Bonds*, representing all interest-earnings assets, have money prices that change if market interest rates change, but not means of payment.

The financial wealth people build up by saving some of their income calls for a decision. People could hold this wealth as money, which pays no interest, but is a *safe asset* because its price is constant. Or they could hold this wealth in bonds, which pay interest income but are *risky* because bond prices move up and down as market interest rates move down and up. If the *expected return* to holding bonds, because the interest rate together with any change in price is positive, why would people hold any money balances?

The demand for money comes in three parts, namely:

1. The transactions demand;

2. The precautionary demand; and
3. The asset or speculative demand.

The transactions demand

As the name suggests, the transactions demand for money is based on money being the means of payment. People and businesses hold some money to pay for their purchases of goods, services and assets. This demand reflects the lack of coordination of receipts and payments. Income is paid bi-weekly or monthly but purchases are made more frequently and in smaller amounts. Pocket money and bank balances that can be transferred by debit card are readily available to make these purchases between paydays. If all income receipts were used on paydays to buy bonds to earn interest income it would be costly and inconvenient to sell bond holdings bit by bit as payments were made. The costs of frequent switching between money, bonds and money would more than offset any interest income earned from very short term bond holdings.

The precautionary demand

Uncertainty about the timing of receipts and payments creates a precautionary demand for money balances. There are two sides to this uncertainty. On one side there may be some unexpected changes in the timing or size of income receipts. Regular payments can still be made if enough money is available, over and above that need for usual expenses and payments. Alternatively, unexpected or emergency expenses in terms of appliance, computer or car breakdowns or unexpected opportunities for bargains or travel can be covered by precautionary money holdings. Money balances cover the unexpected gaps between income receipts and payment requirements without the costs and inconvenience of selling bonds on short notice.

The asset or speculative demand

The asset or speculative demand comes from financial portfolio decisions rather than the lack of coordination and uncertainty behind the two preceding demands. Businesses and professional portfolio managers use money balances to take advantage of expected changes in interest rates. Essentially they speculate by switching between bonds and money based on their own forecasts of future interest rates.

Recall that bond prices and interest rates vary inversely. If while holding money balances you predict a fall in interest rates you should buy bonds. If your prediction is right and interest rates do fall the prices of your bonds rise. Now you can sell and harvest the capital gain you earned by speculating in the bond market. Alternatively, if you correctly predict a rise in interest rates before

it happens you can avoid a capital loss on your bond holds by selling and holding money before the interest rate rises.

Even if portfolio managers are not interested in speculating on interest rate changes there is an asset demand for money. A mixed portfolio of money and bonds is less risky than one that holds only bonds. The money component has a stable market price, while the bond component provides interest income along with the risk of a variable price. Changing the shares of money and bonds in the portfolio allows the manager a trade-off between return and risk. However, as interest rate rise the opportunity cost of holding a share of the portfolio in money rises and the estimated risk from the bond share may fall if interest rates are expected to fall in the near future. As a result rising interest rates reduce the asset demand for money balances.

The demand for money function

We can summarize the demand for money balances using a simple equation. Suppose we let the size of the real money balances people wish to hold for transactions and precautionary reasons be a fraction k of GDP. In Chapter 4 we defined nominal GDP as real GDP times the GDP deflator, P , to give nominal GDP = PY . Using this notation, the demand for *nominal* money balances for transactions and precautionary reasons is kPY , and the demand for *real balances* is kY , where k is a positive fraction. When real income changes, bringing with it changes in spending, the change in the demand for real money balances changes is determined by k .

What is the value of k in Canada? In the first quarter of 2014, Canadians held money balances as measured by M2 of \$1,249 billion. Nominal GDP in that quarter was \$1,746 billion measured at an annual rate. If we divide M2 holdings by GDP, we get $k = 0.71$, or about 70 percent of annual income. This value of k suggests that a rise in GDP of \$100 will increase the demand for M2 money balances by \$70, measured in either nominal or real terms.

Changes in nominal interest rates change the size of the money balances people wish to hold, based on the asset motive. A rise in interest rates increases the opportunity cost of holding money balances rather than bonds. As a result, people will want to use some of their money balances to buy bonds, changing the mix of money and bonds in their wealth holdings. A fall in interest rates has the opposite effect.

The way people adjust their portfolios in response to changes in interest rates results in a negative relationship between the asset demand for money balances and the nominal interest rate. We can use the parameter to measure the change in money balances demanded, L , in response to a change in interest rates. Then $-h = \Delta L / \Delta i$, which is negative. If individual and institutional portfolio managers' decisions are very sensitive to the current interest rates, h will be a large negative number. A small rise in interest rates will cause a large shift from money to bonds. Alternatively, if portfolio decisions are not at all sensitive to interest rate changes, h would be zero.

Putting these components of the demand for real money balances together gives the demand for

money function, which is a demand to hold real money balances L :

$$L = kY - hi \quad (9.1)$$

Figure 9.1 shows the relationship between the demand for real money balances and the interest rate, drawn for a given level of real GDP, Y_0 . The demand for money function would have an intercept of kY_0 on the horizontal axis. At higher interest rates the opportunity cost of holding money balances is higher because the expected return from holding bonds is positive. The negative slope of the demand function shows how people change their demand for money when interest rates change. The slope of the demand curve for money is $-1/h$. The effect of a change in the interest rate is shown by a movement along the L function. A change in real income would require us to draw a new demand for money function, to the right of L_0 if Y increased, or to the left if Y decreased.

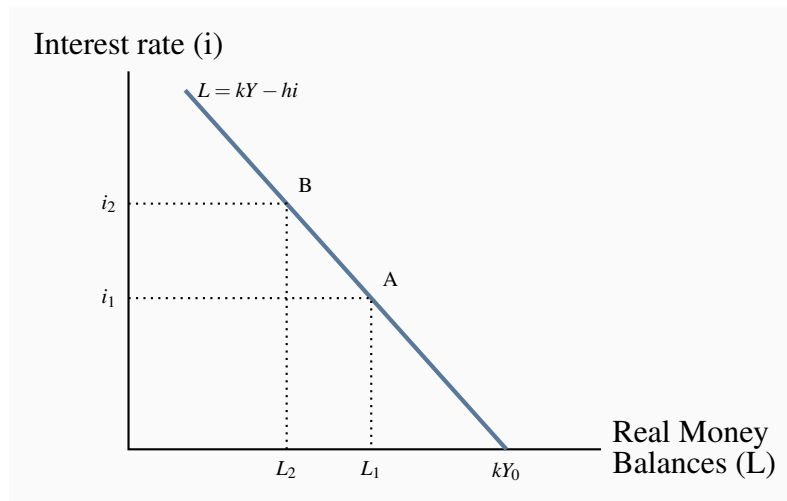


Figure 9.1: The Demand for Real Money Balances

This straight line demand for money function is a useful simplification for our work. However, it would be more realistic to draw the function with a decreasing slope as interest rates decline. That would capture two important ideas. First, as interest rates fall, and fall relative to the costs of buying and selling bonds, opportunity costs decline faster than interest rates. Second, consider the speculative demand for money. As interest rates fall the riskiness of bonds increases. A subsequent rise in interest rates has a larger negative effect on bond prices. Expectations of future increases in interest rates may strengthen as interest rates decline. As a result, portfolio managers may shift funds increasingly from bonds to money as interests fall. If their expectations are confirmed by events they avoid the capital losses caused by falling bond prices.

9.4 Financial market equilibrium & interest rates

Now we combine the money supply and the demand for money to show how financial market equilibrium determines nominal interest rates. We have a *nominal* money supply from the monetary base and the money multiplier from Chapter 8, namely Equation 8.5:

$$M = \frac{(1 + cr)}{(rr + cr)} \times MB$$

The demand for money is a demand for *real* money balances as determined by real income and interest rates.

$$L = kY - hi$$

The **real money supply** is simply the nominal money supply M divided by the price level P , M/P , which measures its purchasing power in terms of goods and services.

Real money supply (M/P): the nominal money supply M divided by the price level P .

The central bank, as the source of the monetary base MB , controls the nominal money supply, *as long as the currency ratio cr and the reserve ratio rr are constant*. In the next chapter we will see how the central bank might manage the monetary base. As long as we keep our assumption that the price level is fixed, the central bank also controls the real money supply. (In later chapters, we allow the price level to change.) Changes in nominal money tend to lead eventually to changes in prices. However, the central bank can still control the real money supply in the short run—it can change M faster than prices P respond—but in the long run other forces determine real money M/P . For the moment, we continue to treat the price level as fixed.

Money market equilibrium

Figure 9.2 combines the demand curve for real money balances from Figure 9.1 with the money supply function we saw in Figure 8.2 above into a money market diagram. The demand curve is drawn for a given level of real income, Y_0 , and the supply curve for a given monetary base MB_0 . With a given price level, the central bank controls the supply of nominal and real money. The supply curve is vertical at M_0/P_0 . Equilibrium in the money market is at E. At the interest rate i_0 , the real money balances people wish to hold just equal the money supplied by the central bank and the banking system.

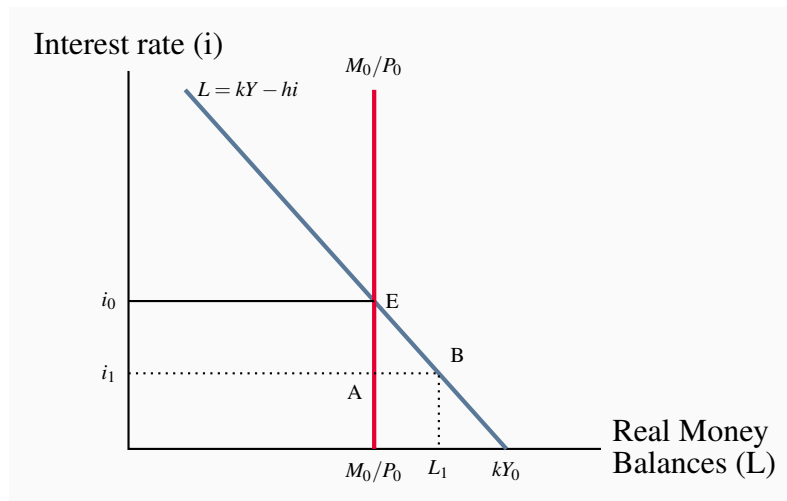


Figure 9.2: Equilibrium in the Money Market

To see how this market operates, suppose the interest rate is i_1 , lower than the equilibrium level i_0 . There is excess demand for money in the amount AB in the diagram. People want to hold money balances equal to B at the interest rate i_0 , but only A is available. How does the market adjust to remove this excess demand? The answer lies in our previous discussion of the portfolio decisions that distribute wealth between money holdings and bonds.

Consider the interaction between the bond and money markets. When portfolio managers want to restructure their holdings of bonds and money they do so by buying or selling bonds on the bond market. Their actions cannot change the supply of money balances. That is fixed by the monetary base and the money supply multiplier. As a result, bond prices and interest rates change to maintain money market equilibrium.

In Figure 9.2 the excess demand for money at the interest rate i_1 will result in a rise in interest rates. With an excess demand for money, people sell bonds to adjust their money balances. There is an excess supply of bonds. Bond prices fall. Lower bond prices mean higher bond yields and interest rates, as you will recall from our earlier discussion of asset prices and yields. The higher interest rates reduce both the excess supply of bonds and the excess demand for money. The money market adjusts by *moving along* the L curve from B to E , as people want smaller money balances relative to their bond holdings at higher interest rates.

From now on, when we discuss adjustments in the money market caused by changes in either the demand for or supply of money balances, those adjustments involve trades in bonds that change bond prices and interest rates to maintain money market equilibrium.

Changes in financial market equilibrium

A shift in either the money supply or money demand changes equilibrium in the money market (and the bond market). Interest rates move to restore equilibrium. Figure 9.3 and 9.4 gives examples.

The effect of a change in the money supply

Suppose the central bank lowers the monetary base and the money supply contracts. For a fixed price level, lower nominal money reduces the real money supply. Figure 9.3 shows this leftward shift in the money supply curve from M_0/P_0 to M_1/P_0 . The equilibrium interest rate rises from i_0 to i_1 as people sell bonds. A higher interest rate reduces the quantity of real money balances demanded, moving along the demand curve $L(Y_0)$, bringing quantity of balances demanded into line with the reduced supply. Hence, a lower money supply raises equilibrium interest rates. Conversely, a rise in the money supply lowers the equilibrium interest rate.

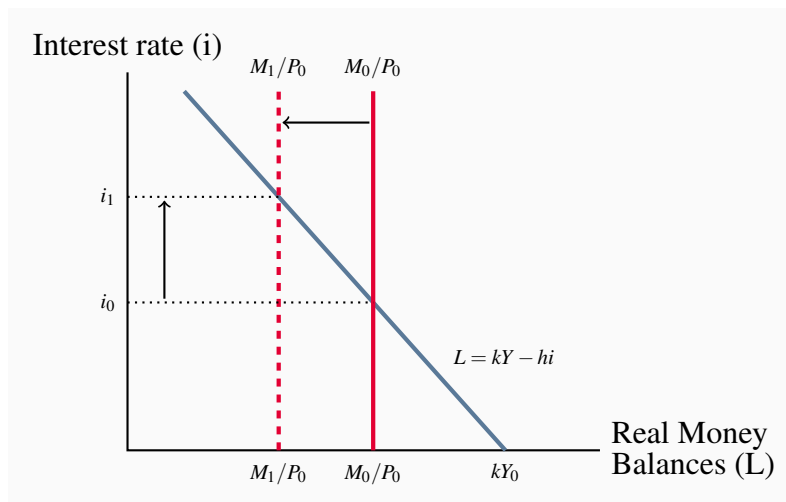


Figure 9.3: Effect of a Fall in the Money Supply

The effect of a change in real income

Figure 9.4 shows real money demand $L(Y_0)$ for the real income Y_0 . A rise in real income increases the quantity of real money balances demanded at each interest rate, shifting the demand for money function from $L(Y_0)$ to $L(Y_1)$. The equilibrium interest rate rises as portfolio managers sell bonds in an attempt to increase their money holdings. The rise in the interest rate lowers the quantity of real balances demanded, moving along the money demand function $L(Y_1)$, and keeps demand for

money equal to the unchanged supply. Conversely, a fall in real income would shift the demand for money to the left and reduce the equilibrium interest rate.

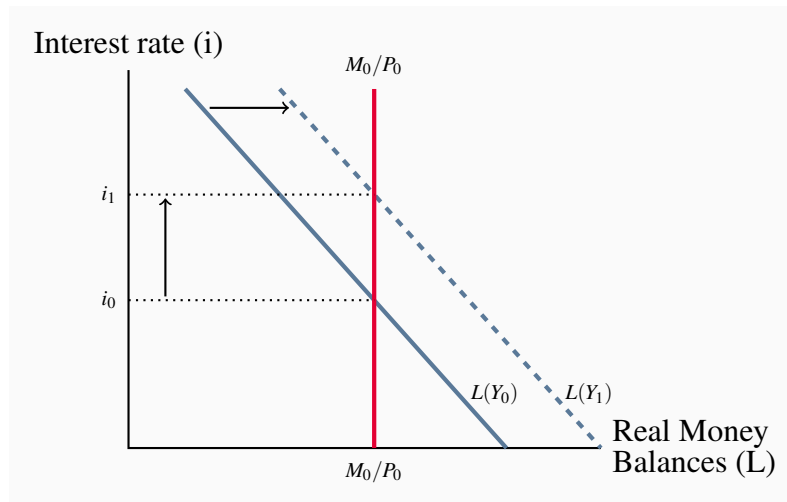


Figure 9.4: Effect of a Rise in Real Income

9.5 Interest rates and foreign exchange rates

The interest rates determined in the money market have important effects on the **foreign exchange rate**. With free international trade in financial assets, portfolio managers, having chosen to hold some part of their portfolios in bonds, have an additional choice. They can hold some bonds issued by domestic borrowers and some issued by foreign borrowers. They might, for example, hold some bonds issued by the Government of Canada, some issued by the United States Treasury and some issued by other governments. Similarly, residents of other countries can choose to include bonds issued by the Government of Canada in their holdings. These choices are made on the basis of the yields on bonds established by conditions in different national money and bond markets.

Foreign exchange rate: the domestic currency price of a unit of foreign currency.

To achieve the highest return on the bond portion of their portfolios, managers buy bonds that offer the highest rate of return for a given level of risk. If interest rates are constant in other financial markets, a rise in Canadian interest rates and bond yields makes Canadian bonds more attractive to both domestic and foreign bondholders. The demand for Canadian bonds increases. A fall in Canadian interest rates has the opposite effect.

Bonds are issued and priced in national currency. Most Government of Canada bonds are denominated in Canadian dollars. U.S. Treasury bonds are denominated in U.S. dollars, and bonds issued by European governments are denominated in euros. If Canadians want to purchase bonds on foreign bond markets they need foreign currency to make payment. Similarly, if residents of other countries want to purchase Canadian bonds they need Canadian dollars to make payment. These *foreign exchange* requirements for trading in financial assets are the same as those for trading in goods and services. The foreign exchange market is the market in which currencies of different countries are bought and sold and foreign exchange rates are determined.

Figure 9.5 shows both the domestic money and foreign exchange markets. The domestic money market is the same as in Figure 9.3 and 9.4. The foreign exchange market shows the supply and demand for foreign exchange, in this case of the U.S. dollar, and the exchange rate which is the Canadian dollar price of one U.S. dollar. The intersection of the supply and demand curves in the foreign exchange market determines the equilibrium foreign exchange rate.

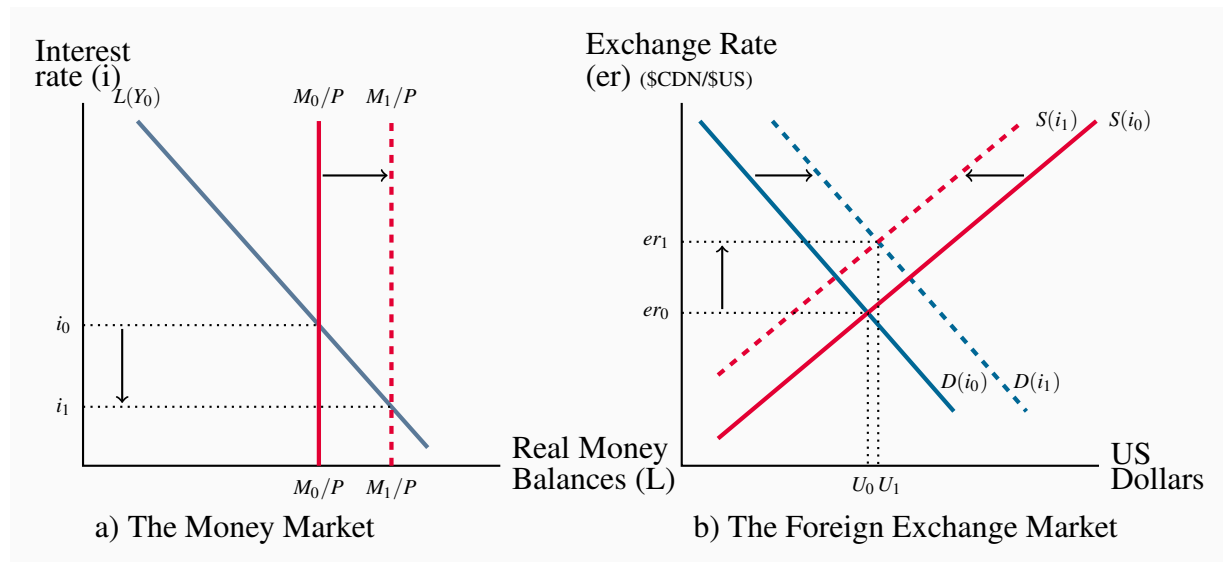


Figure 9.5: Interest Rates and Foreign Exchange Rates

The supply of U.S. dollars on the foreign exchange market comes from the export of goods, services, and financial assets to U.S. residents. Sales of crude oil, lumber, potash, auto parts, financial services, financial assets, and other exports generate receipts in U.S. dollars. Canadian exporters with costs denominated in Canadian dollars sell their U.S. dollar receipts on the Canadian foreign exchange market for Canadian dollars. This is the supply of U.S. dollars on the market.

In Figure 9.5 Panel b) the upward sloping supply curve shows quantities of U.S. dollars coming to the market at different exchange rates, *all other things held constant*. It slopes upward because higher exchange rates lower the prices of Canadian goods and services in foreign markets. As a

result, exports of goods and services, and total receipts from export sales increase, giving a positive slope.

The downward sloping demand curve is also drawn on the assumption that all things except the exchange rate are constant. It is derived from Canadian demand for imports of U.S. goods, services, and financial assets. A fall in the exchange rate lowers the Canadian dollar price of imported goods and services and increases Canadian expenditure on imports. As a result the demand curve for U.S. dollars is downward sloping.

The link between the foreign exchange rate and the money market comes from the interest rate. Demand and supply curves are drawn on the assumption that interest rates, among other things, are constant. This assumption determines the *positions* of the supply and demand curves in the foreign exchange market. However, if the domestic interest rate changes, the supply and demand curves in the foreign exchange market will shift and change the equilibrium exchange rate. Figure 9.5 gives an example.

The solid lines in Figure 9.5 give the initial equilibrium conditions in both the money market and the foreign exchange market. With interest rate i_0 in the money market, the supply and demand curves are $S(i_0)$ and $D(i_0)$ in the foreign exchange market. The intersection of the supply and demand curves determines the equilibrium exchange rate er_1 . This exchange rate is the Canadian dollar price of a U.S. dollar. It was about $\$1.13\text{Cdn} = \1.00U.S. in late-2014 as energy and commodity prices declined. It had been about $\$0.98\text{Cdn} = \1.00U.S. in early 2011.

A change in the domestic money market changes interest rates and, in turn, the foreign exchange rate. The dotted lines in the diagram show the effect of an increase in the domestic money supply. Money and bond market adjustments to the increased money supply lower the interest rate from i_0 to i_1 . At these lower interest rates domestic bond yields are lower relative to foreign bond yields than they were before. This provides the incentive for domestic portfolio managers to switch their purchases from domestic bonds to foreign (U.S.) bonds. To pay for foreign bonds they need foreign currency. The demand for U.S. dollars increases to $D(i_1)$ in Panel b) of the diagram.

Simultaneously, bond holders in the U.S. shift their purchases from the now relatively low-yield Canadian bonds to U.S. bonds. Lower exports of securities to the U.S. market reduce the supply of U.S. dollars to $S(i_1)$ in Panel b) of the diagram. This negative shift in supply combined with the positive shift in demand results in a **depreciation of the Canadian currency**. If the exchange rate er_0 was $\$1.02\text{ Cdn} = \1.00 U.S. , the exchange rate er_1 would be somewhat higher, say $\$1.03\text{ Cdn} = \1.00 U.S.

Depreciation of the national currency: a decline in the value of the currency relative to other national currencies, which results in a rise in the domestic price of foreign currencies.

In this example a fall in domestic interest rates, other things constant, causes depreciation in the domestic currency relative to foreign currencies. This interest rate-exchange rate linkage is sym-

metrical. Rises in domestic interest rates cause **appreciation of the national currency**.

Appreciation of the national currency: an increase in the value of the currency relative to other national currencies, which results in a fall in the domestic currency price of foreign currencies.

A decrease in the money supply or a change in the demand for money with a fixed money supply would affect the foreign exchange rate through the same linkages. Changes in domestic financial markets and foreign exchange markets happen simultaneously. With current communications and information technology these markets adjust very rapidly and continuously. The changes in interest rates and foreign exchange rates that result from changes in domestic money market conditions have important effects on aggregate expenditure and aggregate demand.

9.6 Interest rates, exchange rates, and aggregate demand

Bond prices, interest rates, and exchange rates determined in money and financial markets play a key role in our study of aggregate demand and output. Interest rates and exchange rates link changes in money and financial markets to the expenditure decisions that determine aggregate demand.

The impact of financial markets, interest rates, and exchange rates on aggregate expenditure, aggregate demand, and real output is described by the **transmission mechanism**. It has three important channels, namely:

1. the effect of interest rate changes on consumption expenditure;
2. the effect of interest rate changes on investment expenditure; and
3. the effect of interest rate changes on foreign exchange rates and net exports.

Transmission mechanism: links money, interest rates, and exchange rates through financial markets to output and employment and prices.

Interest rates and consumption expenditure

The basic consumption function in Chapter 6 was illustrated by a straight line relating aggregate consumption to disposable income. The positive slope of that line, the marginal propensity to con-

sume, showed the change in consumption expenditure that would result from a change in disposable income. The vertical intercept of the consumption function showed *autonomous consumption* expenditure, the consumption expenditure *not* determined by disposable income. Changes in income moved households *along* the consumption function. Changes in autonomous consumption expenditure changed the vertical intercept, shifting the consumption function up or down.

Changes in interest rates affect autonomous consumption expenditure in two ways.

1. Through a **wealth effect** from changes in the prices of financial assets; and
2. Through a **cost of credit** effect.

Wealth effect: the change in expenditure caused by a change in real wealth.

Cost of credit: the cost of financing expenditures by borrowing at market interest rates.

As a result falling interest rates raise financial asset prices and rising interest rates reduce financial asset prices. This means that changes in interest rates change the wealth held in household portfolios. A fall in market interest rates raises household financial wealth which increases household consumption expenditure. Autonomous consumption expenditure increases. A rise in interest rates would reduce autonomous consumption expenditure.

Changes in interest rates also have important effects on house prices by changing the **cost of credit**, changing the present values of rental incomes, and changing the market prices of residential real estate. Households may use the market values and equity in their housing to set up home equity lines of credit. This borrowing is used to finance other expenditures. Autonomous consumption expenditures change as interest rate changes change the cost and extent of this financing.

Recently, the Canadian Minister of Finance has expressed concern about the level of household indebtedness caused by these borrowing practices. Similar borrowing against home equity magnified the effect of the 2008 financial crisis in the US and the subsequent impacts of falling house prices on consumption expenditure.

Thus, two forces—wealth effects, and availability and cost of credit—explain the effects of money on planned consumption expenditure. This is one part of the *transmission mechanism* through which money and interest rates affect expenditure. Operating through wealth effects and the supply and cost of credit, changes in money supply and interest rates *shift* the consumption function. We can recognize the effects of both income and interest rates on consumption by using an equation, namely:

$$C = (Y, i) \tag{9.2}$$

with a positive marginal propensity to consume out of national income, $0 < (\Delta C/\Delta Y) < 1$, and a negative relationship between consumption and interest rates, $\Delta C/\Delta i < 0$.

When consumption expenditure is plotted relative to national income as in the 45° line diagrams of Chapters 6 and 7, a change in the interest rate *shifts the consumption function* but does not change its slope. But it is a change autonomous consumption expenditure that will have an change AE and, working through the multiplier, change AD, output, and employment

Interest rates and investment expenditure

In Chapters 4 and 6 we defined investment expenditure as the purchase of currently produced fixed capital, which includes plants, machinery and equipment; and inventories of raw materials, components, and finished goods. Spending on new residential and non-residential construction is also included in investment. We assume investment is independent of current income and therefore an autonomous component of aggregate expenditure. However, the interest rates determined in money and financial markets affect investment expenditure.

The data in Chapters 4 and 6 showed investment at about 20 percent of GDP in 2013 but with the *level* of investment spending changing from year to year within a range of ± 20 percent. Although the total change in inventories is quite small, this component of total investment is volatile and contributes to the fluctuations in the total level of investment. Interest rate changes are responsible for some part of the volatility in investment spending.

Government capital expenditures on buildings, roads, bridges, and machinery and equipment are a part of government expenditure G . We treat government capital expenditure as part of fiscal policy and included in G not in I .

Businesses spend on fixed capital, plant and equipment to expand their output capacity if they expect growth in demand for their output, or if they see opportunities to reduce costs by adopting new technology and production techniques. Wireless companies like Bell Canada, Rogers and TELUS spend continuously on new equipment to accommodate subscriber growth and new products that require more and faster data and voice transmission. Auto makers add to or reduce assembly capacity and develop new product and production technologies to remain competitive and to meet needs for increased fuel efficiency. Solar, wind energy and biofuel companies build new solar farms, wind farms and ethanol plants to provide new sources of electricity and fuels.

The firm's decision to invest is based on its *expectation* of future markets and profits that will justify the estimated cost of new plant and equipment. Financial markets provide some important guidance.

The current market values of existing firms are the present values of their expected profits. A firm thinking about entering an industry or expanding its current capacity can compare the cost of building new plant and buying equipment with the market value of capital already in the industry.

The investment looks profitable if the cost to enter the industry or build and install new capacity is lower than the value the market places on existing businesses. Alternatively, if the value the market places a lower value on existing business than the capital cost of new business there is no incentive to invest in more plant and equipment. However, there might be an opportunity to enter the industry by taking over an existing business.

The present value of expected profits depends on the interest rate. Changes in interest rates change both the values the market puts on existing businesses and productive capacity and the costs of financing new investment. A rise in interest rates lowers the market value of existing firms and increases the costs of financing new investment. A fall in interest rates increases current market values and lowers financing costs. As a result, investment expenditures are inversely related to interest rates, if all other conditions are constant.

Inventory management is another important part of investment expenditure. Some firms hold inventories of basic inputs to production like raw materials and may also hold components and finished product. Other firms organize their production and coordinate with suppliers to minimize inventories to achieve 'just in time' delivery of inputs. Financial services firms often hold inventories of bonds and other assets to help customers adjust their portfolios.

Inventories can accommodate differences in the timing of production and sales for the benefit of both producers and consumers. If demand for output rises sharply, plant capacity cannot be changed overnight. If demand exceeds current output, sellers would rather not disappoint potential customers. Car dealers hold inventories in part to help smooth the flow of production, and in part to be able to offer immediate delivery. Retail stores carry inventories so customers can buy what they want when they want it. As demand fluctuates, it can be more efficient to allow inventories of finished goods to fluctuate than to try to adjust production to volatile market conditions.

But inventories involve costs. To the producer, unsold goods represent costs of labour, materials, and energy paid but not yet recovered from the sale of the product. These costs have to be financed, either by borrowing or tying up internal funds. Retailers have similar carrying costs for their inventories. Thus, interest rates determine the important finance costs of holding inventories. If we assume prices are constant and interest rates rise, producers and retailers will want smaller inventories. Alternatively, if prices are rising, the difference between the nominal interest rate and the rate of inflation is the real cost of carrying inventories.

The **investment function** is based on these explanations of expenditure on fixed capital and inventories. The negative effect of interest rates in the investment function, $(\Delta I/\Delta i) < 0$, shows that higher interest rates cause lower levels of planned investment expenditure. But how sensitive are investment plans to financing costs? If these financing costs were not a large factor in the investment decision, $\Delta I/\Delta i$ would be small. A rise in the interest rate from i_0 to i_1 would still lower planned investment, but by only a small amount. Alternatively, a larger value for $\Delta I/\Delta i$ would mean that investment plans are sensitive to interest rates.

$$I = I(i) \quad (9.3)$$

Investment function, $I = I(i)$: explains the level of planned investment expenditure at each interest rate.

When plotted in a diagram, the slope of the investment function $I = I(i)$ is $-(\Delta i/\Delta I)$. The *position* of the investment function reflects the effect of all factors, other than interest rates, that affect investment decisions. The price of new capital equipment, optimism or pessimism about future markets and market growth, the introduction of new technologies embodied in newly available equipment, and many other factors underlie investment decisions. Changes in any of these conditions would *shift the I function* and change planned investment at every interest rate. Increased business confidence and expectations of stronger and larger markets shift the I curve to the right. Pessimism shifts it to the left.

The volatility of investment that causes business cycle fluctuations in output and national income comes from volatility in business profit expectations, rather than from interest rates. Changes in investment, a result of changes in interest rates or as a result of other factors, shift aggregate expenditure and work through the multiplier to change AD, output, and employment. The reaction of investment expenditure to changes in interest rates provides the important link in the monetary transmission mechanism but does not explain the volatility of investment expenditure we saw in Chapter 6.

Both nominal and real interest rates play important roles in the economy. The nominal (or money) interest rate is the annual percentage of the principal of a loan that the borrower pays to the lender. It is determined by supply and demand conditions in money markets. The real interest rate is the nominal interest rate adjusted for annual changes in the price level (real interest rate = nominal interest rate minus the inflation rate). When the inflation rate is zero, nominal and real interest rates are equal.

Nominal interest rates and financial asset prices are linked. The present value calculation of asset prices uses the nominal rate for discounting. Nominal interest rates and asset prices vary inversely.

Nominal interest rates also affect nominal cash flows of both households and businesses. A rise in nominal rates on lines of credit or mortgages increases the current cash cost of that borrowing. A fall in nominal rates on lines of credit or mortgages releases current cash commitments.

Real interest rates determine the real cost of borrowing and the real return to lending.

A family borrows \$200,000 for one year at a nominal interest rate of 5 percent to buy a house. At the end of the year they would owe the lender \$200,000 plus \$10,000 ($\$200,000 \times 0.05$) interest. Their nominal interest cost is \$10,000. If the price level has been constant over the year, their nominal interest cost and their real interest cost are equal at 5 percent.

Suppose however that the all prices are rising by 3 percent a year. The house bought today for \$200,000 will sell for \$206,000 one year from now. Borrowing at 5 percent to buy the house cost \$10,000 but the rise in the price of the house by \$6,000 offsets part of that cost. The real interest cost is $\$10,000 - \$6,000 = \$4,000$. The real interest rate is 2 percent based on the nominal interest rate of 5 percent minus the change in the price level of 3 percent.

With inflation rates greater than zero, lenders real interest earnings are less than nominal interest earnings. In the preceding example, the mortgage lenders real return was just 2 percent (5 percent – 3 percent inflation) because the \$210,000 received at the end of the year had its purchasing power reduced to approximately \$204,000 by the 3 percent rise in the price level.

Application Box 9.2: Nominal and real interest rates

Exchange rates and net exports

The changes in foreign exchange rates caused by changes in interest rates affect the competitiveness and profitability of imports and exports relative to domestically produced goods and services. A rise in interest rates leads to an appreciation of the domestic currency. Import prices fall relative

to the prices of domestic goods and services. Exports become less competitive and less profitable. Imports rise and exports fall, lowering the net export component of aggregate expenditure and demand. Alternatively, a fall in interest rates leads to a depreciation of the domestic currency. Prices of imported goods and services rise relative to the prices of domestic goods and services. Exports are more competitive and more profitable. Net exports increase.

In Chapter 6 we assumed exports were autonomous, independent of national income but dependent on foreign incomes, foreign prices relative to domestic prices, and the exchange rate, which we held constant. Imports were a function of national income, based on a marginal propensity to import, with an autonomous component to capture relative price and exchange rate conditions. Exchange rates were assumed to be constant.

Dropping the assumption that the exchange rate is constant makes the important third link between interest rates and aggregate expenditure through net exports. Exchange rate effects reinforce the negative relationship between interest rates and expenditures in the consumption and investment functions. If interest rates rise, other things constant, the domestic currency appreciates and the exchange rate, er , falls. Exports fall, and imports rise, reducing net exports and aggregate expenditure. A net export function that describes this relationship would be:

$$NX = NX[Y, Y^*, P, P^*, er(i), \dots] \tag{9.4}$$

with Y^* and P^* representing foreign incomes and prices respectively.

In Equation 9.4, the variable $er(i)$ captures the effect of interest rates on exchange rates and exchange rates on net exports. From the foreign exchange market we know that a rise in interest rates leads to an appreciation of the domestic currency that lowers the exchange rate, $(\Delta er / \Delta i) < 0$. Also, a fall in the exchange rate lowers net exports, $(\Delta NX / \Delta er) > 0$.

The appreciation of the Canadian dollar that reduced the Canadian/U.S. dollar exchange rate from \$1.57Cdn for \$1.00U.S. in 2002 to \$1.014Cdn to \$1U.S. in March 2008 and \$0.9814Cdn to \$1U.S. in November of 2012 illustrates the point. Although due more to the rise in commodity and energy prices than to interest rate differentials, the lower exchange rate increased imports and reduced the viability of manufacturing based on exports to the U.S. market, or competition with imports. To the extent that interest rate changes affect exchange rates, they also change net exports and aggregate expenditure.

Figure 9.6 summarizes the relationship between interest rates and expenditures, assuming all things other than interest rates and exchange rates are constant. The downward sloping line $A(i)$ illustrates the inverse relationship between the consumption, investment, and net export components of autonomous expenditure and the interest rate. Starting with interest rate i_0 , the level of expenditure related to interest rates is $A(i_0)$, given by point D on the expenditure function. A fall in interest rates from i_0 to i_1 increases expenditure to $A(i_1)$, moving along the expenditure function to point E. Lower interest rates increase consumption and investment expenditure directly through wealth

and cost and availability of finance effects. Lower interest rates also increase net exports through the effects of lower interest rates on the foreign exchange rate. A rise in interest rates would have the opposite effect.

The changes in interest rates and exchange rates are the key linkages between the monetary and financial sector and aggregate demand.

9.7 The transmission mechanism

We can now summarize and illustrate the relationships that transmit changes in money, financial markets, and interest rates to aggregate demand, output, and employment. There are four linkages in the transmission mechanism:

1. With prices constant, changes in money supply change interest rates.
2. Changes in interest rates change consumption expenditure through the wealth effect and the cost and availability of credit.
3. Changes in interest rates also cause changes in planned investment expenditure through the cost and availability of credit to finance the purchase of capital equipment and to carry inventories.
4. Changes in interest rates also cause changes in exchange rates, which change the price competitiveness and profitability of trade goods and services.

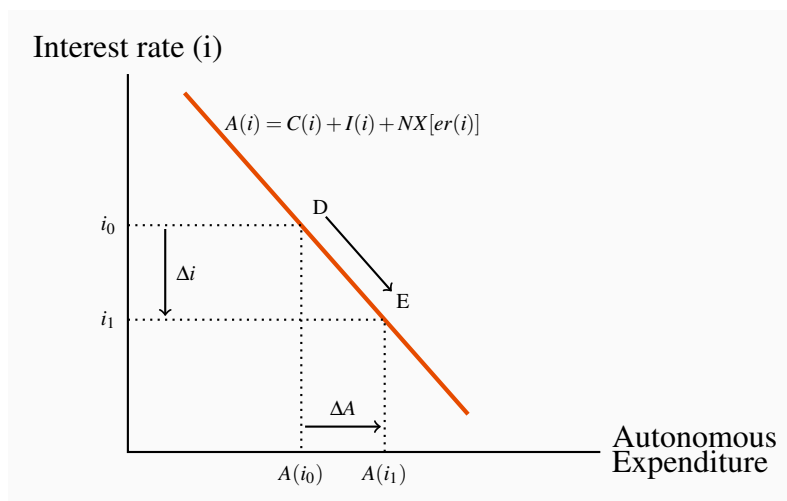


Figure 9.6: Interest Rates & Autonomous Expenditure

Working through these linkages, the effects of changes in money and interest rates on aggregate demand and equilibrium real GDP is illustrated as follows:

$$\Delta M \rightarrow \Delta i \rightarrow \left(\begin{array}{l} \Delta C + \Delta I \\ \Delta er \rightarrow \Delta NX \end{array} \right) \rightarrow \Delta AE \times \mathbf{multiplier} \rightarrow \Delta AD \rightarrow \Delta Y$$

Figure 9.7 shows the transmission mechanism using four interrelated diagrams: a) the money market, b) interest rates and planned expenditure, c) aggregate expenditure and equilibrium output, and d) aggregate demand and supply, output, and prices. We continue to assume a constant price level, as the diagrams show. Changes in the money and financial sector affect aggregate demand and output, to add another dimension to our understanding of the sources of AD and fluctuations in AD.

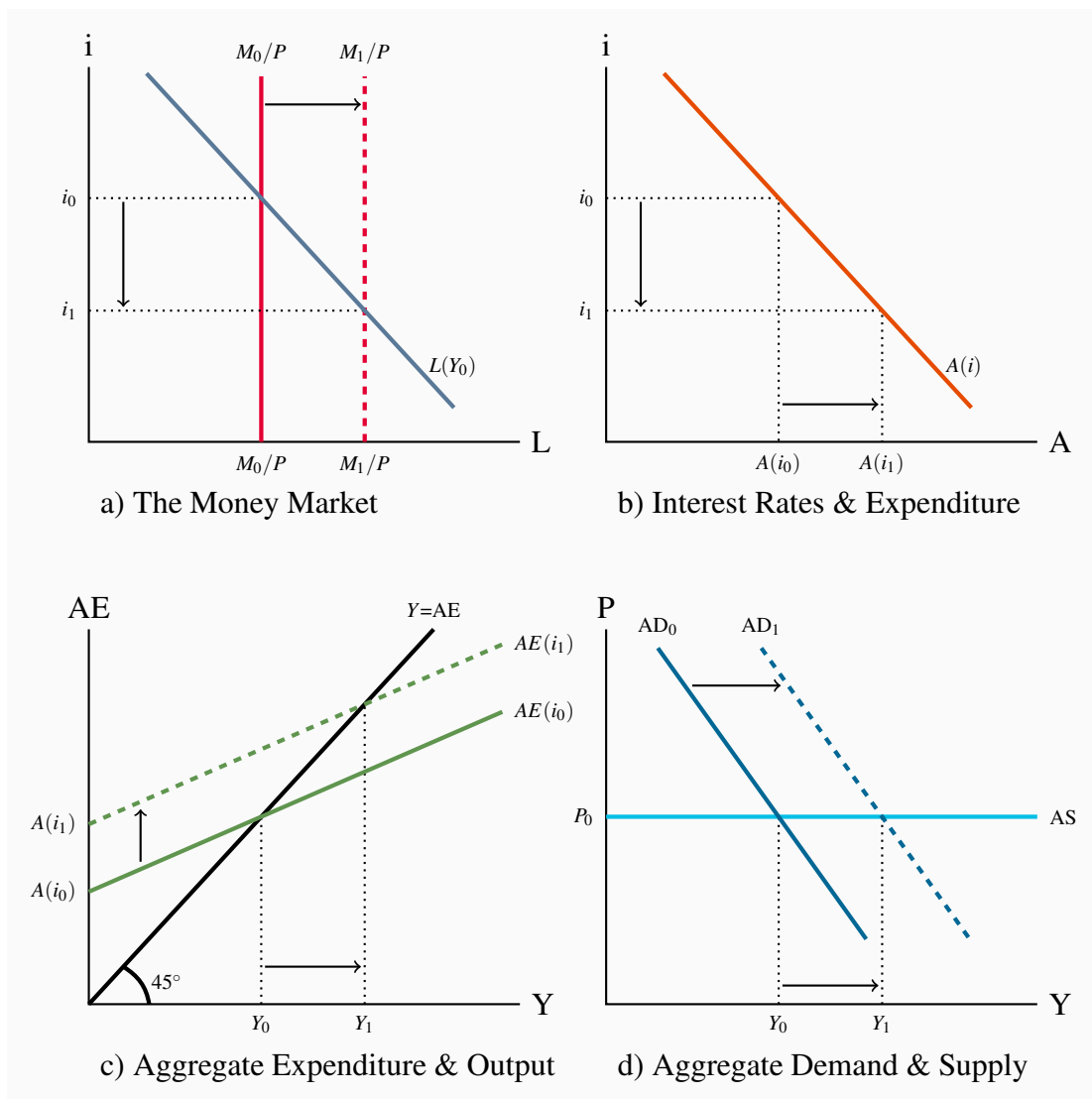


Figure 9.7: The Monetary Transmission Mechanism

To see the linkages in the transmission mechanism start in Panel a) with an equilibrium interest rate i_0 determined by the initial money supply M_0/P and demand for money $L(Y_0)$. This interest rate i_0 induces autonomous expenditure $A(i_0)$ in Panel b). That autonomous expenditure determines the vertical intercept $A(i_0)$ of the aggregate expenditure function $AE(i_0)$ in Panel c), and through the multiplier the equilibrium GDP, Y_0 . In Panel d) the corresponding aggregate demand curve AD_0 crosses the horizontal AS curve at the equilibrium real GDP Y_0 .

An increase in the money supply in Panel a) lowers equilibrium i to i_1 . This induces an increase in autonomous expenditure to $A(i_1)$ in Panel b) and an upward shift in the AE function on Panel c). Increased autonomous expenditure and the multiplier increase equilibrium real GDP and shift the

AD curve to the right by the increase in A times the multiplier.

There are several key aspects to these linkages between money, interest rates, and expenditure. The effect of changes in the money supply on interest rates in the money market depends on the slope of the demand curve for real money balances. A steep curve would show that portfolio managers do not react strongly to changes in market interest rates. It would take relatively large changes in rates to get them to hold higher money balances. Alternatively, if their decisions were very sensitive to the interest rates, the L function would be quite flat. The difference is important to the volatility of financial markets and interest rates, which in turn affect the volatility of expenditure. Panel a) in Figure 9.8 shows the effects of an increase in money supply under different money demand conditions. The sensitivity of expenditure to interest rates and financial conditions is a second important aspect of the transmission mechanism. If the interest rate/expenditure function, in Panel b), is steep, changes in interest rates will have only small effects on expenditure, aggregate demand, and output. A flatter expenditure function has the opposite implication.

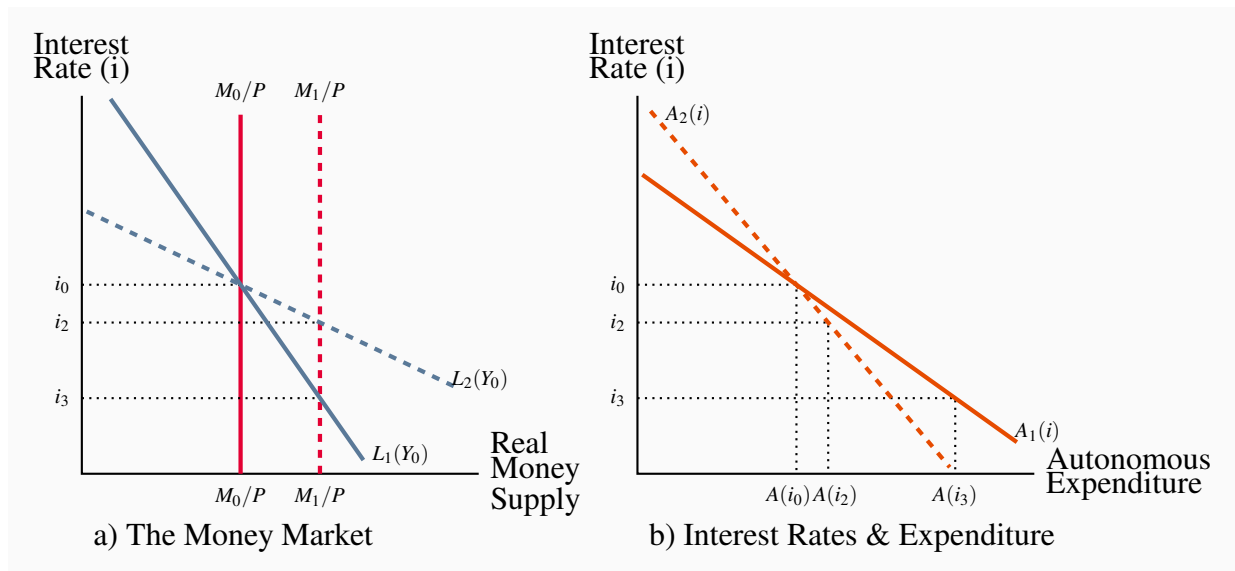


Figure 9.8: The Transmission Mechanism Under Different Conditions

- a) The change in interest rates caused by a change in money supply depends on the interest rate elasticity of the demand for money. L_2 is more elastic than L_1 . A small change in interest rates under L_2 induces portfolio managers to increase their money holdings.
- b) The change in autonomous expenditure caused by a change in interest rates depends on the rate elasticity of autonomous expenditure. Under $A_2(i)$ changes in interest rates have very small effects on expenditures.

Business cycles, output gaps, and policy issues

The effect of money and financial markets on expenditure, output, and employment raises two issues for macroeconomic policy. First, fluctuations in money supply and financial conditions are an important source of business cycle fluctuations in output and employment. These effects are particularly strong and important when the small changes in money supply have big impacts on interest rates and expenditure. A steep $L(i)$ function and a flat expenditure/interest rate function would create these conditions. Stabilization policy would then need to control and stabilize the money supply, a policy approach advocated by monetarists, who see money supply disturbances as the major source of business cycles. If you can fix money supply at M_0 in Figure 9.7, and the demand for money $L(Y, i)$ and the interest rate/expenditure function are stable, you remove monetary disturbances as a source of business cycles.

This Monetarist approach to money and the financial sector concentrates on the “automatic” stabilization effects of money supply control. With the money supply fixed, any tendency for the economy to experience a recessionary or inflationary gap changes the demand for money, and interest rates change in an offsetting direction. A fall in real output that creates a recessionary gap reduces the demand for money $L(Y, i)$ and, with a fixed money supply, interest rates fall to induce additional expenditure. An inflationary gap would produce an automatic rise in interest rates. The monetary sector automatically resists fluctuations in expenditure and output.

The second policy issue is the alternative to this approach. Discretionary monetary policy would attempt to manage money supply or interest rates or financial conditions more broadly. The objective would be to counter persistent autonomous expenditure and financial disturbances that create output gaps. The intent is to manage aggregate demand in an active way. In other words, if business cycles were caused by shifts and fluctuations in the interest rate/expenditure function in Panel b) of Figure 9.7, monetary policy would react by changing interest rates and money supply and move the economy along the new expenditure function to stabilize autonomous expenditure and aggregate demand. Keynesian and New-Keynesian economists advocate this active approach to policy in the money and financial sector, based on a different and broader view of the sources of business cycles in the economy.

Recent experience extends beyond these two policy concerns. A collapse in the financial sector on the supply side was a major cause of the recession of 2009. Banks and other financial institutions suffered losses on large denomination deposits and financial lending. Uncertainty on the part of many lenders about the quality of assets and the risks of lending reduced the availability of credit. Uncertainty on the part of households and businesses reduced their confidence in financial institutions. Although central banks worked to keep interest rates low and bank reserves strong, shifts in the availability of credit and the willingness to borrow shifted the $A(i)$ curve in Figure 9.7 sharply to the left, expenditure fell, and AD shifted left, opening a strong recessionary gap that has been persistent in many industrial countries.

This recent experience has led to serious debates about the role and effectiveness of monetary policy and the objectives of fiscal policy. These are issues we examine in more detail in the chapters

that follow.

Next

In this chapter, we have made the link between money, interest rates, aggregate demand, and output in our model of the economy. We have also shown that monetary policy, working through the monetary transmission mechanism, provides a second policy channel, in addition to fiscal policy, which government might use to stabilize business cycle fluctuations. Chapter 10 studies in detail the monetary policy operations of central banks, including the Bank of Canada.

KEY CONCEPTS

A **financial portfolio** is a mixed holding of money and other financial assets, such as bonds and equities, structured, to balance expected return and risk.

The price of a financial asset like a bond that promises to make future payments is the **present value** of those payments. Because current interest rates are used to discount future payments and determine this present value, **bond prices and interest rates are inversely related**.

The **demand for money** (L) is a demand for real money balances measured in terms of purchasing power over goods and services. It arises from the portfolio decisions people make about the form in which to hold their wealth. Holding money reduces the costs of making both routine and unexpected **transactions**. It also provides a **safe asset**, with a fixed nominal price, as a store of wealth. The cost of holding money is the **interest income** and potential capital gain sacrificed by not holding bonds.

The quantity of real money demanded rises with real incomes, to finance higher transactions, and falls with higher nominal interest rates, the opportunity cost of holding money instead of bonds. The demand for money function is $L = kY - hi$.

The **interest rate** (i), is determined by supply and demand in the money market, together with supply and demand in the bond market. As people adjust the holdings of bonds and money in their wealth portfolios, bond prices and yields adjust to clear both bond and money markets simultaneously.

Interest rates play a key role in the **transmission mechanism** that links money and financial markets to aggregate expenditure.

Household consumption expenditure and business investment expenditure are dependent, in part, on interest rates. A higher interest rate reduces household **wealth** and increases the **finance costs** of borrowing. Lower wealth and higher finance costs reduce planned autonomous consumption, shifting the consumption function down. Lower interest rates have the opposite effect.

Changes in interest rates lead to changes in **exchange rates** that change net exports. The international sector makes an additional link between money, interest rates, and expenditure.

The **monetary transmission mechanism** links changes in money supply to changes in aggregate expenditure, aggregate demand, and output through interest rates and exchange rates.

EXERCISES FOR CHAPTER 9

Exercise 9.1. If the current market interest rate is 3 percent and a bond promises a coupon of \$3 each year in perpetuity (forever), what is the current market price of the bond?

Exercise 9.2. Suppose you are holding a bond that will pay \$5 each year for the next two years from today and mature two years from today.

- (a) If current two-year market interest rates are 4 percent, what is the market price of your bond?
- (b) If market interest rates rise tomorrow to 6 percent, what will be the market price of your bond?
- (c) What is the “market risk” in holding bonds?

Exercise 9.3. You are holding a cash balance that you want to place in the bond market for a period of three years. The market rate of interest on three year bonds today is 5.5 percent. Would you be willing to pay \$1,015 for a \$1,000 bond with a 6 percent coupon maturing three years from today? Explain your answer.

Exercise 9.4. Draw a diagram to illustrate the relationship between the demand for real money balances and the interest rate, $L = kY - hi$ when real GDP has a given value Y_0 .

- (a) Explain your choice of the intersection of your demand for money function with the horizontal axis, and your choice of the slope of the function.
- (b) Using your diagram, illustrate and explain the quantity of real money balances demanded for a specific interest rate, say i_0 . Pay particular attention to the underlying motives for holding these money balances.
- (c) Suppose interest rates declined from your initial assumption of i_0 to a new lower rate i_1 . Illustrate and explain the effect of the change in interest rates on the demand for money balances.
- (d) Holding interest rates constant at either i_0 or i_1 , suppose real GDP were to increase. Illustrate and explain the effect of the increase in real GDP on the demand function and the quantity of real money balances people hold.

Exercise 9.5. Draw a diagram to illustrate equilibrium in the money market.

- (a) Starting from your initial equilibrium, suppose real national income increased. Illustrate and explain how the money market would adjust to this change in economic conditions.
- (b) How does the interest rate in the new equilibrium compare with the interest rate in the initial equilibrium?

Exercise 9.6. Draw a diagram to illustrate the foreign exchange market in which Euros are bought with or sold for Canadian dollars, assuming the current exchange rate is $\$1.54\text{Cdn}=1$ Euro. Starting from that equilibrium exchange rate, suppose Canadian interest rates fall relative to European rates. Using your foreign exchange market, show how the dollar-euro exchange rates would be affected.

Exercise 9.7. Construct a set of diagrams that shows the monetary transmission mechanism linking interest rates to aggregate demand and output. Using these diagrams, show and explain:

- (a) How a reduction in the money supply would affect aggregate demand and output.
- (b) Alternatively, how an increase in the precautionary demand for money balances caused by terrorist activity, or severe weather events, or an increase in uncertainty in general would affect aggregate demand and output. Assume the money supply is held constant.
- (c) Alternatively, how an increase in autonomous investment expenditure and exports would affect interest rates, aggregate demand, and output.

Chapter 10

Central banking and monetary policy

In this chapter we will explore:

- 10.1 Central banking & the Bank of Canada
- 10.2 Central banking operating techniques
- 10.3 Monetary policy targets & instruments
- 10.4 Monetary policy rules
- 10.5 The long-run neutrality of money
- 10.6 Monetary policy indicators

This chapter examines the role of the central bank. The central bank is responsible for monetary policy. Its monopoly control of the supply of cash, or monetary base, gives it a powerful influence in financial markets. Sometimes the central bank controls the monetary base to control the supply of money. Other times it controls short-term interest rates. In either case, central bank actions are designed to affect prices, output, and employment. They work through the transmission mechanism that links monetary policy to aggregate demand, as we discussed in the last chapter.

10.1 Central banking and the Bank of Canada

Most countries have a **central bank**. Some of these central banks, like the Bank of England, were private firms originally, in business for profit, but began to operate in part to promote stability in financial market conditions. The focus of their business shifted to take on an informal role in what is now called monetary policy. As governments also became interested in monetary policy, central banking institutions were established in countries where none previously existed. The Federal Reserve System, the United States central bank, was created under federal law in 1913. It is a system of 12 regional banks, each owned by the commercial banks that are its members. Canada's central bank, the Bank of Canada, was set up and started operations in 1935 as a privately owned institution, but was nationalized in 1938. In the United Kingdom, the Bank of England was founded as a private bank in 1694, acted as a central bank for many years, and was nationalized in 1947.

Central bank: an institution that conducts monetary policy using its control of monetary base and interest rates.

In every case, the important distinction between a private bank and a central bank is the purpose that drives the institution's operations. Private banks are profit-oriented businesses providing financial services to businesses and households. Central banks conduct their operations to influence the behaviour of other banks and intermediaries in the financial system. Profits are *not* the motive behind central banks' operations, although they do make profits. They also serve as banker to the government and to the banks. But their primary role and responsibility is to conduct **monetary policy**: to control the monetary base and interest rates, and perhaps the foreign exchange rate.

Monetary policy: central bank action to control money supply, interest rates, and exchange rates to change aggregate demand and economic performance.

The Bank of Canada is Canada's central bank. We can describe its operations, as we did with the commercial banks in the previous chapter, by looking at the Bank's balance sheet in Table 10.1.

Assets		Liabilities	
Government of Canada securities		Notes in circulation	66,616
Treasury bills	21,586		
Government bonds of maturity		Deposits	
≤ 3 years	34,242	Government of Canada	22,330
> 3 years	32,411	Banks & other CPA members	187
		Other	1307
Advances to members of CPA	–		
Securities from resale agreements	2,206	Foreign central banks	–
Foreign currency deposits	5	Foreign currency liabilities	–
Other assets	856	Other liabilities & capital	866
Total	91,306	Total	91,306

Table 10.1: The balance sheet of the Bank of Canada, 2013 (year-end, millions of dollars)

Source: Statistics Canada, CANSIM Table 176-0010 and author's calculations. Figures have been rounded.

Bank notes in circulation, the main component of the monetary base, are liabilities of the Bank of Canada. The total of notes in circulation is a result of two factors. First, the Bank of Canada makes a decision about the appropriate size of the monetary base and the interest rate. Second is the demand for cash, relative to deposits. These are the banks' reserve ratio (rr), and the public's cash ratio (cr) we saw in the last chapter.

Government securities are the main assets held by the Bank. When the Bank of Canada buys these securities on the open financial market, it pays for them by issuing cash to the non-bank public, or by making deposits in the Bank of Canada for banks and other members of the Canadian Payments Association. Cash and deposits issued by the Bank of Canada increase the monetary base. A larger monetary base allows the banks to expand their lending, according to the deposit multiplier we discussed in Chapter 8.

As bank lending and deposits expand, both the banks and the public demand more cash to meet their desired reserve, and currency ratios. The commercial banks meet these demands for cash by drawing Bank of Canada notes from their deposits in the Bank of Canada. These notes are in turn supplied to the banks' customers, over the counter or through automatic banking machines.

The Bank also has a responsibility to promote stability in financial markets. In the summer of 2008, a credit crisis arising in the short term wholesale deposit and mortgage markets in the United States created a significant increase in the demand for cash in the banking sector. Part of the Bank of Canada's response was to provide funds to the banks through "purchase and resale agreements". These are short-term transactions, usually 28 days, used to provide extra cash to the banks by buying some of the government securities they hold, with the agreement to sell them back at a specific date and price in the near future. Any securities held as a result of these transactions would be shown on the asset side of the Bank's balance sheet. The corresponding increase in cash is an increase in liabilities.

You will notice that the Bank of Canada's balance sheet differs from that of the commercial banks in a couple of important ways. The Bank of Canada does not have a cash reserve ratio. The Bank itself is the source of cash and can issue more on demand. The size of the Bank's balance sheet, measured as the total of either assets or liabilities, is the responsibility of the Governor of the Bank.

The current governor, Stephen Poloz, like governors before him, manages the Bank's balance sheet to implement monetary policy. He can expand the Bank's asset holdings and pay for that expansion by creating new Bank of Canada liabilities, which are additions to the monetary base. Alternatively, he can sell some of the Bank's assets, destroying an equal amount of liabilities and monetary base. No reserve requirements limit these operations. The management of the Bank's balance sheet and the monetary base depends on the wisdom and judgment of the Governor and management of the Bank. They work to get the monetary base and interest rates that are appropriate for the economy.

There is a further interesting difference between the commercial and central bank balance sheets. Private banks concentrate on their deposit base and loan operations. These are the main entries in their balance sheets and the source of their banking profits. The Bank of Canada, by contrast, does very little direct lending, and any it does is of very short duration. Indeed, in Table 10.1 we see

that advances to members of the payments association, which would be central bank loans, were zero at the end of 2013.

Nor does the Bank of Canada hold many deposits. It does not need deposits as a source of funds. Deposit facilities are provided to the commercial banks and other members of the Payments Association for their use in settling cheque-clearing balances among the banks, and to the Government of Canada. Cheques issued by the Government of Canada, like income tax refunds, Old Age Security payments, and Employment Insurance benefits, are drawn on the government's account in the Bank of Canada. This difference in the structure of operations again shows the difference between profit-oriented commercial banks and a central bank with responsibility for monetary policy.

Having the power to conduct monetary policy is one thing; how you use it is another. The Bank of Canada's responsibilities are set out in the *Bank of Canada Act*, the act of Parliament that established the Bank in 1934. According to the *Act*, the Bank is to conduct its policy in ways that support the economy by reducing fluctuations in output, prices, and employment while protecting the external value of the currency. In terms of our study of the economy, we can describe these goals of monetary policy as the pursuit of potential output and low, stable inflation rates.

Exactly how the Bank is to achieve those objectives has been, and continues to be, a topic for discussion and debate. Over the years, our understanding of what monetary policy can and cannot do has evolved, as have the Bank's interpretation of its mandate and the techniques it uses to conduct monetary policy. The Canadian economist Robert Mundell has been a major contributor to this work. His explanations of the transmission mechanism and the strength of monetary policy under different foreign exchange rate systems were recognized by his Nobel Prize in economics.

Currently, the Bank works to maintain inflation within a target range of 1 percent to 3 percent, but that has not always been its explicit policy objective. Gordon Thiessen, a recent Governor of the Bank of Canada, provides an interesting overview of the evolution of monetary policy in Canada from the 1930s to the end of the 1990s.¹

10.2 Central bank operating techniques

The money supply—currency in circulation plus the deposits of the commercial or chartered banks—is partly a liability of the central bank (currency) and partly a liability of the commercial banks (deposits). In Chapter 8 we discussed the *monetary base* supplied by the central bank. You will recall that the *money multiplier* ties the size of the money supply to the size of the monetary base. The money multiplier is larger when

1. the reserve ratio (*rr*) banks hold is smaller; and

¹Thiessen, G., "Can a Bank Change?" Bank of Canada Review, Winter 2000/2001, pp. 35-46, and also available at <http://www.bankofcanada.ca/2000/10/can-a-bank-change/>

2. the currency ratio (cr) the non-bank public wishes to hold is smaller

If these two ratios are constant, the central bank can change the size of the money supply by changing the size of the monetary base.

In general, central banks have three main techniques for the control of the monetary base and the money supply. These are:

1. Establishing reserve requirements
2. Using open-market operations
3. Adjusting central bank lending rates

Not all central banks use all three techniques, but we will examine each of them. Later we will see that the Bank of Canada has some additional operating techniques it uses to influence interest rates in the short run.

In the financial crisis and deep recession of 2008-2009, central banks developed additional techniques to support the banking system, the availability of credit, and the money supply. The ‘Quantitative Easing’ techniques used in the US are examples of these techniques discussed later in this chapter.

Reserve requirements

In some cases, commercial banks operate under a legal **required reserve ratio**. They are required by law to hold cash reserves and central bank deposits not less than some specified percentage of their deposit liabilities.

Required reserve ratio: a legal minimum ratio of cash reserves to deposits.

Banks can hold more than the required reserves but not less. If their reserves fall below the required amount, they must borrow cash, from the central bank, to restore their required reserve ratio. Since a loan from the central bank carries an interest rate, usually higher than the market interest rate, borrowing imposes a cost on the bank and lowers profitability. Banks usually hold slightly larger reserves than required to avoid the costs of falling short.

A required reserve ratio is essentially a regulation used to give the central bank control of the money supply. The reserve ratio is a key determinant of the money multiplier. If a central bank

has the power to change the commercial banks' required reserve ratio, it can use it to change the money supply. For a given monetary base, a rise in the required reserve ratio reduces the size of the money multiplier and the money supply. A reduction in the reserve ratio has the opposite effect.

However, required reserve ratios are blunt techniques for monetary control. Changes in reserve ratios simultaneously affect the reserve positions of all banks in a system and require large adjustments in financial markets. As a result, changes in reserve ratios are not widely used as techniques for money supply control.

Required reserve ratios are different in different national banking systems. In the United States, for example, the Federal Reserve is authorized to impose reserve requirements of 8 percent to 14 percent on chequable deposits, and up to 9 percent on non-personal time deposits. As of February 2002, the ratios were set at 10 percent for chequable deposits and 0 percent for time deposits. The European Central Bank also imposes reserve requirements. In 2012, both India and China reduced deposit reserve ratios on several occasions to encourage monetary expansion in the face of declining GDP growth rates.

Until 1994, banks in Canada were subject to legal minimum reserve requirements. These have now been phased out, as have reserve requirements in many other countries. In Canada, the banks hold reserves made up of very small settlement balances in the Bank of Canada, in addition to their cash holdings. The banks decide the size of their reserve ratios based on their own assessments of their reserve needs, rather than a legal requirement. We will see later that reserve holdings, and the Bank of Canada's management of the available cash reserves, are important to the implementation of monetary policy in Canada.

The absence of legal reserve requirements in Canada means that reserve ratios in the banking system change from time to time. They may change as the banks change their outlook on financial conditions and their evaluation of banker's risk. These changes are linked to the profit motive of the banks rather than the control interests of the central bank. Whether they come from central bank action or commercial bank asset management, changes in the banks' reserve ratio change the money multiplier and the money supply.

Open market operations

Open market operations are the main technique used by central banks to manage the size of the monetary base. Whereas reserve requirements affect the money supply through control of the money multiplier, open market operations work directly on the monetary base. Since the money supply is the monetary base multiplied by the money multiplier, open market operations alter the money supply.

Open market operation: central bank purchases or sales of government securities in the open financial market.

Central banks use open market operations to provide the monetary base needed to support the demand for money and the increase in the demand for money as the economy grows. If monetary policy is conducted by setting interest rates, as discussed later in the chapter, open market operations are passive. They provide the monetary base needed to meet the demand for money at the interest rate set by the central bank. An open market purchase makes a permanent addition to the central bank's assets and monetary base.

There are times when monetary policy is conducted through control of the money supply. If the money multiplier is constant, a central bank can control the size of the money supply by controlling the monetary base using open market operations. Open market purchases increase the monetary base and increased bank lending increases the money supply. Open market sales have the opposite effect.

In times of financial and economic crisis, as in 2008 and 2009, open market operations are used along with interest rate setting. High uncertainty in financial markets and falling demand in goods-and-services markets increase the demand for liquid cash balances. If interest rates are reduced close to zero without increasing lending and spending and asset demand, the central bank may undertake "quantitative easing," using open market purchase to increase the monetary base and offset a shortage of liquidity in the economy. This topic comes up again after we look at monetary policy in more normal times.

Table 10.2 illustrates an open market purchase and its effect on bank reserves and the money supply. To keep the example simple, we will assume the banks hold reserves equal to 5 percent of their deposits, $rr = 0.05$, but the public's currency ratio is zero, $cr = 0$. This means a simple money multiplier is equal to $1/rr = 1/0.05 = 20$.

1. Open market purchase of \$100 million in government bonds.							
Central Bank				Commercial Banks			
Assets	Liabilities			Assets	Liabilities		
Gov't bond	100	Cheque issued	100	No change	No change		
2. Pension fund deposits proceeds of bond sale in commercial bank.							
Central Bank				Commercial Banks			
Assets	Liabilities			Assets	Liabilities		
No change	No change			Central bank cheque	100	Pension fund deposit account	100
3. Central bank cheque clears giving commercial banks \$100 million in cash.							
Central Bank				Commercial Banks			
Assets	Liabilities			Assets	Liabilities		
No change	Cheque o/s	-100		Central bank cheque	-100	No change	
	Cash issued	100		Cash reserves	100		
				(excess reserves +95)			
4. Commercial banks increase lending and create new deposits backed by their increased cash reserves.							
Central Bank				Commercial Banks			
Assets	Liabilities			Assets	Liabilities		
No change	No change			Loans	1900	Deposits	1900
5. Final effect of central bank open market purchase.							
Central Bank				Commercial Banks			
Assets	Liabilities			Assets	Liabilities		
Gov't bond	100	Cash issued	100	Cash reserves	100	Deposits	2000
		(ΔMB)		Loans	<u>1900</u>		
					2000		

Table 10.2: An open market purchase and the money supply

In the example, the central bank buys \$100 million of government bonds on the open market. We'll assume a large pension fund sold these bonds, and received in payment a cheque for \$100 million issued by the central bank. This transaction is recorded (as \$100) under item 1 in the table.

Item 2 in the table records the pension fund's deposit of the central bank cheque in the commercial banking system. The commercial bank issues a deposit to the pension fund in return for the cheque drawn on the central bank.

The commercial bank does not want to hold the central bank cheque. It presents it for payment and receives, in this example, cash in the form of central bank notes. Cash is a reserve asset for the

commercial bank. In item 3 in the table, the central bank has created new monetary base, which has increased the cash reserves of the commercial bank by \$100. The commercial bank now has new reserves of \$100 against its increased deposit liabilities of \$100. Based on its reserve ratio $rr = 0.05$, it has excess reserves of \$95.

Excess reserves in the commercial banking system support an increase in lending and the creation of new bank deposits. Item 4 in the table shows the final results of this loan and deposit expansion, for the entire banking system. Based on a simple money multiplier of 20, we know that the increase in the monetary base in the form of new cash reserves by \$100 will result in an increase in the money supply of \$2000. Bank lending and deposit creation continue until total deposits have increased by \$2000, based on an initial deposit of \$100 and increased lending of \$1900. Item 5 in the table shows these final results.

In this example, an open-market purchase increased the monetary base and the money supply. The purchase was paid for by the creation of new monetary base. An *open market sale* would have the opposite effect. The monetary base and the money supply would be reduced. An open market operation is a technique a central bank can use to shift the money supply function and affect equilibrium conditions in the money market.

Open market operations are today the principal channel by which central banks, including the Bank of Canada, manage the *longer-term* growth of the monetary base.

The bank rate

The **bank rate** is the interest rate the central bank charges the commercial banks if the commercial banks borrow reserves. The bank rate or lending rate is set by central banks as a part of their monetary policy operations.

Bank rate: the interest rate the central bank charges on its loans to commercial banks.

Suppose the banks think the minimum safe ratio of reserves to deposits is 5 percent. It does not matter whether this figure is a commercial judgment, as in Canada, or a legal requirement, as in the United States. Banks may also hold a little extra cash to cover day-to-day ups and downs in deposits and withdrawals, but maximum profit requires minimum cash holdings.

One way in which an individual bank can cover a shortage in its reserves is to borrow from other banks that have unexpected excess reserves. This creates a market for monetary base. In Canada, this borrowing and lending takes place on an overnight basis—you borrow today and repay tomorrow, at the overnight interest rate. In the United States, the rate for similar lending and borrowing among banks is the federal funds rate.

If it happens that no other bank in the system has excess reserves to lend, a bank that is short of reserves borrows from the central bank. The interest rate charged is the *bank rate*, which is set higher than the overnight rate by the central bank, to encourage banks to borrow and lend reserves in the overnight market.

The bank rate is used in different ways by different central banks. There is a long tradition of using changes in the rate as a signal of changes in monetary policy. A cut in the bank rate signals the central bank's intention to increase the monetary base. A rise in the bank rate signals tighter monetary conditions. We will examine in detail the role the bank rate currently plays in Canada later in this chapter.

Government deposit accounts

In Canada, the federal government holds some of its funds on deposit in the Bank of Canada and some in the commercial banks. The government also gives the Bank the authority to manage the distribution of its deposits between the central bank and the commercial banks. This arrangement provides another technique for short-term central bank management of the monetary base.

The Bank can increase the reserves of the commercial banks by transferring government deposits from the central bank to the commercial banks. The commercial banks then have increased government deposit liabilities and an equal increase in their reserve deposits in the Bank of Canada. Because their desired reserves increase by only a small fraction of their increased deposits, the commercial banks have excess reserves. Bank lending and bank deposits can increase. Table 10.3 illustrates a transfer of government deposits.

Central Bank			Commercial Banks		
Assets	Liabilities		Assets	Liabilities	
No change	Reserve deposits of banks	10	Reserve deposits	10	Government deposits
	Government deposits	-10			

Table 10.3: A transfer of government deposits

In this example, the Bank of Canada has moved \$10 in government funds from government accounts in the Bank of Canada (-10) and placed them on deposit in the commercial banks (+10). In payment for these increased deposit liabilities, the banks receive an increase in their reserve deposits in the Bank of Canada.

If the desired reserve ratio of the banks is 5 percent, the banks now have excess reserves of \$9.50, which they will lend.

A transfer of government deposits from the commercial banks to government accounts in the Bank of Canada would have the opposite effect. Commercial bank reserves would be reduced and they would have to reduce their lending and deposit liabilities.

Government deposit transfers were the main tool the Bank of Canada used during the 1990s to manage the cash reserve position of the banking system. The Bank was setting the overnight rate and using government deposit transfers to offset short-term pressure on its rate target. A change in the technology of the payments system in the late 1990s reduced the effectiveness of this technique. SPRA and SRA transactions (explained below) replaced government deposits as the main tool of cash management.

The Bank does still manage government deposits, but the primary objective of that management has changed. Now the banks bid against one another by in terms of the interest rate they are willing to pay on government deposits. As a result transfers play a minor role in offsetting the effects of government receipts and payments on the reserve positions of the commercial banks.

Money supply versus interest rates

Control of the monetary base through open-market operations and stable desired reserve and cash ratios for the banks and the public give the central bank control of the money supply. This is easy in theory but not in practice.

There are several problems. Can the central bank control the monetary base precisely? The commercial banks can borrow from the central bank at the bank rate when they are short of reserves. Borrowings increase the monetary base. In more difficult financial market circumstances, like those of 2007 to 2009, orderly financial markets may call for large changes in the monetary base to offset extraordinary demands for cash. Meeting these demands takes time and adds to turmoil in markets.

What is the size of the money multiplier? Are desired reserve ratios and cash ratios *stable and predictable* or do they fluctuate? If they fluctuate, the size of the money multiplier is difficult to predict. The money supply function may be unstable.

What money supply measure should the central bank control: MB, M1B+, M2, M2+, or some other aggregate? Households and businesses can shift among the different deposits with different terms and interest rates. Furthermore, the banks are imaginative and competitive in developing new types of deposits.

In short, precise control of the money supply is difficult. Most central banks no longer try. Instead, they set interest rates. The television news and financial press report decisions by the central bank about interest rates, not decisions about money supply. The Bank of Canada and the United States Federal Reserve make regular announcements about their settings of the overnight rate and the federal funds rate, respectively.

Figure 10.1 shows the money market under two different conditions. In both cases we draw the demand for money function $L(Y_0)$ for a given level of real GDP. If the central bank can control money supply, then, for a given level of prices, it fixes the money supply at M_0/P . The equilibrium interest rate is i_0 . This is the case in Panel a) of the figure.

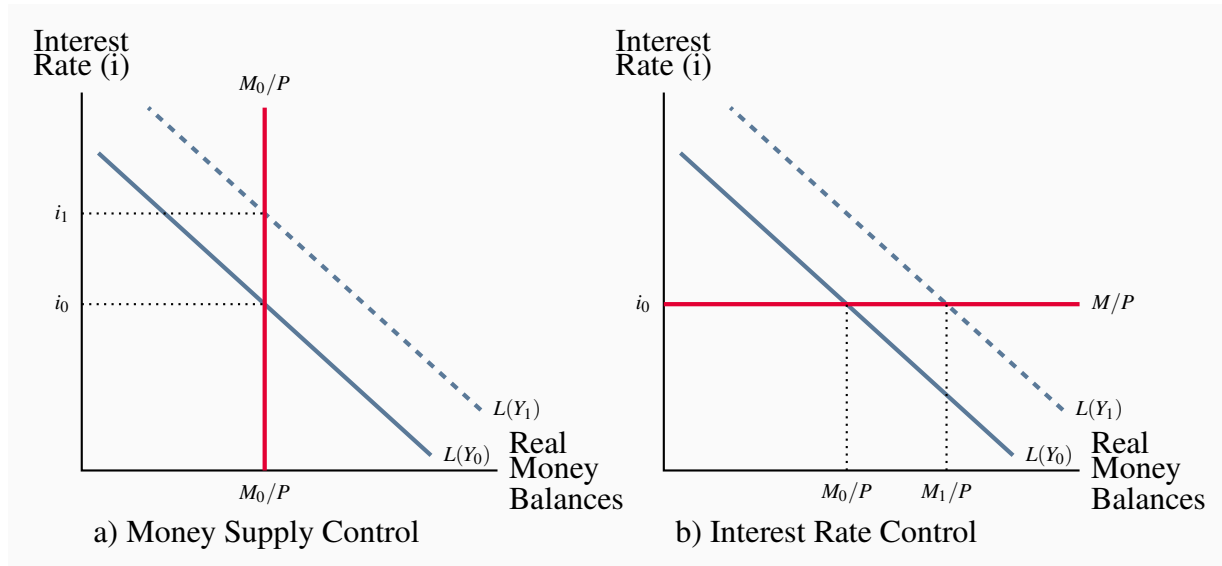


Figure 10.1: Money Supply Control vs. Interest Rate Control

- a) We assume the central bank can fix the money supply at M_0/P and the equilibrium rate is i_0 . An increase in Y increases demand for money from $L(Y_0)$ to $L(Y_1)$. With a fixed money supply, the interest rate rises to i_1 . Alternatively, if the central bank knows the demand for money it can control money supply using interest rates. When Y increases it increases i to i_1 to reduce the demand for money to its money supply target. A fall in Y would call for a fall in interest rates to control money supply.
- b) We assume the Bank sets the interest rate at i_0 . To do this it must supply whatever quantity of money is demanded at i_0 . An increase in Y increases L and results in an increase in M/P . Now the money supply is demand determined.

Alternatively, the central bank can fix the interest rate at i_0 and supply whatever money is needed to clear the market at this rate. This is the case in Panel b). In equilibrium, the central bank supplies exactly the quantity of money demanded at interest rate i_0 . The quantity of money supplied is still M_0/P , but the money supply function is horizontal at the interest rate i_0 .

*The central bank can fix either the money supply or the interest rate **but not both**. If it fixes the money supply, it must accept the equilibrium interest rate implied by the demand for money. If it fixes the interest rate, it must accept the equilibrium money supply implied by the demand for money equation. Central banks now do the latter.*

10.3 Monetary policy objectives & instruments targets

A central bank can use the power it has over the monetary base and interest rates to pursue any one of three possible *instrument targets*. It might:

1. Control the foreign exchange rate, or
2. Control the money supply, or
3. Control the inflation rate.

However, *it must choose*. Controlling one of these instrument targets uses all the central bank's power, and it cannot pursue a second target at the same time.

The central bank chooses among these instrument targets based on its judgment as to which target will achieve the best results in terms of its broad *monetary policy objective*: to promote economic stability at potential output with low inflation. The Bank of Canada has conducted its monetary policy in terms of each of these instruments at different times in the recent past.

From our discussion of the foreign exchange market in Chapter 9, we know that changes in interest rates will result in changes in the foreign exchange rate. Wealth holders shift their financial portfolios between assets of different countries based on differences in interest rates and bond yields between countries. Rather than allow private supply and demand in the foreign exchange market to set the exchange rate, the central bank can intervene to control the rate. It buys or sells foreign exchange in the market, which affects the supply or demand for Canadian dollars in the foreign exchange market and changes the exchange rate.

Purchases or sales in the foreign exchange market change the domestic monetary base just like open market operations in domestic money market. The domestic money supply and interest rates change until the difference between domestic and foreign interest rates is eliminated. To maintain a fixed **exchange rate target**, the central bank matches domestic interest rates to those set in the country to which it wishes to fix its exchange rate. In Canada, for example, to fix the exchange rate between the Canadian dollar and the U. S. dollar, the Bank of Canada would set its interest rate equal to that set by the Federal Reserve.²

Exchange rate target: monetary policy maintains a fixed price for foreign currency in terms of domestic currency.

A central bank may choose to fix the exchange rate because it believes that is the best way to achieve the broader objectives of monetary policy. Canada operated with fixed exchange rates

²We study different exchange rate policies in detail in Chapter 14.

from 1962 to 1970. The Canadian-dollar price of the U.S. dollar was fixed at \$1.075, and the Bank of Canada focused its monetary policy on that target. During the late 1950s and early 1960s, there was an intense debate over the monetary policy pursued by the Bank of Canada. Economic growth was slow, unemployment rates were high, and there was turmoil in financial markets. A fixed exchange rate was seen as the best solution to these economic problems. It essentially gave Canada the monetary policy of the United States, where economic performance had been stronger and more stable than in Canada. The fixed exchange rate target determined Canadian interest rates and money supply until 1970.

Rather than fixing the exchange rate, a central bank can choose to fix the size or growth rate of the domestic money supply. In Chapter 9 we discussed the money market in terms of a fixed money supply. However, central banks have found that the money multiplier, based on the desired reserve ratios of the banks and cash ratios of the public, is not stable enough to give them control of the money supply directly through their control of the monetary base. Instead, they set interest rates to get their target money supply from the demand for money. If money supply is above their target, they raise interest rates, reducing the demand for money until money holdings fall within their target range. They reduce interest rates if money holdings are less than their target.

In the 1970s, a sharp rise in inflation shifted the focus of monetary policy toward inflation control. At that time, developments in economic theory emphasized a strong link between money, money supply growth, and inflation. Central banks in many industrial countries shifted their focus to money supply control. Canada had dropped the fixed exchange rate target in 1970. In 1975, the Bank of Canada adopted **money supply targets** as its policy instrument and used them until 1982 in an attempt to control inflation and promote a strong economy. By adjusting interest rates based on its understanding of the demand for money balances, the Bank was able to meet the targets for the growth in the money supply M1 that it set and revised from time to time.

Money supply target: a central bank adjusts interest rates and the monetary base to control the nominal money supply, or the rate of growth of the nominal money supply.

However, controlling the money supply required wide fluctuations in interest rates and in the exchange rate. Financial markets did not like this volatility. More importantly, success in controlling M1 did not bring success in controlling inflation. The relationship between money supply, prices, and inflation turned out to be less stable than expected. The Bank abandoned its M1 control targets in 1982 and began a search for a better target for monetary policy.

In the early 1990s, the Bank of Canada and central banks in many other countries, including Australia, New Zealand, Sweden, the United Kingdom, and the European Union, decided to set explicit **inflation rate targets** for monetary policy. The Bank of Canada began to use *interest rate setting* as its **monetary policy instrument**, making changes in the interest rate, as necessary, to keep the Canadian inflation rate within a target range of 1 percent to 3 percent.

The shifts to formal inflation targets for monetary policy in 1991, and the adjustment to that policy shift, were sources of a substantial policy debate in Canada. Inflation was reduced as planned, but with a deep and prolonged recession in real GDP and persistently high rates of unemployment. Sustained economic growth did not resume until the mid-1990s, and by most estimates, including those by the Bank of Canada, the recessionary GDP gap persisted until the end of the decade.³ The Bank continues today to focus on an inflation rate in the 1 percent to 3 percent range as its monetary policy target. A summary of the costs and benefits of inflation that lie behind its inflation targeting are offered by the Bank of Canada at: <http://goo.gl/Kh7okG>.

Inflation rate target: monetary policy objective defined as an announced target inflation rate.

Monetary policy instrument: the monetary variable the central bank manipulates in pursuit of its policy target.

Bank of Canada operating techniques

In Canada, the **overnight rate** is now the Bank of Canada's key policy instrument. This is the interest rate that large financial institutions receive or pay on loans from one day until the next. The Bank implements monetary policy by setting a target for the overnight rate at the midpoint of an *operating band* that is plus or minus one-quarter of one percentage point, or 25 basis points, from the target rate.

Overnight rate: the interest rate large financial institutions receive or pay on loans from one day until the next.

The *bank rate* now marks the upper end of this operating band for the overnight rate. It is still the rate at which the Bank of Canada is willing to lend to the banks. The lower end of the operating band, the *deposit rate*, is the interest rate the Bank of Canada pays on deposits. Because the highest cost of borrowing cash is the bank rate, and the lowest return from lending cash is the deposit rate paid by the Bank of Canada, the rate on overnight borrowing and lending among the banks falls within the target range set by the Bank of Canada.

The Bank of Canada tells financial markets the direction in which it wants interest rates to move, by making changes to its target overnight rate and operating band. Changes in the target overnight rate

³You can read about this debate in: D. Laidler, and Wm. Robson, *The Great Canadian Disinflation: The Economics and Politics of Monetary Policy in Canada 1988-1993* (Toronto: C.D. Howe Institute, 1993). P. Fortin, "The Great Canadian Slump," *Canadian Journal of Economics* 29, No. 4 (August 1996), pp. 1082-1092. C. Freedman and T. Macklem, "A Comment on the 'Great Canadian Slump' ", *Canadian Journal of Economics* 31, No. 3 (August 1998), pp. 646-665.

lead to changes in interest rates banks offer to lenders and depositors. A lower target lowers bank lending rates, encouraging more borrowing by households and businesses and a corresponding expansion in the money supply.

Figure 10.2 shows the Bank's settings and changes of the overnight interest rate operating band over the past 13 years. From mid-2004 to late 2007 period, for example, the plot shows the Bank raised its overnight rate setting by steps of 0.25 percent (25 basis points) from 2.5 percent to 4.5 percent. Its intention was to reduce monetary stimulus to keep the economy working at potential output, with projected growth of real GDP at 3.0 percent and projected inflation at its target 2.0 percent.

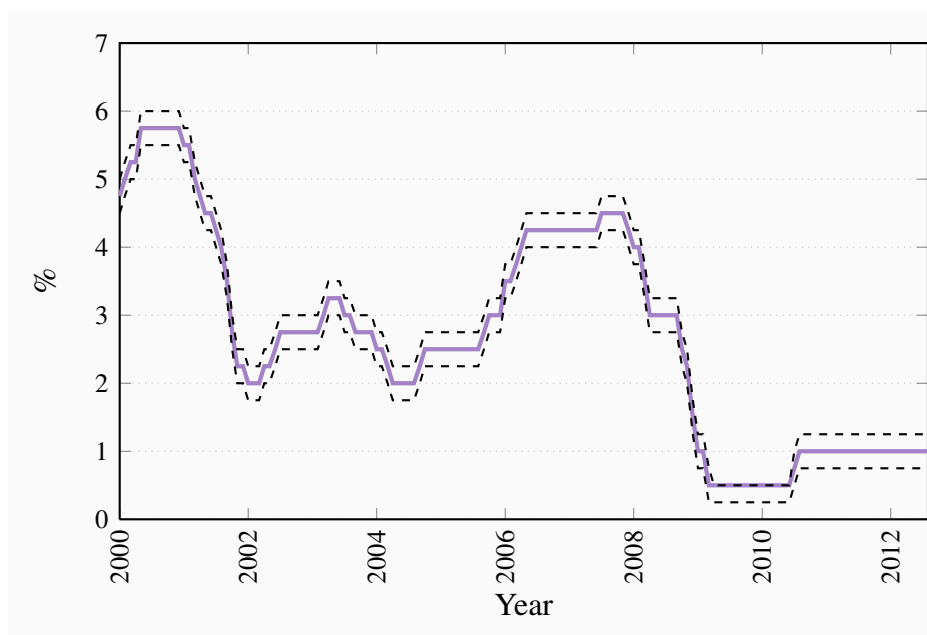


Figure 10.2: The Bank of Canada operating band for the overnight rate

Source: Statistics Canada, CANSIM Series V39076, V39077, V39079.

By contrast from July 2007 to March 2009 the Bank cut its setting for the overnight rate, in steps of 25 to 75 basis points, by a total of 400 basis points from 4.5 percent to 0.5 percent. Its intention then was to provide stimulus to and support for domestic financial markets and economic activity as the global financial crisis developed and spread. You can read a brief analysis underlying each of the Bank's decisions to change or hold constant its overnight rate target in the press releases on the Bank's website: <http://goo.gl/w63EiJ>.

By setting the overnight interest rate the Bank has a direct impact on interest rates that are important to the monetary transmission mechanism. Banks respond to a rise in the overnight rate by raising their **prime lending rate**, which is the base for most of the interest rates on their lending. Rates on business and consumer lines of credit, for example, are linked to the prime rate, and move up and

down with it. The connection to mortgage rates is also strong and they move with the overnight rate, although the link is not quite as tight. These interest rates cover about two thirds of bank financing in Canada. They make a strong link between the Bank of Canada's monetary policy action, expenditure, and aggregate demand. Figure 10.3 shows the relationship between changes in the setting of the overnight rate and other interest rates.

Prime lending rate: the base for setting the interest rates charged by banks on loans and lines of credit.

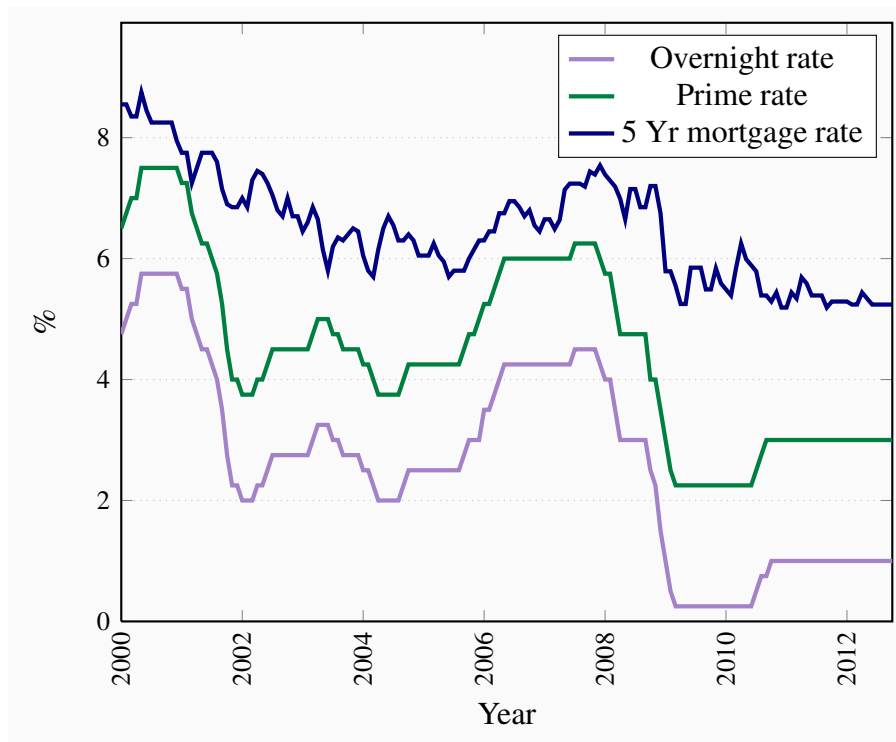


Figure 10.3: The overnight rate, prime rate and 5 year mortgage rate

Source: Statistics Canada, CANSIM Series V39079, V122495, V122521.

Other countries implement monetary policy by setting similar interest rates. The overnight rate set by the Bank of Canada is comparable to the United States Federal Reserve's target for the federal funds rate, and the Bank of England's two-week "repo rate," and the minimum bid rate for refinancing operations, the repo rate, set by the European Central Bank.

Institutional arrangements are the key to the Bank of Canada's use of the overnight rate as its policy instrument. The payments made by individuals and businesses, and their receipts, flow through the banking system. Some are small paper-based transactions that involve the writing of cheques on

deposit accounts. Others, and indeed the majority, are transfers of large deposits between bank customers. On any day, an individual bank may take in more deposits through these transfers than it pays out, or pay out more than it takes in. Any difference in either case is settled using balances held on deposit at the Bank of Canada. Technology now allows for *same day settlement* of large-value transactions, and an individual bank's settlement balances can change quickly.

Chartered banks in Canada operate under a *zero settlement balance requirement*. This means that the balances they hold in their deposit accounts at the Bank of Canada cannot be less than zero at the end of the day. If a bank's account is overdrawn from making payments to other banks, it must borrow to cover the overdraft either from another bank or from the Bank of Canada. Borrowing from other banks costs the *overnight rate*. Borrowing from the Bank of Canada costs the *bank rate*, which is set by the Bank of Canada one-quarter of a percentage point above the overnight rate. As a result, falling short of the zero-balance requirement imposes a cost on a bank, reducing its profitability, which it would like to avoid.

A positive settlement balance also imposes a cost. The Bank of Canada does pay interest on a positive balance in a bank's account, but it pays at its *deposit rate*. That rate is set one-quarter of one percentage point below the overnight rate. Not lending a positive balance to another bank at the overnight rate and accepting the Bank of Canada's *deposit rate* carries an opportunity cost a bank would prefer to avoid. This is a further incentive to maintain a zero settlement balance at the Bank of Canada.

This regulatory and institutional environment gives the Bank of Canada a framework for setting the interest rate to implement its monetary policy. The Bank makes eight scheduled announcements about its target for the overnight rate, and the operating band it is setting for the overnight rate. These announcements are made in press releases and include a brief explanation of the economic conditions on which the Bank's rate-setting decision is based.

Special purchases and sales (SPRAs and SRAs)

To maintain the overnight interest rate within the target band, the Bank of Canada must intervene in the market to cover any shortages or remove any surpluses of funds that would push rates beyond its target. The Bank has two tools it uses for this purpose.

One tool is the **special purchase and resale agreement (SPRA)**. This is a transaction initiated by the Bank of Canada that puts cash into the system on a very short-term basis. It is used to maintain the target overnight rate, more specifically to offset upward pressure on the rate.

In an SPRA, the Bank offers to buy Government of Canada securities from major financial institutions with an agreement to sell them back the next business day, at a predetermined price. The financial market gets an overnight injection of monetary base. The difference between the purchase and resale price determines the overnight interest rate on the transactions. Banks are willing to enter into these agreements with the Bank of Canada because they provide cash for the banks at

rates of interest below what they would otherwise have to pay in the overnight market.

SPRA: A Bank of Canada purchase of securities one day combined with an agreed resale of the securities the next day.

Figure 10.4 shows how this works. We start in equilibrium at E_0 with the demand for cash reserves just equal to the supply of monetary base at the overnight rate set by the Bank. Suppose a change in economic and financial circumstances causes a *temporary* increase in the demand for cash and settlement balances. The demand for monetary base shifts to the right to D_1 . If the Bank took no action the overnight rate would rise to E_1 above the target the Bank has set. To prevent this, the Bank provides an overnight increase in the monetary base by buying securities on the agreement that it will sell them back the next business day. This is an SPRA. It gives a temporary increase in monetary base to MB_1 and reinforces the Bank's overnight rate.

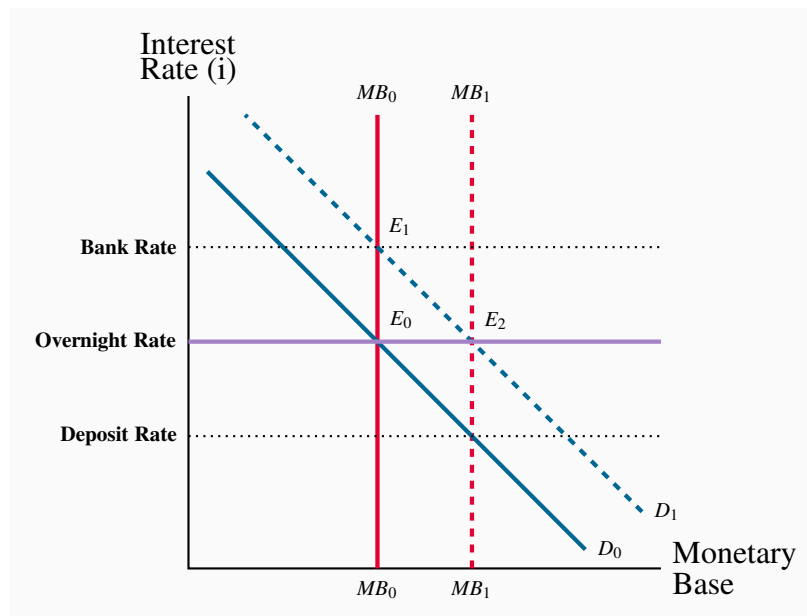


Figure 10.4: Setting the Overnight Interest Rate

In the opposite case of a fall in the demand for monetary base, the Bank makes use of a second tool to reduce the monetary base namely a **sale and repurchase agreement (SRA)**. This is a sale of securities to major financial institutions for one day combined with a repurchase the following day. It makes a one day reduction on the monetary base to offset a drop in the demand for cash that has put downward pressure on the overnight rate.

SRA: A Bank of Canada sale of securities one day combined with an agreed repurchase of the securities the next day.

Figure 10.5 shows the pattern of Bank of Canada interventions in the overnight money market. Although these interventions occur daily, the data plotted in the graph are weekly totals of dollar amounts involved in those interventions. In the period covered by the graph, the Bank was reacting in the latter half of 2007 to upward pressure on the overnight rate. It provided overnight funds to the market using SPRAs: purchasing securities with the agreement to sell them back the next business day. Then, in the first half of 2008, the Bank used SRAs to maintain its overnight rate target by offsetting downward pressure on the rate. However, by mid-summer the developing financial crisis increased the demand for liquidity and concerns about a recession led to reductions in the overnight rate target supported by substantial SPRAs. A period of relative tranquility in the overnight market followed, involving relatively small SRA and SPRA activity. Then starting in mid-summer 2011 SPRA's were used frequently to provide overnight funds and offset upward pressure on the overnight rate.

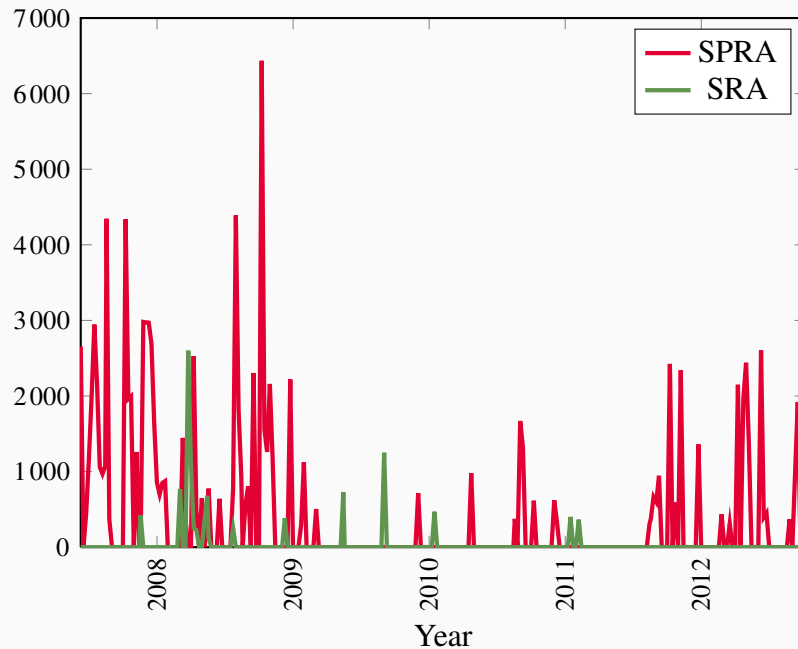


Figure 10.5: Bank of Canada SPRAs and SRAs (weekly totals)

Source: Statistics Canada, CANSIM Table 176-0073.

Special purchase and resale agreements, SPRAs, provide overnight increases in monetary base to offset upward pressure on the overnight rate. Sale and repurchase agreements, SRAs, make overnight reductions in monetary base to offset downward pressure on the overnight rate.

The data in the graph shows Bank of Canada SPRAs offsetting strong upward pressure on the rate from demands for liquidity during the financial crisis of 2007-08. A period of relative balance between supply and demand in the overnight market followed until mid 2011. Then Bank SPRAs again offset upward rate pressure from some excess demand for overnight funds.

What if the increased demand for monetary base is permanent, not just a one-day event? In Chapter 8 we saw how the demand for monetary base comes from public demand and from bank demand for cash and reserve balances. Increases in nominal income increase the demand for money, including cash. Let's suppose the increased demand for monetary base we see in Figure 10.4 is permanent, the result of growth in the economy. Now, if the Bank of Canada wants to keep the overnight rate constant, it must make a permanent increase in the monetary base, not just an overnight increase. It will do this using the *open-market operations* we discussed earlier. An open-market purchase of government securities makes a lasting increase in the Bank of Canada's asset holdings, permanently increasing the monetary base.

While these operations by the Bank of Canada may seem quite complex, they have a simple effect. Like open-market operations, SPRAs and SRAs increase or decrease the monetary base. In this case, however, the buyers and sellers in the market are limited to a few major financial institutions

rather than the full market. Furthermore, changes in the monetary base are very short-term, just one day. The objective is to set and control short-term interest rates, the *monetary policy instrument* used by the Bank of Canada.

10.4 Monetary policy rules

We have seen that central banks use interest rates as the main instrument of monetary policy. Now we need to examine how they decide to set and change the settings of interest rates. What lies behind the announcement of the overnight rate by the Bank of Canada or the setting of the federal funds rate in the United States? How are these interest rate decisions related to economic variables? Professor John Taylor of Stanford University found that most central banks, in fact, adjust interest rates in response to changes in two variables, output and inflation.

This finding was contentious. It implied monetary supply targets no longer played a role in decisions about setting interest rates. Instead, the interest rate target was and is set based on expected inflation and expected output relative to the central bank's inflation target and the economy's potential output.

A central bank that follows a Taylor rule cares about output stability as well as price stability. However, as we know from our introduction to the aggregate demand and supply model in Chapter 5, deviations of output from potential output also tell us what will happen to prices. Booms leading to inflationary gaps push prices up and lead to inflation. Recessionary gaps tend to reduce inflation. Thus, a Taylor rule is also compatible with the interpretation that the central bank cares about prices and inflation, both now and in the future. It is hard to distinguish empirically between these two interpretations of why a Taylor rule is being followed.

Nevertheless, until the financial crisis of 2008, Taylor's claim that such a rule effectively described central bank policy had strong empirical support. Most of the leading central banks, including the U. S. Federal Reserve, the Bank of England, and the new European Central Bank used an interest rate target as a policy instrument in pursuit of an inflation control objective. Taylor's insight is so widely used that it is called the "**Taylor rule**". It provides a useful explanation of monetary policy decisions.

Taylor rule: central bank interest rate settings based on inflation and output targets.

A simple Taylor rule

We continue to assume *prices are constant*, so the inflation rate is zero for the first part of our study of policy rules. When prices are constant, monetary policy follows the output part of a Taylor rule. In simple algebra, the rule is:

$$i = i_0 + \beta(Y - Y_P) \quad (10.1)$$

When real output (Y) is at potential output (Y_P), the interest rate is set at i_0 . This is the nominal and real interest rate under our assumption that prices are fixed. It is set by the central bank, based on the central bank's judgment about the interest rate required to support aggregate demand and equilibrium at potential output. According to this rule, when output *temporarily* exceeds Y_P , the central bank raises interest rates. At levels of output below Y_P , it lowers interest rates.

Figure 10.6 shows how this policy rule works. In Panel a), output is measured on the horizontal axis and interest rates on the vertical axis. A vertical line is drawn at the potential output level Y_P . The positively sloped line showing the central bank's reaction to fluctuations in output crosses the Y_P line at the interest rate i_0 with a slope of β . If output were lower than Y_P , at Y_1 for example, the bank would lower interest rates to i_1 to provide some stimulus to aggregate expenditure.

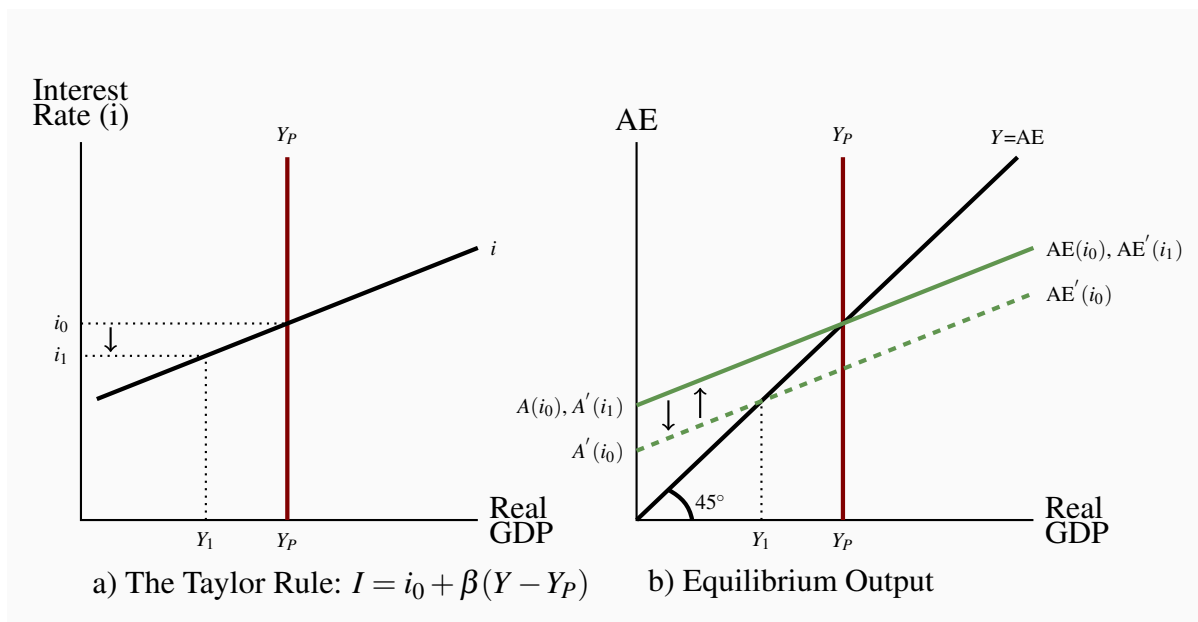


Figure 10.6: Interest Rates and Output with a Simple Taylor Rule

a) Central bank sets interest rate i_0 consistent with Y_P . $Y \neq Y_P$ changes i with a set range. Slope of line defines central bank reaction to *temporary* $Y \neq Y_P$.

b) A fall in $A(i)$ causes recessionary fluctuation in Y to Y_1 . Bank reacts, allowing $i < i_1$. Lower i increases $A(i)$ to restore AE and equilibrium $Y = Y_P$.

If decline in A is persistent and not offset by small fall in i the Bank will reset its target rate.

Alternatively, for an output greater than Y_P , the central bank would raise interest rates to reduce aggregate expenditure. This simple Taylor rule describes how the central bank resets its interest rate to achieve the target of equilibrium output at Y_P , and reacts to offset or moderate *temporary fluctuations* about Y_P .

Panel b) shows the effect of the changes in interest rates on equilibrium output. We studied the transmission mechanism from interest rate changes to expenditure changes in Chapter 9. The central bank chooses the interest rate i_0 that gives aggregate expenditure $AE(i_0)$ and equilibrium output at Y_P .

If *short-run* economic conditions changed and autonomous expenditure declined, the AE line would shift down to $AE'(i_0)$. Y would fall to Y_1 , which is less than Y_P . From the Taylor rule in Panel a), we see the reaction of the central bank. It lowers the interest rate to i_1 . Lower interest rates work through the cost of and availability of finance, wealth effects, and exchange rate effects to increase expenditure. The AE line shifts back up to $AE'(i_1)$ to restore equilibrium at Y_P . By reacting to temporary changes in the state of the economy, the central bank attempts to stabilize output at Y_P .

A specific Taylor rule in Figure 10.6 sets an interest rate target i_0 based on an assessment of the *fundamental conditions* in the economy. It calls for changes in the interest rate in response to temporary fluctuations in those conditions. A more lasting change in economic conditions would need a different policy rule. The central bank would choose an interest rate target different from i_0 , and appropriate to equilibrium at Y_P in the new conditions. A more expansionary monetary policy at each output level would mean a target rate lower than i_0 . The policy rule line in Panel a) would *shift down* to cross the vertical line at Y_P at the new lower target rate. A more restrictive policy would *shift the line vertically up*. Changes in the overnight rate in Canada or the federal funds rate in the United States are announced to tell financial markets of these changes in monetary policy.

Policy rules and inflation

When we drop our assumption that prices are constant, the policy rules we have discussed are too simple. Central banks today, like the Bank of Canada, conduct their monetary policy by setting *inflation targets*. This does not mean that they ignore the level of output in the economy. Instead, inflationary and recessionary gaps are seen as important predictors of future inflation. We know this relationship from our brief discussion of the AD/AS model in Chapter 5. To recognize the current approach to monetary policy, we need to extend our monetary policy rule.

The central bank's policy for setting the interest rate could be described by the following equation, where π^* is the bank's target inflation rate:

$$i = i_0 + a(\pi - \pi^*) + \beta(Y - Y_P) \quad (10.2)$$

As before, the central bank sets an interest rate i_0 . This is the nominal interest rate the bank thinks is consistent with output at potential output and inflation at the target rate π^* under current conditions.

The Bank of Canada's current inflation target, for example, is 2 percent, the midpoint of a 1 percent to 3 percent range. If inflation rises above the target π^* , the central bank raises the nominal interest rate. The parameter a in the equation tells us by how much the nominal interest rate is changed in response to an inflation rate different from the bank's target.

Expenditure decisions depend on the interest rate. To stick to its inflation target, the bank must change the interest rate by changing the nominal interest rate by more than any change in inflation. This requires the parameter $a > 1$. A rise in inflation is then met by a rise in interest rates that is large enough to reduce expenditure and inflationary pressure.

By this rule, the central bank also reacts to any departure of output from potential output, as it did in our earlier study of the simple rule, Equation 10.1. The parameter β measures how much the central bank would raise the interest rate in response to an inflationary gap, or lower it in response

to a recessionary gap. Output stabilization requires that $\beta > 0$.

Changing interest rates to offset an output gap is intended to stabilize output, but it will also work to offset any changes in the *future* inflation rate that would be caused by a persistent output gap. The size of the central bank's reactions, as measured by the parameters a and β are indications of the relative importance it attaches to inflation control and output stabilization.

Any change in economic conditions that the central bank thinks is *going to last for some time* will result in a change in its setting of i_0 . The policy line in a diagram would shift up or down. Interest rates would then be higher or lower for all inflation rates and output gaps, depending on the change in i_0 . The central bank would announce this change in the setting of its policy instrument, the overnight rate in Canada or the federal funds rate in the United States.

This approach to monetary policy has similarities to our earlier discussion of fiscal policy. In that case, we distinguished between automatic and discretionary policy. In the case of monetary policy, the discretionary component is the setting of the operating range for the overnight rate. These decisions are based on an evaluation of longer-term economic conditions relative to the target inflation rate. It *positions* the monetary policy line in a diagram in much the same way as the structural budget balance *positions* the government's *BB* line in Chapter 7. Short-term fluctuations in economic conditions result in short-term variations in the overnight rate—movements along the monetary policy line. This is similar to the automatic stabilization that comes from movements along the government's *BB* line as a result of fluctuations in output and income.

There is, however, an important difference between monetary and fiscal policy. Monetary policy that uses the interest rate as the policy instrument provides strong automatic stabilization in response to money and financial market disturbances. Automatic stabilization in fiscal policy reduces the effects of fluctuations in autonomous expenditures.

The effective lower bound (ELB)

The financial crisis and recession of 2008-09 led to new and more intense monetary policy actions by central banks. Most continued with cuts to basic policy rates as their first response. The Federal Reserve in the United States lowered its federal funds rate, in steps, to a range of zero to 0.25 percent. The Bank of Canada followed, lowering its overnight rate setting to 0.5 percent by early March 2009. But these lower rates were not sufficient to stimulate borrowing and expenditure. Banks and other lenders were concerned by the increased risks of losses on their current lending and the risks involved in new lending. They had suffered losses on previous large denomination wholesale and mortgage lending. Bankruptcies were rising rates of across many business and consumer loan markets.

With their policy interest rates cut to near zero, central banks hit the **effective lower bound (ELB)**. They needed additional policy tools to meet deep concerns about risk and liquidity in financial markets. Increased demands for liquidity raised desired reserve and currency ratios and lowered

money supply multipliers in many countries, and restricted access to bank credit.

Effective lower bound (ELB): A Bank's policy interest rate cannot be set below a small positive number.

Two previously used techniques were introduced. The first was increased “**moral suasion**,” an increase in communications with financial market participants to emphasize the central bank's longer-term support for markets and its actions to promote stability. More directly the banks were urged to maintain their lending operations.

Moral suasion: a central bank persuades and encourages banks to follow its policy initiatives and guidance.

The second was “**quantitative easing**,” and in the case of the U.S., an even more extensive “**credit easing**.” “Quantitative easing” is the large scale purchase of government securities on the open market. It expands the central bank's balance sheet and the size of the monetary base. A version of this policy action was used in Japan earlier in the decade after the Bank of Japan had lowered its borrowing rate to zero and wanted to provide further economic stimulus.

Quantitative easing: a large scale purchase of government securities to increase the monetary base.

Credit easing is measured by the expanded variety of loans and securities the central bank willingly holds on its balance sheet. These come from purchases of private sector assets in certain troubled credit markets. The mortgage market for example was in trouble as a result of falling real estate prices and mortgage defaults. Cash is put directly into specific markets rather than letting it feed it through commercial banks' lending and loan portfolio decisions.

Credit easing: the management of the central bank's assets designed to support lending in specific financial markets.

Monetary policy practice continues to evolve. In the last few years, with policy interest rates at or near the effective lower bound and persistent weakness in economic growth and employment, major central banks have relied increasingly on “**forward guidance**” to support their economies. Forward guidance is contained in the explanation a Bank gives in its formal announcement of setting of the policy interest rate. If for example the Bank's opinion that economic growth and inflation will be slow and weak, the Bank suggests that interest rates will be unchanged for some time into the future. Alternatively a prediction of a revival in growth and inflationary pressure may

lead the Bank to predict increases in policy interest rates in the near.

Forward guidance: information on the timing of future changes in the central banks interest rate setting.

This forward guidance is intended to help firms and households make expenditure decisions that require debt financing. In some cases it is based on an explicit economic criterion.

For example, the US and the UK recently introduced unemployment rate thresholds for changes in the monetary policy rate settings. This is in essence a variety of forward guidance. In the UK, for example, in August 2013 the Bank of England, under the heading “Forward Guidance” announced:

In particular, the MPC [Monetary Policy Committee] intends not to raise Bank Rate from its current level of 0.5% at least until the Labour Force Survey headline measure of the unemployment rate has fallen to a threshold of 7%, subject to the conditions below.

Source: <http://goo.gl/2weyWk>.

In Chapter 5, Figure 5.9 illustrated the close relationship between the unemployment rate and the output gap. In effect, putting an unemployment rate target into the interest rate setting rule is a variation on the Taylor Rule specified by Equation 10.2. It adds to or replaces the output gap target with an unemployment rate target.

10.5 The long-run neutrality of money

There is a long historic tradition of discussing money, economic activity, and prices based on the **equation of exchange**. In terms of real GDP, that equation is an identity, true by definition, namely:

$$MV \equiv PY \quad (10.3)$$

Equation of exchange: the identity between total money expenditure and nominal GDP.

Suppose M is the money supply, V the velocity of circulation or the number of times a unit of money changes hands in a given time period, and P the flexible general price level like the GDP

deflator, and Y real GDP. Then, in the equation of exchange, the total of expenditure, MV , is by *definition* equal to the money value of goods and services bought.

The equation of exchange is the foundation of the famous *quantity theory of money*, a theory of the price level or the inflation rate. Assume that V , the velocity of circulation of money is a constant, V_0 . This velocity of circulation is just the inverse of the demand for money, L , based on the current financial structure and practice of making payments, without the effect of interest rates on that demand for money balances.

Assume as well that the economy operates at the level of potential real GDP, Y_P . Further assume that the money supply is determined and firmly controlled by the central bank. Based on these assumptions, the quantity theory of money says that the price level P is determined by the size of the money supply. This can be written as follows:

$$MV_0 = PY_P$$

or restated as:

$$P = M \times \frac{V_0}{Y_P} \quad (10.4)$$

With (V_0/Y_P) a constant, a change in money supply M causes a change in P . If M doubles then P doubles. If M grows at 10 percent a year then P grows at 10 percent a year. The inflation rate is determined by the rate of growth of the money supply.

Neutrality of money: monetary policy can set prices and inflation rates in the long run, but not output and employment.

By this quantity theory of money and the price level, **money is neutral**. Changes in the money supply have no effect on the level of real output. Real output is constant at Y_P . Central bank or government control of the money supply gives the policy authorities control of the price level and the inflation rate.

Current approaches to monetary policy recognize that the conditions assumed by the quantity theory are not met in the short run. The demand for money is variable and thus the velocity of circulation is not constant. Real GDP and real GDP growth rates fluctuate about the trend of potential output. Prices in some markets are sticky and slow to adjust to changes in demand. The central bank's control of the money supply and the growth rate of the money supply are not precise. The quantity theory and the neutrality of money have important long-run implications but short-run conditions call for a different approach.

Monetary policy as described by the policy rule targets inflation by stabilizing output at potential output. In short time periods, prices tend to be sticky. This means that the central bank is able to change nominal interest rates more rapidly than prices change. Changes in the interest rates then change aggregate demand through the transmission mechanism we examined in Chapter 9.

Longer-term inflation targets are met by keeping actual output close to potential output. In an aggregate supply and demand model, prices or inflation rates change as a result of persistent recessionary or inflationary gaps. If monetary policy can reduce or eliminate the gaps by shifting the AD curve, it stabilizes both output and inflation.

What monetary policy cannot do is change *potential output*. Suppose in Figure 10.7 the central bank decides it could raise output above Y_P and lower the unemployment rate below the natural rate u_n . The central bank then sets the interest rate lower at i_1 . According to the transmission mechanism, AD increases and Y increases. The short-run effect of this shift to monetary expansion is, indeed, to increase output and employment and lower the unemployment rate creating an inflationary gap ($Y_1 - Y_P$).

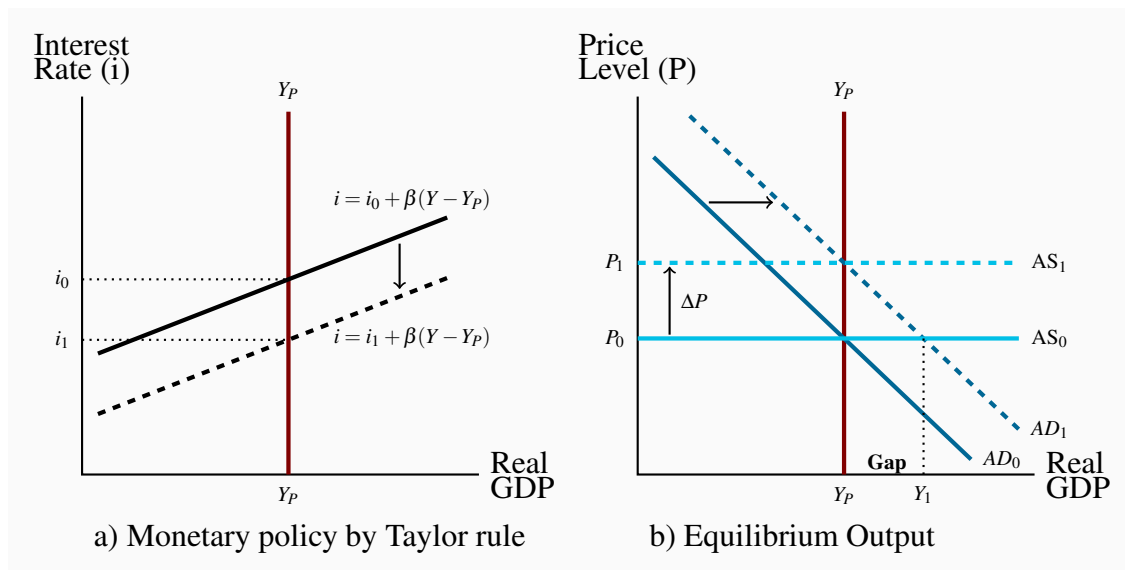


Figure 10.7: The Neutrality of Money

Starting with monetary policy $I = i_0 + \beta(Y - Y_P)$ equilibrium at P_0Y_0 , an expansionary monetary policy lowers i from i_0 to i_1 with a corresponding increase in money supply. Lower i shifts AD from AD_0 to AD_1 , causes a short run increase in Y to Y_1 and creates an inflationary gap. If this gap persists it pushes wages and prices up shifting AS to AS_1 at the price level P_1 . Expansionary monetary policy introduced at $Y = Y_P$. It does not make a lasting change in real GDP but it just increases P . Money is neutral.

But if the inflationary gap created by expansionary monetary policy persists, costs and prices will rise. Low unemployment rates, high rates of utilization of plant and equipment, and strong demand

for other inputs to production raise input prices and production costs, as we will discuss in more detail in Chapters 11 and 12. With strong demand for final output, higher costs result in higher prices. Rising prices reduce expenditure until output falls back to potential output. The only lasting effect of expansionary monetary policy is the higher price level P_1 .

In the long run, money is neutral. Monetary policy can change the price level or the inflation rate in the long run, but it cannot change potential output. As a result, central banks set inflation targets for monetary policy, not output or employment targets.

10.6 Monetary policy indicators

Policy rules describe how a central bank, like the Bank of Canada, would use interest rates to stabilize output, prices, and inflation in the economy. To see how the Bank's actions affect economic activity and inflation, we need some indicators of the expansionary or restrictive stance of monetary policy. These **monetary policy indicators** will allow us to go beyond the central bank's descriptions of its policy and observe the effects of its policy actions on monetary conditions in the economy.

Monetary policy indicators: variables that provide information about the stimulus or restraint coming from the central bank's policy.

Our earlier discussion of the monetary transmission mechanism suggests two monetary policy indicators, namely, *interest rates* and *exchange rates*. The central bank sets nominal interest rates, which have important effects on asset prices, cash flows, and expenditures. Interest rates are also important to expenditure decisions. Changes in nominal interest rates over time will show us how monetary policy has been implemented.

We have also mentioned briefly the foreign exchange rate and net exports. Because exchange rates change in part as a result of interest rate differences between countries, changes in the exchange rate provide an indicator of the thrust of domestic monetary policy relative to foreign monetary policy. Although in Canada it is important to recognize that commodity prices also have strong exchange rate effects.

The monetary transmission mechanism works through both interest rates and exchange rates. In setting its interest rates, a central bank in a small open economy needs to consider recent changes in the exchange rate. If economic conditions, or policies in other countries, have caused changes in the foreign exchange rate, those changes will affect expenditures and output in Canada.

The depreciation of the U.S. dollar in 2003 and 2006 is an important example. The corresponding appreciation of the Canadian dollar lowered import prices and reduced the profitability of exports.

Without offsetting policy action expenditure and output in Canada would fall. The Bank of Canada had to make a decision. Was the setting of its operating range for the overnight rate still consistent with its inflation target once the exchange rate had fallen? Should the Bank respond to the lower AD caused by the appreciation of the Canadian dollar by lowering its interest rate to provide some offsetting stimulus? If it were to respond, by how much should it lower interest rates? Clearly, the combined effect of interest rates and exchange rates is very important for monetary policy.

While interest rates and exchange rates provide important indicators of monetary policy, many economists and the Bank also regard the money supply or the rate of growth of the money supply as a policy indicator. Some suggest a monetary policy rule for money supply, which uses money supply as the central bank's policy instrument. We also know that the demand for nominal money balances depends on nominal income. Taking this into account, we can use the difference between the rate of growth on the money supply measure, M1B, and the rate of growth of nominal GDP as an indicator of the stance of monetary policy. M1B growth that exceeds growth in nominal GDP provides easier financial market conditions and suggests an expansionary policy stance.

The growth rates in the money aggregates M1B+ and real M2+, adjusted for inflation, provide alternative indicators of the effect of monetary policy. In the current policy context, the Bank of Canada sets the interest rates and the growth rates of money supply reflect the demand for money balances at those interest rates. Empirical research at the Bank and by other monetary economists has found that the growth in real M1B+ is a useful indicator of future growth in real GDP. Growth in real M2+ also provides a leading indicator of inflation. From these findings, an observed increase in the growth rates of these money aggregates indicates that the Bank's current policy is adding to aggregate demand.

Thus we have a set of monetary policy indicators: interest rates, exchange rates, and the growth rate in nominal and real measure of money supply. They come from our understanding of the way changes in monetary variables may affect expenditures, incomes, and prices and from our discussion of how monetary policy is designed and implemented.

Next

We have now completed our discussion of the basic expenditure and monetary structure of the economy under the assumption that the general price level is constant. In Chapter 11, we return to the traditional aggregate demand and aggregate supply models based on fixed money supply and short term price flexibility we introduced in Chapter 5. Then in Chapter 12 we introduce a basic modern AD/AS model that explains short run fluctuations output in and inflation. That model is built on modern monetary policy that sets interest rates to achieve inflation control.

KEY CONCEPTS

Central banks operate to influence the behaviour of other banks and intermediaries in the financial system.

A central bank conducts **monetary policy** through its control of the monetary base and interest rates. It is also banker to the government and to the commercial banks.

The **Bank of Canada** is Canada's central bank. It is the source of the monetary base. It sets short-term interest rates, acts as banker to the commercial banks and the federal government, and is the lender of last resort to the banks.

Monetary policy in Canada is the responsibility of the Bank of Canada. The Bank uses its control of the monetary base and interest rates to promote economic stability at potential output and a low stable inflation rate.

Central banks have three main operating techniques: **reserve requirements imposed on commercial banks**, **open-market operations**, and **bank rate** setting. These techniques are used to manage the monetary base, the money multiplier, and interest rates.

Central banks can implement **monetary policy through the monetary base and money supply control** or through interest rate control, but cannot do both simultaneously.

In practice, the Bank cannot control money supply exactly. Thus, for most central banks, a short-term **interest rate is the instrument of monetary policy**.

The Bank of Canada uses the **overnight interest rate as its policy instrument**, and an inflation rate of **1 percent to 3 percent as its policy target**.

The Bank of Canada uses **SPRAs** and **SRAs** to intervene in the market for overnight funds and to reinforce its setting of the overnight interest rate.

A **monetary policy rule** such as a Taylor rule for setting the interest rate provides a useful description of the way the central bank sets and adjusts its interest rate policy instrument.

Changes in the central bank's policy instrument change nominal and real interest rates and change aggregate demand through the **transmission mechanism**, which includes wealth effects, cost of financing effects, and exchange rate effects on the components of aggregate expenditure.

Quantitative easing is the use of central bank purchases of securities with the aim of increasing the monetary base to meet unusually high demands for liquid cash balances in times of

financial and economic crisis.

Credit easing is the increase in specific kinds of central bank asset holdings, commercial paper for example, designed to provide liquidity and support lending in specific markets facing shortages of funds.

Forward guidance: information on the timing of future changes in the central banks interest rate setting.

In the short run, fixed or sticky prices allow the central bank to change real interest rates, real money supply, aggregate demand, and real output.

In the long run, when all prices are flexible, money is neutral. The central bank can change nominal interest rates, prices, and inflation rates, but cannot change real interest rates or real output.

Real and nominal interest rates, exchange rates and rates of growth of money aggregates relative to national income can be used as **monetary policy indicators**.

EXERCISES FOR CHAPTER 10

Exercise 10.1. Explain carefully why a central bank does not operate to make a profit but a commercial bank does. What is the central bank's operating objective? What unique power does a central bank have that allows it to pursue its operating objective?

Exercise 10.2. Explain carefully why a central bank's power to conduct monetary policy is based on its unique position as supplier of the monetary base.

Exercise 10.3. Why would a change in the monetary base ΔMB cause a change in the money supply?

Exercise 10.4. (a) Suppose a central bank buys \$10 million on the open market. What effect does this have on the monetary base and the reserve position of the commercial banks?

(b) If the banks hold reserves equal to 2.5 percent of their deposit liabilities, and the public holds cash equal to 7.5 percent of their deposit holdings, calculate the effect of this open-market transaction on:

- (a) The money supply
- (b) The public's cash balances
- (c) The banks' reserve balances

Exercise 10.5. Suppose the central bank decides to use its power to set interest rates. Use a money market diagram to show and explain what happens to the real money supply if real output increases ($\Delta Y > 0$) and the central bank maintains a constant interest rate.

Exercise 10.6. (a) What is the Bank of Canada's monetary policy target?

(b) What monetary policy instrument does the Bank use to pursue this target?

(c) What do the Bank's procedures for implementing policy mean for its control over money supply?

Exercise 10.7. Use a diagram to show circumstances in the market for overnight funds that might lead the Bank of Canada to make an SRA. Why would the Bank use an SRA in this case rather than an open market operation?

Exercise 10.8. Suppose a central bank decides to conduct monetary policy according to a Taylor rule for interest rates.

- (a) How does it choose the basic setting for the interest rate within the rule?
- (b) How would it respond to a rise in the unemployment rate?
- (c) How would the bank react to an inflation rate higher than its target inflation rate?
- (d) Why would the bank decide to change the basic setting of its interest rate?

Exercise 10.9. Use diagrams to show and explain how monetary policy conducted according to a Taylor rule would stabilize real output at potential output.

Part Four

Real GDP, Business Cycles, Policy and Growth

11. A traditional AD/ AS model

12. An AD/ AS model of the inflation rate and real GDP

13. Economic growth

This Part extends the macroeconomic models in three important ways. First, it drops the assumption of a constant price level that has been important to the aggregate expenditure models developed in the preceding chapters. Second, assuming the general price level is variable; it develops two alternative macroeconomic models that explain business cycles. Third, it introduces growth theory and the growth in potential GDP. Chapter 11 builds a ‘traditional’ Aggregate Demand – Aggregate Supply model to explain the *price level* and real GDP. Chapter 12 builds a ‘modern’ Aggregate Demand – Aggregate Supply model to explain the *inflation rate* and real GDP. The differences between these models reflect the important differences between traditional and modern monetary and fiscal policy objectives and instruments. Chapter 13 introduces theories of economic growth and productivity growth in the aggregate economy.

Chapter 11

A traditional AD/ AS model

In this chapter we will explore:

- 11.1 The construction of an AD curve
- 11.2 The slope and position of an AD curve
- 11.3 The short run AS curve
- 11.4 Short run equilibrium GDP and price level
- 11.5 The causes of business cycles in real GDP
- 11.6 Internal adjustment to output gaps?
- 11.7 Monetary policy and fiscal policy

The Great Recession that followed the financial crisis of 2009, and persists in many industrial countries today, is the most prolonged slowdown in economic activity since the Great Depression of the 1930's. What caused this recession and what prolongs it? How did it spread through the economy? Can governments take action to stimulate and support a speedy recovery? A carefully constructed macroeconomic model is needed to answer this question.

This chapter and the next chapter draw together the material of the last five chapters to provide two such models. The first model is an AD/AS model built on a *fixed exogenous money supply* and a constant equilibrium price level. The second model is a 'current' or modern AD/AS model built on an *exogenous interest rate* and an *equilibrium inflation rate*. Both models involve a negatively sloped AD curve and an AS curve, but with different underlying explanations. While the first model is the 'traditional' model of undergraduate economics courses, the second model is a basic version of the type of model currently in use by policy analysts, central banks and fiscal policy authorities.

Fiscal policy and monetary policy provide two broad sets of tools that governments can use to manage aggregate demand, output, prices, and inflation. The short-run AD/AS models are used to study how changes in fiscal and monetary policy can fight recessions and inflationary gaps. The recent performance of the Canadian economy under different monetary and fiscal policies provides interesting examples of macroeconomic policy in action.

We continue to work in the short run; the labour force, the stock of capital, and the state of technology are fixed, fixing potential output Y_P . The position of the short-run aggregate supply curve is based on Y_P , given money wage rate conditions, and a given rate of indirect taxes. With these conditions, fluctuations in aggregate demand or aggregate supply conditions cause the fluctuations in output, employment and prices we often describe as business cycles. Interesting questions arise over the economy's potential for internal adjustment to long run equilibrium levels of real GDP and prices and the design of monetary and fiscal policies.

11.1 The construction of an AD curve

As explained in Chapter 5, aggregate demand is different from the market demand for an individual product or service. Aggregate demand explains how changes in the *general price level*, either the GDP deflator or the consumer price index, cause changes in aggregate expenditure. National accounts showed that this relationship is not based on changes in prices relative to income, as in the market for an individual product. Instead, we saw that the strongest links between the price level and aggregate expenditure come from financial markets, working through the monetary transmission mechanism we have studied in the last three chapters. Direct wealth effects on consumption and substitution effects on net exports may also provide some of the explanation for this relationship.

To explore this in more detail we start with a key assumption, namely *that the central bank sets and controls the size of the nominal money supply, M_0* . In our earlier study of the money market, we looked at the way the demand for real money balances and the supply of real money balances interact to determine the equilibrium interest rate. When the nominal money supply is fixed at any specific size, say M_0 , a change in the price level changes the **real money supply** (M_0/P), disrupts the equilibrium in the money market, and causes a change in the interest rate and the foreign exchange rate.

Real money supply (M/P): the purchasing power of the nominal money supply derived by deflating the nominal money supply by the general price level.

We can see this relationship in the money market equilibrium condition from Chapter 9, namely:

$$\frac{M_0}{P} = L(Y, i) \quad (11.1)$$

The real money supply, measured in terms of the amount of goods and services it would buy, is the nominal money supply M_0 divided by the general price level P . The demand for real money balances is positively related to real GDP, Y , and negatively related to the nominal interest rate, i .

Figure 11.1 uses a money market diagram to show how a change in the price level affects interest rates. In the initial equilibrium, the central bank has set the nominal money supply at M_0 , and conditions in the economy give a price level P_0 . Real output or GDP is constant at Y_0 . The money market is in equilibrium at the interest rate i_0 .

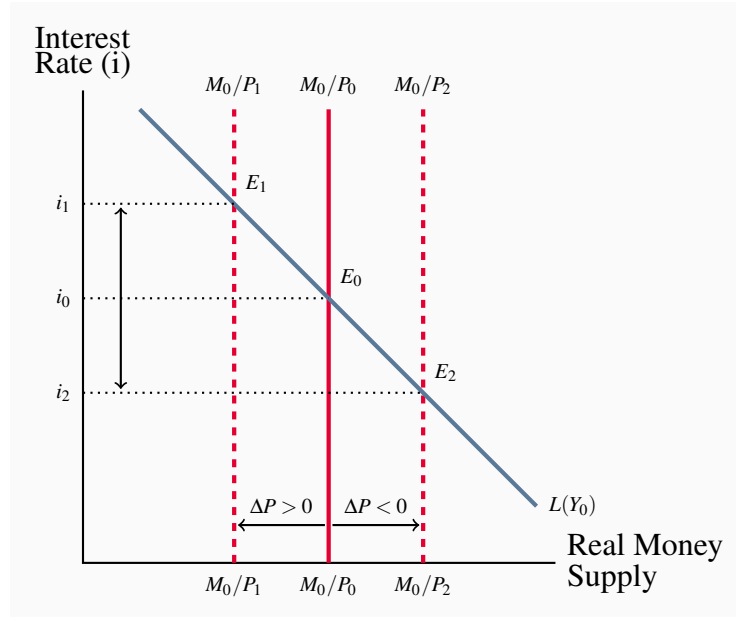


Figure 11.1: Price Level Changes and Interest Rates

Changes in price level change the real money supply, shifting the M_0/P line and disrupting the initial equilibrium. The real money supply line in the diagram shifts to the left if prices rise and to the right if they fall. Equilibrium is restored by a change in interest rates.

From the monetary transmission mechanism, we know that changes in interest rates will cause changes in aggregate expenditure. We will extend our discussion of the effect of changes in the price level, and make that linkage to expenditure and output, very shortly. First there is an interesting question to consider: How much do interest rates change as a result of a change in the price level? The answer is important for the effect of price changes on equilibrium output.

In the discussion of the monetary transmission mechanism in Chapter 9, Figure 9.8 illustrated the importance of the interest rate elasticity of demand for money market adjustments to equilibrium. From that discussion we know that *lower interest rate elasticities* in the demand for money would result in *larger changes in interest rates* following a change in the real money supply. Figure 9.8 also showed *higher interest rate elasticities* in autonomous expenditure resulted in *larger changes in expenditures* when interest rates changed. These two conditions are the determinants of the *slope of the AD curve*.

Now we can derive an aggregate demand curve showing the relationship between the general price level and the equilibrium level of planned expenditure and output. To focus on this relationship, we assume that the nominal money supply is fixed by the central bank. We also assume that expenditures that are *not* related to interest rates and exchange rates are constant. Changes in any of these assumptions will change the *position* of the aggregate demand curve, shifting it either left or right as explained in earlier chapters.

Changes in the general price level change equilibrium expenditure and output through the monetary transmission mechanism. A rise in the price level lowers the real money supply. Interest rates rise in the money market and, if the exchange rate is flexible, the domestic currency appreciates and the foreign exchange rate—the Canadian dollar price of the U.S. dollar—falls.

Higher interest rates raise the costs of carrying the lines of credit outstanding to households and business, reducing their funds for other expenditures. Flexible mortgage rates have the same effect. The costs of new borrowing are similarly increased, and the fall in asset prices that comes with a rise in interest rates reduces household and business borrowing capacity. Domestic consumption and investment expenditure are reduced. The fall in the foreign exchange rate lowers import prices and reduces export competitiveness and profitability. Net exports fall. Through these linkages in the monetary transmission mechanism a higher price level, when the nominal money supply is fixed, reduces planned expenditure and equilibrium output. The economy *moves up to the left along the AD curve*.

A fall in the general price level would have the opposite effects on nominal and real interest rates and exchange rates, raising planned expenditure and equilibrium output. Again, a change in the price level moves the economy along the AD curve.

The linkages between changes in the general price level and changes in output can be summarized as follows, again using the Greek letter Δ to mean “change in”:

$$\Delta P \rightarrow \Delta(M/P) \rightarrow \begin{pmatrix} \Delta i \rightarrow \Delta(C+I) \\ \Delta er \rightarrow \Delta NX \end{pmatrix} \rightarrow \Delta AE \rightarrow \Delta Y$$

Figure 11.2 shows this derivation of the aggregate demand curve by combining diagrams we have used before. Panel a) shows money market equilibrium at i_0 with $M_0/P_0 = L(Y_0)$, based on an initial nominal money supply M_0 , set by the central bank, and price level P_0 .

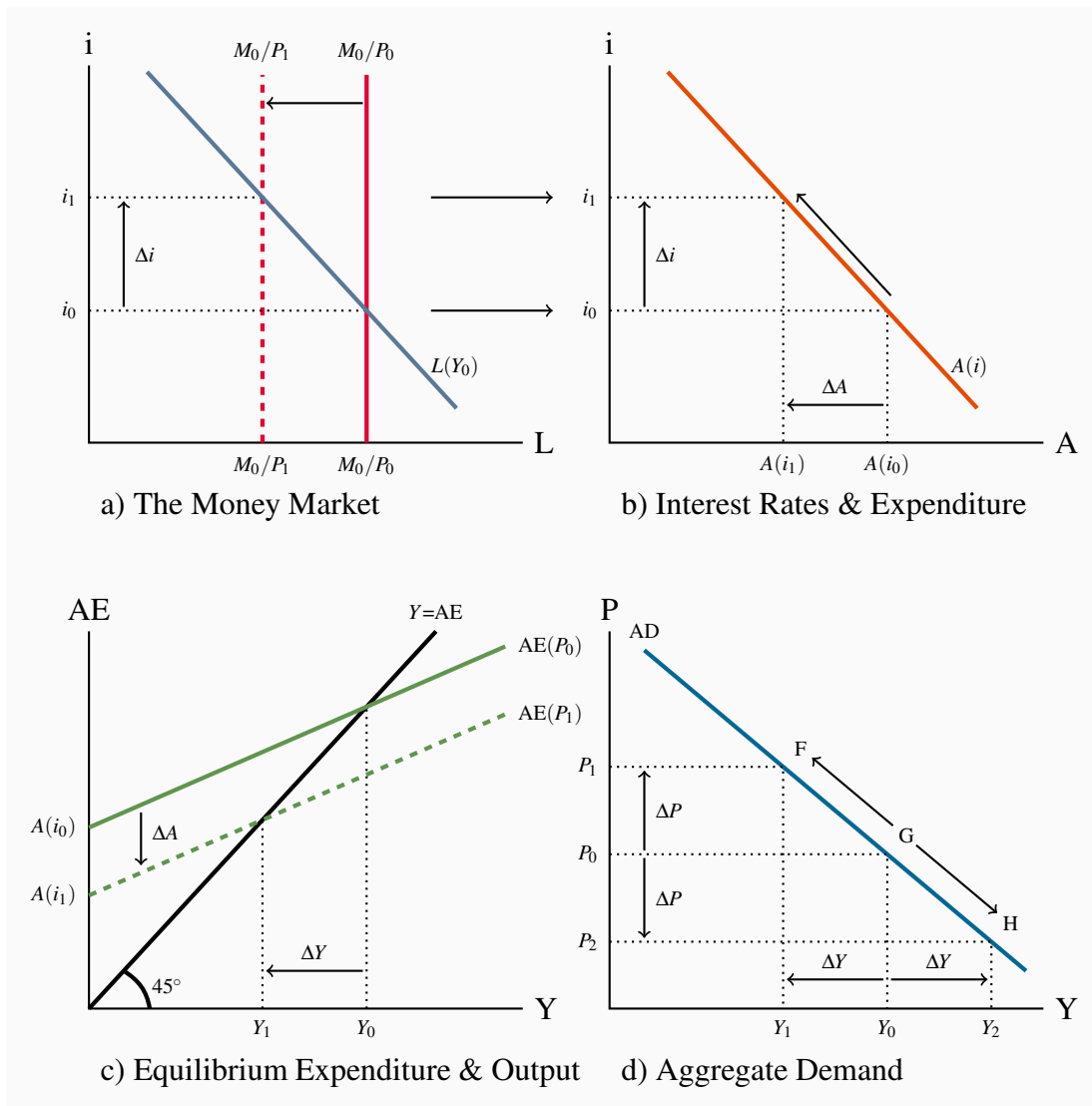


Figure 11.2: Constructing the AD Curve when Nominal Money Supply is Fixed

In Panel b), the interest rate i_0 determined in the money market results in a total of consumption, investment, and net export expenditure that is sensitive to the interest rate equal to $A(i_0)$. (In equilibrium, prices are constant, the inflation rate is zero, and therefore nominal interest rates equal real interest rates.) The net export part of this comes from exchange rate effects.

Panel c) shows the equilibrium level of aggregate expenditure and real output Y_0 , based on autonomous expenditure, expenditure related to interest rates and exchange rates, and expenditure induced by the marginal propensities to consume and import and the marginal tax rate. These induced expenditures are the source of the multiplier studied in Chapters 6 and 7.

The information in Panels a), b), and c), shows that when there is one general price level P_0 , the corresponding equilibrium real output is Y_0 . This combination is plotted in Panel d) at point G.

The aggregate demand curve describes what would happen to equilibrium real output if the general price level changed, everything else held constant. To show this, return to Panel a) in Figure 11.2 and assume the price level rises to P_1 . This price increase reduces the real money supply and raises the interest rate to i_1 . A higher interest rate i_1 reduces expenditure in Panel b), and this in turn lowers the AE curve in Panel c). The multiplier works to give a new equilibrium output Y_1 . Plotting P_1, Y_1 in Panel d) gives point F. Alternatively, assuming a fall in the general price level to P_2 , the same process would lead to P_2, Y_2 , and point H in Panel d). G, F, and H are three points on the aggregate demand curve AD_0 . The AD curve is the locus of equilibrium points based on $Y = AE$ at different price levels.

11.2 The slope and position of the AD curve

The slope and the position of the AD curve describe a set of conditions in the economy. Changes in the general price level P cause *movements along the AD curve*. From the diagrams in Figure 11.2 the slope of AD, which describes the size of the change in Y caused by a change in P , is determined by *three economic relationships*:

1. The interest sensitivity of the demand for money as shown by the slope of the demand curve for money balances in Panel a).
2. The interest sensitivity of planned expenditure as shown by the slope of the $A(i)$ curve in Panel b).
3. The size of the multiplier, which is determined by the slope of the AE line in Panel c).

You can experiment with the diagrams to see that, if the demand for money is very sensitive to interest rates, and if expenditure does not change much when interest rates change, and the expenditure multiplier is small, the AD curve will be steeply sloped. The effects of changes in the general price level P on equilibrium expenditure and output Y will be small.

If conditions in the economy are the opposite of those just described, the AD curve will be flatter, and changes in P will have large effects on Y .

The position and slope of the AD curve summarizes the material of Chapters 6 to 9 into one function. Its *position* is determined by:

1. Autonomous consumption, investment, and government and net export expenditures;

2. The nominal money supply set by the central bank;
3. The monetary transmission mechanism through interest rates and exchange rates; and
4. The multiplier.

A change in any of these conditions results in a *shift* to a new AD curve.

The monetary transmission mechanism and the multiplier are also captured in the slope of the AD curve.

The AD curve provides an explanation of how the financial crisis of 2008 led to a recession in 2009 and to the policy responses available to governments. If we understand the internal workings of AD, it shows how changes in autonomous consumption, investment, exports, government budgets, interest rates, and other conditions affect output, employment, and incomes. All these expenditures in AD were involved in the 2009 recession and the later recovery. When AD is combined with the short-run AS curve, we can also see the effects of changing economic conditions on both output and price levels, and identify the roles for fiscal and monetary policy to stabilize output, employment, and prices.

11.3 Short-run aggregate supply

The short-run aggregate supply (AS) curve defines a relationship between real GDP and the general price level. It is based on the following assumptions:

1. Prices of the factors of production, the money wage rates for labour in particular, are constant.
2. The stock of capital equipment, the buildings and equipment used in the production process, and the technology of production are constant.
3. The size of the labour force is constant but the level of employment is variable.
4. The rates of indirect taxation imposed by governments are held constant.
5. The prices of key raw material inputs, which are determined in international markets like the market for crude oil, are constant.

These conditions determine the *position* of the AS curve. If the price level is constant, the AS curve is a horizontal line.

If the price level is not constant, but positively linked to the level of real GDP, the short-run AS curve is upward sloping. The steepness of its slope is a measure of the flexibility or stickiness of the general price level. This degree of price flexibility reflects the underlying structure of industry in the aggregate economy, production costs, and the way output and price decisions are made.

The determinants of the slope and position of the short-run aggregate supply curve were explained briefly in Chapter 5. Based on the income approach to measuring GDP and the GDP deflator, the relationship between output and the general price level on the supply side of the economy depends on what happens to unit costs (factor cost per unit of output) as output increases or decreases. In the short run, with constant factor prices, unit costs and prices depend on *factor productivity* as output changes. The largest component of factor cost is labour cost (about 70 percent), based on its share of factor income in national accounts.

With a fixed capital stock an increase in employment to produce more output means plant and equipment are used more intensively. In simple terms each employee has less capital to work with. As a result, labour productivity measured by output per hour worked decreases as employment and output increase. With the money wage rate constant, unit labour costs and unit factor costs of production rise. Business will be willing to increase output only if output prices rise to cover the rise in unit costs,

The positively sloped short-run AS is based on the assumption that unit costs rise as output and employment increase *in at least some sectors* of the economy. Figure 11.3 illustrates the AS curve.

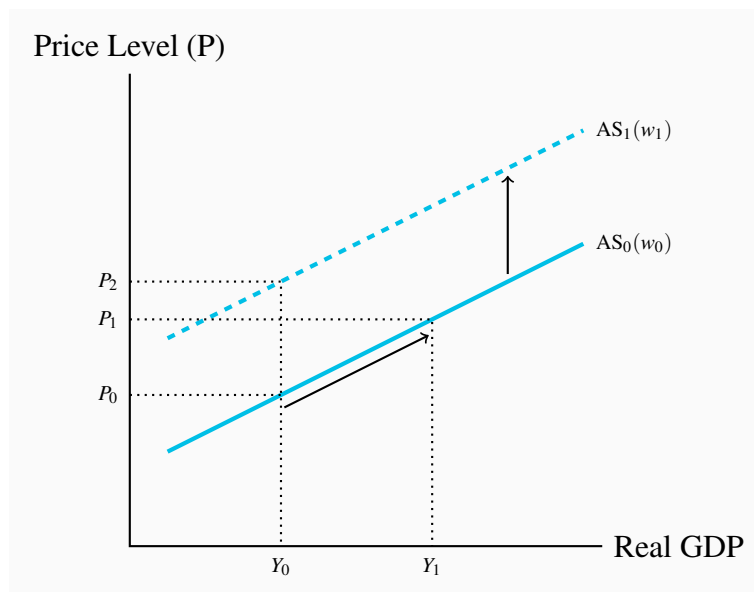


Figure 11.3: The Short-Run Aggregate Supply Curve

With constant money wage rate w_0 and increase in Y from Y_0 to Y_1 comes with an increase in unit costs and an increase in the price level from P_0 to P_1 moving along the AS curve. An increase in the money wage rate from w_0 to w_1 increases unit costs at any level of output. The AS curve shifts up.

The AS curve in Figure 11.3 shows the relationship between the output of goods and services, real GDP, and the general price level, all other conditions held constant. The curve AS_0 is drawn for a given level of money wage rates w_0 . Point P_0Y_0 on AS_0 reflects unit costs at output Y_0 and producer decisions with respect to output at that price.

If output were higher at Y_1 producers' unit costs would be higher because factor productivity is lower at that higher output. A higher price, P_1 , would be required to cover costs and make producers willing to supply goods and services. With everything but price and output held constant, movements along the upward-sloping AS curve show the prices producers would need in order to supply different aggregate outputs as measured by real GDP.

A change in any of the conditions underlying AS_0 would *shift* the aggregate supply curve. The money wage rate is a key factor driving shifts in AS because wages are the largest component of costs in GDP. But changes in indirect taxes like the GST, PST, or HST, or changes in commodity prices like the price of energy will also shift the AS curves.

In Figure 11.3 the aggregate supply curve AS_1 is drawn based on a money wage rate w_1 greater than the wage rate w_0 underlying AS_0 . A higher money wage rate means higher unit labour costs at every level of output. A higher price is necessary at every output if producers are to cover their costs. At output Y_0 , for example, producers now need P_2 to cover the increase in unit labour costs and maintain their profits.

11.4 Short-run equilibrium output and prices

Figure 11.4 shows *short-run equilibrium* real GDP and prices determined by aggregate demand and short-run aggregate supply. The aggregate demand curve is based on a given nominal money supply set by the central bank, planned private sector and government expenditures, and a multiplier. The aggregate supply curve is based on a given stock of capital, a given supply of labour, a given state of technology, and fixed prices for factor inputs. The intersection of the aggregate demand and supply curves gives a combination of real GDP and price level P_0Y_0 , at which planned expenditures and outputs are equal. There is a corresponding level of employment.

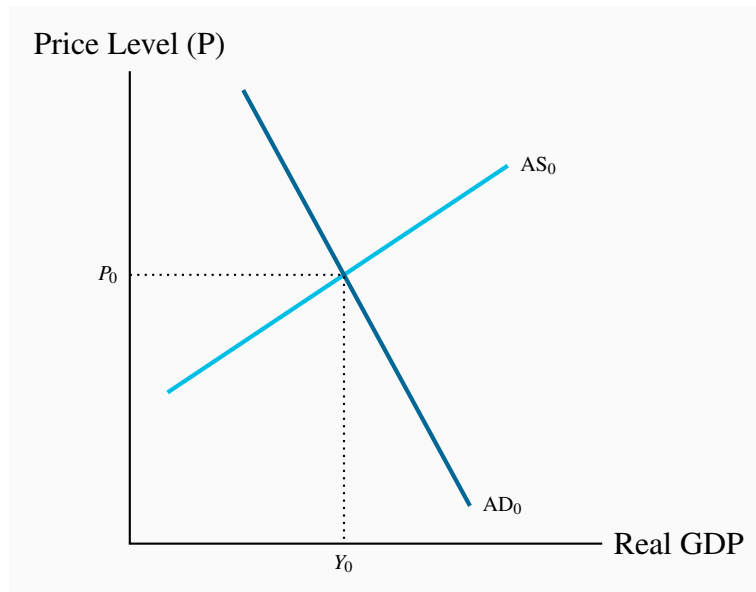


Figure 11.4: Short-Run Equilibrium Output and Price

Aggregate demand, AD_0 , and short-run aggregate supply, AS_0 , determine the equilibrium output Y_0 and price level P_0 .

11.5 Business cycles in output and prices

This AD/AS framework provides a useful way to study how the economy reacts to changes in economic conditions. Some changes affect AD, others affect AS, and some more complex events affect both AD and AS. In all cases, the AD/AS model shows how changes in economic conditions change output, employment, and the price level. An economy that experiences a series of disturbances to AD and AS, both positive and negative, over time goes through **business cycles**. Real GDP and unemployment rates fluctuate around potential GDP and the natural unemployment rate.

Business cycles: fluctuations in real GDP, employment and the price level that involve recessions, recoveries, booms.

Unexpected shifts in AD

Changes in autonomous expenditure that shift the AD curve are one cause of business cycles. These might be changes in investment expenditure as a result of changes in business expectations of future markets, or changes in exports as a result of events in other countries, or changes in

household expenditure plans. Regardless of the cause, a change in autonomous expenditure shifts AD, *horizontally*, by the expenditure change times the multiplier. In the short-run AD and AS model, real output and the price level both change in the same direction in response to an AD shock. In the recession of 2009, for example, falling investment, consumption, and exports reduced AD and output and employment dropped on an international scale. The recession was relatively short lived in Canada, although the economy has not yet returned to full employment. Recessions in other countries were deeper and more prolonged and in some European economies recessions returned after a brief recovery phase.

Unexpected shifts in AS

Changes in production costs and indirect taxes shift the AS curve. Although we assume *factor prices are constant* in the short run, commodity prices are not. Changes in the prices of base metals like steel, copper, and nickel come from international market conditions. Large international increases in energy and commodity prices in 2008 and the precipitous declines in 2009 provide a clear example of the volatility in prices of these inputs. The same applies to the prices of sugar, cocoa, coffee, and cereal grains. Producers of products and services that contain these commodities experience changes in their costs as commodity prices fluctuate. They pass these changes along to buyers through the pricing of their outputs. Rising commodity prices raise costs and push the AS curve up. Falling commodity prices pull the AS curve down.

Changes in the prices of crude oil and natural gas have been the most visible and widely reported of these supply shocks in recent years. As consumers, we see the effects of fluctuating crude oil prices in the price of gasoline at the pump and the costs of home heating oil. Fuel prices also affect production and distribution costs across the economy. The costs of petroleum-based feed stocks fluctuate. These are raw material inputs to many of the products we buy. Transportation costs rise as fuel costs go up, and fall as fuel costs fall. Persistently higher crude oil prices eventually work their way into the market prices of goods and services as producers price to recover their costs. The AS curve shifts up as a result, the equilibrium price level rises, and real GDP falls.

By contrast, natural gas prices fell from about \$13 per million BTUs in 2008 to about \$3.50 per million BTUs in late 2012. This price decline has reduced costs in industries using natural gas as fuel and raw material, and reduced the cost of generating electricity. These reduced costs shift the AS curve down.

From the national accounts we know that market prices include indirect taxes in addition to material input and factor costs. If governments change the indirect tax rate, raising or lowering sales and excise taxes, market prices change in the same direction. Producers and sellers will continue to supply the same output only if they can collect the increased tax they must remit to governments through an increase in price. Increases in the GST or HST, or the gasoline tax, or a carbon tax or a provincial retail sales tax, shift AS up by the amount of the tax increase at each level of output. Cuts in the GST by the Conservative government in 2006 and 2008 shifted AS down.

The effects of AS shifts cause business cycles in equilibrium output and price but the characteristics of those cycles are different from the effects of AD shifts. A negative AS shift moves the short-run AS upwards. Equilibrium real output falls and prices increase. A positive AS shift lowers prices and increases real output

AD and AS shifts compared

Figure 11.5 illustrates the effects of aggregate demand and supply shifts on real output and prices. In the left-hand panel, the initial short-run equilibrium is at point A, with price level P_0 and real output Y_0 . Aggregate demand shifts—for example, increases or decreases in investment expenditures—shift AD right and left between AD_1 and AD_2 . The equilibrium output and price level fluctuate up and down as a result.

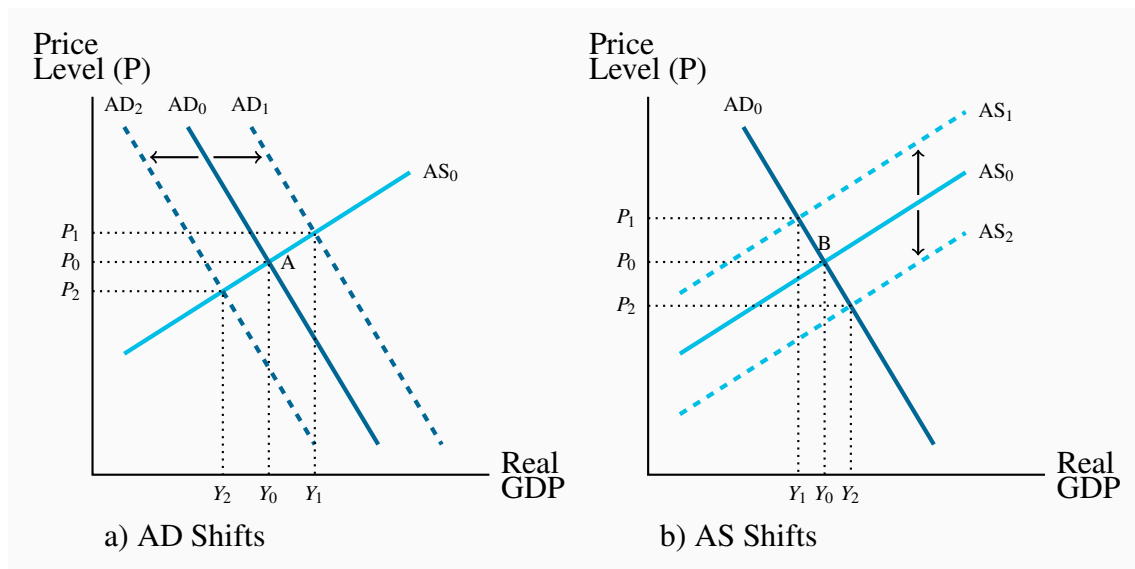


Figure 11.5: Effects of Unexpected AD/AS Shifts on Short-Run Equilibrium

- a) Unexpected shifts in autonomous expenditures shift AD right and left. Output and the price level move up and down together.
- b) Unexpected shifts in input prices or indirect taxes shift AS up and down. Output and the price level move in opposite directions.

The addition of the upward sloping short-run AS curve reduces the effects of AD fluctuations on output, compared with our analysis of earlier chapters, where the AS was horizontal. The size of the shift in AD is exactly the same, but the change in equilibrium output is smaller.

Price changes cause some offsetting changes in expenditure by changes in interest rates that reduce the impact on equilibrium output. In the case of positive AD shifts as from AD_0 to AD_1 these price

and interest rate effects ‘**crowd out**’ some interest sensitive expenditures. As a result the increase in equilibrium output from Y_0 to Y_1 is less than the shift in AD.

Crowding out (in): changes in interest sensitive expenditures caused by the price and interest rate effects of a change in autonomous expenditure.

Furthermore, notice that the steeper the slope of AS and the flatter the slope of AD the smaller will be the variation in Y for given variations in AD, and the larger will be the variation in the price level. Crowding in or out in these conditions works to stabilize equilibrium output. The downside is greater price level volatility.

In the right-hand panel of Figure 11.5, the initial short-run equilibrium is at B with price level P_0 and real output Y_0 . Aggregate supply shocks—for example, large variations in the price of crude oil—shift AS up, if crude oil prices increase, or down when they decrease. Short-run equilibrium output and prices fluctuate. A rise in crude oil prices reduces output and raises the price level. A fall in crude price does the opposite. Notice that the slope of the AD curve determines the size of the variations in Y as a result of shifts in the AS curve.

Often the world is not as simple as these examples suggest. AD and AS may both move, making predictions of the outcome more challenging. In 2007 and 2008 rising energy and commodity prices raised costs and pushed that AS curve up. At the same time commodity prices and easy credit conditions provided stimulus to investment expenditure in resource development, residential construction, and consumption. AD shifted to the right. Canada and many other countries experienced strong growth and pressure on prices.

After mid-2008, conditions changed first in financial and credit markets, and then in energy and commodity markets. The availability of credit collapsed with the financial crisis. Residential construction collapsed, especially in the U.S., taking with it the demand for building materials and machinery. Falling demand for energy reduced energy prices sharply with crude oil falling from an average of over \$90 a barrel 2008 to just over \$50 in 2009. Investment in energy and commodity production dropped sharply. With declines in both incomes and access to credit, consumption expenditure fell. Declines in export markets impacted strongly on countries like Canada with high shares of exports in AD. As a result of these changes in economic conditions, AS shifted down, AD shifted to the left. But the drop in AD overshadowed any stimulus from lower prices on the AS side. The recession was international in scope.

The aggregate demand and supply model offers explanations of short-run fluctuations in real GDP and prices, which are linked to employment and unemployment rates. But it does not provide enough information for us to evaluate either the performance of the economy or the need for economic policy. We need to re-introduce *the benchmarks of potential output and the natural unemployment rate* we used in earlier chapters to judge performance and policy needs.

Figure 11.6 adds the level of potential output (Y_P) into the short-run AD/AS model. Keep in mind

that potential output is *independent of short-run economic conditions*. It is determined by the stock of capital, the state of technology, and the size of the labour supply when all factor-input markets are in equilibrium. The unemployment rate is then equal to the natural unemployment rate.

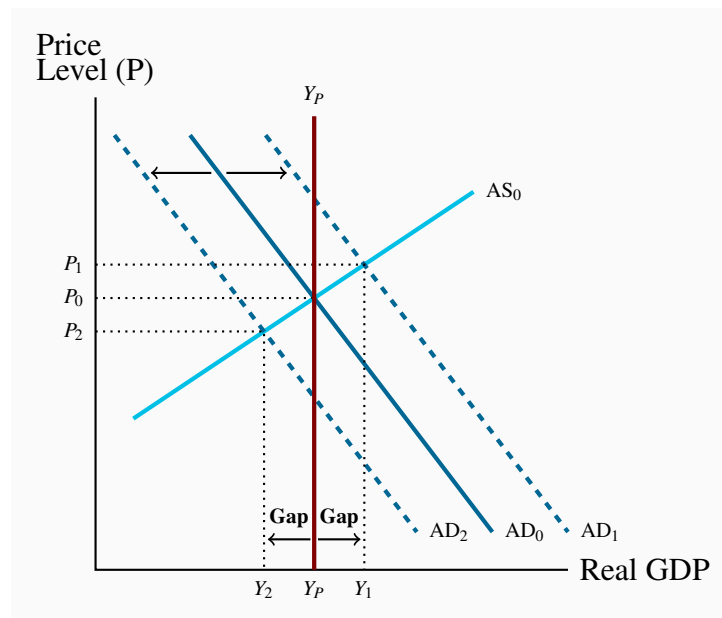


Figure 11.6: Short-Run Equilibrium vs. Potential Output

Short-run equilibrium output and price depend mainly on AD. With AD_0 the economy operates at potential output Y_p , the natural unemployment rate u_n and price level P_0 . The inflation rate is zero. Short-run shifts in AD cause business cycle fluctuations in output and employment, between Y_2 and Y_1 , creating recessionary and inflationary output gaps.

Short-run equilibrium output may or may not equal potential output. Indeed, it is useful to think of fluctuations in short-run output, i.e., business cycles, as variations in actual output around potential output that create recessionary and inflationary gaps. Factor prices that are sticky in the short run allow for these output and employment fluctuations, which mean unemployment rates fluctuate around the natural rate. Figure 11.6 shows the effects of different short-run aggregate demand conditions on output and prices.

In the short run, the prices of factor inputs, especially money wage rates, are fixed. Weak AD as a result of business pessimism and reduced investment, or a fall in exports, may last for months. The recessionary gap and labour market disequilibrium at Y_2 , for example, means high unemployment rates. Some employees have been laid off by their employers, and new jobs are scarce as fewer businesses are hiring. Money wage rate cuts in industries under high stress, like parts of the auto industry in 2009, are possible but unusual, and in any case the average wage rate across all occupations is slow to adjust. Total levels of employment fall. Lost employment and output reduce incomes and standards of living, with those who have lost jobs and those trying to find their first

jobs most seriously affected. There are people willing to work for the current money and real wage rate who cannot find employment.

The differences between short-run equilibrium output and potential output may be persistent. Most business cycles involve output gaps that last only few months as you may recall from Figure 4.1 They are caused by short-term fluctuations in autonomous expenditure. Short term changes in monetary and fiscal policies can moderate these.

However, some business cycles originate in financial market crises as in 2008 and 2009. These cause prolonged recessions and slow recoveries, especially when the underlying financial issues are international in scope. Experience since 2008 shows how difficult it can be to design monetary and fiscal policies that promote recovery in these cases.

11.6 Internal adjustment to output gaps?

Do demand or supply shifts that move the economy away from potential output and create an output gap trigger an *internal adjustment process*? In combining the AD and AS curves, we are assuming the market for goods and services clears even in the short run, but the labour market takes longer. As it adjusts *changes in the money wage rate* gradually *shift* short-run aggregate supply to reflect the effect of money wage rates changes on costs and prices.

In the ‘traditional’ model with a constant price level and zero inflation in equilibrium, the economy goes through wage and price level inflations or deflations as the money wage rate adjusts when unemployment rates differ from the natural rate. The important question is whether or not these movements in the money wage rates and prices, by changing AS conditions, can eliminate short run output gaps. Unfortunately there are awkward asymmetries in the economy’s internal responses to recessionary and inflationary gaps.

Increases in the money wage rate in times of inflationary gaps may reduce output and employment, moving the economy to potential output at a higher equilibrium price level. The process may involve a prolonged period of inflation but ultimately the fixed nominal money supply will eliminate the inflationary pressure and leave the economy at potential output with a higher price level.

By contrast, if high unemployment in times of recessionary gaps leads to cuts in money rates *AD may change along with AS leading to persistent recessionary gaps*. This adjustment process involves **deflation** in money wage rates and the price level. Deflation has long been recognized as having negative effect on expenditures and output that can exacerbate rather than reduce recessionary gaps.

Recognition of this risk prompted strong expansionary policy responses to the ‘dot com’ collapse in 2000, terrorist attack of 2001 and the financial crisis in 2008. Recently, persistent low inflation rates in the US, Canada and the EU, in 2013-14 and the possibility of deflation have worried central

bankers in all three economies.

Deflation: a continuous fall in the general price level.

Consider first the adjustment to a persistent *inflationary* gap, and then the case of a persistent *recessionary* gap.

Adjustment to an inflationary gap

Figure 11.7 illustrates the internal adjustment sequence that might eliminate a short-run inflationary gap and move the economy to long run equilibrium at potential output *without policy intervention*. In the diagram, initial short run equilibrium is at point A with real GDP at Y_1 and price level P_0 . This short run equilibrium creates an inflationary gap equal to $Y_1 - Y_P$. With real GDP greater than Y_P the unemployment rate is less the natural rate.

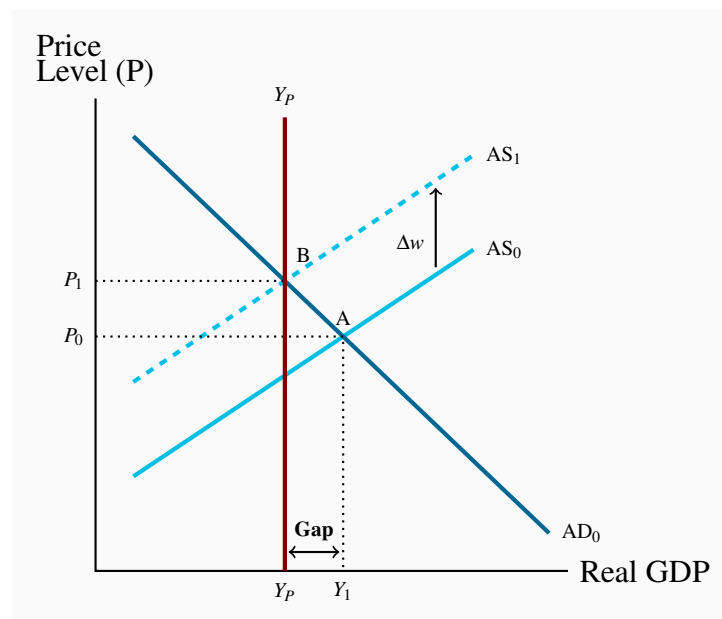


Figure 11.7: Adjustment to an Inflationary Gap

Inflationary gap $Y_1 - Y_P$ and strong demand for labour raises money wage rates, costs and prices. AS_0 shifts up to AS_1 . Higher prices reduce M/P , raising I , lowering AE moving along AD eliminating the inflationary gap to give equilibrium $P_1 Y_P$.

If AD remains at AD_0 and the inflationary gap persists the money wage rate will rise. A higher money wage rate increases costs of production, which are passed on by producers to a higher price

level. This adjustment process continues and pushes the AS curve up to AS_1 . Simultaneously, higher price levels reduce the real money supply, M/P , push interest rates up and reduce aggregate expenditure. Figure 11.7 shows this adjustment as a movement along the AD curve. When AS rises equilibrium moves from point A to point B. This new short-run equilibrium is also a *long run equilibrium* with $Y = Y_P$.

It is important to recognize that the financial sector and financial assets and financial contracts have a supporting role in this adjustment that reduces AD to eliminate an inflationary gap. A rising price level and interest rate cause wealth effects by lowering the real money supply and lowering the nominal and real market value of fixed income assets like bonds and mortgages held in financial portfolios. At the same time, debtors with student loans, lines of credit, mortgage and car payments, and business that need to service their debts will find the burdens reduced by higher incomes. Nevertheless we assume the AD curve does not shift as a result of the redistribution from creditors to debtors and higher money incomes. Adjustment is focused on the monetary transmission mechanism as it moves the economy along the AD curve.

Adjustment to a recessionary gap?

Figure 11.8 illustrates the internal adjustment sequence that *might* eliminate a short-run recessionary gap and move the economy to long run equilibrium at potential output *without policy intervention*. In short-run equilibrium at point A with P_0, Y_1 there is a recessionary gap $Y_1 - Y_P$. With output below potential the unemployment rate is above the natural rate. As in the case of an inflationary gap, changes in the money wage rate that change costs and price levels and shift the AS curve are the key mechanism in the adjustment from a short run recessionary gap to equilibrium at Y_P and the natural unemployment rate.

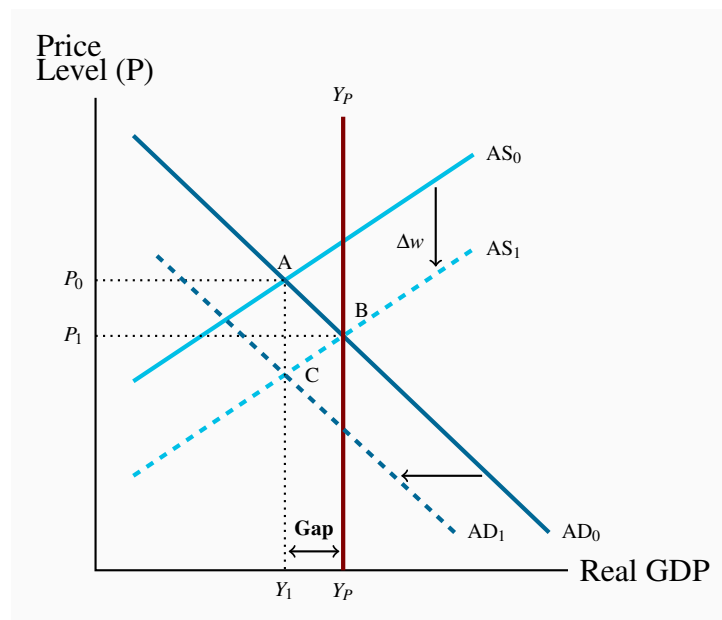


Figure 11.8: Adjustment to a Recessionary Gap

Recessionary gap $Y_1 - Y_P$ causes high unemployment that reduces the money wage rate, costs and prices. If AD undisturbed the economy moves to long run equilibrium at $P_1 Y_P$. If price deflation reduces AD_0 to AD_1 , or less, the recessionary gap will persist.

If the *wage rate and the price level were flexible* in some short time frame, and *changes in money incomes and prices do not disturb AD*, the economy might adjust to a recessionary gap internally. In Figure 11.8 the movement from short-run equilibrium at A to equilibrium at B, with $P_1 Y_P$, illustrates this process. A lower wage rate means lower costs, a lower price level and a higher real money supply. The AS curve shifts down to AS_1 and the monetary transmission mechanism moves the economy along AD_0 .

However, the internal adjustment to recessionary gaps may be difficult for two reasons. First there is strong resistance in labour markets to cuts in the money wage rate. Labour markets generally accept *different rates of increase* in money wages but absolute cuts are another matter. A fall in the economy wide money wage rate is unlikely in times of mild recession although not unusual in times of deep, prolonged recession or depression.

The resistance to cuts in the money wage rate comes in part from the rigidity in the financial commitments of households and businesses. If the wage rate and money income are cut, the ratios of household and business debt to current income increase. Furthermore the costs of servicing debt take a higher share of cash flow. Expenditures on currently produced goods and services have to be cut to meet debt obligations. In some cases insolvencies are unavoidable and extensive.

Creditors and those with little or no debt are in the opposite position. While money incomes and

prices may have fallen in the same proportion leaving real income unchanged, the real values of financial assets and the real returns to holding cash balances have increased. Expenditures may increase with this increase in wealth, but at the same time there is a reward for postponing expenditures until the price level stops falling. Aggregate demand may be further restrained.

These effects of cuts in the wage rate and the price level mean that the deflation and the recessionary gap that caused it can be persistent. *The AD curve may shift when AS shifts.* Figure 11.8 provides an illustration by drawing the dotted AD curve AD_1 . This is a cautious example in that the cut in the wage rate that shifts AS down is just offset by the fall in AD to leave the recessionary gap unchanged. AD could fall farther making the gap even larger. Japan's experience with deflation in the 1990's, the two decades of stagnation that followed, and current economic conditions provides an important example of the risks involved when recessionary gaps lead to deflation. The IMF has recently raised the same concern about a number of EU countries. The Bank of Canada's concerns about deflation are explained briefly in the 'Backgrounder' it gives at: <http://goo.gl/wfiZFT>

11.7 Monetary policy and fiscal policy

The time lags and uncertainties involved in an economy's internal adjustments to output gaps create the role for monetary and fiscal policies. These are aggregate demand management policies that have two main objectives in the context of the traditional model. Policy programs themselves have built-in stabilization effects that work to reduce the size of the AD fluctuations that cause output gaps. In addition, monetary and fiscal authorities can make changes in policy programs and policy instruments to change AD as needed to eliminate persistent output gaps. The traditional AD/AS model developed in this chapter embeds a set of monetary and fiscal policy options.

Monetary policy

Monetary policy that controls the nominal money supply is the basis for the AD curve in this traditional model. With the nominal money supply fixed by the central bank, the price level and demand conditions in the money market determine the interest rate. This interest rate affects the level of autonomous expenditure on final goods and services and, working through the monetary transmission mechanism and the expenditure multiplier, determines the position of the AD curve.

The monetary policy target is equilibrium at potential output Y_P . In both short and long run equilibrium the price level is constant and the inflation rate is zero. Changing price levels, either inflations or deflations, only appear when the economy is adjusting internally to an output gap. If equilibrium at Y_P is the central bank's monetary policy target, monetary policy also minimizes price level adjustments.

Monetary policy in this context can be described and illustrated by a simple **McCallum Rule**.

The McCallum rule is an alternative to the Taylor Rule described in Chapter 10. The important difference is the choice of the *monetary base as the monetary policy instrument*, rather than the interest rate. The monetary base is set as required to achieve the Bank's target, equilibrium at Y_P .

McCallum Rule: central bank monetary base settings based on inflation and output targets.

A simple McCallum Rule for an economy with zero inflation in equilibrium at Y_P would be specified as follows:

$$MB = MB_0 - \mu(Y - Y_P) \quad (11.2)$$

Based on its assessment of fundamental economic conditions the Bank sets the monetary base at MB_0 needed to support AD at Y_P . As long as these fundamental conditions are stable the Bank makes only temporary counter-cyclical adjustments to offset transitory fluctuations in real GDP relative to potential GDP. The parameter μ in Equation 11.2 defines size of the Bank's reaction to these fluctuations, while the negative sign attached to μ indicates the reaction is counter cyclical. A small inflationary gap $(Y - Y_P) > 0$ would be met by a temporary reduction in MB to dampen AD. The negative slope of the MB function in Figure 11.9 illustrates $(-\mu)$ this 'automatic' stabilization.

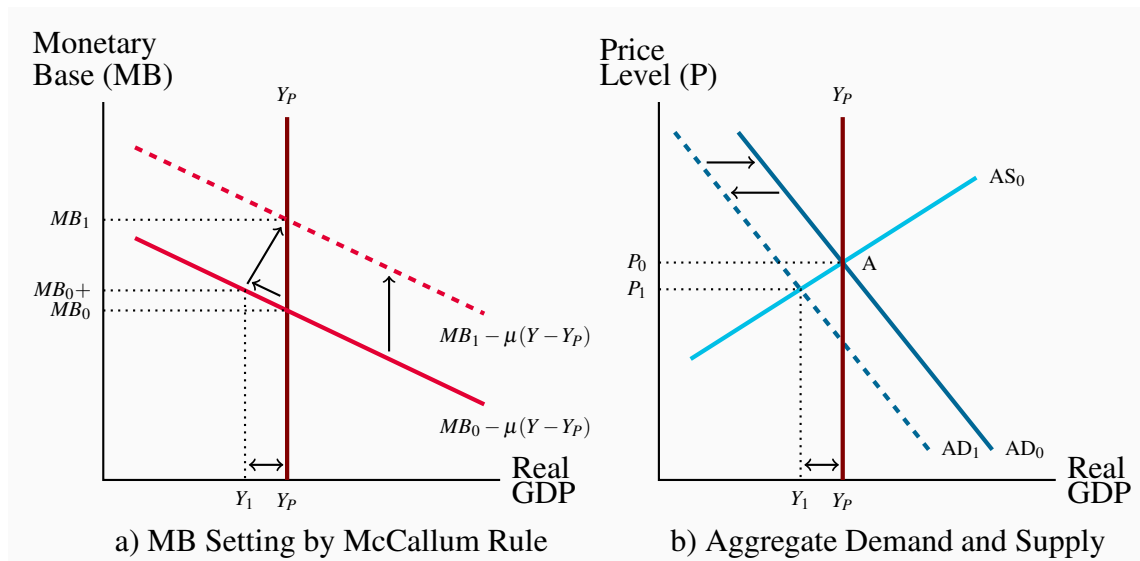


Figure 11.9: Monetary Policy by a McCallum Rule

Monetary policy sets MB_0 to support equilibrium P_0Y_P at A in b). Then a fall in AD to AD_1 opens a recessionary gap $Y_1 - Y_P$. The central bank's initial reaction allows some increase in MB to $MB_0 +$, moving along its reaction function. This provides some temporary offsetting monetary stimulus. If the fall in AD is persistent the central bank introduces sustained monetary stimulus by increasing its monetary base setting to MB_1 . AD shifts back to AD_0 and equilibrium is P_0Y_P .

If the Bank expects or sees a change in fundamental conditions it changes its MB setting. Sustained declines in exports, or investment or government expenditures would call for monetary stimulus and an increase from MB_0 to MB_1 as shown in Panel a) of 11.9. Alternatively, sustained increases in autonomous expenditures that would otherwise create an inflationary gap would call for monetary restraint in the form of a cut in the setting MB_0 . The change in monetary policy that provides stimulus is illustrated in Figure 11.9 by the upward shift in the MB function.

Of course the power of the central bank to change AD by changing the monetary base depends on the strength of the monetary transmission mechanism. If the money multiplier is constant a change in MB produces a predictable change in the money supply M . But the effect of a change in M on expenditure and AD depends on the interest rate elasticity of the demand for money and the interest rate elasticity of expenditures. As we saw in Figure 9.8, low interest rate elasticity in the demand for money and high interest rate elasticity in expenditure makes monetary policy a strong demand management tool. On the other hand, if the interest rate elasticity of the demand for money is high and the interest rate elasticity of expenditure is low monetary policy is a weak demand management tool.

These monetary transmission mechanism conditions are also important for the power of fiscal policy to manage aggregate demand.

Fiscal policy

Fiscal policy, which we discussed in Chapter 7, is demand management policy. Taxes, transfer payments, and government expenditures on goods and services are the tools of fiscal policy. They influence aggregate expenditure, equilibrium output, and aggregate demand through disposable income and consumption expenditure, and directly through government expenditures. The net tax rate, determined by the government's tax and transfer programs, also affects the size of the expenditure multiplier. Changes in tax rates, transfer rates, and government expenditures shift the AD curve.

We can look at fiscal policy design and action in a way that is similar to our treatment of monetary policy. The government has two broad fiscal policy objectives or targets that are important for aggregate demand. It wants:

1. Stable aggregate demand consistent with full employment and potential output, and
2. Control of the debt ratio.

The debt ratio is the size of the public (government) debt relative to GDP. The government's *budget balance is the instrument of fiscal policy*. It changes the budget balance by changing its net tax and expenditure programs to shift the AD curve and try to get equilibrium at potential output, or to control its budget balance and debt.

However, the fiscal policy objectives are interdependent. Changes in the budget designed to manage aggregate demand also have effects on the government's debt. At times the size of government debt relative to GDP may constrain the government's use of expansionary fiscal policy. At other times, fiscal policy and budget changes aimed at deficit and debt control can reduce aggregate demand, even though a recessionary gap would call for fiscal stimulus. We look at fiscal policies in this chapter in terms of income stabilization in the traditional AD/AS model. The dynamics of the debt ratio and debt ratio control are covered in Chapter 12.

Figure 11.10 shows the effects of fiscal policy on aggregate demand. The AD_0 curve in Panel b) includes the government fiscal program defined by the budget function BB_0 . You will recall from Chapter 7 that $BB = tY - G$. The budget function BB_0 comes from the policy decision to set a specific net tax rate of t_0 and expenditure level G_0 . This budget function is shown in Panel a). Government expenditures are part of the autonomous expenditure that positions the AD_0 curve. Net taxes are reflected in the slope of AD_0 through their effect on the expenditure multiplier. We start at P_0 and Y_P in Panel b) and the structural budget balance SBB_0 in Panel a).

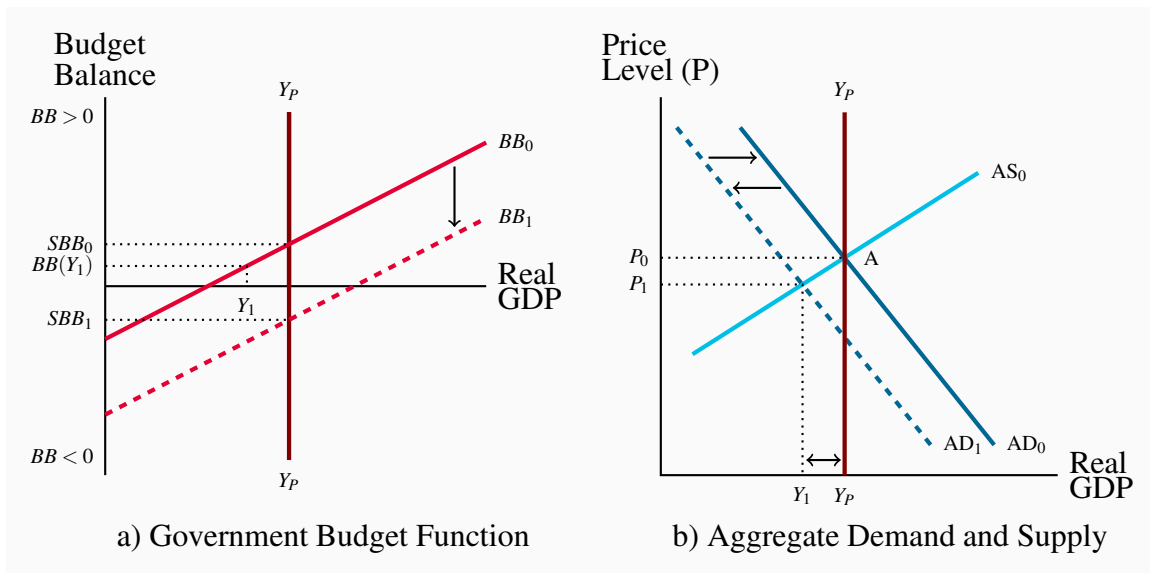


Figure 11.10: Fiscal Policy and Aggregate Demand

Starting from equilibrium at A in b), a drop in autonomous expenditure creates a recessionary gap. The automatic fiscal stabilization in the budget lowers the surplus from SBB_0 to $BB(Y_1)$. If the fall in autonomous expenditure persists the government adds discretionary fiscal stimulus through tax cuts and/or expenditure increases, cutting its structural balance from SBB_0 to SBB_1 . Fiscal stimulus shifts AD back to AD_0 , eliminating the output gap.

To see the use of fiscal policies to manage AD and stabilize real GDP, consider a fall in autonomous consumption, investment, or exports that shifts AD to the left to AD_1 . The recession of 2009 is a good example. National income and output falls to Y_1 . The net tax system provides some automatic stabilization, indicated by the movement along the budget function BB_0 to the budget balance $BB(Y_1)$, but does not prevent the recessionary gap. The short-run equilibrium in the absence of discretionary stimulus is P_1Y_1 .

If lower expenditure, output, and income persist, the Minister of Finance may use discretionary fiscal policy, *changing the structural budget balance by an increase in expenditure or a cut in taxes*, or both, to stimulate the economy. An increase in G , for example, shifts the policy BB function down as the structural budget balance SBB_0 is reduced to SBB_1 . Thus it gives fiscal stimulus to AD. The increased government expenditure working through the multiplier eventually shifts AD back to AD_0 , restoring output to Y_P at P_0 . Fiscal policy has been used to manage aggregate demand when the fiscal policy target is Y_P .

As an alternative to increased expenditure, the government could add fiscal stimulus to increase AD and close the recessionary gap by cutting the net tax rate. The slope of the BB function would be reduced by a cut in t , to give the reduction in the structural balance required to shift AD to the right. The increase in AD would come from increases in both disposable income and the multiplier.

This example is based on a fall in autonomous expenditure that reduced AD and created a recessionary gap. The opposite conditions also call for discretionary fiscal policy if Y_P is the policy objective. Starting from a short-run equilibrium at Y_P , a strong increase in exports would create an inflationary gap, $Y > Y_P$. Automatic stabilizers would limit, but not eliminate, the gap. Fiscal restraint, from expenditure cuts or tax increases, would be required to reduce AD and eliminate the gap. In terms of the diagram, the budget function would shift up and the structural budget balance would be increased.

Discretionary fiscal policy can provide either fiscal stimulus or restraint by changing government expenditure, the net tax rate, or both. An interesting policy question is whether it is better to implement fiscal policy through government expenditure changes, or tax changes, or a combination of changes in expenditure and tax rates. This was an important part of the often heated political debates in both Canada and the U.S. when the federal governments were designing fiscal stimulus packages to fight the 2009 recession. Similar debates dominated the US presidential election campaign in 2012. Those debates reflected differences in political philosophy, differences in opinions about the relative strengths of tax changes and expenditure changes for fiscal stimulus, and different ideas about the best structure of tax and expenditure changes.

Budget data for the Canadian federal government in Table 11.1 show the change in fiscal policy used to fight the crisis and recession of 2008-09. Using changes in the structural budget balance (SBB) as an indicator of discretionary fiscal policy, the data show some fiscal restraint from a structural surplus in fiscal year 2006-07 period. The cyclical surplus provided further automatic restraint. The government's primary policy objective during this period was to continue reducing the outstanding public debt.

	2006-07	2009-10	2012-13
Actual balance ($BB = tY - G - iPD$)	13,752	-55,598	-18,929
Structural balance ($SBB = tY_P - G - iPD$)	7,640	-12,434	-15,047
Cyclical balance ($BB - SBB$)	6,112	-43,164	-3,882

Table 11.1: A federal government budget balances in Canada by fiscal year 2006-07, 2009-10, 2012-13 (millions of dollars)

Source: Fiscal Reference Tables 2013, Table 17, Department of Finance Canada, October 2013, and author's calculations.

The government's 'Economic Action Plan' in response to the recession of 2008-09 changed the fiscal policy objective and budget balances significantly. The cut in the structural budget balance from a surplus in 2006-07 to a deficit 2009-10 amounted to about \$20 billion in discretionary fiscal stimulus. This would appear as a downward shift in the budget function in Panel a) of Figure 11.10.

The change in the actual budget balance BB , from a surplus of \$13.7 billion to a deficit of \$55.6

billion was a result of the added discretionary stimulus and cyclical impact of the recession on revenues and expenditures. The cyclical budget balance changed from a \$6 billion surplus in 2006-07 to a \$43 billion deficit in 2009-2010. This ‘automatic stabilization’, would be a movement along the budget function in Table 11.1.

A drop in the cyclical balance in this case overstates the scale of the automatic stabilization and understates the scale of discretionary stimulus. In reporting the budget data in 2011 and later years the Department of Finance defined the ‘Economic Action Plan’ as a cyclical budget component because it was ‘temporary’ in its design. As a result the measures introduced in the ‘Plan’ were not reported as ‘discretionary’ fiscal stimulus, leaving the government’s reported structural balance with a smaller deficit. Evaluating the shares of discretionary and automatic stimulus in the change in the total budget balance is complicated by this change in reporting practice.

The fall in the total budget deficit from 2009-10 to 2012-13 was the result of three coincident events. The winding down of the ‘Economic Action Plan’ and the partial recovery from the recession resulted in a \$40 billion decrease in the cyclical balance. This was partly offset by an increase in the structural deficit, which suggests some small fiscal stimulus. Reporting the “Economic Action Plan” as a cyclical part of the budget the data makes it appear that a much larger part in the budget change came through automatic stabilization than from discretionary fiscal restraint through cuts in government expenditures.

Interactions between monetary and fiscal policy

Although both monetary policy and fiscal policy can change aggregate demand, the two policies are not interchangeable. They affect aggregate demand through different routes and have different implications for the composition of aggregate demand. Furthermore, they may at times reinforce one another, or conflict. The *mix* of monetary and fiscal policy is important.

There are two ways to increase AD. First, there is expansionary fiscal policy, with high government expenditure and low tax rates resulting in structural budget deficits. If this leads to high aggregate demand, perhaps exceeding Y_P at P_0 , tight monetary policy is needed to keep income in check. The central bank must reduce the money supply to raise interest rates and reduce aggregate demand. In this case, the mix of easy fiscal policy and tight monetary policy means that some private expenditure on consumption, investment, and net exports is crowded out by high interest rates and a low exchange rate. Government expenditure is a larger share of national income, and private expenditure is a smaller share.

An alternative mix is tight fiscal policy and easy monetary policy. Aggregate demand still gives income at Y_P , but the underlying conditions are quite different. The central bank can set a lower interest rate, and the government’s budget balance is higher. The lower interest rate and higher exchange rate support higher private-sector spending to offset the restraint in government expenditure. With easier monetary policy and tighter fiscal policy, the share of private expenditure is higher and the share of government expenditure is lower. With lower interest rates, there is less

crowding out of private expenditure.

Of course, easy monetary policy and easy fiscal policy together can be strongly expansionary. That is the policy mix used to fight the recession of 2009. Conversely, tight monetary policy and tight fiscal policy are highly restrictive. The challenge is to get the mix of policy that is consistent with the central bank's inflation target, the government's potential output and debt ratio targets, and society's preferred mix of public and private services.

Suppose, however, that the target of monetary policy and fiscal policy is not Y_p . The target of monetary policy is, instead, an inflation rate π^* lower than the current inflation rate and the target of fiscal policy is a ratio of public debt to GDP lower than the current ratio. Aggregate demand effects are not the primary policy focus of these policy targets. Both policies will be restrictive and, to the extent that restrictive monetary policy reduces AD, it will make the fiscal policy target of debt ratio reduction more elusive. We saw some of this in the Canadian experience with monetary and fiscal policy in the 1990s.

Next

Now we have explained the 'traditional' aggregate demand and aggregate supply model that determines output and the price level. This model is built on a fixed nominal money supply and a fixed money wage rate. The price elasticity in aggregate demand is determined by the conditions of the monetary transmission mechanism and the expenditure multiplier. Aggregate supply conditions reflect unit production costs determined by the wage rate and productivity, combined with producer output and pricing decisions. Long run equilibrium output is potential output and the long run equilibrium price level is constant. The inflation rate is zero.

Fluctuations in aggregate demand and supply conditions cause short run business cycles in output and the price level. There may be some internal capacity for adjustment in the economy to eliminate short run output gaps, but particularly in times of recessionary gaps internal adjustment based on deflation may make conditions worse.

Monetary and fiscal policy might be used to manage aggregate demand and offset fluctuations in output, employment, and price. Chapter 12 examines monetary and fiscal policy in more detail in terms of a 'modern' AD/AS model. Chapter 14 explains why the design and effectiveness of monetary and fiscal policies to manage aggregate demand depend importantly on the exchange rate policy a country adopts.

KEY CONCEPTS

Aggregate demand (AD) is the relationship between the general price level, and equilibrium real GDP.

Aggregate demand integrates the explanation of **equilibrium aggregate expenditure**, the money and financial markets, monetary policy, and fiscal policy into a price/output function.

In the traditional model aggregate demand is constructed by assuming a **fixed nominal money supply**.

The central bank conducts monetary policy, using its control and setting of the **nominal money supply** as the policy instrument.

Changes in the general price level change the **real money supply** and real expenditure through the monetary transmission mechanism.

The slope and position of the aggregate demand curve describe economic conditions in the economy and the setting of economic policy. Money market conditions, the response of expenditure to changes in interest rates, and the expenditure multiplier determine the **slope of AD**. Autonomous expenditures and the expenditure multiplier and the nominal money supply determine the **position of AD**. Changes in autonomous expenditures cause business cycles by shifting the AD curve.

Short-run aggregate supply (AS) defines the relationship between the economy's output (GDP) and the price level when factor prices, particularly wage rates, are constant but output prices are flexible. With constant money wage rates, the AS curve is upward sloping if labour productivity—output per worker—declines as employment and output increase, raising labour cost per unit of output.

AD and AS determine **short-run equilibrium** real GDP and the price level.

Persistent output gaps ($Y - Y_p \neq 0$) in short run equilibrium may lead to **automatic adjustment** to long run equilibrium at Y_p and zero inflation. The adjustment process based on changes in the money wage rate and the price level is time consuming and potential unstable.

Monetary policy is a **demand management** tool. The central bank uses its control of the monetary base and interest rates to create AD conditions consistent with potential output.

Fiscal policy is a **demand management** tool. Changes in fiscal policy change structural budget balances and change the slope and position of the AD curve. At times, the income

stabilization and debt control objectives will conflict.

The **mix of monetary and fiscal policy** is important to the effects they have on AD and on the structure of national income and output.

The relative **effectiveness of monetary and fiscal policies** as AD management tools depends on conditions in the monetary transmission mechanism.

EXERCISES FOR CHAPTER 11

Exercise 11.1. Assume the central bank conducts monetary policy by setting a nominal money supply.

- Use a money-market diagram to show how changes in the general price level (P) would affect the equilibrium interest rate.
- Use a 45° line diagram to show how changes in expenditure caused by the changes in interest rates in (a) would change equilibrium real GDP.
- Combining the results from parts a) and b), construct an AD curve that shows combinations of real GDP and the general price level when autonomous expenditures and money supply are constant.

Exercise 11.2. Draw diagrams for a demand for money and an interest rate/expenditure function that show conditions under which changes in the general price level cause large changes in aggregate expenditure and equilibrium real GDP.

Exercise 11.3. Do you agree that a flatter AE curve (a lower value for the slope) would result in a steeper AD curve? Explain why.

Exercise 11.4. Consider a numerical example of an AD curve when the central bank sets the money supply: $AE = 100 + 0.5Y + 0.2(M/P)$, and $M = 500$.

- Suppose the nominal money supply $M = 500$. Find and write the AE function for each of the price levels 1.0, 2.0, and 3.0.
- Explain why a change in the price level changes planned aggregate expenditure.
- Based on the equilibrium condition $Y = AE$, plot combinations of P and Y in a diagram and draw the AD curve.
- Suppose an increase in investment increased autonomous expenditure by 25. Plot the new AD curve in your diagram.

Exercise 11.5. Consider a numerical example of a short run aggregate supply curve (AS) for an economy in which producers are price setters as follows: $P = 100 + 1.5 \times W/(Y/N)$. Assume the money wage rate $W = \$1000$, and labour productivity (Y/N) declines as employment and output increases according to: $Y/N = 200 - 10N$. This gives the following values: $Y = 360, Y/N = 180$; $Y = 640, Y/N = 160$; $Y = 840, Y/N = 140$.

- Calculate the price level P for each income level given, and plot the resulting AS curve in a diagram.

- (b) Explain the reason for the change in the price level as real output Y increases and the economy moves along the AS curve.
- (c) Suppose the money wage rate increased by 10 percent from \$1000 to \$1100. Calculate the price levels for incomes of $Y = 360, 640$ and 840 and plot this AS curve in the same diagram used in part a).
- (d) What effect does a change in money wage rates have on the AS curve? Why?

Exercise 11.6. An economy has the following aggregate demand and short-run aggregate supply conditions: AD: $Y = 1000 - 30P$, and AS: $Y = 500P - 6950$

- (a) Plot the AD and AS functions in a diagram.
- (b) What are the equilibrium values for real GDP and the price level?
- (c) If potential output is $Y_P = 650$, what type of output gap, if any, do you observe?
- (d) Suppose research reveals that the aggregate expenditure function underlying the AD curve has a slope $[c(1 - t) - m] = 0.5$. What change, if any, in the expenditure component of fiscal policy would be needed to eliminate any observed output gap?

Exercise 11.7. Use an AD/AS diagram for an economy in short run equilibrium at potential output Y_P , to illustrate and explain the effect of a fall in international demand for the economy's manufactured exports. What type of output gap, if any, is caused by the fall in exports?

Exercise 11.8. Explain why a fall in the money wage rate might not reduce or eliminate a recessionary gap and might in fact make the gap larger.

Exercise 11.9. Explain why a rise in the money wage rate might work to eliminate an inflationary gap.

Exercise 11.10. Use diagrams to show a monetary policy that manages the money base using a McCallum rule $MB = MB_0 - \mu(Y - Y_P)$ and the corresponding AD curve in an AD/AS/ Y_P model.

Exercise 11.11. Use diagrams to show how the central bank following a McCallum rule would change monetary policy to reduce or eliminate an inflationary gap.

Exercise 11.12. Use a government budget function to show how an output gap affects the government's budget balance.

Exercise 11.13. Using a diagram, illustrate the difference, if any, between the actual budget balance and the structural budget balance for an economy with an inflationary gap.

Exercise 11.14. If the Finance Minister's changes fiscal policy to remove a recessionary gap, use a diagram to show the new budget function and the actual and structural balances that result.

Chapter 12

An AD/ AS model of the inflation rate and real GDP

In this chapter we will explore:

- 12.1 Inflation and aggregate demand
- 12.2 Aggregate supply
- 12.3 The equilibrium inflation rate
- 12.4 Adjustment to output gaps
- 12.5 Monetary & fiscal policy
- 12.6 Recession, disinflation and deflation

This chapter develops a basic model of the economy that is representative of the models currently used by central banks and policy researchers. It is an alternative to the ‘traditional’ AD/AS model of Chapter 11 although it can be built using some of the relationships in that model. This example of a ‘modern’ model gives more current explanation of the performance of the economy and the roles for monetary and fiscal policies.

The framework for a basic modern model is quite similar to the traditional model. Labour force and technology are fixed, fixing potential output at Y_P as in the traditional model. But instead of a fixed short term *price level*, the modern model assumes money wage rates and inflation rates are stable in the short run and adjust slowly to output gaps. But monetary policy has a different objective and a different policy instrument. The policy objective is *inflation control* using the *short term interest rate* as the instrument.

Building on these assumptions the model provides explanations of business cycle fluctuations in output, employment and inflation rates. In addition to the fundamental role it defines for monetary policy it identifies important roles for fiscal policy and addresses the difficult policy choices created by the financial crisis of 2008 and the recessions that have followed.

12.1 Inflation and aggregate demand

The aggregate demand curve is built on the monetary policy of the central bank. In Chapter 11, the aggregate demand curve was derived from changes in the general *price level* relative to a *fixed money supply* set by central bank monetary policy. Changes in the general price level changed the real money supply, causing changes in interest rates and asset prices. These worked through the monetary transmission mechanism to change equilibrium aggregate expenditure and move the economy along an AD curve. That is the traditional approach to AD in a price level-output model.

When central banks set *interest rates* to control the *inflation rate* based on an inflation rate target, the AD curve must be based on this alternative monetary policy. A monetary policy that reacts to changes in the inflation rate by changing the interest rate causes changes in expenditures. The link between the inflation rate and aggregate expenditure still comes through interest rates and the monetary transmission mechanism, but it is the central bank's decision to change its policy interest rate that provides the impulse.

Figure 12.1 illustrates this monetary policy. Assume the central bank has an inflation control target such as π^* . Based on its evaluation of current and near future aggregate expenditure and supply conditions the Bank sets the interest rate i_0 to get its target inflation rate. If the actual inflation rate differs from π^* as a result of changes in economic conditions that the Bank views as temporary, rather than fundamental, it reacts with temporary changes in its interest rate, allowing some variation around i_0 such as i_1 to i_2 . The upward sloping line in the diagram shows this 'reaction function'.

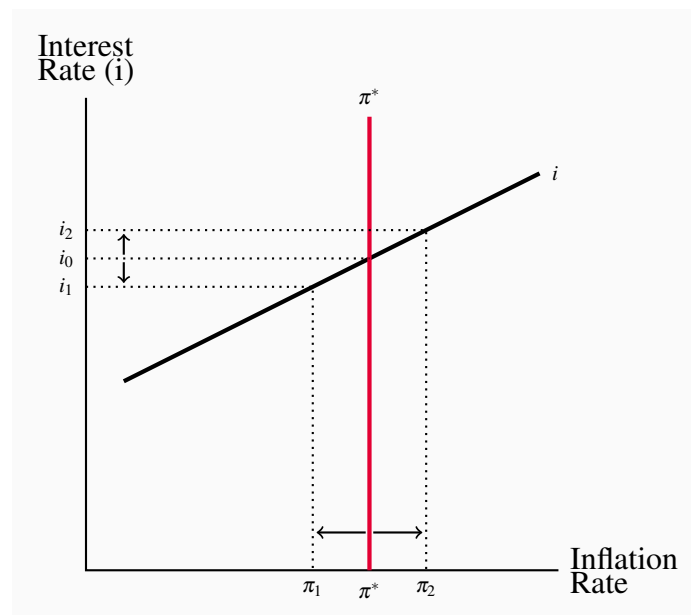


Figure 12.1: Monetary Policy Sets Interest Rate

$$\text{A Taylor Rule: } i = i_0 + \beta(\pi - \pi^*).$$

This is a simple Taylor Rule you will recall from Chapter 10.

An equation that describes this policy rule would be:

$$i = i_0 + \beta(\pi - \pi^*) \quad (12.1)$$

Where i_0 is the interest rate the Bank sets and announces to get a target inflation rate at π^* . It is set based on the underlying demand conditions in the economy relative to potential output. An economy working at potential output would have a constant inflation rate.

The parameter β defines the size of the change in the Bank would make to its interest rate in response to temporary differences between the observed inflation rate and the target rate. β is the slope of the interest rate line (i) in the diagram. If the inflation rate were to rise to π_2 in Figure 12.1 the Bank would raise its interest rate to i_2 to defend its inflation rate target.

Using this approach to monetary policy and the inflation rate brings the model up to date. Aggregate demand is still based on two familiar relationships. The first is the monetary transmission mechanism as in the traditional approach to AD. The second is the expenditure multiplier. Equilibrium aggregate expenditure and real GDP are determined by: autonomous expenditure, expenditure that is sensitive to interest rates, and a multiplier.

Figure 12.2 shows the derivation the aggregate demand curve labelled $AD\pi$ to distinguish it from the traditional AD curve based on a fixed money supply and a fixed price level.

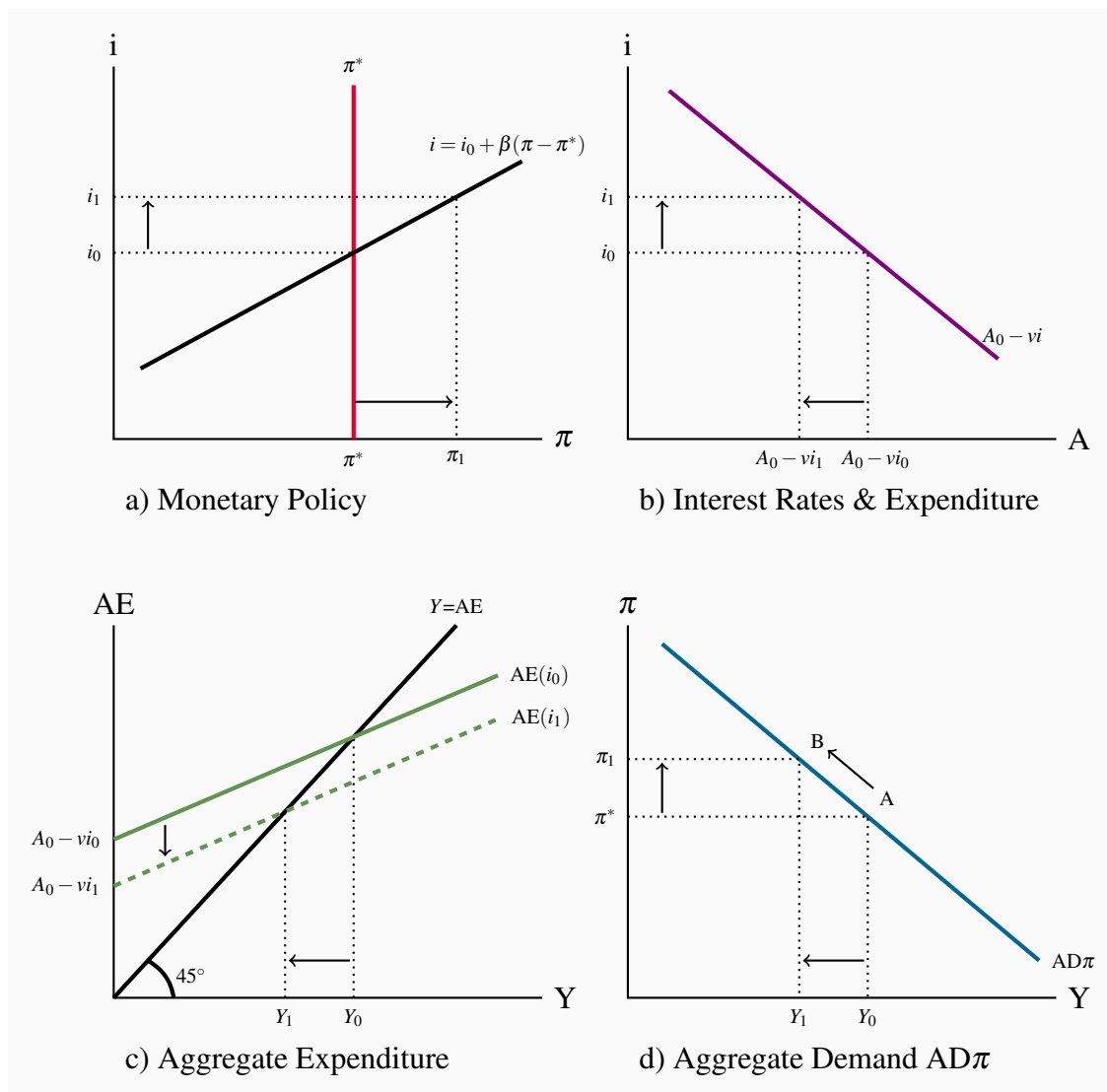


Figure 12.2: The $AD\pi$ Function

Start in equilibrium with $\pi = \pi^*$ and interest rate $i = i_0$ in a), and π^* and Y_0 at A in d). Suppose the inflation rate rises to π_1 . The central bank then raises its interest rate to i_1 . The higher interest rate reduces expenditure in b), lowering AE in c) and equilibrium real GDP to Y_1 . The new equilibrium combination $\pi_1 Y_1$ is point B on the $AD\pi$ curve.

Monetary policy as described by a Taylor type rule or reaction function like Equation 12.1 is in Panel a) of the diagram. Interest rates set by policy in Panel a) determine autonomous expenditures in Panel b) giving the monetary transmission mechanism. Autonomous expenditures determine the position of the AE line in Panel c) and work through the multiplier to determine equilibrium real GDP. The combination of the inflation rate π^* and equilibrium real GDP Y_0 give one point (π^*, Y_0) on an $AD\pi$ curve plotted in Panel d) and labelled A.

The central bank's reactions to changes in the inflation rate, other things constant, move the economy *along* the $AD\pi$ function. In Panel a) the Bank reacts to a transitory rise in the inflation rate to π_1 by raising its policy interest rate to i_1 . This reduces autonomous expenditure in Panel b) to $A_0 - vi_1$ and lowers the AE curve in Panel c) to $AE(i_1)$. The multiplier then lowers equilibrium real GDP to Y_1 and plotting (π_1, Y_1) in Panel d) gives a second point on an $AD\pi$ curve labelled B.

Changes in autonomous expenditures *not* caused by changes in interest rates (ΔA_0), like changes in autonomous consumption, investment, exports, or government expenditure would shift the $AD\pi$ function by amounts driven by the multiplier. Similarly, a *change in monetary policy made by changing i_0* , in response to a change in *economic fundamentals* would *shift the $AD\pi$ function*.

The recession of 2009, for example, brought a sharp drop in Canadian exports and a shift in $AD\pi$ to the left. The Bank of Canada lowered its setting for the overnight interest rate in steps from 4.75 percent to 0.25 percent to offset some of this drop in $AD\pi$. However monetary stimulus through lower interest rates was not enough to avoid a recession. Fiscal stimulus was also needed.

12.2 Aggregate supply

The supply side of the economy explains output, *inflation, and the economy's adjustment* to equilibrium at Y_P , potential output. Assuming there is no long run trade-off between inflation rates and output. If the economy is operating with an output gap, changes in the *rate of increase in wage rates* and other factor prices will push the economy toward a long run equilibrium at potential output and a constant rate of inflation.

No matter what time frame we use, the economy's output depends on the level of technology, the quantities of factor inputs to production (labour, capital, land, energy, and entrepreneurship) and the efficiency with which resources and technology are used. A simple **production function** defines the relationship between outputs and labour and capital inputs to production as follows:

$$Y = A \times F(N, K) \quad (12.2)$$

Production function: outputs determined by technology and inputs of labour and capital.

In this equation, Y is real GDP, A is the state of technology, and N and K are inputs of labour and capital, respectively, used in the production process.

The notation $F(\dots)$ tells us that the size of output as measured by real GDP depends on the amount of labour and capital used in the production process. More labour and more capital used means more output. An improvement in technology would make A larger, and increase the output pro-

duced by any given amount of labour and capital employed. This would be an increase in **productivity**.

Productivity: output per unit of input.

Long run aggregate supply (Y_P)

Potential output (Y_P) is determined by the current state of technology, A_0 , the current stock of capital, K_0 , and the *equilibrium* level of employment, N_F . In terms of the simple production function, this means:

$$Y_P = A_0 \times F(N_F, K_0)$$

Potential output (Y_P): the real GDP the economy can produce on a sustained basis with current labour capital and technology without generating inflationary pressure on prices.

The short-run fluctuations in output we studied in earlier chapters are linked to differences between actual labour input N and the “full employment” labour input N_F . Unemployment rates fluctuate as a result of these changes in actual output and employment relative to potential output and full employment.

If wages and prices are flexible, how does inflation, a continuous rise in the price level (and a corresponding increase in money wage rates), affect the incentives producers have to supply more goods and services? The answer depends on the state of **money illusion**, the confusion of nominal (money) and real variables.

Money illusion: confusion of nominal (money) and real variables.

Thinking in *real terms*, producers compare the **real wage rate** (the money wage rate w divided by the price level P) with the real output of another unit of labour employed. Similarly, workers compare real take-home pay (the purchasing power of their money wage in terms of goods and services) with the disutility of sacrificing more leisure to work more. If wage rates and output prices both double, real wage rates are unaffected. Neither producers nor workers would change their behaviour. In the absence of money illusion, long run aggregate supply (Y_P) is unaffected by pure inflation, since everything nominal, measured in money terms, rises in the same proportion.

Real wage rate: the quantity of goods and services the money wage rate will buy.

Short run aggregate supply

Short-run aggregate supply in the ‘modern’ model defines the relationship between output and the inflation rate, when capital stock, technology and the *rate of growth in money wages* are fixed. The basic argument is that monopolistically competitive firms set prices at a mark-up over marginal costs of production. The rates of increase in marginal costs of production depend in turn on the rates of increase in money wage rates, prices of material inputs, and productivity.

Prices are sticky in the very short-run. Changing prices is costly and competition among producers means relative prices are important to market position. As a result price changes only follow changes in costs that last beyond the current short term. A horizontal short run aggregate supply curve captures this output – inflation relationship.

Persistently strong aggregate demand would increase employment, output and capacity utilization, and lower productivity. Employment would rise and the unemployment rate would fall below the **NAIRU**, increasing the growth in money wage rates. This upward pressure on current and future marginal costs would compress producers’ markups and profitability. Alternatively, persistently weak aggregate demand would lower *rates of increase* in money wage rates, lower material costs, lower marginal costs and increase mark-ups. Producers wouldn’t adjust price setting practices immediately in either case. But they would react if their mark-ups are persistently pushed away from what they see as the profit maximizing level.

NAIRU: the ‘non-accelerating inflation rate of unemployment’ that corresponds to N_F at Y_P .

These short run aggregate conditions are described in simple AS π function that explains the inflation rate as:

$$\pi = \pi_{-1} + \gamma[(Y - Y_P)/Y_P]_{-1} + \sigma \quad (12.3)$$

In the short run firms inherit a rate of growth in the nominal wage rate $\omega_0 [= (w_{t-2} - w_{t-1})/w_{t-1}]$ equal to π_0^e , the expected rate of inflation based on past wage rate negotiations and contracts. These negotiations anticipated full employment and potential output equilibrium. By keeping up with inflation, nominal wage rate growth is expected to maintain the real wage rate required for equilibrium at potential output. The variable σ is a disturbance term which would capture things like commodity price shocks and shift the aggregate supply curve

Equation 12.3 gives a horizontal short run AS π curve that is sometimes called an ‘inflation adjustment’ function. The current inflation rate (π) is ‘last year’s’ inflation rate π_{-1} adjusted up or down in reaction to ‘last year’s’ output gap. In other words the inflation rate changes with a lag in response to the effect of an output gap on costs and prices. It could be specified as an upward sloping function by dropping the lag on the output gap, but that would remove some of the short run stickiness observed in wage rates and prices. Figure 12.3 illustrates potential output and short run aggregate supply.

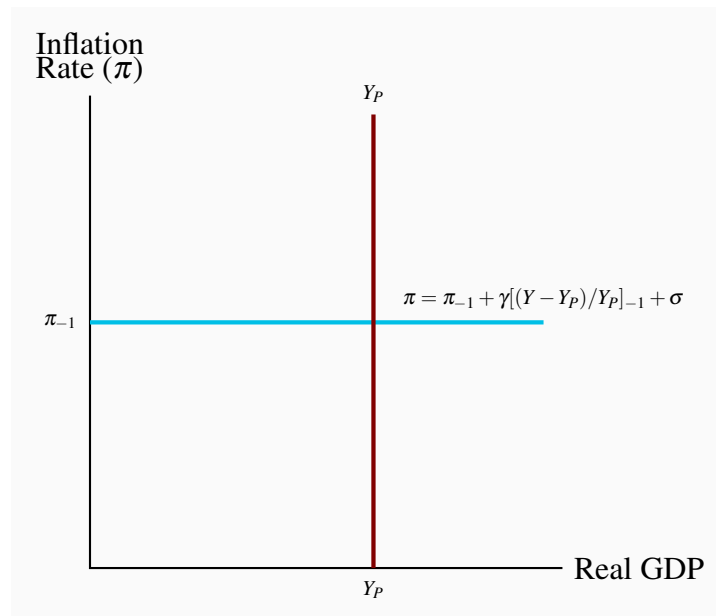


Figure 12.3: Potential Output and Short-Run AS

In the short run the inflation rate is constant as long as the economy is at Y_P . If the economy is not at Y_P the output gap will change the π rate, shifting the line up or down in the next time period.

12.3 The equilibrium inflation rate

When wages and prices are flexible, and there is no money illusion, Figure 12.4 shows the aggregate demand curve $AD\pi_0$ and the vertical long-run aggregate supply curve Y_P . Output is at potential output, and the *inflation rate*, π^* , is determined by aggregate demand. At point A there is equilibrium in all markets: for output, money, and labour.

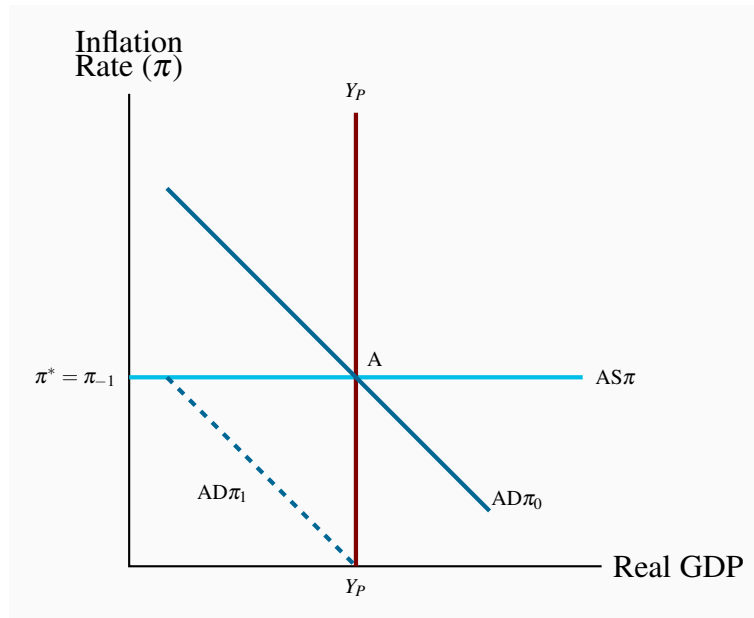


Figure 12.4: The Equilibrium Inflation Rate

The equilibrium inflation rate is determined by $AD\pi_0$ and Y_P , as at point A in the diagram. This is also the short run equilibrium inflation rate. If π^* is the central bank's monetary policy target the bank sets its interest rate to get $AD\pi_0$

The position of aggregate demand curve $AD\pi_0$, is determined by autonomous expenditure, fiscal policy, and the monetary policy of the central bank.

If monetary policy were directed to a constant equilibrium *price level*, as seen in previous chapters, the equilibrium inflation rate is zero. This is shown in Figure 12.4 by the aggregate demand curve $AD\pi_1$. Then equilibrium is at output Y_P and the inflation rate $\pi = 0$. This $AD\pi_1$ curve is not extended below a zero inflation rate. The discussion of deflation, negative inflation rates, on output and policy are important issues covered in Section 12.6.

In practice, central banks don't set zero inflation targets for monetary policy. As we have seen, some, including the Bank of Canada, set explicit low inflation rate targets. Others, including the United States Federal Reserve, work to implicit inflation rate targets that are also positive and low. There has been and still is a lot of discussion among economists about the appropriate level of the inflation rate target. The Bank of Canada's 2 percent target represents a current consensus on the issue.

The $AD\pi_0$ curve in Figure 12.4 is based on a monetary policy inflation target of π^* . In setting its inflation target, the central bank recognizes that *money is neutral* when wages and prices are flexible and there is no money illusion. This means that the central bank cannot influence potential output, but it can determine the equilibrium inflation rate. It sets the interest rate and accepts growth

in the money supply consistent with its inflation target. A rate of inflation, $[(P_t - P_{t-1})/P_{t-1}]$, greater than zero means the rate of growth of the money supply, $[(M_t - M_{t-1})/M_{t-1}]$, is greater than zero. This puts the $AD\pi$ curve at $AD\pi_0$, and keeps it there as inflation raises the price level at the target rate.

12.4 Adjustments to output gaps

Now consider how demand or supply shocks that move the economy away from potential output trigger an *adjustment process*. In combining the $AD\pi$ and $AS\pi$ curves, we are assuming the market for goods and services clears even in the short run, but the labour market takes longer to adjust. The inflation rate changes over time as wage rate growth adjusts to the unemployment rate. If this process goes smoothly and other conditions are tranquil and it may eventually restore full employment at potential output. But in the meantime output gaps can be quite persistent.

Figure 12.5 provides some empirical evidence. For Canada the recessionary gap of the last half of the 1990s lasted for about five years. The small inflationary gaps that followed persisted for seven years and were followed by the large recessionary gaps of the recession that followed the financial crisis of 2008-09. The data show that automatic adjustments are slow at best.

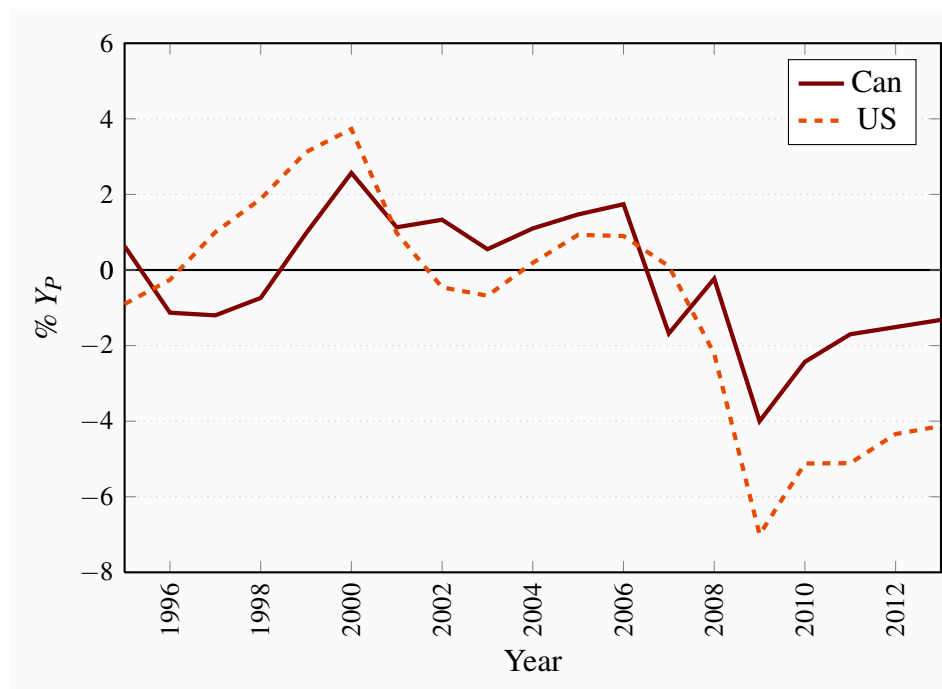


Figure 12.5: Output gaps: Canada and the US

Source: IMF World Economic Outlook Database, April 2014

An aggregate demand shock

Figure 12.6 shows the adjustment to an output gap that is built into the $AD\pi/AS\pi$ model. In the diagram an unexpected fall in aggregate demand shifts the $AD\pi$ function to the left. A decline in exports or investment or government expenditure, or a change in the inflation target set for monetary policy, would have this effect on $AD\pi$. Before this change, the economy was in equilibrium at full employment and potential output with inflation rate π^* , the central banks inflation target.

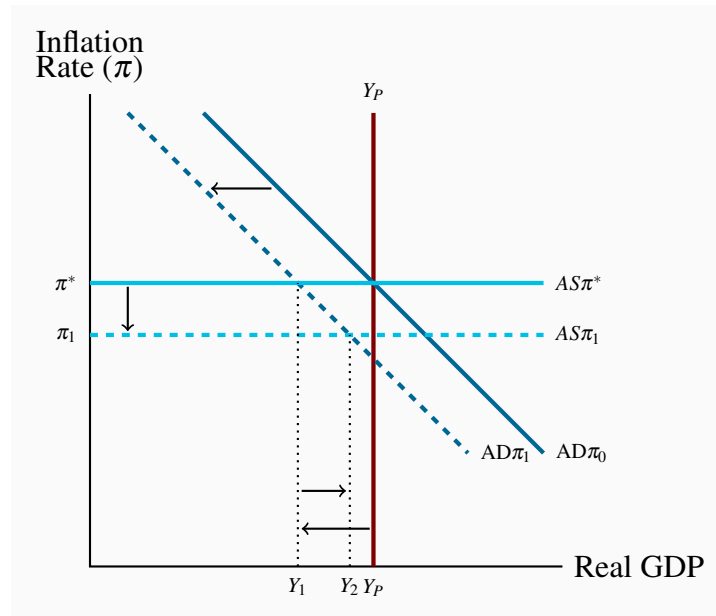


Figure 12.6: Adjustment to a Recessionary Gap

A fall in $AD\pi$ to $AD\pi_1$ creates a recessionary gap ($Y_1 - Y_P$). The increase in unemployment and reduction in output cuts the rate of increase in wage rates and prices to π_1 . Lower inflation leads the central bank to reduce its interest rate, supporting a move along $AD\pi_1$ to Y_2 .

In the short run, the fall in $AD\pi$ creates a recessionary gap $Y_1 - Y_P$. Since producers cannot cut costs per unit of output they reduce employment and output to Y_1 to cut total costs. Unemployment increases. At Y_1 the goods market clears. It is a point on both the $AS\pi^*$ and $AD\pi_1$ curves. Inflation has not fallen because of the short run stickiness in wage rate increases and price increases.

As time passes there are opportunities to negotiate smaller wage rate increases and to reduce some planned price increases. The scale of these changes depends on the size of the output gap and the sensitivity of costs and prices to that gap. In the $AS\pi$ function the term $\gamma[(Y_1 - Y_P)/Y_P]_{t-1}$ defines this adjustment. $AS\pi$ shifts down to $AS\pi_1$. As long as the central bank allows some flexibility in its policy interest rate expenditure can increase along $AD\pi_1$ to Y_2 and offset some of the output gap.

In the real world, adjustments to changes in aggregate supply come from the effects of GDP gaps and unemployment on the wage agreements negotiated, formally and informally, in labour markets. A recessionary gap like that in Figure 12.6 lowers *wage rate increases*, lowers inflation, and allows monetary policy to support an increase in demand *along the $AD\pi_1$ curve*. The output gap gradually disappears but the inflation rate is below the central bank's target.

An inflationary gap results in the opposite process. Employment and output rise. Unemployment rates fall. Wage rate increases rise, inflation rises, and monetary policy reactions result in higher real interest rates to reduce expenditure. In both cases, the eventual changes in wage rate agreements together with the reaction of monetary policy to changes in inflation rates move the economy, over time, from short-run to long-run equilibrium. But the new equilibrium inflation rate would be higher than the Bank's target.

This adjustment process has important implications for the inflation targets set by monetary policy. It means *prolonged changes in aggregate demand conditions* require changes in the central bank's interest rate setting to defend the inflation target. It also means that, if the inflation target is cut, shifting the $AD\pi$ curve to the left, the economy will go through a recession, and perhaps a prolonged recession, while money wage rate agreements are renegotiated and price setting practices adjust to reflect the new inflation target. The time required for this adjustment is linked in a very important way to the independence and the credibility of the central bank. Canadian experience in the 1990s provides an interesting example. Recessionary gaps were persistent after the Bank of Canada an inflation target of 2 percent at a time when current inflation rates were about 5 percent.

An aggregate supply shock

Figure 12.7 shows the model's internal adjustment to unexpected shift in $AS\pi$. A sharp increase in crude oil and commodity prices, for example enters the $AS\pi$ function as an increase in σ ($\Delta\sigma > 0$) in Equation 12.3. That pushes costs up and prices follow, increasing the inflation rate at least temporarily. Increases in indirect taxes like the HST or the taxes on alcohol and gasoline would have a similar effect. They increase the sellers' tax remittances to government, which sellers attempt to offset by increasing prices.

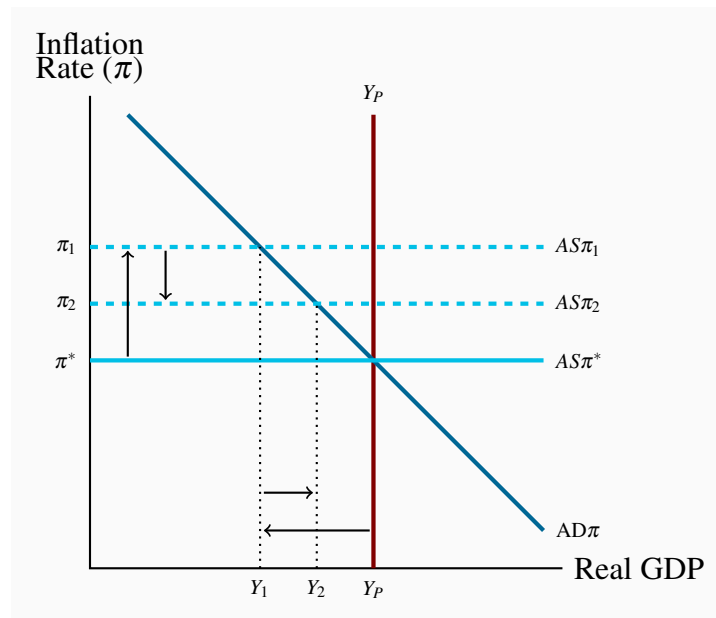


Figure 12.7: An Aggregate Supply Shift

An increase in commodity prices ($\Delta\sigma > 0$) increase π as $AS\pi$ shifts up to $AS\pi_1$. Inflation is higher than the Bank's π target and output falls, creating a recessionary gap. This is 'stagflation'. The central bank faces a dilemma. It cannot defend its inflation target without increasing the gap. Alternatively it can wait until π falls back to π^* .

In Figure 12.7 the $AS\pi$ curve shifts up to $AS\pi_1$. The inflation rate is higher and output falls creating a recessionary gap. These are the economic conditions often described as 'stagflation'. They pose a dilemma for the central bank.

Inflation is higher than its official target rate but trying to bring inflation down by raising the policy interest setting would only make things worse. Alternatively, cutting the policy interest rate to reduce the recessionary gap would shift $AD\pi$ to the right and validate the higher inflation rate. Doing nothing, on the assumption that the increase in commodity prices is a one-time jump, would mean living with inflation above the target and high unemployment until the rates of increase in wage rates and prices fall. Then $AS\pi$ would shift down to $AS\pi^*$. The cost of waiting is the cumulative loss of employment and output during the adjustment process and the redistribution of income in favour of commodity producers.

12.5 Monetary and fiscal policies

The inflation – output model sets clear roles for monetary and fiscal policies. Monetary policy, which is embedded in the $AD\pi$ curve, is aimed at an inflation control target using a short term

interest rate instrument. Within the structure of the model this monetary policy simultaneously moderates business cycle fluctuations in output and supports equilibrium output at potential output because there is no long run trade-off between inflation and output. Fiscal policy can be aimed at a government debt ratio target through budget balance control. The net tax rate in the government's budget provides automatic fiscal stabilization to moderate business cycle fluctuations.

Canadian monetary and fiscal policy followed this pattern from the early 1990's until the financial crisis of 2008. The Bank of Canada, in consultation with the Ministry of Finance has set inflation control targets for monetary policy since 1991. With the policy independence provided by a flexible exchange rate it uses the overnight interest rate as its policy instrument and intervenes in the market for overnight clearing balances to keep this interest rate within the operating band it sets. An interest rate policy rule provides a useful description of the Bank's reactions to inflation rates that deviate from its control target.

In 1994 the Government of Canada announced *A New Framework for Economic Policy* that focused fiscal policy on deficit control and debt ratio reduction. It set an initial budget deficit target of 3 percent of GDP as the first step in a fiscal policy program aimed at achieving first a balanced budget and then a surplus to reduce the federal government debt as a percentage of GDP. This was followed in 2004 by a target of reducing the debt-to-GDP ratio to 25 percent within 10 years. The government then managed the budget balance through a combination of taxation and expenditure programs to pursue this debt ratio target.

Monetary policy

In practical terms central banks set their short term interest rate instruments based on their inflation rate control target and their assessment of current and future economic conditions. This approach is described by a policy rule for setting the interest rate like we introduced in Chapter 10, namely:

$$i = i_0 + a(\pi - \pi^*) + \beta [(Y - Y_P)/Y_P] \quad (12.4)$$

Adding a term for the output gap means the central bank looks at both the inflation rate and the state of the economy in making its interest rate setting decisions. In terms of the AD π /AS π model, the output gap is a predictor of the way the inflation rate will move if current conditions persist. In times of recession, for example, the output gap term in the policy rule calls for a cut in interest rates even if the inflation rate is still π^* . This way the central bank pre-empts the fall in inflation that a recession would cause.

Figure 12.8 illustrates the central bank's policy response to a *persistent* fall in AD π . Lower AD π creates a recessionary gap but does not immediately lower the inflation rate. The central bank sees the fall in AD π as a lasting change in economic conditions that will reduce inflation below its inflation control target. It cuts its policy interest rate setting from i_0 to i_1 to increase AD π and

reduce the output gap and downward pressure on the inflation rate.

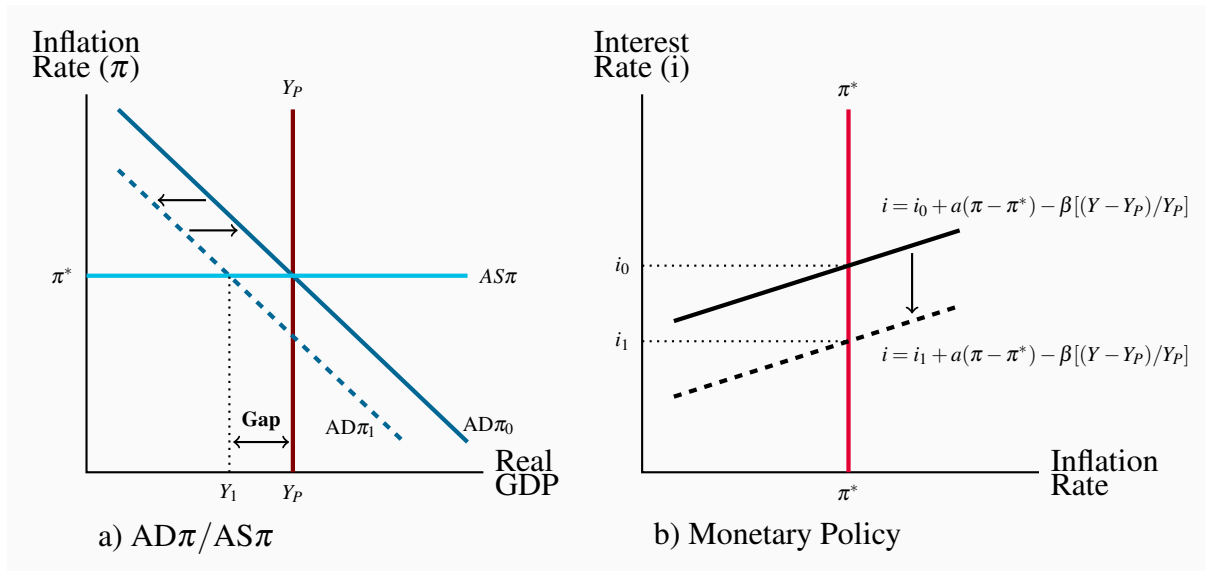


Figure 12.8: Central Bank Lowers Overnight Rate Target

Initially, equilibrium is $Y_P\pi^*$ in a) with the Bank's overnight rate set at i_0 . Then $AD\pi$ falls to $AD\pi_1$ as a global recession reduces exports. GDP falls to Y_1 causing an output gap $Y_1 - Y_P$. The central bank reacts to the output gap with a cut in its overnight rate target to i_1 in b), to provide stimulus and increase $AD\pi$.

The Bank of Canada's cut in its overnight rate target by 75 basis points (3/4 of 1 percentage point) in December 2008 is a real world example of this monetary policy. In the press release announcing this rate cut the Bank explained that the outlook for the global recession was worse than earlier predicted. The prospects for Canadian GDP growth and inflation were weaker than previously thought. In these circumstances the cut in the overnight rate was intended to provide some offsetting monetary stimulus. In terms of Figure 12.8, the cut in the interest rate target is the downward shift in the monetary policy rule. It was intended to pre-empt the shift from $AD\pi_0$ to $AD\pi_1$ at least in part. You can read the full text of the press release at: <http://goo.gl/W6UMg0>.

Figure 12.9 shows that the Bank of Canada's setting for its overnight interest rate has been related to the output gap over the 1995-2012 period. The interest rate setting rule described by Equation 12.4 calls for the Bank to raise its overnight rate as the output gap increases and lower its rate when the output gap falls. Figure 12.8 gives one example of how this works in theory. It is indeed the pattern of overnight rate settings we see in the data Figure 12.9.

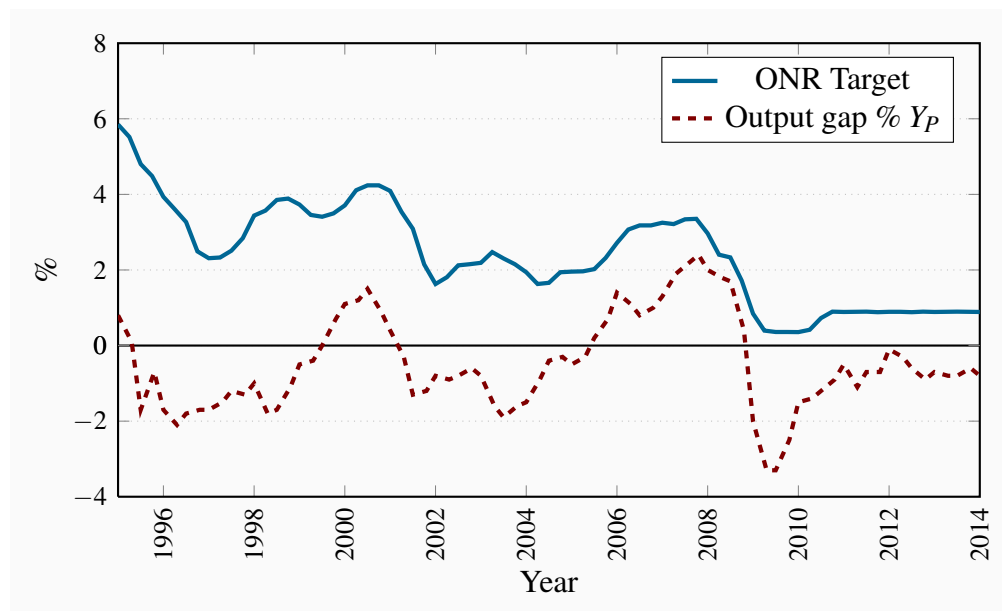


Figure 12.9: The ONR and the output gap

Source: CANSIM Series V39078, Bank of Canada, Indicators and author's calculations.

Changing overnight interest rates in response to changes in the output gap is only one aspect of the interest rate rule. The underlying argument is that output gaps are indicators of future changes in inflation rates. This is consistent with the $AD\pi/AS\pi$ model, which explains changes in the inflation rate that follow from persistent output gaps. The $AS\pi$ function also provides for changes in the inflation rate as a result of other economic changes such as changes in the prices of raw materials or changes in indirect taxes. The Bank might change its overnight rate setting in response to these changes in inflation that are not driven by the output gaps.

Figure 12.10 shows success of the Bank of Canada's monetary policy over the 1996-2012 period. The inflation rate as measured by the annualized rate of change in the Consumer Price Index has averaged 2.0 percent. This is the mid-point of the Bank's inflation control target range. Monetary policy cannot eliminate all variations in the inflation rate. Many changes come and go before the underlying causes are recognized. Furthermore, it takes considerable time for changes in the interest rate to work their way into the economy and affect inflation. Recognizing the transitory nature of short term fluctuations in the inflation rate and the time lags in the effects of interest rate changes the Bank aims to hit its inflation rate target within a time frame of six to eight quarters of a year.

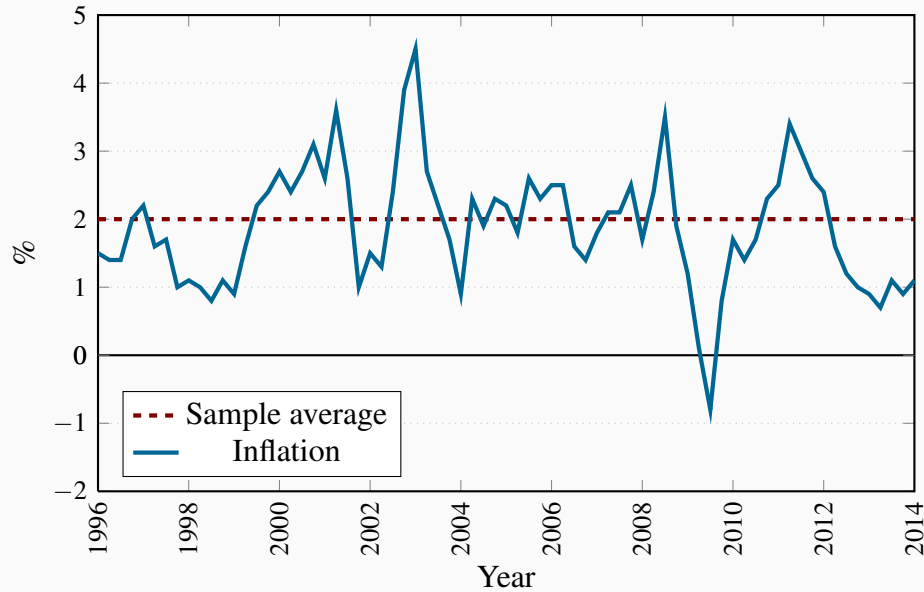


Figure 12.10: Canadian inflation rates, 1996-2013

Source: CANSIM V41690914 and author's calculations.

The data plotted in Figure 12.10 shows the volatility of the annualized quarterly inflation rates but the average rate over the period is indeed 2 percent. Over the same period the economy went through both recessionary and inflationary gaps, with a small recessionary gap, -0.5 percent of Y_P , on average. If the period following the financial crisis of 2008 is excluded the average output gap from 1995 to 2008 is -0.2 percent with a range of -2.1 percent to +2.4 percent.

While success with inflation control did not eliminate the business cycle in real GDP and employment, economic performance was consistent with the argument of the $AD\pi/AS\pi$ model. From 1995 to 2007 the inflation rate fluctuated around the 2 percent target and output was, on average, close to estimates of potential output.

The financial crisis of 2008 changed the economic fundamentals, the focus of monetary and fiscal policies, and the economic performance of the economy. We will examine this more recent experience after we look fiscal policy in the $AD\pi/AS\pi$ model.

Fiscal policy

In the $AD\pi/AS\pi$ model with a flexible foreign exchange rate monetary policy dominates *discretionary* fiscal policy. Monetary policy sets the interest rate that will give the $AD\pi$ needed to get the inflation rate target at potential output. A change in discretionary fiscal policy would change

the conditions on which the Bank's interest rate is set. To defend its inflation rate target the Bank would react, changing its interest rate setting to offset the any new fiscal stimulus or restraint. Monetary policy deliberately crowds out the effect of fiscal policy on $AD\pi$ through the interest rate exchange rate links in the monetary transmission mechanism.

However, fiscal policy does have two important roles to play. Government tax and expenditure programs linked to GDP provide *automatic* fiscal stabilization, as we have explained in Chapter 7. In addition, with a monetary policy consistent with equilibrium at potential output, *discretionary* fiscal policy can aim to control the **public debt ratio (PD/Y)** by managing the government's budget balance. This is the fiscal policy objective that is currently the cause of serious debates in both the US and Europe.

Public debt ratio (PD/Y): the ratio of government debt to GDP.

Fiscal policy is implemented through the government's budget. The budget balance function provides the framework. Elaborating on the basic government budget of Chapter 7 to recognize the importance of the public debt gives:

$$BB = tY - G - iPD \quad (12.5)$$

The term iPD is the interest paid on the government bonds, PD , issued to finance past budget deficits in that amount. G represents *program spending*. $G + iPD$ is total government spending.

Automatic fiscal stabilization comes from the *net tax rate* t in the budget function. This rate changes government revenues and transfers automatically when GDP changes. Cyclical changes in the government budget balance reduce the size of the expenditure multiplier and the size of the change in GDP caused by shifts in $AD\pi/AS\pi$ conditions. The budget function:

$$BB = SPBB + t(Y - Y_P) - iPD \quad (12.6)$$

separates the structural primary budget balance and the *cyclical component* $t(Y - Y_P)$ of the actual budget balance BB . The **structural primary budget balance ($SPBB$)** evaluates the government's fiscal program *net of interest payments on the public debt* at Y_P , ($SPBB = tY_P - G$). The cyclical component is the effect of an output gap on the actual budget balance. The actual budget balance BB has three components, the structural primary budget balance, the cyclical component and the interest payments on the public debt.

Structural primary government balance ($SPBB$): the difference between net tax revenue at Y_P and government program expenditure. It excludes interest payments on the public debt and the

effect of output gaps.

The two objectives of fiscal policy are:

1. Provide automatic fiscal stabilization, and
2. Control, and perhaps reduce, the ratio of the public debt to GDP.

The fiscal policy instruments are:

1. The net tax rate, t , set in the budget plan, which will also be a component of,
2. The structural primary budget balance, $SPBB$.

Current interest payments on the public debt are the result of past issues of government bonds and the average of coupon rates on those bonds. This expenditure cannot be changed in the current budget but can be controlled going forward as current budget balances reduce or increase the public debt.

Setting the net tax rate that will provide automatic stabilization is a simple mechanical question but a difficult economic and political question. A higher net tax rate provides more stabilization. It involves the design of the tax system and transfer payment programs like employment insurance, social assistance programs and subsidy programs where revenues collected and expenditures made vary inversely to economic conditions. The types of taxes to be used and the bases to which those taxes are to be applied generate heated debates. The design and eligibility requirements for transfer benefits are also controversial. There are also strong differences of opinion over the economic impacts of different types and rates of taxes and transfers. These issues have been important to recent election campaigns in Canada and the US and will dominate ongoing US debates about budget deficits and public debt control.

We will leave the details of those debates to specialists in public finance and ask a question that is somewhat easier to answer. Have changes in the cyclical balance of the Canadian federal government budget provided automatic stabilization. To answer this question Figure 12.11 plots the output gap and the cyclical budget balance over the 1995-2012 time period. These data show a pattern of *cyclical* budget deficits and surpluses that coincide with recessionary and inflationary gaps to provide automatic fiscal stabilization.

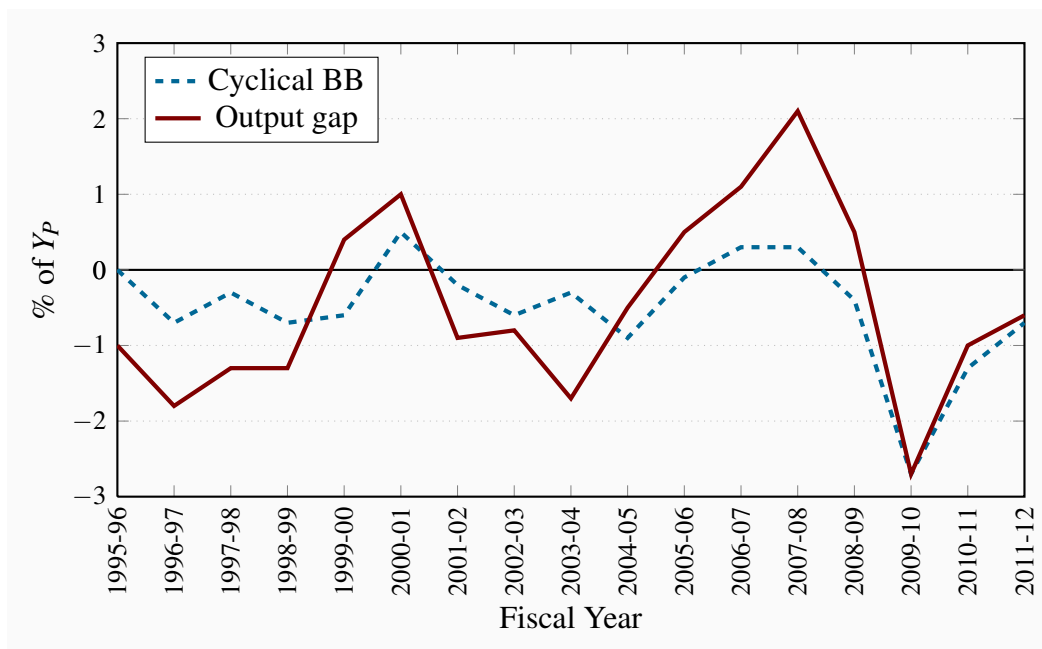


Figure 12.11: Output gaps and the cyclical budget balance, 1995-96 to 2011-12

Source: Department of Finance, Fiscal Reference Tables, 2012, Bank of Canada and author's calculations.

For most years in the period covered by Figure 12.11 the absolute magnitude of the cyclical budget balance is noticeably less than that of the output gap. That pattern changes after 2008 when expansionary fiscal policy, the *Economic Action Plan* of 2009 was introduced to fight the recession that followed the 2008 financial crisis. Although this was clearly a discretionary policy change the Department of Finance reported it in its *Fiscal Reference Tables, 2011* as a component of the cyclical balance, excluding it from its structural budget balance estimates, and continues this practice with additional revisions in the Fiscal Reference Tables 2014. This is an interesting treatment of this discretionary stimulus program that was extended into 2011 and 2014 and continues to feature prominently in government advertisements. As a result, the 'automatic stabilization' illustrated in Figure 12.11 is overstated in the 2009-2014 period and the reported structural budget balance is increased.

Explaining the budget balances required to control and reduce the *debt ratio* is a bit more complicated. The change in the debt ratio, PD/Y from one year to the next is determined by the percentage change in the debt $\Delta PD/PD$ and the percentage change in GDP, $\Delta Y/Y$.

The annual change in the debt is equal to the annual budget deficit or surplus. Even if the primary budget is balanced, $PBB = tY - G = 0$, interest payments on the public debt will increase the outstanding debt by iPD . This increase in the public debt, the numerator of the debt ratio, will increase the debt ratio unless it is offset by an increase in GDP, the denominator of the ratio.

To control the debt ratio the role of fiscal policy has to set net tax rates and program expenditures that give a primary budget balance that offsets the difference between the interest rate on the public debt and the growth rate in GDP. The arithmetic behind this debt control target and budget balance illustrates the process.

Letting lower case letters indicate *values relative to GDP* gives:

$$\begin{aligned}bb &= BB/Y \\spbb &= SPBB/Y \\pd &= PD/Y, \text{ and} \\ipd &= iPD/Y\end{aligned}$$

The growth in nominal GDP is, by the similar notation $n = \Delta Y/Y$. This allows us to define the *annual change in the debt ratio* with the following equation:

$$\Delta pd = -spbb + ipd - npd,$$

which gives:

$$\Delta pd = -spbb + (i - n)pd \quad (12.7)$$

This equation shows that the debt ratio will grow unless the structural primary budget surplus relative to GDP ($spbb$) is greater than the difference between the interest rate on the public debt and the growth rate of GDP ($i - n$). Furthermore, a larger public debt ratio or growth in the public debt ratio will increase the $(i - n)pd$ component of Δpd . Stabilizing or reducing the debt ratio would then require a larger structural primary surplus.

Table 12.1 provides a numerical example of the arithmetic of the federal government debt ratio for the 2001-02 to 2007-08 fiscal years. In this period before the financial crisis the federal government was continuing the debt ratio reduction program started in 1995. The target for that program was a debt ratio of 25 percent by 2015. The data show the debt ratio declining steadily toward that target.

Fiscal Year	$spbb$	$(i - n)$	pd	Δpd	Predicted pd
2001-02	0.045	0.051	0.46	–	–
2002-03	0.045	0.010	0.43	–0.02	0.44
2003-04	0.039	0.016	0.41	–0.04	0.39
2004-05	0.036	–0.015	0.38	–0.03	0.37
2005-06	0.036	–0.012	0.34	–0.04	0.34
2006-07	0.031	0.010	0.32	–0.04	0.30
2007-08	0.024	–0.01	0.30	–0.03	0.29

Table 12.1: The causes of change in the public debt ratio: Canada 2001-02, 2007-08

$spbb$ =structural primary budget balance. $(i - n)$ =spread between interest rate on public debt (i) and GDP growth rate (n). pd =ratio of public debt to GDP. $\Delta pd = -spbb + (i - n)pd$. Sources: Department of Finance, Fiscal Reference Tables 2012, Statistics Canada, CANSIM Table 380-0001 and author's calculations.

The data also show the sources of the reduction in the net debt ratio using Equation 12.7. Over the time period in the table the structural primary budget was in surplus. In every year these surpluses, although declining, more than offset the increase in the debt ratio that was caused by interest rates on the public debt that were greater than growth in GDP. In 2004-05 and 2005-06, however, growth in GDP exceeded the rate of interest on the public debt and reinforced the budget surplus contribution to debt ratio reductions.

The debt ratio equation does not describe the change in the debt ratio exactly but the annual errors are small. Some errors inevitably arise from errors in the data. Other errors come from using the structural primary budget balance rather than the actual budget balance. These two budget measures differ by the cyclical budget component. The actual balance drives the debt ratio while the structural balance is the policy instrument.

This arithmetic of the debt ratio can be used to define the structural primary budget balance need to control or reduce the debt ratio. Suppose the fiscal policy target is to hold the debt ratio at its current value. This sets $\Delta pd = 0$ in Equation 12.7 to give the following requirement $spbb^*$: $0 = -spbb + (i - n)pd$, and

$$spbb^* = (i - n)pd \quad (12.8)$$

Alternatively, if the policy objective is to reduce the debt ratio, $\Delta db < 0$, the structural primary budget balance would have to be larger.

When the Government of Canada in 1995 set reducing the public debt ratio as its fiscal policy target, that ratio stood at 68 percent of GDP. The primary budget balance was in deficit and interest payments on the public debt absorbed about 35 percent of government revenue. In the years that followed the public debt ratio declined steadily to a low 29 percent in 2008-09 before rising as a result of the shift to fiscal stimulus in 2009. Interest payments on the debt fell to less than 13 percent of revenue. Fiscal policy was on track to meet the debt ratio target of 25 percent set in the 2004 Budget. Significant structural primary surpluses were the major fiscal contributor to this decline in the ratio.

Figure 12.12 illustrates the sources of this significant reduction in the Canadian federal public debt ratio. The large increase in the structural primary budget surplus (*spbb*) was the main part of the fiscal adjustment, particularly in the first five years when it was increased from 2.5 percent to 6.5 percent of GDP. Its effect on the debt ratio is shown by the lower line in the diagram which plots ($-spbb$). The weighted interest rate-growth rate spread ($i - n$) was a much smaller factor and on balance put upward pressure on the debt ratio. Clearly the budget surplus offset this effect and as the debt ratio declined the budget surplus was reduced and fiscal restraint eased.

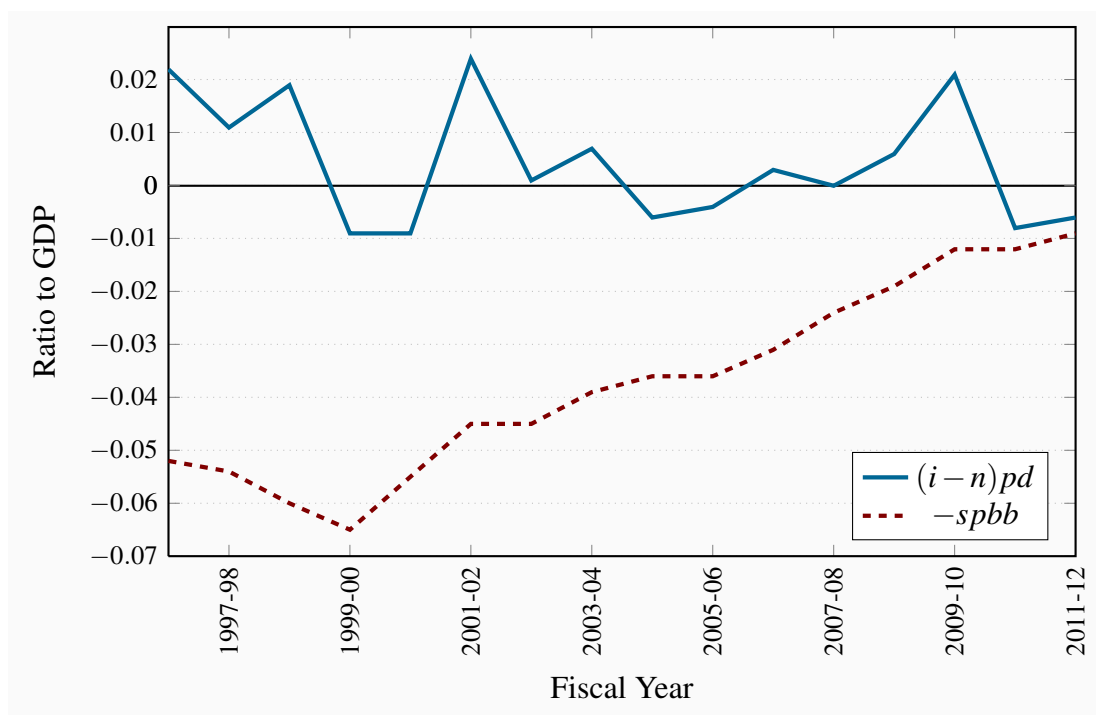


Figure 12.12: Sources of change in the public debt ratio, Canada 1995-2012

Source: Department of Finance, Fiscal Reference Tables 2012, CANSIM Table 380-0001 and author's calculations.

Canadian success with debt ratio control and reduction has been cited as an example for countries currently facing very high debt ratios. But it may not be fit with current economic conditions in

those countries. Canada's fiscal adjustment was made easier by a substantial easing of monetary conditions in terms of both interest rates and exchange rates and strong growth in the US economy, which all supported a large increase in exports. This economic environment is not available to the countries that now face a debt crisis.

Even with favourable conditions, the Canadian adjustment was costly. There was a cumulative loss of output from an output gap that lasted from 1995 to 1999 that was at times as large as 2 percent of Y_P . Unemployment rates reached 9 percent and low rates of capacity utilization in industry reduced profitability and investment in new capacity and technology.

These and the negative fiscal effects of the earlier monetary restraint following the shift to inflation targeting are now sunk costs. In the years that followed monetary and fiscal policies worked to deliver stable inflation and declining public debt ratios until the crisis and recession of 2008-09.

12.6 Recession, disinflation and deflation

The financial crisis of 2008 and the recession that followed uncovered the limitations of monetary policy and renewed the case for fiscal stimulation. The assignment of monetary policy to an inflation target at Y_P and fiscal policy to debt ratio control did not work in the new economic conditions. Moreover, the depth of the recession and the collapse of the banking and financial sectors led to **disinflation** and raised fears of **deflation** as a result of rising real interest rates and output gaps. The Great Depression of the 1930's was an historical example. The Japanese experience starting in the 1990's with zero interest rates and a continuing slump was another. A rethinking of macroeconomic policy was necessary.

Disinflation: a persistent fall in the inflation rate.

Deflation: a persistent fall in the general price level.

We can explain some of the issues involved with the basic $AD\pi/AS\pi$ model. In Figure 12.13 a financial crisis shifts $AD\pi$ by undermining the interest rate – expenditure link in the monetary transmission mechanism. Financial risk and uncertainty increase and demands for liquidity increase. Banks are reluctant to lend and businesses are reluctant to borrow. The $AD\pi$ curve shifts left and pivots to show the reduction in financing and the fall in the interest sensitivity of expenditure. Equilibrium shifts to π^*Y_1 with a recessionary gap.

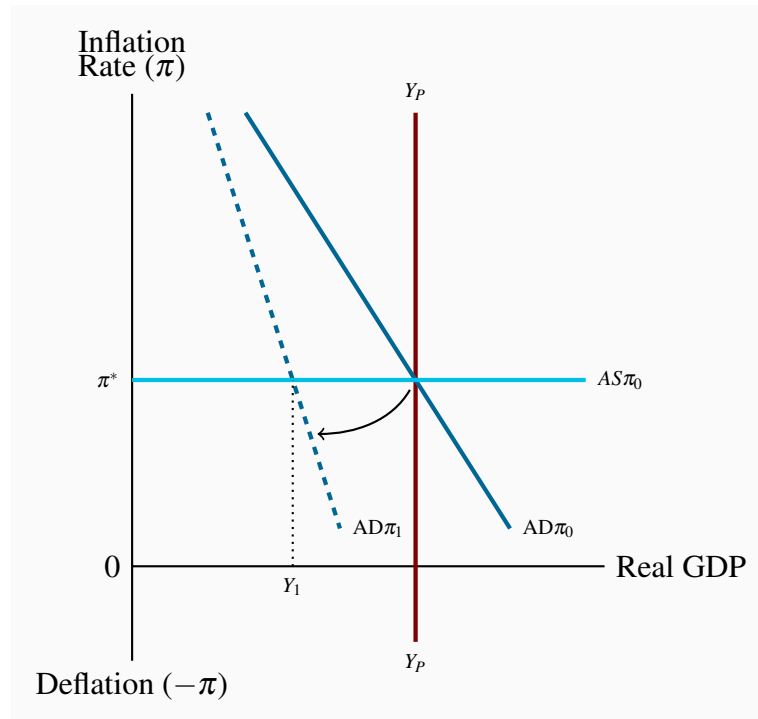


Figure 12.13: Recession, Dis-inflation & Monetary Policy

Financial crisis undermines monetary transmission mechanism. $AD\pi$ falls but central bank interest rate cuts cannot offset the fall in π . At zero lower bound deflation raises real interest rate and the output gap continues to grow.

The recessionary gap triggers two reactions. The inflation rate falls and the central bank cuts its interest rate to offset the fall in inflation and output. But the steeper $AD\pi_1$ function reflects the disruption to financial markets. Nominal interest rate cuts have limited the effects of on expenditure. To prevent a rise in the real interest rate ($i - \pi$) the Bank must cut its nominal policy rate by more than the fall in inflation.

But the central bank cannot lower its rate below zero – it hits the lower bound. *If the output gap persists and pushes disinflation into deflation, rising real interest rates cut expenditure and increase the gap. The $AD\pi$ function would be kinked backward at $i = 0$ to capture these negative effects of deflation.*

Fortunately economic conditions did not deteriorate to that extent:

It appears today that the world will likely avoid a major deflation and thus avoid the deadly interaction of larger and larger deflation, higher and higher real interest rates and larger and larger output gaps.”

Blanchard, O.et. al. (2010). Rethinking Macroeconomic Policy. *IMF Staff Position Note*, SPN/10/03

Still, faced with the financial crisis and recession major industrial countries shifted their policy programs. Cutting interest rates to defend inflation targets was the first policy initiative. The Bank of Canada cut its target overnight interest rate from 4.25 percent in late 2007 to a record low 0.25 percent in early 2009 and held the rate at that level until mid-2010. In the US the Federal Reserve cut its federal funds rate, the policy rate that corresponds to the Bank of Canada's overnight rate, from 5.25 percent in late 2007 to 0.0 percent in late 2008. It is still at that rate today in late 2014. These interest rate cuts reduced policy rates to the zero lower bound and exhausted the potential for monetary stimulus with that policy instrument.

Monetary policy in the US turned then to earlier instruments. The first was increased “moral suasion,” an increase in communications with financial market participants, including *conditional statements about the future path of policy rates*, to emphasize the central bank's longer-term support for markets and its actions to promote stability. More directly the banks were urged to maintain their lending operations. The second was “**quantitative easing**,” and in the case of the U.S., an even more extensive “**credit easing**.” “Quantitative easing” extends the use of open market operations described above. The central bank purchases a broader range of financial assets to expand its balance sheet to increase substantially the monetary base and cash positions of the banks. In other words, the objective is to increase the quantity of cash reserves in the banking system directly.

Quantitative easing: a central bank purchases of financial assets to increase its asset holdings and the monetary base.

Credit easing: the management of the central bank's assets designed to support lending in specific financial markets.

Open market operations usually involve central bank purchases of short-term government bonds. The U.S. Federal Reserve went beyond this, introducing three sets of policy tools:

1. lending to financial institutions,
2. providing liquidity directly to other key credit markets by buying highly rated commercial paper, and
3. buying longer-term securities, including mortgage backed securities.

Using these tools increases the size of the central bank's balance sheet and changes the structure of central bank asset holdings. Quantitative easing is measured by the impact on the quantity of bank reserves. Credit easing is measured by the wider variety of loans and securities the central bank willingly holds on its balance sheet. A purchase of these assets puts cash directly into specific markets rather than feeding it through banks and bank lending. Both are intended to increase lending to businesses and households in times when very low, near zero, interest rates alone are not working.

The effect of three rounds of quantitative easing by the US Federal Reserve has been to raise the monetary base in the US from about \$800 billion in to \$2.62 trillion in October 2012. While this monetary stimulus has not offset the full effects of the 2008-09 recession, it is credited with avoiding a US deflation. A version of this policy action was used in Japan earlier in the decade after the Bank of Japan had lowered its borrowing rate to zero and wanted to provide further economic stimulus. In terms of the $AD\pi/AS\pi$ model the intent was to support demand and shift the $AD\pi$ curve to the right or least avoid deflation if recessionary gaps persisted.

The Bank of Canada also developed plans for quantitative and easing that were not used as economic conditions improved more quickly here than in some other countries. You can see the Bank's explanation of these policies in its Monetary Policy Report, April 2009 pp. 24-28, at <http://goo.gl/z3i3Gj>.

These monetary policies were supported by discretionary fiscal policies. With interest rates at zero, crowding out was not a concern and increased $AD\pi$ was the objective. The earlier focus on deficit and debt ratio control was set aside to provide aggregate demand stimulus. In Canada the federal government's '*Action Plan*' included direct support for infrastructure projects and tax incentives for certain household expenditures. In terms of budget data the federal government structural budget shifted from a surplus of \$3.8 billion in fiscal 2007-08 to a deficit of \$10.6 billion in 2009-10. But as noted earlier, the '*Action Plan*' stimulus was treated as a 'cyclical' budget component. Thus the change in the actual federal budget balance from a surplus of \$9.6 billion in fiscal 2007-08 to a deficit of \$55.6 billion in fiscal 2009-10 is probably a better measure of the fiscal stimulus that addressed the recession. However, this stimulus was relatively short lived as the government returned to its earlier deficit and debt control focus and left monetary policy to provide sustained support for economic recovery.

The Algebra of the $AD\pi$ curve

The $AD\pi$ curve is based on:

1. An AE function that includes the effect of interest rates on expenditures, and
2. Central bank monetary policy sets interest rates to defend and inflation rate target.

The AE function is:

$$AE = A_0 - vi + [c(1 - t) - m]Y \quad (1)$$

In this equation A_0 is autonomous expenditure, v measures the impact of a change in the interest rate, i , on expenditure, and $[c(1 - t) - m]$, the marginal propensity to spend. Using the equilibrium expenditure condition $Y = AE$ gives:

$$Y = A_0 - vi + [c(1 - t) - m]Y$$

$$Y = \frac{A_0 - vi}{1 - c(1 - t) + m} \quad (2)$$

The central bank sets interest rates to achieve a *target inflation rate* and reacts to changes in the inflation rate by changing short-term interest rates according to:

$$i = i_0 + \beta(\pi - \pi^*) \quad (3)$$

In this equation i is the Bank's interest rate instrument, π^* is the Bank's inflation rate target and π is the actual inflation rate. With $\beta > 1$ the central bank's response to a change in the inflation rate changes the nominal interest rate enough to change the real interest rate. The monetary policy objective is to keep inflation at the target value π^* .

Substituting the interest rate determined by monetary policy in (3) into the equilibrium expenditure condition (2) gives an aggregate demand curve that includes the inflation rate:

$$AD\pi = \frac{A_0 - v[i_0 + \beta(\pi - \pi^*)]}{1 - c(1 - t) + m} \quad (4)$$

This aggregate demand curve is labeled $AD\pi$ to distinguish it from the traditional P, Y aggregate demand curve. $AD\pi$ is the relationship between *real output and inflation*.

A numerical example illustrates this $AD\pi$ curve. Suppose

$$AE = 200 + 0.5Y - 10i,$$

and the central bank has an inflation target $\pi^* = 1.0$ percent. The bank estimates that a real interest rate of 2.0 percent is needed for equilibrium at potential output. It sets the nominal interest rate $i_0 = (r + \pi^*) = 3.0$ and reacts to *transitory* departures from its inflation target according to the policy rule:

$$i = 3.0 + 1.5(\pi - 1)$$

Then by substitution,

$$\begin{aligned} AE &= 200 + 0.5Y - 10[3.0 + 1.5(\pi - 1.0)] \\ AE &= 185 - 15\pi + 0.5Y \end{aligned}$$

In equilibrium $Y = AE$ giving:

$$Y = \frac{185 - 15\pi}{(1 - 0.5)} = 370 - 30\pi \quad (5)$$

The aggregate demand curve:

$$AD\pi : Y = 370 - 30\pi$$

defines a negative relationship between the inflation rate and equilibrium real GDP.

When the inflation rate is equal to the monetary policy target of 1 percent ($\pi = \pi^*$), the equilibrium level of real GDP and demand is 340. If the inflation rate were to rise to 1.5 percent, which exceeds the target by 0.5 percent, the Bank's reaction would be to raise the interest rate by $[1.5(1.5 - 1)] = 0.75$ percent. This would lower aggregate expenditure by $(10 \times 0.75 = 7.5)$ and equilibrium real GDP by $(7.5 \times \text{multiplier} = 15)$ to 325, moving up along the $AD\pi$ curve. A fall in inflation from the target would bring the opposite reaction.

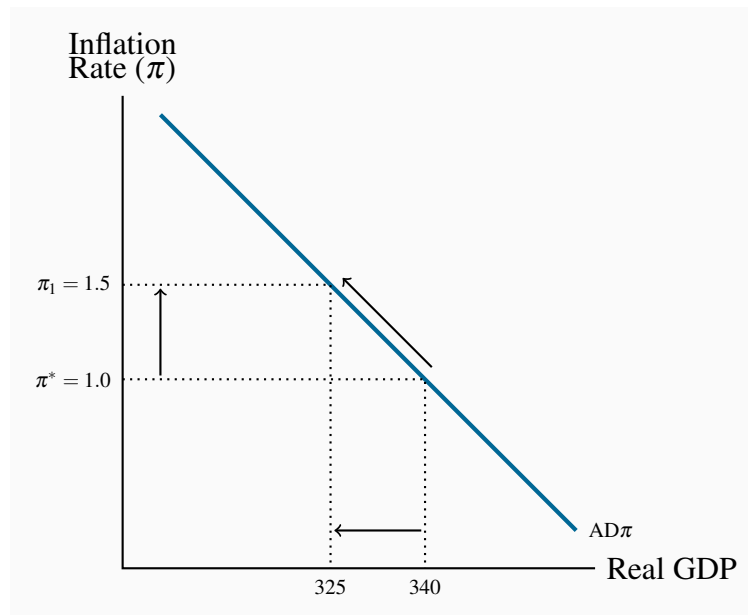


Figure 12.14: The $AD\pi$ Curve

Next

This chapter provides a basic model for the analysis macroeconomic performance and policy that integrates the design, instruments and objectives of modern monetary and fiscal policies. Inflation, deflation, public debt ratios and business cycles are explained. But two issues remain. One is the important topic of economic growth, growth theory and growth accounting. The other is an extension of the coverage of international macroeconomics to elaborate on trade, finance and exchange rate questions. These are covered in the next two chapters.

KEY CONCEPTS

The $AD\pi$ curve describes the relationship between equilibrium real GDP and the inflation rate.

Monetary policy that sets an **inflation rate target** and uses the **short run interest rate** as a policy instrument is integral to the $AD\pi$ curve.

The **production function** $Y = A \times F(N, K)$ determines the output of goods and services.

In the long run labour market equilibrium determines the equilibrium level of employment and **potential output** Y_P .

In the short run, employment and output fluctuate in response to changing economic conditions. However, there is **no trade-off between inflation rates and output**.

The short run $AS\pi$ function describes the lagged adjustment to the inflation rate in reaction to output gaps.

The $AS\pi$ function is based on the **price setting decisions** of producers in imperfectly competitive markets.

The **equilibrium inflation rate** is the inflation control target set by the central bank.

Business cycles in output and employment caused by persistent $AD\pi$ and/or $AS\pi$ shifts create output gaps.

Persistent output gaps lead to an **internal adjustment** based on **changes in the rate of increase in money wage rates and changes in the rate of inflation**.

A **monetary policy rule** describes the central bank's setting of its interest rate policy instrument as reactions to inflation rates that differ from its inflation control target and to output gaps.

Fiscal policy controls government budget balances to control or reduce the size of the **public debt ratio**.

The **structural primary budget balance** is the **fiscal policy instrument**.

The arithmetic of changes in the public debt ratio links the **change in the debt ratio** to the primary budget balance and the difference between the interest rate on the debt and the growth rate of GDP.

Over the 1995-2008 period Canadian monetary and fiscal policies effectively **controlled the Canadian inflation rate and reduced the federal government debt ratio.**

The financial crisis of 2008 and the recession that followed in 2008-09 demonstrated the limits of monetary policies based on interest rates and fiscal policies focused on debt ratio control. In Canada a combination of monetary and fiscal stimulus reduced the fall in output and employment. In other countries a broader set monetary policy instruments and fiscal austerity have yet to solve employment and public debt issues.

EXERCISES FOR CHAPTER 12

Exercise 12.1. Use a diagram to illustrate the equilibrium inflation rate. In this diagram, show how a permanent increase in export demand would affect the equilibrium inflation rate, if the central bank did not react and change its monetary policy. If the central bank did react to this change in the equilibrium inflation rate to defend its inflation target, what change in the interest rate setting and money supply growth would you observe? How would this change in the interest rate setting affect $AD\pi$ and the composition of $AD\pi$?

Exercise 12.2. If careful research estimates potential output Y_P at 1000, and the $AD\pi$ function is $Y = 1,150 - 25\pi$, what is the equilibrium inflation rate? If the central bank's inflation rate target is 4.0 what change in the interest rate must the central bank make to defend its inflation target?

Exercise 12.3. Suppose opportunities for investing in high tech applications boost aggregate demand in the short run, and aggregate supply in the long run. Using $AS\pi$ and $AD\pi$ curves with equilibrium at potential output, show why output might rise without much of an increase in inflation.

Exercise 12.4. Suppose a new round of labour negotiations results in a higher average rate of increase in money wage rates for the next three years. Illustrate and explain how this would affect short-run aggregate supply conditions and the $AS\pi$ curve.

Exercise 12.5. Draw an aggregate supply and demand curve diagram to show an economy in short run equilibrium at potential output. Suppose a wide-spread recession reduces incomes in foreign countries, leading to reduced demand for exports. Illustrate and explain how this would affect the short run equilibrium Y and π in your diagram.

Exercise 12.6. Suppose central banks have reduced their policy interest rates to the lower bound to fight a deep and prolonged recession. Use a diagram to show how either a reduction in the inflation rate, or deflation, would change the slope of the $AD\pi$ curve. Would cuts in nominal money wage rates and further reductions in the inflation rate reduce the recessionary gap when the central bank is constrained by the lower bound on its interest rate?

Exercise 12.7. In the two years before 2008 the federal government reduced the GST from 7 percent to 5 percent. Use an $AD\pi/AS\pi/Y_P$ diagram to illustrate and explain the effects of this tax change on equilibrium output and inflation. If the economy was in equilibrium at Y_P and the target inflation rate π^* before the tax cut, what monetary policy action, if any, would the central bank make to maintain those equilibrium conditions after the tax cut? What short run net benefit, if any, would households and businesses realize as a result of the cut in the GST?

Exercise 12.8. Suppose the federal government wants to stabilize the public debt ratio at its current level. The change in the public debt ratio (Δpd) is given by: $\Delta pd = -spbb + (i - n)pd$, where $spbb$ is the structural primary budget balance, i is the interest rate on outstanding government bonds and n is the annual rate of growth of Y .

(a) What is the $spbb$ required to make $\Delta pd = 0$?

- (b) Suppose the rate of growth of Y falls. What change in fiscal policy as measured by the $spbb$ is required to maintain the public debt ratio?
- (c) How would this policy change affect $AD\pi$?
- (d) What support might monetary policy give to the government's $\Delta pd = 0$ policy?

In this chapter we will explore:

- 13.1 Growth in potential output
- 13.2 Growth in real per capital GDP
- 13.3 Technology & growth in per capita output
- 13.4 Neoclassical growth theory and the convergence hypothesis
- 13.5 Recent growth studies and policy issues

Economic growth is one of the most interesting and important topics in Macroeconomics. The AD/AS models try to explain business cycle fluctuations in GDP relative to potential output, (Y_P). Standards of living are measured by real GDP per capita, and growth in real GDP is growth in Y_P . Over time, growth in Y_P that exceeds population growth raises per capita real GDP and standards of living. But what determines growth in real GDP and real GDP per capita? A theory of economic growth is needed to answer that question.

Economic growth: the annual percentage change in real GDP or per capita real GDP.

Economic growth rates differ widely among countries. Over the 1991-2007 period before the financial crisis and recession disrupted national growth trends, real per capita GDP in Canada and the US grew at an average annual rate of just over 2 percent. Per capita real GDP in China grew at an annual average rate of 8.7 percent, in India 5.2 percent and in South Korea 4.5 percent, all measured in terms of constant US dollars. Absolute levels of per capita real GDP and standards of living were different in these different countries, but those with higher growth rates were catching up to those with lower growth rates.

These observations raise three questions.

1. What is long-term growth?
2. What are the causes or sources of growth?

3. Can economic policies affect growth?

Although we will focus mainly on industrial countries, the growth or lack of it in poor countries is also an extremely important issue for the economics of development. To see many other interesting dimensions of growth compared across a much larger sample of countries over longer time periods, visit the website www.gapminder.org.

13.1 Growth in potential output

Economic growth theory applies to the **very long run**, a time frame in which wages *and* prices are fully flexible, and the labour force, the stock of capital equipment, and the technology used in production can change. In this time frame, output fluctuations around potential output are swamped by the growth of potential output itself.

Very long run: the time required for changes to occur in the stock of capital, the size of the labour force, and the technology of production.

The aggregate production function we used in Chapter 12 described the links between inputs to production and real GDP produced. Recall that, for the whole economy, Y is real GDP produced by using inputs of labour (N) and capital (K). The function F tells us how much we get out of particular amounts of labour and capital used in the production process.

$$Y = A \times F(N, K) \quad (13.1)$$

The function $F(\dots)$ does not change, but changes in N and K cause changes in output Y . We also capture technical progress or improvements in technology separately through A , which measures the state of technology at any date. As technology improves, A increases and we get more real GDP from the same inputs of labour and capital. A 10 percent increase in A gives 10 percent more real GDP from the same inputs of labour and capital. We describe this as an increase in productivity because outputs per worker and per machine increase. A is often called **total factor productivity (TFP)**.

Total factor productivity (TFP): output relative to the combined inputs of labour and capital, the total factor inputs to production.

Actual real GDP is the output produced at any time based on the actual inputs of capital and labour. In terms of our production function, we would show this by writing:

$$Y_t = A_t \times F(N_t, K_t) \quad (13.2)$$

In this equation, Y_t is real GDP in year t , A_t is determined by the current state of technology, and K_t and N_t measure the actual use of capital and labour in year t .

Potential output is the real GDP produced when labour and capital are employed at equilibrium rates using the best available technology. To recognize this, we write a specific production function:

$$Y_P = A_t \times F(N_F, K_0) \quad (13.3)$$

Y_P is potential output produced by operating plants and machinery at their designed capacity (K_0) and using the full employment equilibrium supply of labour services (N_F). A_t is the state of knowledge and technology used in the production process and reflected in the productivity of labour and capital.

Any *growth* in the potential output of goods and services then comes from *growth* in labour inputs to production, capital inputs to production, and *changes* in factor productivity as a result of new and improved technology.

Growth accounting measures the sources of growth in real GDP. From the production function, it follows that:

$$\begin{array}{ccccccc} \text{Growth in} & = & \text{Effect of} & + & \text{Effect of} & + & \text{Effect of} \\ \text{Real GDP} & & \text{Growth in} & & \text{Growth in} & & \text{Growth in} \\ & & \text{Total Factor} & & \text{Labour Inputs} & & \text{Capital Inputs} \\ & & \text{Productivity} & & & & \end{array}$$

Growth accounting: measurement of the contributions of labour, capital, and technology to growth in output.

The way that growth in capital and labour affects the growth in total output can be measured by the incomes they receive. The income approach to the measurement of net domestic product and GDP in Section 4.4 identifies these income shares. Table 4.5 provides data on GDP in Canada in 2013. From that data we see that employment income was about two-thirds of net domestic income. This is close to the longer-term average of employment income in net domestic product,

and it shows where the measure comes from. Labour's average contribution to and share of national income, measured over time periods of many years, is approximately two-thirds of national income. Capital's contribution and share is the remaining one-third of national income.

The growth in potential GDP over time can then be expressed as the growth in total factor productivity plus the *weighted sum* of the growth in the capital and labour inputs to production as follows:

$$\frac{\Delta Y_P}{Y_P} = \frac{\Delta A}{A} + \frac{2}{3} \left(\frac{\Delta N}{N} \right) + \frac{1}{3} \left(\frac{\Delta K}{K} \right) \quad (13.4)$$

The weights $2/3$ and $1/3$ applied to growth in labour and capital inputs are based on their shares in national income. They determine the rate of growth in real GDP as a result of growth in the inputs of capital and labour. By these weights, a 10 percent increase in labour input, capital and technology held constant, would result in an increase in real GDP of $2/3 \times 10$ percent, which is 6.6 percent. Similarly, a 10 percent increase in capital input would result in a $1/3 \times 10$ percent increase in real GDP.

The increase in productivity from improvements in technology cannot be seen and measured directly. As a result, growth accounting classifies these effects as a *residual*. The difference between the growth in real GDP and the weighted sum of the growth in labour and capital inputs is called the **Solow residual**, named after Professor Robert Solow, whose work on growth theory was recognized with a Nobel Prize. The Solow Residual is a measure of the contribution to growth made by improvements in the technology of production that raise the productivity of both labour and capital.

Solow residual: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology.

The Solow residual measured by $\Delta A/A$ is found by rearranging the growth accounting Equation 13.4 as follows:

$$\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - \frac{2}{3} \left(\frac{\Delta N}{N} \right) - \frac{1}{3} \left(\frac{\Delta K}{K} \right) \quad (13.5)$$

The numerical example in Table 13.1 illustrates the procedure. It assumes we know the growth rates of real GDP, capital stock, and employment, measured as annual percentage changes.

Observed growth rates %:	$\Delta Y/Y$	$\Delta N/N$	$\Delta K/K$
	5.0	2.4	3.9
Calculating the Solow residual by Equation 13.5:			
$(\Delta A/A) = 5.0 - 2/3(2.4) - 1/3(3.9)$			
$(\Delta A/A) = 5.0 - 1.6 - 1.3$			
$(\Delta A/A) = 2.1$			

Table 13.1: An example of growth accounting

The calculation made using growth accounting shows that the increased productivity of both labour and capital resulting from improvements in technology was the source of 2.1 percent of the 5.0 percent growth in real GDP in our example.

Recent research at the Bank of Canada¹ estimated the sources of growth in real GDP and potential GDP in Canada over the period 1950 to 1996 and projections for future growth in potential GDP. The contributions of capital and labour inputs are weighted as in the simple example above. Growth in actual and potential real GDP are the result of growth in factor inputs and the growth in productivity coming from improvements in the technology of production.

That work shows growth in real GDP and potential GDP declined over the 1950 to 1996 period. This slowdown was partly a result of a slowdown in the growth of population, and labour and capital inputs to production. But starting in the 1970s there was also a slowdown in productivity growth, which reduced the rate of growth of output per worker. We will look at this slowdown in productivity in more detail later in this chapter. It had important implications for the standard of living in many countries, including Canada. Some further research on productivity growth in Canada by the Centre for the Study of Standards of Living, www.cslls.ca, and at the Bank of Canada has uncovered another productivity slowdown in Canada relative to the United States after the year 2000, which has continued and is a current source of concern.

13.2 Growth in per capita GDP

Growth in potential GDP measures the increase in the size of the economy, but it does not tell us what is happening to per capita GDP and *standards of living*. To discover the sources of growth in per capita GDP and improvements in standards of living, we need to study the production function

¹J. Kuszczak and R. Dion, "Potential Output Growth: Some Long-Term Projections." Bank of Canada Review, Winter 1997-1998.

in more detail. Then we can use growth accounting to uncover the sources of past growth in per capita GDP.

Consider the same production function we have used for total GDP:

$$Y = A \times F(N, K)$$

Again, we will assume that Y will grow by two-thirds of the growth in labour input and one-third the growth in capital input. If, for example, labour force growth increases employment by 10 percent, with fixed capital stock, K , and technology, A , GDP will increase by 6.67 percent. You can make a similar calculation for the effects of growth in the capital stock. The weights $2/3$ and $1/3$ are the *elasticities* of output with respect to the inputs of labour and capital.

Factor contributions and scale economies

The increase in total output when an additional unit of a factor (labour or capital) is used in the production process, and other inputs are held constant, is the **marginal product** of that added factor. The production functions widely used in economics have *diminishing marginal productivity*. As more and more workers are employed using a fixed number of machines, each additional worker adds less and less to total output. The marginal product of labour, $\Delta Y / \Delta N$, falls. Furthermore, because each additional input of labour adds less to total output than the unit before it, output per worker, Y/N , also falls.

Marginal product: the change in total output caused by a change of one unit in the input of that factor to production.

It is often assumed that production involves *constant returns to scale*. Instead of increasing just one input to production, suppose all inputs are increased together, in the same proportions. Labour and capital inputs might both be doubled, for example. Then, if output increases in exactly the same proportions as inputs have increased, there are constant returns to scale.

The production functions used in growth accounting have these properties. Consider the following example. Holding technology constant at $A = 1$ to simplify matters, we can write:

$$Y = N^{2/3} \times K^{1/3} \tag{13.6}$$

using the weights we have used in growth accounting to measure the contributions of labour and capital to output, based on their shares in national income, as the exponents on labour and capital inputs. Table 13.2 gives numerical examples of the way this production function works.

Production function:		$Y = N^{2/3} \times K^{1/3}$			
Labour Input (N)	Capital Input (K)	Output (Y)	$\% \Delta N$	$\% \Delta K$	$\% \Delta Y$
50	20	36.8	–	–	–
55	20	39.3	10.0	0	6.6
55	22	40.5	0	10.0	3.3
60.5	24.2	44.6	10.0	10.0	10.0

Table 13.2: Changes in outputs as factor inputs change

The first row of the table shows that a labour input of 50 units combined with a capital input of 20 units gives output:

$$Y = 50^{2/3} \times 20^{1/3} = 36.8 \text{ units}$$

The next three rows illustrate the underlying diminishing returns and constant returns to scale in this production process. An increase of either labour input of 10 percent or capital input of 10 percent with the other input constant increases output, but by less than 10 percent in each case. Because output grows by less than the growth of the input in each case, output per worker or per unit of capital falls.

However, when only one input grows, output per unit of the factor held constant rises. In the second row of the table, capital input is constant when labour input grows. More labour inputs increase total output and output per unit of capital. Similarly, in the third row an increase in capital input increases labour productivity.

The fourth row of the table shows constant returns to scale. When labour and capital inputs both increase by the same proportion output increases by the same proportion, 10 percent in this example. As a result, output per worker and output per unit of capital are constant. In terms of economic growth, equal growth rates of labour force and capital stock make total GDP grow at that same rate, *but leave per capita GDP unchanged.*

To see the sources of growth in *per capita GDP*, we can manipulate the production function and apply growth accounting. To get per capita GDP, simply divide both sides of the production func-

tion 13.6 by N to give output per worker as follows:

$$Y = A \times N^{2/3} \times K^{1/3}$$

$$Y/N = A \times (N^{2/3} \times K^{1/3})/N$$

$$Y/N = A \times (N^{-1/3} \times K^{1/3}) = A \times (K/N)^{1/3}$$

To make the notation a bit neater, we can use lower case letters to indicate output per worker ($y = Y/N$) and capital per worker ($k = K/N$). This gives:

$$y = A \times k^{1/3} \quad (13.7)$$

Figure 13.1 illustrates this production in a diagram. The ratio of capital stock to labour, k , is measured on the horizontal axis. Output per worker, y , is measured on the vertical axis. Two per-worker production functions are used to distinguish between the effects of increases in capital stock and the effects of improvements in technology.

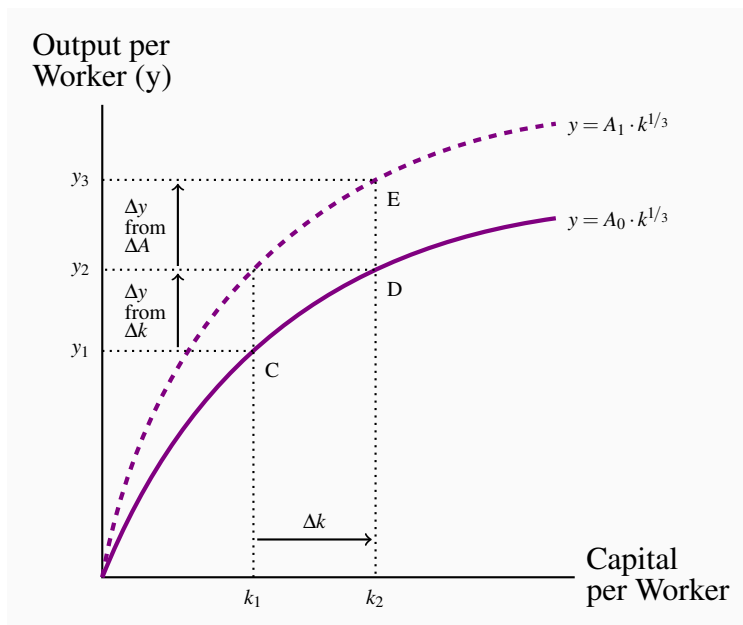


Figure 13.1: The Effects of Increases in the Capital Labour Ratio and Improvements in Technology on Output per Worker

An increase in the capital to labour ratio from k_1 to k_2 raises output per worker from y_1 to y_2 . The shape of the production function shows that further increases in k will give further but smaller increases in y . A change in technology shifts the production function up as y increases at every k . The combined effects of an increase in k and an increase in A are increased output per worker from y_1 to y_3 .

The declining slopes of both production functions illustrate the diminishing returns that lead to the declining changes in output per worker as the capital/labour ratio increases. For example, starting at point C, an increase in the ratio of capital to labour moves the economy along the production function to point D. Output per worker increases at a decreasing rate. This shows that increased capital to labour ratios can increase output per worker until diminishing returns set in and limit sustained increases in output per worker.

An improvement in technology that increases productivity shifts the production function up. At capital to labour ratio k_2 , for example, the increased productivity moves the economy from D to E as output per worker rises from y_2 to y_3 . This shows us that growth in per capita output, moving from y_1 to y_3 , points C to E in Figure 13.1, is a result of both the growth in the capital to labour ratio and improvements in productivity.

Once again, growth accounting allows us to sort out the effects of these two factors on growth in output per worker and per capita GDP. Table 13.3 uses Canadian experience before the ‘Great Recession’ of 2008-09 as an example.

	Real GDP Y (bill \$97)	Employ N (mil- lions)	Capital Stock K (bill \$97)	Real GDP per Worker $Y/N = y$ (000 \$97)	Capital per Worker K/N (000 \$97)	Growth in Y/N Δy	Growth in K/N $\% \Delta k$	Contributio from $\Delta k =$ $\% \Delta k / 3$	Solow Residual $\% \Delta A$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)=(7)/3	(9)=(6)-(8)
1990	762	13.07	1,308	58.30	100.07	–	–	–	–
1995	832	13.27	1,450	62.69	109.27	7.5	9.2	3.1	4.4
2000	1,010	14.76	1,560	69.11	105.69	10.2	–3.3	–1.1	11.3
2005	1,158	16.18	1,873	71.56	115.76	3.5	9.5	3.2	0.3

Table 13.3: Sources of growth in per-worker GDP in Canada, 1990 to 2005

Source: Adapted from Statistics Canada CANSIM Database Table 380-0002 Series V1992067, Table 031-0002 Series V4419841, and Table 282-0087 Series V2062811, and author’s calculations.

The first three columns of the table give data on real GDP, employment, and real capital stock for four years over the 1990 to 2005 period. Columns (4) and (5) use these data to calculate the output per worker and capital per worker that we see in our per-worker production function. The growth in output per worker and the growth in capital per worker are reported in columns (6) and (7) as the percentage changes over the five-year periods.

Growth accounting divides the sources of growth in output per worker between increases in capital per worker and increases in productivity based on improvements in technology. From the production function, we know that an increase in the capital/labour ratio increases output per worker by a factor of $1/3$. Column (8) in the table reports this weighted contribution of the increase in capital per worker to the increase we see in output per worker. Subtracting these contributions from the increases in output per worker gives the Solow residual, column (9), which again is a measure of the effect of improvements in technology on output per worker.

The 1990 to 2005 period is of interest because the Canadian experience provides three different examples of growth in GDP per worker. In the first five years, 1990 to 1995, there was very little growth in employment but substantial growth in capital stock. As a result, the capital to labour ratio, k , increased by 9.2 percent and accounted for 3.1 percentage points, or 41 percent of the 7.5 percent growth in real GDP per worker. Improved technology as measured by the Solow residual contributed the other 4.4 percentage points.

By contrast, employment and capital stock both grew strongly from 1995 to 2000, but employment growth (11.2 percent) exceeded capital stock growth (7.6 percent). As a result, the growth in the capital to labour ratio was negative, at -3.3 percent. Nevertheless, output per worker grew more in the second period, up 10.2 percent. Productivity gains from improved technology, again measured by the Solow residual, were the major source of strong growth in GDP per worker.

The decline in the capital to labour ratio in the 1995 to 2000 period appears to have reduced the growth in output per worker in the 2000 to 2005 period. Even though capital stock increased by about 20 percent and employment grew by just 9.6 percent, output per worker increased by only 3.5 percent over the period. The Solow residual in column (9) shows a very small contribution to growth in output per worker from improved technology.

Thinking of these experiences in terms of the production functions in Figure 13.1 illustrates the differences between sub-periods. From 1990 to 1995, the economy moved to the right along the production function as k grew by 9.2 per cent, for example, from C to D in the diagram. This provided a 3.1 percent increase in y , as from y_1 to y_2 . Improved technology shifted the production function up to further increase output per worker from y_2 to y_3 at point E in the diagram. In the next period, 1995 to 2000, the movement along the production function was in the opposite direction, to the left from E, as k declined. However, a very strong effect from improved technology as measured by the Solow residual of 11.3 percent shifted the production function upward (not shown in the diagram) and sustained the growth in output per worker at 10.2 percent.

By contrast, the economy experienced a sharp slowdown in productivity growth in the 2000 to 2005 period. Even though capital per worker did grow strongly in this five-year period, output per worker grew by only 3.5 percent. The Solow residual shows a very weak contribution by improvements in technology to the growth in productivity. This slowdown in productivity has raised concerns about future improvements in standards of living and calls for government action to address this decline in productivity growth and the lower rate of productivity growth in Canada than in the United States.

These examples and our discussion of the nature and sources of growth emphasize two key aspects of the growth process. One aspect is the growth in the stock of capital, which comes from the flow of savings and investment in the economy. The other is changing technical knowledge and technology of production. These are the keys to sustained growth in total output and standards of living, but their sources are more obscure than the sources of growth in capital stock. Indeed, pessimism about the fate of society was based on both the inadequacy of investment and stagnant technology.

13.3 Technology & growth in per capita output

Advances in knowledge based on research and development and experience are the key to sustained rates of productivity growth and improvements in standards of living.

Technical knowledge

Every society has some level technical knowledge about production practices. Part of this knowledge is recorded in technical documents books and plans. But it develops and is often captured in current working practices based on experience. This technical knowledge grows through **invention** that uncovers new understanding and knowledge. What usually follows is innovation that applies new knowledge to actual production techniques.

Invention: the discovery of new knowledge.

Innovation: the application of new knowledge into production techniques.

Industrial and economic history is often written in terms of the sequence of major inventions and innovations. Improvements in transportation from the wheel, to steam engines, internal combustion engines and aircraft transformed the size of the market and the degree of specialization and trade. The generation and transmission of electricity provided a new, more efficient and flexible source of light and power leading to improved communications and data management.

The agriculture ‘revolution’ was based on the application of science and technology to products and production processes. New organization and techniques increased productivity. New machinery further increased labour productivity and yielded economies of scale. New science provided better seed, fertilizer and fuels to power new mechanical equipment. Increases in agriculture productivity based on these and other advances reduced the labour and land required to supply food to the population. At the same time increased industrialization increased the demand for labour. Economies became more sector specialized with identifiable primary, manufacturing and service

sectors that worked together to improve productivity and standards of living.

Additions to human capital were as important as increases in physical capital in this growth process. Human capital is knowledge and experience with production processes. Experience improves workers' efficiency. Higher levels of education and training lets workers use more complex production equipment and techniques and contribute to cost improvements in the organization of production. In short productivity is enhanced by the complementarity and synergy between human and physical capital.

The role of research and development

The invention and innovation that lies behind productivity improvements has many sources. Familiarity with a product, process or production technique often suggests a better way to work, or a better product design. Experience and frustration can led curiosity and invention. However, most invention and innovation has its origin in specialized research and development. From this perspective the output of new ideas depends on the resources allocated to R&D. There are costs involved and the focus and usefulness of the results may not be apparent for some time, if ever. Some research is pure research that seeks new knowledge and understanding. Most of it takes place in university departments, usually funded in part by industry, in part by government and in part by private individuals. Applied research, on the other hand is usually based in and financed by industrial firms, with some support from government grants and tax incentives. New knowledge with commercial applications rather is the goal of this applied R&D.

Investment in R&D like investment in human and fixed capital is risky. You cannot know in advance that new, useful knowledge will result. Funding is provided and committed in the hope and expectation that research projects will be successful. Even if research succeeds in it may be difficult to apply the new knowledge or technology in a way the increases your market power enough to allow recovery of the costs. Success gives competitors strong incentives to copy the new product or create a close substitute for it. Patent laws and government subsidies are designed to help private companies and individuals recover their costs of R&D, recognizing that society benefits from improvements in technology.

13.4 Neoclassical growth theory and the convergence hypothesis

Now we look in more detail at the links between output growth, factor accumulation, and technical progress. Our production function again provides the framework for our discussion. We have seen that growth in output and in output per worker comes from growth in the inputs of labour and capital, changes in the ratio of capital to labour, and changes in the technology of production.

Where does growth in capital and the ratio of capital to labour come from? In other words, what is the theory of economic growth? How does the theory of growth explain the *growth in productivity* as measured by *output per worker*?

Neoclassical growth theory has roots in the work of Roy Harrod and Evesy Domar in the 1940s and Robert Solow in the 1950s. It is *neoclassical* because it assumes investment always equals saving and output is potential output. It ignores short run fluctuations in output. The focus is on the very long run.

The labour force and the stock of capital grow over this long run time horizon. ‘Equilibrium’ is used in the usual way to mean that things are not changing, but equilibrium, involves growth rates and ratios not levels. Equilibrium in growth theory means a *steady state*. In the **steady-state growth**, output, capital, and labour grow at the same rate. This means that, with constant returns to scale, capital per worker and output per worker are constant.

Steady state growth: when output, capital, and labour all grow at the same rate.

Assume that the population and labour force grow at a constant rate, n . To keep things simple, we also assume a constant fraction, s , of income is saved; the rest is consumed. Investment, which results in capital formation, is the part of output not consumed. Therefore, savings determine investment. We also ignore the rate of depreciation of the capital stock. Investment first widens and then deepens capital. In a growing economy, **capital-widening** extends existing capital per worker to new workers entering the labour force. **Capital-deepening** raises capital per worker for all workers.

Capital widening: provides capital to workers entering the labour force.

Capital deepening raises the capital/worker ratio.

To keep capital per worker constant, we need more investment per worker the faster is the growth in the labour force, $\Delta N/N = n$ (extra workers for whom capital must be provided), and the higher the ratio of capital to labour. If capital stock grows faster than the labour force, more capital per worker is added to production, k increases, and output per worker, y , increases. But, as we have seen earlier, increasing capital per worker raises output per worker with diminishing returns. Since a constant fraction, s , of output is saved and invested, the rate of growth of the capital stock declines as income increases.

In the steady state, capital per worker is constant. As a result, investment per worker, sy , must equal nk , the growth in capital stock per worker needed to keep capital per worker constant by increasing the capital stock at the same rate as the labour force. Point E in Figure 13.2 shows the steady-state condition:

$$sy = nk \quad (13.8)$$

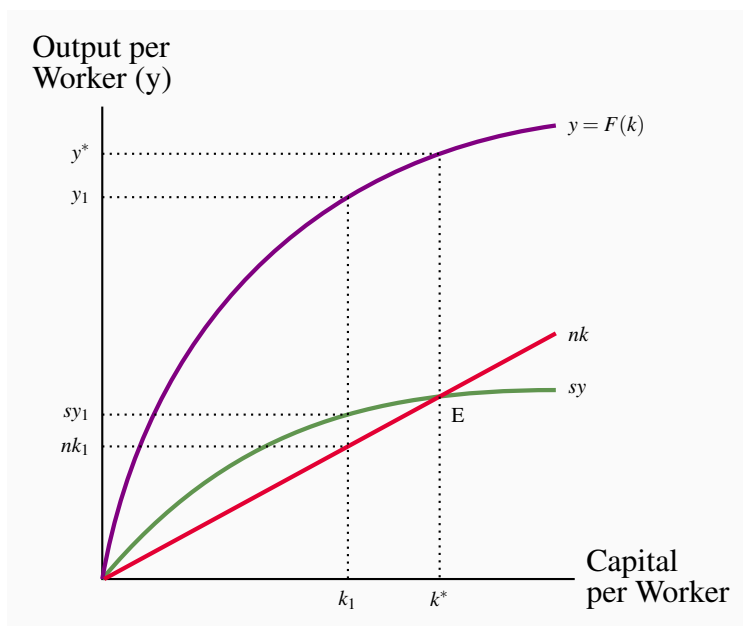


Figure 13.2: Steady State Neoclassical Growth Model

The line nk shows the investment per worker that maintains the ratio of capital per worker as the labour force grows. At E the economy is in a steady state. Investment $sy = nk$ as needed to keep k constant at k^* . Per worker output is constant at y^* . At any $k \neq k^*$, such as k_1 , $sy \neq nk$, and k changes, moving the economy towards k^* and E.

Let us define k^* as the capital/labour ratio where this condition is met.

Figure 13.2 also shows what happens if the economy is not in the steady state. If capital per worker is less than k^* , at k_1 , for example, we see that per worker saving and investment sy_1 exceed nk_1 , the investment required to keep capital growing with labour. Indeed, for any k less than k^* the line sy is above the line nk . So, capital per worker rises and output per worker rises, moving toward the steady state. Conversely, to the right of k^* , sy lies below nk . Capital per worker and output per worker fall back toward k^* and y^* . The theory says and the diagram shows that, whatever level of capital and output per worker the economy starts with, it gradually *converges* to the (unique) steady state.

Consider a numerical example that illustrates the steady state condition. Suppose output per worker by the per worker production function is $y = k^{1/2}$. Assume that the saving in this economy, based on the propensity to save is $s = 0.1y$, and the labour force grows at the rate of 2 percent a year ($n = 0.02$).

What are the steady state values for capital stock per worker and output per worker?

From the production function and the savings function, saving per worker, which is the increase in capital stock, is $s = 0.1y$, so:

$$s = 0.1k^{1/2}$$

A constant ratio of capital per worker as the number of workers grows by 2 percent a year ($\Delta N/N = 0.02$) requires a growth of capital stock equal to 2 percent a year ($\Delta K/K = 0.02$), and therefore requires $s = 0.02k$.

Equating actual saving with that required to maintain the ratio of capital per worker gives $0.1k^{1/2} = 0.02k$, so:

$$k = 25$$

the ratio of capital per worker in the steady state.

From the production function $y = k^{1/2}$, output per worker is 5.0, savings and investment per worker are 0.5, which gives a rate of growth of capital equal to $0.5/25 = 0.02$ that matches the rate of growth of the labour force.

Capital stock per worker and output per worker are constant while labour force, capital stock, and output all grow by 2 percent a year. The economy is in a steady state.

Now suppose that capital per worker was less than the steady state value, say $k = 20$ rather than $k = 25$. Would the economy adjust toward the steady state with a higher ratio of capital to labour? The adjustment would require growth in capital per worker greater than the growth in labour force. Based on $k = 20$:

$$y = 20^{1/2} = 4.47$$

Then saving per worker is:

$$sy = 0.1(4.47) = 0.447$$

With labour force growing at 2 percent a year, a constant capital-to-labour ratio requires growth in capital equal to nk :

$$0.02k = 0.02(20) = 0.4$$

However, savings and investment at the current level of income is 0.447, with the result that capital stock per worker and output per worker are growing toward the steady state values determined above. Furthermore, growth in total output is higher than the growth in labour force and higher than it will be in the steady state.

Economies with ratios of capital per worker and output per worker less than their steady state values tend to grow faster than those with the same characteristics that are at or closer to their steady states.

This property of the neoclassical growth model leads to the convergence hypothesis. The **convergence hypothesis** asserts that countries with lower per capita incomes grow more quickly than average, while countries with higher per capita incomes grow more slowly, with the result that per capita incomes tend to *converge across countries*. This explanation of convergence is based purely on the adjustment to the steady state through different country rates of investment and capital accumulation, starting from different initial capital to labour ratios.

Convergence hypothesis: Higher rates of growth in lower per capita income countries than in higher per capita income countries leads to the convergence of per capita incomes across countries.

A second explanation for convergence operates through a different channel. It introduces changes in technology, which, as we have seen from growth accounting, are an important source of growth in output per worker. Suppose that high per capita income countries have human and physical capital to undertake R&D, and that it is in these countries that technical progress is made. However, once discovered, new ideas and technologies are soon spread to other countries. Since lower-income countries do not have to use their own resources to make technical breakthroughs, they can devote scarce investment resources to capital that embodies the latest technology from other countries. By using the slipstream from the higher-income countries, they can grow faster as their technology catches up.

Figure 13.3 provides some evidence in support of the convergence hypothesis. It shows a scatter plot of growth rates in per capita real GDP over the 1950 to 2004 period compared with average levels of per capita GDP in 1950 to 1955 for OECD countries. For convergence, we need an inverse relationship between income levels and income growth rates. Countries with lower incomes at the start of the period must grow faster than countries with higher incomes. This is the pattern observed in the data, as the downward-sloping line in the diagram illustrates. Countries with lower per capita real GDP in 1950 to 1955, like Greece, had higher average growth rates in real GDP over the 1950 to 2000 period than did high-income countries like the United States and Switzerland. Canada and Norway were in the middle of the OECD group, in terms of initial income and income growth.

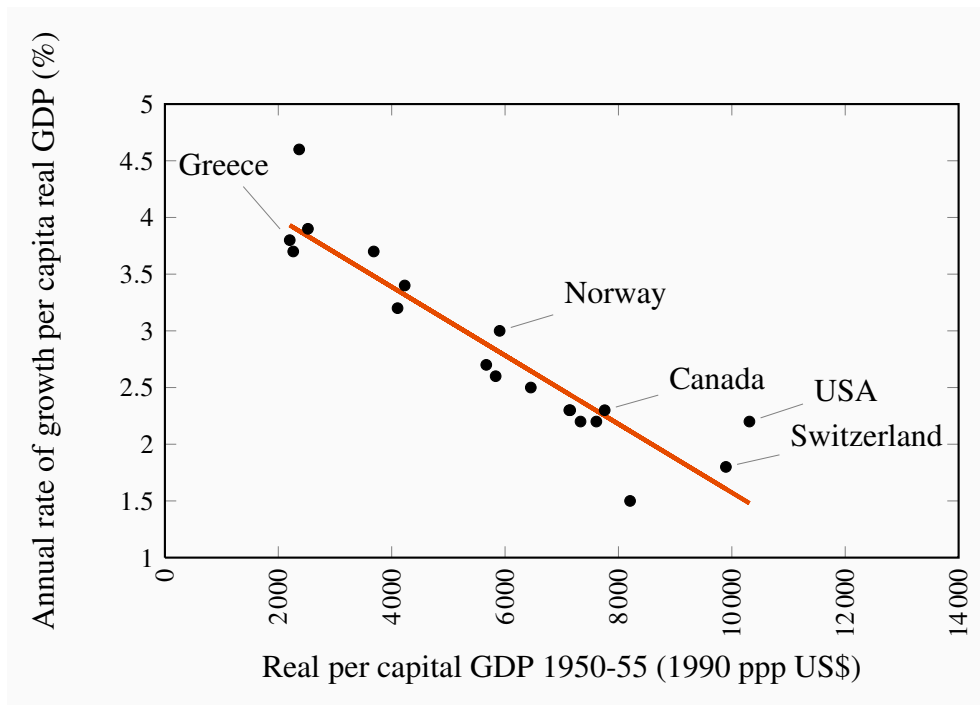


Figure 13.3: Average annual growth in per capita real GDP 1950-2004 vs. average per capita real GDP 1950-55

Source: www.rug.nl/research/ggdc/data/total-economy-database-

Unfortunately, not all countries are members of the “convergence club.” Growth in per capita real GDP depends on growth in the ratio of capital to labour and on improvements in technology. Many low-income countries do not have incomes high enough to support the levels of investment necessary to raise their capital stock more quickly than their labour force grows. They may also lack the basic infrastructure, education levels, and institutional frameworks needed to adopt better production technologies. As a result, the two key sources of growth identified by the neoclassical growth model are not available. The gap between high-income and low-income countries tends to widen, not diminish.

13.5 Recent growth studies and policy issues

Neoclassical growth theory and the basic growth accounting methodology based on it leave a large part of aggregate growth and productivity growth in the Solow Residual. Growth in employment and capital stock, and the relationship between them, play important roles in aggregate growth and labour productivity growth, but the effects of changes in the characteristics of labour and the composition of capital stock reside in the total factor productivity estimates of the Solow residual. This residual captures changes in technology along with other undefined factors.

Recent work on productivity growth still uses the growth accounting methodology, but focused on particular sectors of the economy and with extensions designed to unpack some things previously left in the residual. These include, in particular, investment in different components of the capital stock and changes in the composition and quality of labour.

Increases in capital per worker or per hour of work—capital deepening—continues to be important, but increases in capital stock are disaggregated into investment into several categories such as:

- Information and communications technology;
- Machinery and equipment; and
- Physical structures.

Changes in educational qualifications, gender structure, and age structure are used as indicators of changes in the composition and quality of the labour force. To the extent that these measures of change in characteristics and structure affect productivity less remains in the residual. More importantly, these are areas in which policies to support education, training, and labour force participation could affect productivity growth. Table 13.4 gives an example of some recent results based on this approach.

	1974-96	1997-00	2000-05
Labour productivity	1.4	3.0	1.0
Capital deepening	1.1	1.0	0.7
Info & communications			
Technology (ICT)	0.4	0.7	0.3
Non-ICT	0.7	0.4	0.4
Labour quality	0.4	0.4	0.4
Total factor productivity	0.0	1.6	-0.1

Table 13.4: Canadian business sector: labour productivity growth, 1974-2005 (% yr)

Source: R. Dion, “Interpreting Canada’s Productivity Performance in the Past Decade: Lessons from Recent Research.” Bank of Canada Review, Summer 2007.

The results in the table show clearly the increase in the information, communications, and technology components of the capital stock. Particularly in the 1997 to 2000 period, the increase in

capital per unit of labour input was the largest part of capital deepening. This is also the period of strongest growth in labour productivity and the largest increase in total factor productivity. The latter captures the effects of improved technology embodied in the new capital stock.

The estimated contributions of changes in labour quality to labour productivity growth provide an interesting refinement of the growth accounting methodology. Ignoring this change, as the simple accounting process did in Section 13.2, leaves the contribution of changes in the structure and characteristics of the labour force in the residual measure of total factor productivity. The results in the table extract and quantify this important source of productivity growth.

Changes in the structure of investment and in the quality of labour are both areas in which public policy plays a role. Government tax policy can be designed to encourage producers to direct investment to areas like communications and information technology. Some of this investment has effects confined to specific industries. Other parts create and strengthen national capacity and efficiency that is widely available and used by business and households, for example high-speed internet service and expanded wireless service and capacity. Educational policy and other human resource policies contribute to the quality, adaptability, and mobility of the labour force.

Endogenous growth theory

Another interesting strand of work makes more fundamental changes in growth theory. The simple neoclassical growth theory made economic growth depend on **exogenous variables**, the rate of population growth, the saving rate, and the rate of capital accumulation, whose values are determined outside the growth model. The subsequent work on catch-up and convergence makes technical progress respond to economic and political factors. But it would be nice to have a stronger link between economic behaviour and the rate of economic growth. We want to make *growth endogenous*, or determined within our model. **Endogenous growth** implies that the steady-state growth rate is affected by economic behaviour and economic policy.

Exogenous variable: a variable with a value determined outside the model.

Neoclassical growth theory: an exogenous growth theory.

Endogenous growth: growth determined economic behaviour and policy within the model.

Professor Paul Romer of the University of Chicago pioneered in endogenous growth theory. Growth theories are built on the saving that drives investment and capital accumulation. With the production function of the neoclassical growth model, increasing the stock of capital and the capital labour ratio leads to a diminishing marginal product of capital. Output and output per worker increase at a decreasing rate but in the steady state output grows at the rate of growth of population and labour force. Output per worker cannot grow indefinitely.

Endogenous growth theory is based on a different view of the roles capital plays in the growth process. It retains the assumption that, for the individual firm, the marginal product of capital decreases as capital stock increases. But it adds to that the insight that in the aggregate economy there may be significant positive externalities to the increase in capital stock. In other words increases in capital stock by one firm may result in improved productivity and output in other firms. Improved internet speed and access, or faster wireless voice and data transmission comes from investment by internet service providers and wireless companies. Using the new capacity provided improves the efficiency and productivity of production in other companies. Aggregate productivity and output grows as a result of increased investment by individual producers.

This line of argument is illustrated by the shapes of the production functions. For the individual firm the production function still looks like that in Figure 13.2, concave to the horizontal axis. Increases in the capital/labour ratio increase output per worker at a decreasing rate. For the aggregate economy, according to endogenous growth theory, increases in capital per worker do not face diminishing returns because of the externalities that come with increases in the capital stock. As a result, the aggregate production function has *constant returns* to capital. It is a straight line rising from the origin with a constant slope. Growth in the capital/labour ratio produces a constant rate of growth in output per worker and aggregate output.

Consider the following simple example of the aggregate economy. Per worker output, y , is proportional to capital per worker, k . To focus on the importance of investment, we assume there is *no technical progress*. Each new unit of capital is identical to all previously existing units. Then suppose we have:

$$y = A \times k \quad (13.9)$$

where A is constant and the exponent on k is 1 instead of the $1/3$ in our neoclassical model. This gives constant returns, as a 10 percent increase in k gives a 10 percent increase in y . Figure 13.4 illustrates this simple model.

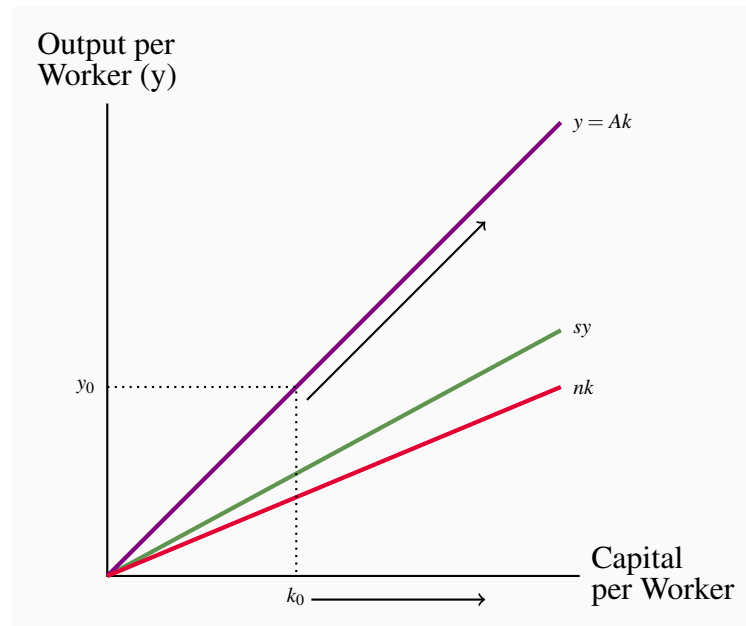


Figure 13.4: A Simple Endogenous Growth Model

The aggregate production function $y = Ak$ has constant returns to capital per worker. The saving rate s exceeds the rate of labour force growth n , increasing the ratio of capital to labour. As a result of output per worker y grows continuously without diminishing returns.

Constant returns to raising the *aggregate* capital to labour ratio in the economy allows an escape from the key growth limitation in the neoclassical theory. It makes growth endogenous and dependent upon parameters that could be influenced by private behaviour or public policy.

In the neoclassical model, without technical progress, steady-state growth in total output is always n , the rate of population and labour force growth, and growth in per capita output is zero. These results hold whatever the saving rate s , or the level of productivity A . However, with constant returns to rising capital to labour ratios, any policy that succeeded in raising the saving rate s would permanently raise the growth rate. Similarly, any policy achieving a one-time rise in the level of A , for example, greater workplace efficiency would permanently raise the growth rate of k . Since $y = A \times k$, this would mean permanently faster output growth.

Not only can government policy affect growth in this framework, government intervention may also increase efficiency. In the simple endogenous model described here, there are externalities to capital accumulation. Individual producers may not realize that by investing to increase their capital stock they may also improve productivity in other firms. Public policy that recognizes this economy wide effect can subsidize investment to increase investment and aggregate economic growth. By the same argument, externalities to investment in human capital support government subsidies to education and training.

Neoclassical growth theory suggests that different rates of growth among countries reflect the tendency for convergence of per capita incomes in the steady state equilibrium. By contrast, endogenous growth models provide an explanation for persistently different growth rates across countries and the absence of convergence. Differences patterns of savings relative to labour force growth result in permanently different growth rates.

If output per worker and per capita is too low to provide more than a minimal standard of living there is no room for saving and investment to increase the capital stock as fast as the population is increasing. Capital-labour ratios decline and output does not grow enough to maintain living standards. Some countries stagnate and others suffer increasing poverty.

However, endogenous growth theory faces criticism based on the assumption that there are exactly constant returns in the aggregate from accumulating one factor of production. The diminishing returns in the neoclassical model make long run growth exogenous. An economy with *increasing* returns does not have a steady state growth path but instead experiences continuously increasing capital stock and output. This sort of explosive growth does not correspond to any empirical observation. That means endogenous growth must be based on *constant returns*, neither diminishing nor increasing returns will work. This is a very narrow and demanding condition.

Furthermore, the production function $y = Ak$ implies, from the growth accounting perspective, that the share of capital income in national income is 100 percent while that of labour income is zero. By contrast, an examination of national accounts over time reveals a remarkably constant distribution of national income between labour income and non-labour income, with the share of labour income about two-thirds of national income. This does not support the argument for a constant returns aggregate production function.

There is a way to reconcile the new growth theory with the neoclassical growth theory. This could be accomplished by combining the neoclassical per worker production function of Figure 13.1 with the new growth theory function of Figure 13.4. Figure 13.5 illustrates this. The basic neoclassical growth theory treats all labour and capital as homogeneous inputs. Each new input is the same as all existing inputs. Marginal productivities of labour and capital are diminishing. Technological change is exogenous.

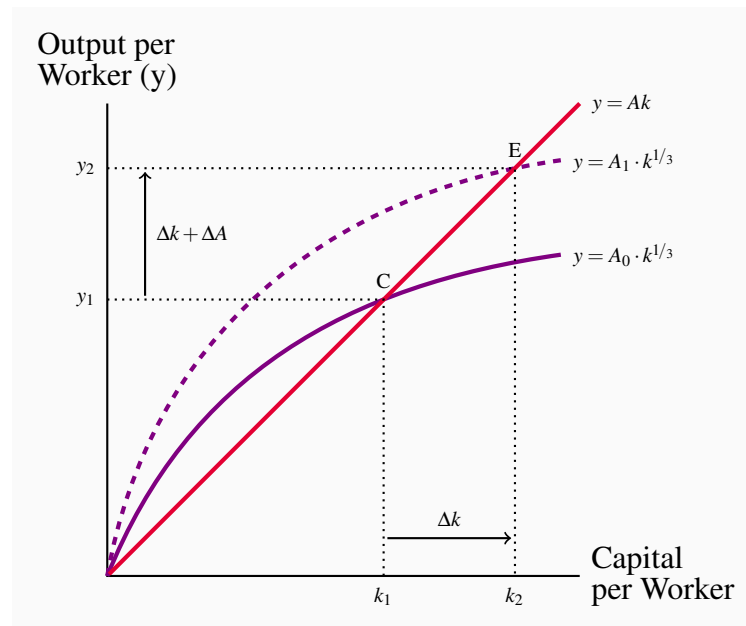


Figure 13.5: Growth Theory with Technology Embodied in Capital and Labour

The $y = Ak$ line traces the locus of changes in output per worker as a result of growth in capital per worker. New additions to capital stock and labour embody new technology. As a result increases in capital per worker shift the production function up, offsetting diminishing returns. The economy appears to grow along $y = Ak$.

New growth theory emphasizes the roles of research and development, innovation, education and “learning by doing” as sources of improved technology and productivity. Research, development, and innovation come from decisions to invest in new knowledge and to apply it to production processes. Education comes from decisions to invest in human capital. Learning by doing is a natural outcome of employment experience. All these are ongoing processes, although they may be pursued unevenly over time as economic conditions and economic policies change.

As a result, increases in the stock of capital and the level of employment always embody new technology and knowledge. There is no separation between increases in the capital to labour ratio and the state of technology, as in the basic neoclassical model. In Figure 13.5, the per worker production function shifts up as capital per worker increases because the new capital stock and new employees bring new technology to the production process. As k increases from k_1 to k_2 the economy moves from C to E. These points also appear as two points on the $y = Ak$ function because the embodied technological improvements offset otherwise diminishing returns.

Recent studies of the sources of productivity growth based on growth accounting are consistent with this approach to reconciling neoclassical and new growth theory. The findings reported in Table 13.4 above show the contributions to productivity growth made by different types of capital equipment and changes in labour force structure. These changes in “technology” are made integral

parts of the growth in capital stock and employment rather than left as exogenous residuals.

The costs of growth

Can the benefits of economic growth be outweighed by its costs? Pollution, congestion, and a hectic lifestyle are a high price to pay for more cars, washing machines, video games, MP3players, smart phones and tablets.

Since GDP is an imperfect measure of the true economic value of goods and services produced by the economy, there is no presumption we should want to maximize the growth of measured GDP. Without government intervention, a free market economy produces too much pollution. But the elimination of all pollution is also wasteful. Society should undertake activities accompanied by pollution up to the point at which the marginal net benefit of the goods produced equals the marginal pollution cost imposed on society. Government intervention, through pollution taxes or regulation of environmental standards, can move the economy towards a more efficient allocation of resources and a higher standard of living, broadly defined.

The full implementation of such a policy would (optimally) reduce growth of measured GDP to below the rate when there is no restriction on pollution and congestion. This is the most sensible way in which to approach the problem. It tackles the issues directly.

In contrast, the “zero growth” solution is a blunt instrument. It does not differentiate measured outputs that have social costs, from outputs without new social costs. As a result there are no new incentives to minimize the externalities already caused by pollution, congestion and environmental degradation. These call for taxes or incentives to reduce current social costs. ‘No growth’ does not go far enough.

A more extensive and inclusive measure of GDP would be a step toward recognizing and dealing with the costs of growth. Such a measure might include both positive aspects of production and consumption that contribute to welfare, such as environmental quality and low levels of congestion. It might also adjust to give a more complete measure of both private and social costs of different patterns of production, consumption and leisure. We have seen one way to approach this in the United Nations Human Development Index in Chapter 4, but a broader based index is needed.

Next

We have now studied the performance and policy issues in the macro economy in terms of business cycle fluctuations, the stabilization role of government, and the sources of economic growth, all of which are linked to the standard of living.

Two important topics remain. Although trade in goods and services and foreign exchange rates have been covered as part of the discussion of theory and policy, they need more detailed explanation. Chapter 14 explains international macroeconomics in terms of the balance of payments, exchange rate policies and the importance of both for macroeconomic policy. Chapter 15 covers the international trade theory that explains the underlying incentives for international trade, the impacts of international trade on efficiency and living standards, and the policies that might be directed at international trade flows.

KEY CONCEPTS

Economic growth is the percentage annual increase in real GDP or per capita real GDP. It is an imperfect measure of the rate of increase of economic well-being because of the limitations of the measurement of GDP.

When all markets have had time to adjust to equilibrium, economic growth measures the **growth in potential output**. For most countries, the strong growth trend in potential GDP swamps the short-run business cycle fluctuations in GDP.

Growth in potential output has **three main sources**, namely, growth in labour force, growth in capital stock, and improvements in productivity as a result of technical change. **Growth accounting** provides a way of measuring the contribution of each of these sources to overall growth. Different growth rates among countries reflect differences in one or more of these sources of growth.

Recent research on the **growth of Canada's potential GDP** found that the contribution of productivity growth from technology declined in the 1980s and early 1990s and again from 2000 to 2005.

Growth in per capita real GDP has **two main sources**, namely, growth in the ratio of capital to labour in the production process, and improvements in technology. Growth accounting provides a way of measuring the sources of growth in per capita real GDP.

Sustained growth in per capita real GDP, in a neoclassical model of growth, depends on improvements in technology to overcome the diminishing returns to increases in the capital to labour ratio.

Neoclassical growth theory argues that, in the absence of technological change, a country will adjust to a steady-state rate of growth in total real GDP equal to the rate of growth of population. In this steady state, a positive rate of growth in per capita real GDP depends on the rate of growth of productivity based on technological change.

The **convergence hypothesis** based on the neoclassical growth model says that similar countries will tend to move toward and converge upon the same level of per capita real GDP. This means that countries with relatively low per capita real GDP will experience faster growth in per capita real GDP than countries with relatively high per capita real GDP. The experience of OECD countries since 1950 provides some evidence in support of the convergence hypothesis.

Recent work on **new or endogenous growth theory** suggests that positive externalities from the growth in a country's capital stock may offset the tendency toward diminishing returns to capital, and allow sustained growth in per capita real GDP based on a country's saving rate

and rate of technology-based productivity growth. This argument gives an important role for policies that might change the rate of saving and investment.

Although growth in per capita real GDP may improve well-being or standards of living, growth also has costs. More output means more **pollution and congestion**.

The costs of growth create a role for **government policy intervention through pollution taxes, regulation, and environmental standards** to move the economy toward a more efficient allocation of resources and a higher standard of living, broadly defined, even if that reduces the growth rate of measured real GDP.

EXERCISES FOR CHAPTER 13

Exercise 13.1. (a) What is the distinction between growth in potential GDP and growth in per capita real GDP?

(b) Why is this distinction important to an evaluation of the relationship between economic growth and growth in standards of living?

(c) Which grows more rapidly, potential GDP or per capita real GDP?

Exercise 13.2. Consider two countries with the same level of potential GDP, say \$100 billion, today. Suppose potential GDP grows at an annual rate of 3.5 percent (0.0325) in one country and 3.25 percent (0.035) in the second country. Based on this information:

(a) What do you predict for the percentage difference in potential GDP between the two countries 10 years in the future?

(b) 20 years in the future? [Note that the growth rates will compound to determine real GDP according to the following formula: $Y_t = Y_0(1 + \text{growth rate})^t$.]

Exercise 13.3. Suppose you have the following information about an economy:

Average annual rates of growth from 1998 to 2008:

Potential GDP	3.5%
Labour force	2.1%
Capital stock	3.0%

Share of labour income in national income: $2/3$. Using growth accounting, find the contribution to the annual growth in potential GDP that came from:

(a) Growth in labour force

(b) Growth in capital stock

(c) Improved productivity as measured by the Solow residual.

Exercise 13.4. If technology were constant while labour force grew at a rate of 2.5% a year, capital stock grew at 1.5% per year and the share of labour income in national income was 70%, how fast would potential GDP grow?

Exercise 13.5. Suppose you have the following information for two economies:

		Country A	Country B
Average annual	i. Labour force	2.5%	4.0%
growth rates:	ii. Capital stock	3.5%	3.5%
Labour income/national income:		2/3	2/3

- Assuming a constant state of technology, which of these two countries will have the faster rate of growth in total real GDP?
- Which of the two countries will have the faster rate of growth in per capita real GDP?
- What differences, if any, do you see in the growth rates of the capital to labour ratios in the two countries?
- Explain the reasons for the differences in growth rates you have found?

Exercise 13.6. In Wonderland labour force and capital stock both grow at the rate of 2.5% a year but technology is constant. At what rate will potential GDP grow? At what rate will per capita GDP grow? If improvements in technology increased total factor productivity by 1.5% year, how fast would per capita real GDP grow?

- Exercise 13.7.** (a) Why do economists emphasize that improvements in technology are the key to improvements in standards of living?
- Using a diagram that shows the relationship between capital per worker and output per worker, illustrate and explain why growth in capital per worker cannot provide sustained growth in output per worker and standards of living.
 - In the diagram in (b), show how an improvement in productivity coming from improved technology could provide sustained increases in standards of living.

Exercise 13.8. Suppose an economy has the following conditions:

Per worker GDP: $y = k^{1/3}$

Savings per worker: $s = 0.2y$

Population and labour force growth: $n = 0.05$

- What is the steady-state level of output per worker, y ?
- What is the rate of growth of total GDP required for the steady state?
- If savings increased to $s_1 = 0.25y$, what new steady-state output would result?
- What is the rate of growth of total GDP required for the new steady state?

- (e) Use a diagram to show the steady-state output per worker in (a) and in (c).

Exercise 13.9. (a) Explain the convergence hypothesis.

- (b) Why does the convergence hypothesis anticipate faster growth in standards of living in the lower per capita income OECD countries than in the higher per capita income OECD countries?
- (c) Does the convergence hypothesis offer hope for improved standards of living in poor African countries? Why or why not?

Part Five

International Macroeconomics and Trade Theory

14. International Macroeconomics

15. International Trade

This part extends the coverage of the international aspects of macroeconomics and the explanation of international trade in goods and services. Chapter 14 introduces the balance of payments and makes the link to exchange rates. Then it explains the importance of exchange rate policy choices to the design, coordination and effectiveness of monetary and fiscal policies. The importance of exports and imports to Aggregate Demand was covered in Chapter 6 and again as part of the monetary transmission mechanism in Chapter 9. Chapter 15 introduces the theory of international trade, its effects on output, employment and productivity, and the importance of trade policies.

In this chapter we will explore:

- 14.1 The balance of payments accounts
- 14.2 The foreign exchange market
- 14.3 Flexible exchange rates and fixed exchange rates
- 14.4 Monetary and fiscal policy under flexible exchange rates
- 14.5 Monetary and fiscal policy under fixed exchange rates

In 1999 the Canadian economist Robert Mundell won the Nobel Prize in Economics for his work on the importance of exchange rate policy for the effectiveness of monetary and fiscal policies as tools to manage aggregate demand. Mundell showed for a small open economy like Canada, with a high degree of international capital mobility, that:

- With *flexible* exchange rates monetary policy is a powerful demand management tool, but fiscal policy is weak, and
- With *fixed* exchange rates monetary policy is ineffective as a demand management tool, but fiscal policy is strong.

In this chapter we study the foreign exchange market, flexible and fixed exchange rates and the reasons why different exchange rate policies affect the design and effectiveness of monetary and fiscal policy.

14.1 The balance of payments

The **balance of payments accounts** provide the background to supply and demand in the foreign exchange market. They record transactions between residents of one country and the rest of the

world that involve payments in different national currencies. Taking the Canadian economy as the domestic economy and the United States as the “rest of the world,” all transactions that give rise to an inflow of U.S. dollars to Canada are entered as credits in the Canadian balance of payments. Transactions requiring payments in U.S. dollars are debits, entered with a minus sign. Table 14.1 shows the actual Canadian balance of payments accounts in 2012.

Balance of payments accounts: a record of trade and financial transactions between residents of one country and the rest of the world.

	Exports (receipts)	Imports (payments)	Balance
1. Current account			
Merchandise trade (goods)	458.2	455.9	2.3
Non-merchandise trade (services)	75.3	100.0	−24.7
Investment income, (interest & dividends)	66.4	89.0	−22.7
Transfers, etc.	8.7	12.0	−3.3
Balance			−48.4
2. Capital account			
Capital account: net transfers & intangibles			4.8
Financial account:			
Investment:			
Foreign in Canada	161.5		161.5
Canada in foreign countries	−	110.5	−110.5
Balance			55.8
3. Statistical discrepancy			−7.5
4. Change in official international reserves			−0.1
5. Balance of payments [(1) + (2) + (3) − (4)]			0

Table 14.1: The Canadian balance of payments, 2011 (\$Cdn billions)

Source: Bank of Canada Banking and Financial Statistics, October 2014, Tables J1 and J2, Bank of Canada, 2014.

The **current account** of the balance of payments records international flows of goods, services, and transfer payments. The merchandise trade is exports and imports of goods, things like cars and car parts, steel, wheat, and electronic equipment. Non-merchandise trade measures exports and imports of services like travel, banking and financial services, transportation, and tourism. The total of merchandise and non-merchandise trade is the trade balance we have seen as *net exports* in our earlier study of planned expenditure and aggregate demand.

Current account: a record of trade in goods, services, and transfer payments.

However, the trade balance is not the same thing as the current account of the balance of payments. There are also flows of investment income in the form of interest payments, dividends and reinvested earnings, and transfer payments between countries as a result of government programs like foreign aid, and private receipts and payments. The flows of investment income are what create the difference between GDP and GNP we saw in Chapter 4.

Table 14.1 shows Canada had a trade surplus in goods in 2012, offset partly by deficits on trade in services and other transactions. Combining the trade in goods, services, and other transfers, the current account balance of the balance of payments was $-\$48.4$ billion, a deficit.

A current account deficit means that a country's foreign spending exceeds its foreign income. A current account surplus would mean that its foreign income exceeds its foreign spending. These surpluses and deficits are saving and dissaving, and lead to the purchase or sale of foreign assets.

The **Capital Account** of the balance of payments records two types of transactions. Under the sub-title '*capital account*' it records internationals net a transfer such as migrant's assets, inheritances and government pension payments. The '*financial account*' records the flows of funds for international purchases and sales of real and financial assets. Table 14.1 shows a net capital inflow of $\$55.8$ billion in 2012. The payments by foreigners buying Canadian assets exceeded the payments made by Canadians buying foreign physical and financial assets. A capital account surplus was the result.

Capital account: the record of capital transfers and the purchases and sales of real and financial assets.

A government's holdings of foreign currencies are in its official international reserves account. These balances are like investments in foreign countries because they show the government's holdings of foreign assets. An increase in the official reserves is like a payment item in the capital account of the balance of payments. The **change in official international reserves** in Table 14.1 records the increase or decrease in the Government of Canada's holdings of foreign currency balances. Because Canada maintains a flexible exchange rate annual changes in international reserves are small. As we will see later when discussing different exchange rate policies, countries that

adopt fixed exchange rates often experience large changes in their foreign currency reserves in defence of the exchange rate they have set.

Change in official international reserves: the change in the Government of Canada's foreign currency balances.

The **balance of payments** is the sum of the balances in current and capital accounts minus the change in the official international reserves account. In Table 14.1, this balance is shown as the sum of accounts [(1) + (2) + (3) - (4)] namely $(-48.4 + 55.8 - 7.5 - (-0.1) = 0)$. If all items in the accounts were measured correctly, the balance would be zero. To recognize this, a statistical discrepancy adjustment is made, as shown in the table, to account for any errors in the measurement of other items.

Balance of payments: the sum of the balances in current accounts and capital accounts, minus the change in the holdings of official reserves.

A simple numerical example helps to illustrate the Balance of Payments identity, which by definition gives total receipts minus total payments equal to zero. Suppose, measured accurately with no statistical discrepancy, the balance on current account (*CA*) is a deficit, a net payment of -5 , and the balance on capital account (*KA*) is a surplus, a net receipt of $+3$. Then by addition:

$$\begin{array}{rclcl} \text{Balance on} & + & \text{Balance on} & = & \text{Change in international} \\ \text{current account (CA)} & & \text{capital account (KA)} & & \text{reserves } (\Delta OR) \end{array}$$

Using the numbers in the example:

$$\begin{aligned} CA + KA &= \Delta OR \\ -5 + 3 &= -2 \end{aligned}$$

Payments exceed receipts by 2 and are financed by a decline in official reserves.

Recognizing that the change in official reserves is a payment to cover the shortfall between receipts and payments, and putting all net payments on the left hand side of the identity gives:

$$\begin{aligned} CA + KA - \Delta OR &= 0 \\ -5 + 3 - 2 &= 0 \end{aligned}$$

Now the balance of payments is zero. Line 5 in Table 14.1 shows the balance in the balance of payments in the same way.

The balance of payments shows the net flow of money to the country when individuals, firms, and governments make the transactions they wish to make under existing market conditions. It is in surplus (deficit) when there is a net inflow (outflow) of money. It takes account of the transactions that individuals wish to make in importing and exporting and in buying and selling foreign assets, and the transactions that governments wish to make in the form of foreign aid, maintaining foreign embassies, military spending abroad, and so on.

The record of the change in official reserves is always of equal magnitude to the sum of the balances on the current and capital account, if there is no statistical discrepancy in the measurements. As a result, the *balance of payments always balances*, but the state of the individual accounts underlying that overall balance needs further study.

Determinants of the current account

The exports and imports of goods and services are the largest components of the current account. As we discussed in Chapter 9, trade in goods and services is based, in part, on the price of domestic goods and services relative to foreign goods and services. Three factors determine the prices of foreign goods relative to domestic goods namely:

1. The domestic price level, P_{CDN}
2. The foreign currency price of imports, P_{US} , in the case of imports from the U.S.,
3. The **nominal exchange rate** (er) the domestic currency price of foreign currency.

The **real exchange rate**, which combines these three factors, measures *international price competitiveness*. For example, the real exchange rate between Canada and the United States would be:

$$\text{Real exchange rate} = \frac{er \times P_{\text{US}}}{P_{\text{CDN}}} \quad (14.1)$$

where the nominal exchange rate er is the Canadian dollar price of the U.S. dollar and P_{US} and P_{CDN} are general price levels as measured, for example, by GDP deflators or consumer price indexes. It measures the price of United States goods and services in Canadian dollars *relative to* Canadian goods and services in Canadian dollars.

Nominal exchange rate (er): the domestic currency price of a unit of foreign currency.

Real exchange rate: the relative price of goods and services from different countries measured in a common currency.

Consider the following example:

1. The nominal exchange rate $er = \$1.25\text{Cdn}/\1U.S.
2. The GDP deflator for Canada is 121.3, on the base year 2002.
3. The GDP deflator for the U.S. is 110.4, on the base year 2002.

Then the real exchange rate, which gives the price of U.S. goods in Canadian dollars relative to the price of Canadian goods in Canadian dollars, is:

$$\text{Real exchange rate} = \frac{er \times P_{\text{US}}}{P_{\text{CDN}}} = \frac{1.25 \times 110.4}{121.3} = 1.138 \quad (14.2)$$

By this example, U.S. goods and services are about 14 percent more expensive than Canadian goods and services, on average, when both are priced in Canadian dollars.

Suppose you are planning to buy a notebook computer and wondering whether it would be cheaper to buy it in Canada or go to the US to buy it. Before you decide you could compare the price in the US to the price in Canada by converting the US dollar price to Canadian dollars. Suppose the US dollar price is \$1000 and the exchange rate makes \$1.00 US cost about \$1.15 Cdn as in late in the year 2014. Then the Canadian dollar price of the notebook bought in the US would be \$1150. Say Canadian dollar price for the same notebook is \$1,095. Then based on this one product the real exchange rate is $[(\$1.15 \times \$1000)/1095] = 1.05$. When the real exchange rate is greater than 1.00 the importing notebook costs more than the buying it at home.

Holding all other things constant, a rise in the real exchange rate makes imports more expensive relative to competing domestic goods and services and reduces expenditure on imports. From Equation 14.1, a rise in the nominal exchange rate, or in foreign prices, raises the real exchange rate and lowers imports. Conversely, a fall in the nominal exchange rate or foreign prices lowers the real exchange rate and increases imports.

Purchasing power parity (PPP) describes the long run equilibrium value of the real exchange rate. That value is one. It means that nominal exchange rates adjust to the value required to make imports of goods and services equal to exports of goods and services and net exports are zero.

Purchasing power parity (PPP): a real exchange rate equal to one.

Although economic conditions are seldom tranquil long enough for nominal exchange rates to adjust to the values required for a real exchange rate of one, purchasing power parity is still useful for understanding changes in nominal rates over time. For example, if inflation rates differ between trading partners, purchasing power parity predicts a depreciation of the currency of the country with the higher inflation rate. In terms of Equation 14.1, a rise in the domestic price level P_{CDN} relative to the foreign price level P_{US} calls for a rise in er to maintain a constant real exchange rate. Alternatively, differences in productivity growth rates among countries, by affecting the way

domestic price levels change over time, call for offsetting changes in nominal exchange rates to maintain the real exchange rate.

Exports

Chapter 6 assumed that demand for exports was autonomous and given. We now recognize that the demand for Canadian exports depends on two things. First, since Canadian exports are imports by the rest of the world, higher income in other countries leads to higher Canadian exports. Second, the higher is the Canadian *real exchange rate*, the greater is Canadian competitiveness and export profitability, and the larger are Canadian exports.

Exports respond quickly to changes in world income, but changes in competitiveness affect exports more slowly. Exporters may be unsure if the change in competitiveness is temporary or permanent. If they believe it to be temporary, they may change their profit margins but leave the price of their goods in foreign currency unaffected. Car manufacturers do not change the U.S. dollar prices of the cars they assemble in Canada and sell in the United States with each change in the exchange rate. The profit margins on those sales vary when exchange rates change.

Even when this means losses in the short run, it may be cheaper in the long run than temporarily repricing products or withdrawing from these markets and having to spend large sums on advertising and marketing to win back market share when competitiveness improves again. But if competitiveness fails to improve and the real exchange rate remains low, firms will gradually conclude that they should quit the exporting business. These are the sorts of decisions faced by many Canadian manufacturing firms in the last few years as the strong rise in the Canadian dollar relative to the U.S. dollar (the fall in *er*) has lowered the real exchange rate substantially. The recession of 2009 further complicated the situation as the decline in U.S. GDP and U.S. demand for Canadian exports more than offset the improvements in competitiveness provided by the rise in the nominal and real exchange rate. Weak growth in Canada's major trading partners and the strong Canadian dollar continue to pose challenges for Canadian manufactured exports.

Imports

The higher domestic income is, the larger is the demand for imports, as we recognized with the marginal propensity to import in Chapter 6. But import demand is also larger when the real exchange rate is lower, which makes foreign goods and services cheaper relative to Canadian goods and services when both are measured in Canadian dollars. Again, in practice, imports respond more quickly to changes in domestic income than to changes in the real exchange rate. However, if sustained, a fall in the real exchange rate eventually raises imports. The costs of travel and shopping in foreign countries are reduced and foreign products are offered for sale in Canada at lower Canadian dollar prices. The experience of recent years as the Canadian dollar appreciated strongly

as the U.S. dollar weakened internationally illustrates this exchange rate effect on international travel and import prices.

There are three things of major importance to the exports and imports in the current account balance, namely:

1. Incomes at home and abroad, Y_{CDN} and Y_f ,
2. Prices at home and abroad, P_{CDN} and P_f , and
3. The nominal exchange rate, er .

These can be summarized in export and import functions. For exports, we can write:

$$X = X(Y_f, P_f, P_{\text{CDN}}, er) \quad (14.3)$$

and for imports:

$$IM = IM(Y_{\text{CDN}}, P_f, P_{\text{CDN}}, er) \quad (14.4)$$

In each case, Y_{CDN} and Y_f are incomes in home and foreign countries, P_{CDN} and P_f are price levels, and er is the nominal exchange rate, the Canadian dollar price of the U.S. dollar. When we come to look at the foreign exchange market, it will be helpful to see that the incomes and prices that determine exports and imports also determine supply and demand in the foreign exchange market.

Furthermore, we can use Equations 14.3 and 14.4 to derive the net export function $NX = X - IM$ we included in aggregate expenditure in Chapter 6.

By subtraction, we have:

$$NX = NX(Y_{\text{CDN}}, Y_f, P_f, P_{\text{CDN}}, er) \quad (14.5)$$

$\begin{matrix} - & + & + & - & + \end{matrix}$

For this function, the $+/-$ sign under each variable indicates the effect an increase in that variable would have on our net exports and our balance in current account. When we plotted the net export function in Chapter 6, we put particular emphasis on the relationship between national income and net exports. The marginal propensity to import meant that an *increase* in real GDP, Y_{CDN} in this case, *increased* IM and *reduced* NX . The net export function has a *negative slope* with respect to domestic national income, but *shifts if foreign national income changes*. That's why we have the negative sign ($-$) under Y_{CDN} and the positive sign ($+$) under Y_f in Equation 14.5.

Other items in the current account

Foreign aid and spending on military bases and action abroad are matters of government policy. The net flow of interest, dividend, and profit income between countries arises because residents

of one country hold assets in another. The size of this net flow of income depends on the pattern of international asset holding and on the level of interest rate, profits, and dividends at home and abroad and the currencies in which assets are denominated.

The capital account

Inflows and outflows in the capital account reflect sales and purchases of foreign assets. These flows have become increasingly important. Computers and electronic communications make it as easy for a Canadian resident to buy and sell stocks and bonds in the financial markets of New York or London as in Toronto. Moreover, controls on international capital flows have gradually been dismantled with globalization and financial integration.

The world's financial markets now have two crucial features. First, capital account restrictions have been abolished for capital flows between advanced countries. Funds can move freely from one country to another in search of the highest *rate of return*. Second, trillions of dollars are internationally footloose, capable of being switched between countries and currencies when assets with similar degrees of risk are expected to offer different rates of return in different countries and currencies.

This is the age of **perfect capital mobility** when small differences in expected returns trigger very large flows of funds from country to country. Indeed, the stock of international funds is now so huge that capital flows could swamp the typical current account flows from exports and imports.

Perfect capital mobility: when very small differences in expected returns cause very large international flows of funds.

In international asset markets, capital gains or losses arise not merely from changes in the domestic price of an asset, but also from changes in exchange rates while temporarily holding foreign assets. Table 14.2 provides an example. Suppose you can invest \$1000 Canadian for a year. Canadian one-year interest rates are 4 percent. In the United States one-year rates are 5 percent. The higher United States rates look attractive. If you keep your funds in Canadian dollars, row 1 shows that you will have \$1040 at the end of the year. Can you do better by buying a United States asset?

	Interest Rate	Exchange rate		Final		
	(\$1,000)	(%)	(\$CDN/\$U.S.)		asset value	
Lent in		Initial	Final	\$CDN	\$U.S.	
1. Canada	4.0			1040.00		
2. United States	5.0	1.03	1.009	1028.50	1019.41	

Table 14.2: Returns from lending \$1,000 for a year

Row 2 shows what happens if you convert \$1000CDN into U.S. dollars at an initial exchange rate of \$1.03 CDN/\$1U.S. You have \$970.87U.S. to invest at the United States interest rate of 5 percent. You get \$1019.41U.S. at the end of one year. You would be ahead *if the exchange rate remained constant*. \$1019.41U.S. is \$1050CDN, a return of 5 percent, as you would expect.

Suppose, however, the exchange rate changes while your funds are out of the country. Let's say the Canadian dollar appreciates by 2 percent during the year, lowering the exchange rate to \$1.009CDN/\$1U.S. When converted back to Canadian dollars your \$1019.41U.S. now buys \$1028.50CDN. You get 1 percent more interest income from holding the United States asset instead of the Canadian asset, but you suffer a capital loss of 2 percent by temporarily holding U.S. dollars, whose value relative to Canadian dollars fell by 2 percent in that year.

In this example, you end up with about \$1028.50CDN if you lend in U.S. dollars. The Canadian dollar appreciated by more than 1 percent, the difference between Canadian and United States interest rates. As a result, the capital loss from the exchange rate while holding U.S. dollars outweighed the gain on interest. This was the experience of many portfolios in 2008 as the Canadian dollar appreciated strongly and the exchange rate fell. The total return on lending in U.S. dollars was lower than the return in Canadian dollars.

Conversely, if the Canadian dollar depreciated against the U.S. dollar while you were holding your United States asset, your total return would be higher than the 1 percent interest rate differential. You would get a gain on the exchange rate when you converted back to Canadian dollars. This was the experience of portfolios holding assets denominated in U.S. dollars as the Canadian dollar depreciated over the period from May 2008 to March 2009, raising the nominal exchange rate from $er = 0.9994$ to $er = 1.2645$. The exchange rate movement provided a 26.5% annual return, in terms of Canadian dollars, to portfolios holding U.S. dollar assets.

Equation 14.6 summarizes this important result. The total return on temporarily lending in a foreign currency is the interest paid on assets in that currency plus any capital gain (or minus any capital loss) arising from the depreciation (appreciation) of the domestic currency during the period.

$$\begin{array}{l} \text{Return} \\ \text{on asset} \end{array} = \begin{array}{l} \text{Return on} \\ \text{foreign asset} \end{array} = \begin{array}{l} \text{Foreign interest rate} + / - \\ \% \text{ increase/decrease in} \\ \text{nominal exchange rate } (er) \end{array}$$

$$\text{Total return on foreign asset} = i_f + \% \Delta er \quad (14.6)$$

When the *total return* expected from holding a foreign asset according to Equation 14.6 is equal to the domestic rate of interest, we have the **interest parity** condition. Any interest rate differential between countries is offset by an expected change in the exchange rate.

Interest parity: interest rate differentials between countries are offset by *expected* exchange rate changes.

With near perfect capital mobility, there is a vast capital *outflow* if the expected net return to foreign lending exceeds the total return on domestic lending. There is a huge capital inflow if the expected return on domestic lending exceeds the return on foreign lending. As a result, with no barriers to capital mobility, expected total returns are the same in assets of different currencies.

Three things determine the direction and size of the net capital flow that appears as the balance in the capital account in the balance of payments, namely: the difference between domestic and foreign interest rates, the current nominal exchange rate, and the nominal exchange rate expected in the future.

$$CF = CF \left(\begin{array}{c} (i - i_f), \\ + \\ (er^e / er - 1) \\ - \end{array} \right) \quad (14.7)$$

Equation 14.7 summarizes this relationship. The net capital flow depends positively on the differential between domestic and foreign nominal interest rates ($i - i_f$). A rise in domestic rates relative to foreign rates would attract a flow of funds into the domestic financial market. A fall in domestic rates would push the flow toward foreign financial markets, assuming in both cases that the exchange rate is not expected to change in an offsetting direction.

Alternatively, assuming the interest rate differential is constant, the capital flow depends negatively on the expected rate of depreciation of the domestic currency suggested by $[(er^e / er) - 1]$. An expectation that the domestic currency will depreciate (a rise in er^e) will increase the returns from holding foreign assets and lead to a net capital outflow ($CF < 0$). An expected appreciation would reduce expected returns on foreign assets. These capital flows have important effects on the supply and demand for foreign exchange on the foreign exchange market.

14.2 The foreign exchange market

The foreign exchange market is the market in which the currencies of different countries are bought and sold and the prices of currencies, the foreign exchange rates, are established. Consider the market for U.S. dollars as foreign currency. The sources of supply and demand for foreign exchange are shown by the balance of payments in Table 14.1. Exports of goods, services, and financial assets generate receipts in foreign currencies that are sold in the foreign exchange market for Canadian dollars. Imports of goods, services, and securities must be paid for in foreign currencies. The demand for foreign exchange is derived from this demand for imports. Without intervention by governments, demand and supply determine the exchange rate, as, for example, $er_0 = 1.05$ in Figure 14.1.

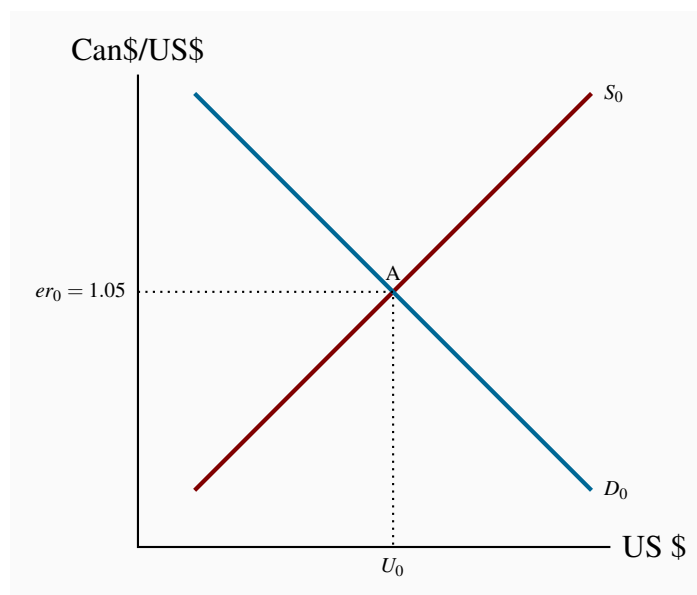


Figure 14.1: The Foreign Exchange Market

The supply of US dollars on the foreign exchange market comes from US purchases of Canadian goods, services and assets. The demand for US dollars comes from Canadian demand for imports of goods, services and assets. Supply and demand determine the equilibrium exchange rate er_0 .

The exchange rate $er_0 = \$1.05$ is what it costs in Canadian dollars to buy each U.S. dollar you want for your winter reading week break in Florida. Alternatively, if you as an exporter of lumber to the U.S. market receive \$1000U.S. for every 1000 board feet of 2x4's you sell to U.S. builders, your Canadian dollar revenue to cover your Canadian costs is \$1050.

If the price of goods in U.S. markets is constant, a lower exchange rate er_1 ; say, $er_1 = 1.01$, *other things constant*, by lowering the price and raising the quantity of Canadian imports, must raise the demand for U.S. dollars. In Figure 14.1, the demand curve for U.S. dollars D_0 slopes downwards.

More U.S. dollars are demanded to buy more imports at a lower CDN\$/U.S.\$ exchange rate.

The U.S. dollars supplied on the foreign exchange market are the receipts from the export of goods, services, and securities to U.S. residents. From our discussion of the current and capital accounts of the balance of payments, exports of goods and services depend on foreign income, the relative prices of domestic and foreign goods and services, and the exchange rate. Net exports of securities depend on the difference between domestic and foreign interest rates, for given expectations of the future exchange rate.

In Figure 14.1, the supply curve shows the quantities of U.S. dollars that would come to the market at different exchange rates, er , *all other things constant*. It slopes upward because a higher CDN\$/U.S.\$ exchange rate ($er > \$1.05$) *lowers* the prices of Canadian goods and services to U.S. buyers. As a result, United States residents buy more Canadian exports and total export receipts rise. The quantity of U.S. dollars coming onto the foreign exchange market increases as we move up the supply curve. The supply curve has a *positive slope*.

Figure 14.1 assumes that the demand for Canadian exports and the Canadian demand for imports are price elastic. Price increases caused by changes in the exchange rate reduce total revenue. Price reductions caused by changes in the exchange rate increase total revenue. These conditions give the slopes shown for the supply and demand curves.

At the equilibrium exchange rate er_0 , the quantities of U.S. dollars supplied and demanded are equal. In terms of the balance of payments, the balance is zero. Receipts equal payments.

In practice, as seen in Table 14.2, the balance of payments is recorded in domestic currency. However, the equality of receipts and payments still holds. Both are easily converted to Canadian dollars by multiplying the U.S. dollar amounts by the exchange rate. In terms of Figure 14.1, multiplying U_0 on the horizontal axis by the exchange rate er_0 on the vertical axis gives the area of the rectangle er_0AU_0O , the Canadian dollar value of total receipts or total payments recorded in the balance of payments.

What would change the equilibrium in Figure 14.1? A change in any of the factors we have held constant in order to draw the supply and demand curves will shift one or the other or both curves. We see this in both the net export and capital flow functions. A rise in United States income would increase U.S. imports from Canada and shift the supply of foreign exchange to the right. As we discussed in Chapter 9, a change in interest rates in Canada or the United States would change the trade in financial assets and affect both the supply curve and the demand curve. In short, a change in any market condition *other than the exchange rate er* will change supply and demand conditions in the market. The exchange rate will then change to a new equilibrium. Figure 14.2 and 14.3 provide examples.

The effect of a recession in the U.S. economy on the exchange rate

The demand and supply curves in the foreign exchange market of Figure 14.2 are drawn on the assumption that tastes, incomes, prices of goods and services, interest rates, and expectations of future exchange rates are constant. The flows of payments and receipts under these conditions result in the equilibrium exchange rate er_0 . This would be a Canadian dollar price for the U.S. dollar of, for example, \$1.05. From the United States perspective, a Canadian dollar costs a United States resident about \$0.952U.S.

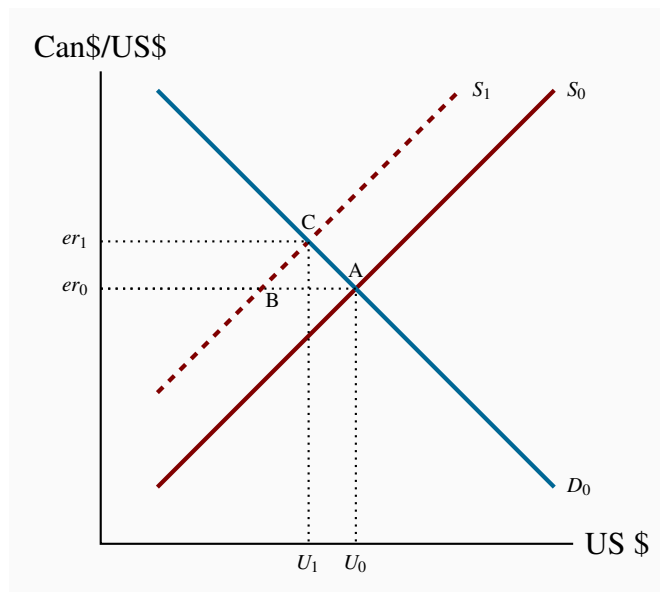


Figure 14.2: The Effect of a Recession in the US on the Exchange Rate

A recession in the US reduces Canadian exports to the US and reduces the supply of US\$ on the foreign market. S shifts from S_0 to S_1 . The exchange rate rises as the Can\$ depreciates.

Now suppose, as occurred in early 2008 and 2009, a recession in the United States lowers United States real income. United States imports fall, based on the U.S. marginal propensity to import. United States imports are Canadian exports, and the U.S. dollar receipts of Canadian exporters are reduced. The recession and difficult household financial conditions reduce U.S. residential construction and Canadian lumber exports decline. Recession also reduces travel by U.S. residents, and the Canadian tourism industry suffers a decline in bookings and receipts. If expenditures on new cars in the United States are reduced, Canadian auto industry sales to the United States market are reduced. In the balance of payments, the balance on trade in goods and services falls, and in the foreign exchange market *the supply of U.S. dollars on the market is reduced*.

The supply curve in Figure 14.2 shifts leftward to S_1 . At the initial exchange rate er_0 , the demand for U.S. dollars exceeds the supply, putting upward pressure on the exchange rate. In terms of

the balance of payments, the excess demand for U.S. dollars represents a balance of payments deficit. In the example shown here, the Canadian dollar depreciates and the exchange rate rises to restore equilibrium in the foreign exchange market and the balance of payments. A higher price for the U.S. dollar reduces Canadian imports and increases the Canadian dollar receipts of Canadian exporters. The Canadian balance of payments effects of the U.S. recession are offset by the exchange rate change.

The rise in the exchange rate in this case is a **depreciation** of the Canadian dollar and a corresponding **appreciation** of the U.S. dollar.

Currency depreciation: a fall in external value of the domestic currency that raises domestic currency price of foreign currency.

Currency appreciation: a rise in external value of the domestic currency that lowers the domestic currency price of foreign currency.

Before the recession of 2009, Canadian experience was the opposite of this example. High GDP growth rates in the U.S. and Asia created very strong international demand for Canadian commodities and crude oil at high international prices. Strong oil and commodity exports increased the supply of foreign currencies on the Canadian foreign exchange market. The Canadian dollar *appreciated* strongly, with the exchange rate falling from \$1.57CDN/\$1U.S. in 2002 to an average of \$0.9994 CDN/\$1U.S. in May of 2008, a fall of about 60 percent over the six year period. Exchange rate changes led to a restructuring of both exports and imports to maintain equilibrium in the balance of payments as Canada's international trade changed dramatically.

The effect of a fall in foreign interest rates on the foreign exchange rate

In the previous example a change in foreign income and the supply of foreign exchange disrupted the equilibrium in the foreign exchange market and changed the exchange rate. As an alternative to that example, consider the effects of a cut in foreign interest rates.

In Figure 14.3 the foreign exchange market is in equilibrium, initially at an exchange rate er_0 . A fall in foreign interest rates, other things constant, disrupts this equilibrium. Now lower foreign rates make domestic (Canadian) bonds more attractive to foreign portfolios than they were previously. The demand for domestic bonds rises. The supply of U.S. dollars on the market to pay for these bond exports increases, shifting S_0 to S_1 in the diagram. At the same time, the attractiveness of foreign bonds for domestic portfolios is reduced, reducing the demand for U.S. dollars to pay for them. The demand curve shifts from D_0 to D_1 . The equilibrium exchange rate falls to er_1 .

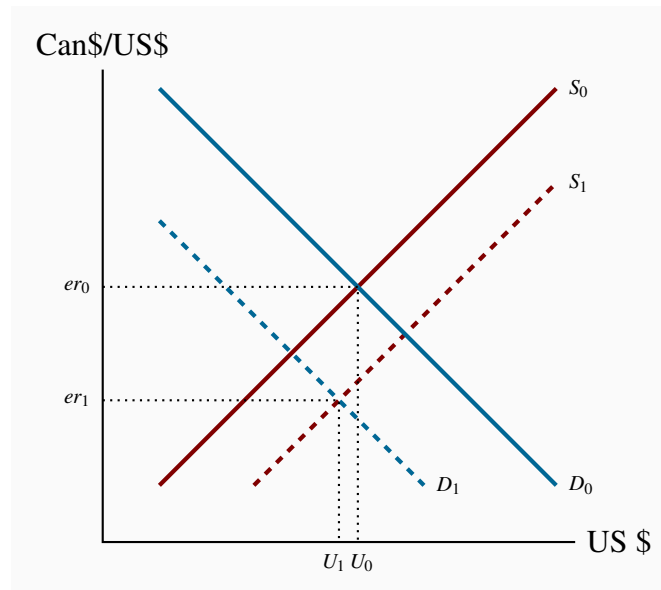


Figure 14.3: The Effect of a Cut in Foreign Interest Rates

A cut in foreign interest rates shifts portfolios toward the Canadian bond market and away from foreign markets. The supply of foreign currency increases from the increased export of bonds at the same time as the demand for foreign currency to buy foreign bonds falls. The domestic currency appreciates and the exchange rate falls.

In balance of payments terms the net capital inflow, the balance on capital account, is increased. The change in the exchange rate causes an offsetting change in the current account that restores equilibrium in the foreign exchange market and the balance of payments. A lower nominal exchange rate lowers the real exchange rate. Imports are now cheaper and exports, priced internationally in U.S. dollars, are less profitable. Export receipts are reduced. As we saw in Chapter 9, changes in the exchange rate are one channel by which changes in financial conditions impact AD and equilibrium GDP.

Figures 14.2 and 14.3 provide two examples of adjustments in the foreign exchange rate. The underlying assumption is that *exchange rates are flexible* and allow the market to adjust freely and quickly to changing circumstances.

However, there are alternative exchange rate arrangements. To understand how the foreign exchange rate operates in different countries, we need to consider the different *exchange rate policies* governments can adopt. These result in different foreign exchange rate regimes, different ways that the balance of payments adjusts to change, and different roles for monetary and fiscal policies.

14.3 Flexible exchange rates and fixed exchange rates

To grasp the basics of **exchange rate regimes**, we focus on two extreme forms that have been adopted to handle international transactions in the world economy: *flexible exchange rates and fixed exchange rates*.

Exchange rate regime: the policy choice that determines how foreign exchange markets operate.

Floating or flexible rates

In a **floating or flexible exchange rate** regime, the exchange rate is allowed to find its equilibrium level on the foreign exchange market *without central bank intervention*.

Flexible exchange rates: Supply and demand in the foreign exchange market determine the equilibrium exchange rate without central bank intervention.

Figures 14.2 and 14.3 showed the exchange rates that would result if rates adjusted flexibly and freely in response to changes in demand and supply. The central bank *did not intervene* to fix or adjust the rate. The rise in the demand for U.S. dollars would result in a rise in the exchange rate to clear the foreign exchange market and maintain the balance of payments. Alternatively, the fall in demand would result in a fall in the exchange rate. The Bank of Canada would not intervene in either case. The holdings of official foreign exchange reserves and the domestic money supply would not be affected by foreign exchange market adjustments.

The alternative is a *fixed exchange rate* as explained below. In this regime, the central bank intervenes in the foreign exchange market to offset the effects of fluctuations in supply and demand and maintain a constant exchange rate.

How do countries choose between fixed and floating exchange rates? Obviously, there is not one answer for all countries or we would not see different exchange rate regimes today. With flexible rates, the foreign exchange market sets the exchange rate, and monetary policy is available to pursue other targets. On the other hand, fixed exchange rates require central bank intervention. *Monetary policy is aimed at the exchange rate.*

The importance a country attaches to an *independent monetary policy* is one very important factor in the choice of an exchange rate regime. Another is the size and volatility of the international trade sector of the economy. A flexible exchange rate provides some *automatic adjustment and stabilization* in times of change in net exports or net capital flows.

Fixed exchange rates

In a **fixed exchange rate** regime, the government intervenes actively through the central bank to maintain convertibility of their currency into other currencies at a fixed exchange rate. A currency is **convertible** if the central bank will buy or sell as much of the foreign currency as people wish to trade at a fixed exchange rate.

Fixed exchange rate: an exchange rate set by government policy that does not change as a result of changes in market conditions.

Convertible currency: a national currency that can be freely exchanged for a different national currency at the prevailing exchange rate.

In Figure 14.4, suppose the exchange rate is *fixed at* er^* . There would be a free market equilibrium at A if the supply curve for U.S. dollars is S_1 and the demand curve for U.S. dollars is D_1 . The central bank does not need to buy or sell U.S. dollars. The market is in equilibrium and clears by itself at the fixed rate.

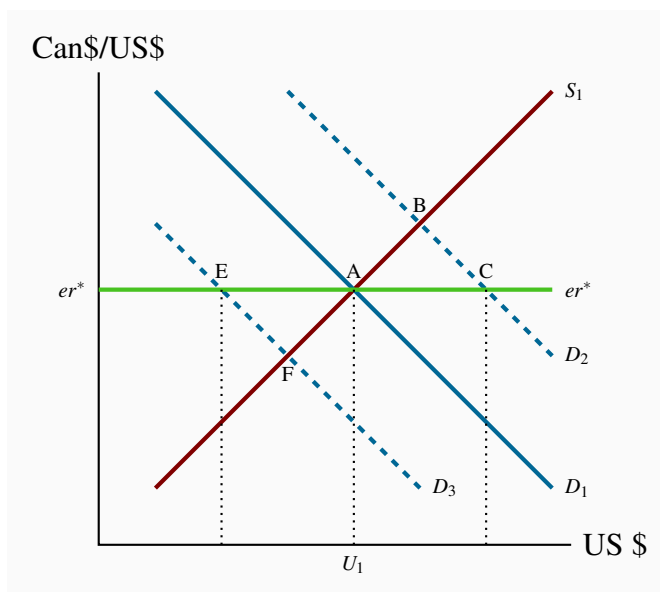


Figure 14.4: Central Bank Intervention to Fix the Exchange Rate

With exchange rate fixed at er^* a shift in demand for US\$ to D_2 creates excess demand AC. The central bank intervenes, supplying AC US\$ from official reserve holdings in exchange for Can\$. To maintain er^* if demand shifted to D_3 would create the opposite condition and central bank would have to buy US\$.

Suppose demand for U.S. dollars shifts from D_1 to D_2 . Canadians want to spend more time in Florida to escape the long, cold Canadian winter. They need more U.S. dollars to finance their expenditures in the United States. The free market equilibrium would be at B, and the exchange rate would rise if the Bank of Canada took no action.

However, with the exchange rate fixed by policy at er^* there is an excess demand for U.S. dollars equal to AC. To peg the exchange rate, the Bank of Canada sells U.S. dollars from the **official exchange reserves** in the amount AC. The supply of U.S. dollars on the market is then the “market” supply represented by S_1 plus the amount AC supplied by the Bank of Canada. The payment the Bank receives in Canadian dollars is the amount $(er^* \times AC)$, which *reduces the monetary base* by that amount, just like an open market sale of government bonds. *The exchange rate target drives the Bank’s monetary policy.*

Official exchange reserves: government foreign currency holdings managed by the central bank.

What if the demand for U.S. dollars falls to D_3 ? The market equilibrium would be at F. At the exchange rate at er^* there is an excess supply of U.S. dollars EA. To defend the peg, the Bank of Canada would have to buy EA U.S. dollars, reducing the supply of U.S. dollars on the market to meet the “unofficial” demand. The Bank of Canada’s would have to buy EA U.S. dollars, reducing the supply of U.S. dollars on the market to meet the “unofficial” demand. The Bank of Canada’s purchase would be added to foreign exchange reserves. The Bank would pay for these U.S. dollars by *creating more monetary base*, as in the case of an open market purchase of government securities. In either case, maintaining a fixed exchange rate requires **central bank intervention** in the foreign currency market. The central bank’s monetary policy is committed to the exchange rate target.

Central bank intervention: purchases or sales of foreign currency intended to manage the exchange rate.

When the demand schedule is D_2 , foreign exchange reserves are running down. When the demand schedule is D_3 , foreign exchange reserves are increasing. If the demand for U.S. dollars fluctuates between D_2 and D_3 , the Bank of Canada can sustain and stabilize the exchange rate in the long run.

However, if the demand for U.S. dollars is, on average, D_2 , the foreign exchange reserves are steadily declining to support the exchange rate er^* , and the monetary base is falling as well. In this case, the Canadian dollar is overvalued at er^* ; or, in other words, er^* is too low a price for the U.S. dollar. A higher er is required for long-run equilibrium in the foreign exchange market and the balance of payments. As reserves start to run out, the government may try to borrow foreign exchange reserves from other countries and the International Monetary Fund (IMF), an international body that exists primarily to lend to countries in short-term difficulties.

At best, this is only a temporary solution. Unless the demand for U.S. dollars decreases, or the supply increases in the longer term, it is necessary to **devalue** the Canadian dollar. If a fixed exchange rate is to be maintained, the official rate must be reset at a higher domestic currency price for foreign currency.

Devaluation (revaluation): a reduction (increase) in the international value of the domestic currency.

Frequent media and political discussions of the persistent rise in China's foreign exchange holdings provide a good example of the defence of an undervalued currency. With the yuan at its current fixed rate relative to U.S. dollars and other currencies, China has a large current account surplus that is not offset by a capital account deficit. Balance of payments equilibrium requires ongoing intervention by the Chinese central bank to buy foreign exchange and add to official reserve holdings. Buying foreign exchange adds to the monetary base and money supply, raising concerns about inflation. The Bank has responded in part with a small revaluation of the yuan and in part with an increase in the reserve requirements for Chinese banks. Neither of these adjustments has been sufficient to change the situation fundamentally and growth in official foreign exchange reserves continues.

Of course, it is not necessary to adopt the extreme regimes of pure or clean floating on the one hand and perfectly fixed exchange rates on the other hand. *Dirty or managed floating* is used to offset large and rapid shifts in supply or demand schedules in the short run. The intent is to smooth the adjustment as the exchange rate is gradually allowed to find its equilibrium level in response to longer-term changes.

14.4 Monetary and fiscal policy with flexible exchange rates

In a closed economy with slow wage and price adjustments, monetary and fiscal policies are both important tools for Aggregate Demand management in the short run. Things are different in open economies with high international capital mobility. *With flexible exchange rates monetary policy is powerful* tool for changing AD. It works through both interest rate and exchange rate linkages in the transmission mechanism, not just the interest rate linkages of the closed economy. By contrast, *the effects of fiscal policy on Aggregate Demand are reduced*. In the absence of supporting monetary policy, fiscal expansions crowd out private sector expenditures through both interest rate and exchange rate linkages, leaving AD unchanged.

As we will see later, *fixed exchange rates* have the opposite implications for policy effectiveness as an AD management tool. *The effects of fiscal policy are enhanced by induced change in monetary conditions, but monetary policy alone is almost powerless to change AD*. As a result, the first important step in the design of macroeconomic policy in the open economy is the choice of an

exchange rate regime.

Monetary policy

With flexible exchange rates, monetary policy causes changes in both interest rates and exchange rates. Equation 14.7 defines the net international capital flows that link exchange rates and changes in domestic interest rates when exchange rates are flexible. Given the exchange rate expected in the long run, higher interest rates in the short to medium run cause a capital inflow, an increased supply of foreign exchange on the foreign exchange market, which lowers the exchange rate, *er*.

Conversely, lower domestic interest rates relative to international rates cause a rise in the exchange rate, *er*.

As a result, current monetary policy and expected future monetary policies have strong effects on the nominal exchange rate and the international competitiveness of the domestic economy and AD. Changing current interest rates for a short time will have only small exchange rate effects. However, a credible change in monetary policy for a sustained period will cause a large and persistent change in current exchange rates. This can have large short-run effects on the real economy.

As a result, in an open economy with flexible exchange rates, monetary policy affects Aggregate Demand not just through the effects of interest rates on consumption and investment. Changing interest rates, by changing the exchange rate, also change the international competitiveness of exports and imports. Net exports change in the same direction as domestic expenditure, increasing the impact of interest changes on Aggregate Demand. Lower interest rates boost domestic expenditure, raise the exchange rate, and increase net exports. Higher interest rates reduce domestic expenditure, lower the exchange rate, and reduce net exports. With linkages through both domestic and international components of expenditure, monetary policy is more powerful under flexible exchange rates than in a closed economy.

Canada and a number of other countries conduct monetary policy in terms of a target for the domestic inflation rate. A flexible exchange rate policy is essential for the monetary policy independence and power required to pursue that target. That is why the Bank of Canada defines Canada's flexible exchange rate as a key component of Canada's monetary policy framework. The other key component is the Bank's inflation control target.

Fiscal policy

With flexible exchange rates, but without monetary policy accommodation or support, the effect of interest rate changes on exchange rates and competitiveness *undermines* the power of fiscal policy to manage Aggregate Demand.

Suppose the government undertakes a *fiscal expansion*, raising government expenditures or lowering taxes or some combination of the two. Aggregate demand increases. When monetary policy targets an inflation rate based on either an interest rate rule or a money supply rule, the expansion in AD caused by fiscal policy changes the economic fundamentals on which the central bank's policy had been set and induces the bank to *raise interest rates*. The higher interest rates cause a net capital inflow and an increased supply of foreign exchange on the foreign exchange market, and the nominal exchange rate falls. A fall in the nominal foreign exchange rate *lowers the real exchange rate*. International price competitiveness as measured by the real exchange rate is reduced and net exports fall. *With flexible exchange rates monetary policy targeted to the inflation rate dominates fiscal policy* as a tool for AD management.

Canadian experience provides an example. In the 2005-2007 period, the federal government provided fiscal stimulus through tax cuts and expenditure increases. The primary structural budget balance fell from an average 3.4 percent of potential GDP for 2002 to 2004 to 2.6 percent for 2005 to 2007. At the same time the Bank of Canada's estimates showed the economy operating with a small but persistent inflationary gap. The inflation rate was in the upper level of the Bank's target range. The Bank responded to strong current and expected demand, coming from both the government and private sector, by raising its overnight rate in steps from 2.5 percent in late 2005 to 4.5 percent by mid-2007 to defend its inflation target. The inflationary gap and inflation were contained as higher interest rates and lower exchange rates limited the growth of aggregate demand, including that coming from fiscal stimulus.

In a closed economy, fiscal expansions that push up interest rates cause partial crowding out of private expenditure by reducing consumption and investment. In an open economy with flexible exchange rates the crowding out mechanism is stronger. Fiscal expansion causes both a rise in interest rates and a fall in the exchange rate. Both domestic expenditure and net exports are reduced. The extended crowding out through the change in exchange rates and net exports when exchange rates are flexible reduces the power of fiscal policy to manage aggregate demand in the short run.

However, if control or reduction of the debt ratio is the prime target of fiscal policy, the flexible exchange rate is helpful. If the government raises tax rates or cuts expenditures to raise its structural budget balance and reduce the debt ratio, lower interest rates and a rising exchange rate provide some offsetting "crowding in" through both domestic expenditure and net exports. The limited Aggregate Demand effects of fiscal policy under flexible exchange rates facilitate control of the government's budget balance and debt ratio.

Policy co-ordination

This analysis of the policy implications of flexible rate regimes leads to a clear recommendation for policy co-ordination. Flexible exchange rates provide the framework for effective monetary policy focused on a medium term inflation target. The exchange rate regime enhances the power of monetary policy to moderate business cycle fluctuations and the output gaps they create. Stabilizing the economy at or close to potential output avoids the cumulative inflationary or recessionary

pressures that would push inflation rates away from the monetary policy target. Monetary policy is then the Aggregate Demand management tool.

Fiscal policy is not an effective AD management tool when exchange rates are flexible. Its impacts on aggregate demand are limited by crowding out and dominated by monetary policy. However, this does enhance the power of fiscal policy to pursue deficit control and debt ratio control. The effects of fiscal restraint aimed at improved public finances are moderated by a monetary policy focused on an inflation target in a flexible exchange rate regime.

The Canadian experience with economic policy and performance provides an excellent example of this sort of coordinated policy. Starting in 1995 the federal government introduced a policy of strong fiscal adjustment through restraint aimed at reducing the public debt-to-GDP ratio. The structural primary budget balance was increased through expenditure cuts and tax increases. At the same time, monetary policy was aimed at maintaining inflation within the 1-3 percent target band, which required monetary stimulus. The nominal and real overnight interest rates were reduced. Economic growth was constrained by the fiscal austerity but still sufficient to eliminate the recessionary gap by the end of the decade. The support of domestic monetary policy, a significant depreciation of the Canadian dollar, strong growth in the US economy and strong export growth were keys to this successful fiscal adjustment. The coordination of fiscal restraint and monetary stimulus moved the economy to potential output with stable inflation and a falling ratio of public debt to GDP.

Policy responses to the recession of 2009 also involved strong policy co-ordination, both domestic and international. Monetary policy was the first line response, with central banks in most industrial countries lowering their interest rate to or close to the **zero lower bound**. Some countries, like the U.S., then went further to provide quantitative and credit easing through general and selective open market operations. Fiscal stimulus added to these highly accommodative monetary conditions. Central bank commitments, like those in both the U.S. and Canada to maintain policy rates at their minimum for periods as long as a year or more eliminated concerns about fiscal crowding out.

Zero lower bound: a problem that occurs when the short-term nominal interest rate is at or near zero.

Co-coordinating the focus of both monetary policy and fiscal policy was designed to stimulate aggregate demand and restore growth in real GDP. In a time of deep recession, high indebtedness, and high uncertainty even very low interest rates won't induce households and business to take on more debt to build more houses or factories. There is already an excess supply of productive capacity and housing. Monetary conditions can support an expansion in expenditure but cannot trigger it.

Fiscal policy, by contrast, can add directly to expenditure and aggregate demand, especially expenditure on infrastructure, education, research, and similar public investments. Tax cuts are likely to have smaller expenditure effects if only because the recipients have marginal propensities to

spend that are less than one. Nonetheless, there is an important debate about whether expenditure increases or tax cuts should be used for fiscal stimulus, and which will have the larger and more desirable effect.

With this policy coordination there is no cause for concern about crowding out. Central banks were not concerned about the effects of increased aggregate demand on inflation rates and their inflation targets. Quite the opposite, like the Bank of Canada they hoped to raise inflation to their target. Fiscal expansion will not induce higher interest rates or lower exchange rates.

14.5 Monetary and fiscal policy with fixed exchange rates

Monetary policy

If a country adopts a fixed exchange rate policy, *the exchange rate is the target of monetary policy*. Monetary policy cannot pursue an inflation target or an output target at the same time as it pursues an exchange rate target. Nor can it set either interest rates or money supply growth rates independently.

With a fixed exchange rate, interest rates must be set as needed to maintain the exchange rate when capital mobility is high. Indeed, the higher international capital mobility is, the less is the scope for independent monetary policy. This is what we mean when we say fixed exchange rates eliminate monetary policy sovereignty. The central bank cannot follow an independent monetary policy.

Fiscal policy with fixed exchange rates

A fixed exchange rate and perfect capital mobility undermine the scope for monetary policy, but maintain the effectiveness of fiscal policy.

In a closed economy, in the short run, fiscal expansion raises output. Under a Taylor rule, *as long as output is less than potential output*, the central bank supports the increase in output by maintaining interest rates and increasing the money supply as output expands. However, at outputs equal to or greater than potential output, central banks raise interest rates to crowd out the effect of fiscal expansion.

In an open economy with fixed exchange rates, monetary policy adjusts passively to keep the interest rate fixed in order to defend the exchange rate. Interest rates do not change to support fiscal policy or moderate the effect of fiscal policy. Hence, any fall in domestic demand can be offset by a fiscal expansion to help restore potential output. If the change in domestic demand is the only reason that the current account balance departed from equilibrium, this fiscal expansion

will also restore the current account balance.

Fiscal policy is potentially an important stabilization policy under fixed exchange rates. It helps to compensate for the fact that monetary policy can no longer be used. Automatic fiscal stabilizers play this role. Discretionary changes in government spending or taxes are useful only if fiscal policy can react quickly to temporary shocks. In some political systems, such as in Canada this is feasible. In others such as in the United States, where Congress and the President may be from different parties and budget decisions are more protracted, rapid changes in fiscal policy are more difficult.

In times of prolonged recession, discretionary fiscal policy can contribute importantly to a return to potential output, *provided it is not constrained by high public debt ratios*. With interest rates tied to the exchange rate, financing a fiscal expansion does not push rates up to crowd out private sector expenditure; nor does the recovery of the economy result in rising rates. Indeed, fiscal policy is the only effective domestic demand management tool available.

Unfortunately, high public debt ratios and concerns about the default risk of sovereign debt cause problems for fiscal policy. This is the current situation in Europe. Fiscal expansion is impossible if financial markets are unwilling to buy more sovereign debt from economies in recession that already have high debt ratios. On the other hand, fiscal austerity to control deficits and debt ratios makes recessions worse and may even raise already high debt ratios as GDP and government net revenue fall. The euro fixes exchange rates within Europe and precludes stimulus from currency depreciation. Neither domestic fiscal nor monetary policy offers a solution.

Things further complicated because many European countries have similar economic and financial difficulties. Canadian success with fiscal austerity and adjustment in the 1990s came from very different economic environment. Monetary policy and exchange rate depreciation provided stimulus. Strong economic growth in major trade partners provided further stimulus through export growth. These conditions are clearly not met in Europe and coordinated fiscal austerity to address sovereign debt issues has been described as an ‘economic suicide pact’.

Next

This chapter extended the discussion of short-run macroeconomic performance and policy by covering in more detail the importance of international trade, capital flows, and exchange rates for the design and co-ordination of monetary and fiscal policies. The next chapter explains the theory of international trade, the benefits of trade and the design of trade policies that underpin the net export component of aggregate demand.

KEY CONCEPTS

The **balance of payments** records transactions between residents of one country and the rest of the world. The **current account** shows the trade balance plus net international transfer payments, and income earned on holdings of foreign assets. The **capital account** shows net purchases and sales of foreign assets. The balance of payments is the sum of the current and capital account balances.

The trade in goods and services recorded in the current account is **net exports**, based on tastes, incomes, and the real exchange rate, which measures the price of foreign goods and services relative to the price of domestic goods and services.

The **trade in financial** assets recorded in the capital account is based on the total return expected from holding foreign rather than domestic assets.

The total return on holdings of foreign assets depends on the interest rate differential between countries and the change in the exchange rate during the period in which assets are held. **Perfect international capital mobility** means that an enormous quantity of funds shifts between currencies when the perceived rate of return differs across currencies.

The **interest parity** condition says that, when capital mobility is perfect, the interest rate differential across countries should be offset by expected exchange rate changes, so that the total expected return is equated across currencies.

The **foreign exchange market** is the market in which currencies of different countries are bought and sold and foreign exchange rates are established. The **exchange rate** is the price at which one currency trades for another.

The **demand for foreign currency** on the foreign exchange market arises from imports of goods and services and purchases of foreign assets. The **supply of foreign currency** on the foreign exchange market arises from exports of goods and services and sales of domestic assets to foreigners.

Under a **fixed exchange rate regime**, a balance of payments surplus or deficit must be matched by an offsetting quantity of **official financing**. The **central bank** intervenes in the foreign exchange market.

Under **floating or flexible exchange rates**, supply and demand in the foreign exchange market change the exchange rate as necessary for a current account balance that offsets a capital account balance. As a result, the balance of payments is zero and *no official intervention* is involved.

The **choice between fixed and floating exchange rate regimes** reflects a country's assessment of *the importance of an independent monetary policy*, the volatility of exports and imports, and the financial discipline that may come with fixed rates.

Flexible exchange rates increase the *effectiveness of monetary policy* as a tool to manage aggregate demand. *The effectiveness of fiscal policy* for demand management is reduced, but pursuit of deficit and debt ratio control may be enhanced.

Monetary policy sovereignty is lost when **fixed exchange rates** are adopted. Monetary policy cannot effectively pursue domestic inflation or output targets. However, *the effectiveness of fiscal policy as a demand management tool is enhanced*.

EXERCISES FOR CHAPTER 14

Exercise 14.1. Suppose a country has a current account surplus of \$20 billion, but a capital account deficit of \$18 billion.

- (a) Is its balance of payments in deficit or surplus? Why?
- (b) What change in official exchange reserves would you see? Why?
- (c) Is the central bank buying or selling foreign currency?
- (d) What effect does the central bank's foreign currency purchase or sale have on the monetary base? Explain why?

Exercise 14.2. Assume the initial exchange rate is \$1.20CDN for \$1.00U.S. After 10 years, the United States price level has risen from 100 to 200, and the Canadian price level has risen from 100 to 175. What was the inflation rate in each country? What nominal exchange rate would preserve the initial real exchange rate? Which country's currency depreciated?

Exercise 14.3. Suppose portfolio managers shift \$100 million in assets under their control out of Canadian government securities and into United States government securities. What change would this portfolio shift make in the Canadian balance of payments?

Exercise 14.4. What is the expected rate of appreciation of the US dollar if interest rate parity prevails and Canadian nominal interest rates are 1 percent higher than United States interest rates?

Exercise 14.5. Explain the "interest parity condition." If Canadian interest rates are 1.5 percentage points lower than United States interest rates, what change in the international value of the Canadian dollar would you predict?

Exercise 14.6. Suppose natural gas and crude oil prices were to drop sharply and expectations were they would remain low. Use a foreign exchange market diagram to show the effect on the Canadian/US dollar exchange rate?

Exercise 14.7. Using a diagram to illustrate:

- (a) The demand for foreign exchange and the demand curve for foreign exchange.
- (b) The supply of foreign exchange and the supply curve for foreign exchange.
- (c) The equilibrium exchange rate.

Exercise 14.8. Use a foreign exchange market diagram to show equilibrium with a flexible or floating exchange rate to show:

- (a) How a decline in exports would affect the foreign exchange rate?

- (b) How exports and imports would change to give balance of payments equilibrium at the new equilibrium exchange rate?
- (c) The effects, if any, on the holdings of official reserves.

Exercise 14.9. Use a foreign exchange market diagram to show:

- (a) Equilibrium with a fixed exchange rate.
- (b) The effect of a decline in exports on conditions in the foreign exchange market when the exchange rate is fixed.
- (c) The amount of the purchase or sale of foreign exchange reserves required if the central bank defends the fixed exchange rate.
- (d) The effects change in the holdings of official reserves and the monetary base as a result of the defence of the fixed exchange rate.

Exercise 14.10. Use AD/AS and foreign exchange market diagrams to show why monetary policy is powerful and fiscal policy is weak when a country has a flexible exchange rate regime.

Exercise 14.11. Use AD/AS and foreign exchange market diagrams to show why the choice of a fixed exchange rate makes fiscal policy a more powerful tool for demand management. What happens to the domestic money supply when a government austerity program cuts its expenditures on goods and services and raises taxes?

In this chapter we will explore:

- 15.1 Trade in our daily lives
- 15.2 Canada in the world economy
- 15.3 Comparative advantage: the gains from trade
- 15.4 Returns to scale
- 15.5 Trade barriers: tariffs, subsidies and quotas
- 15.6 The politics of protection
- 15.7 Institutions governing trade

15.1 Trade in our daily lives

Virtually every economy in the modern world trades with other economies – they are what we call ‘open’ economies. Evidence of such openness is everywhere evident in our daily life. The world eats Canadian wheat; China exports manufactured goods to virtually anywhere we can think of; and Canadians take their holidays in Florida.

As consumers we value the choice and variety of products that trade offers. We benefit from lower prices than would prevail in a world of protectionism. At the same time there is a constant chorus of voices calling for protection from international competition: Manufacturers are threatened by production in Asia; dairy farmers cry out against the imports of poultry, beef, and dairy products; even the service sector is concerned about offshore competition from call centres and designers. In this world of competing views it is vital to understand how trade has the potential to improve the well-being of economies.

This chapter examines the theory of international trade, trade flows, and trade policy: who trades with whom, in what commodities, and why. In general, countries trade with one another because

they can buy foreign products at a lower price than it costs to make them at home. International trade reflects specialization and exchange, which in turn improve living standards. It is cost differences between countries rather than technological differences that drive trade: In principle, Canada could supply Toronto with olives and oranges grown in Nunavut greenhouses. But it makes more sense to import them from Greece, Florida or Mexico

Trade between Canada and other countries differs from trade between provinces. By definition, international trade involves jumping a border, whereas most trade within Canada does not. Internal borders are present in some instances – for example when it comes to recognizing professional qualifications acquired out of province. In the second instance, international trade may involve different currencies. When Canadians trade with Europeans the trade is accompanied by financial transactions involving Canadian dollars and Euros. A Canadian buyer of French wine pays in Canadian dollars, but the French vineyard worker is paid in euros. Exchange rates are one factor in determining national competitiveness in international markets. Evidently, not every international trade requires currency trades at the same time – members of the European Union all use the Euro. Indeed a common currency was seen as a means of facilitating trade between member nations of the EU, and thus a means of integrating the constituent economies more effectively.

15.2 Canada in the world economy

World trade has grown rapidly since the end of World War II, indicating that trade has become ever more important to national economies. Canada has been no exception. Canada signed the Free Trade Agreement with the US in 1989, and this agreement was expanded in 1994 when Mexico was included under the North America Free Trade Agreement (NAFTA). Imports and exports rose dramatically, from approximately one quarter to forty percent of GDP. Canada is now what is termed a very ‘open’ economy – one where trade forms a large fraction of total production.

Smaller economies are typically more open than large economies—Belgium and the Netherlands depend upon trade more than the United States. This is because large economies have a sufficient variety of resources to supply much of an individual country’s needs. The European Union is similar, in population terms, to the United States, but it is composed of many distinct economies. Some European economies are similar in size to individual American states. But trade between California and New York is not international, whereas trade between Italy and the Denmark is.

Because our economy is increasingly open to international trade, events in other countries affect our daily lives much more than they did some decades ago. The conditions in international markets for basic commodities and energy affect all nations, both importers and exporters. For example, the prices of primary commodities on world markets increased dramatically in the latter part of the 2000s. Higher prices for grains, oil, and fertilizers on world markets brought enormous benefits to Canada, particular the Western provinces, which produce these commodities. If these primary commodity prices fall to where they were at the turn of the millennium, Canada will lose considerably.

The service sector accounts for more of our GDP than the manufacturing sector. As incomes grow, the demand for health, education, leisure, financial services, tourism etc. dominates the demand for physical products. Technically the income elasticity demand for the former group exceeds the income elasticity of demand for the latter. Internationally, while trade in services is growing rapidly, it still forms a relatively small part of total world trade. Trade in goods—merchandise trade—remains dominant, partly because many countries import goods, add some value, and re-export them. Even though the value added from such import–export activity may make just a small contribution to GDP, the gross flows of imports and exports can still be large relative to GDP. The transition from agriculture to manufacturing and then to services has been underway in developed economies for over a century. This transition has been facilitated in recent decades by the communications revolution and globalization. Globalization has seen a rapid shift in production from the developed to the developing world.

Table 15.1 shows the patterns of Canadian merchandise trade in 2008. The United States was and still is Canada’s major trading partner, buying over 75 percent of exports and supplying more than 50 percent of Canadian imports. Table 15.2 details exports by type. Although exports of resource-based products account for only about 40 percent of total exports, Canada is now viewed as a resource-based economy. This is in part because manufactured products account for almost 80 percent of U.S. and European exports but only about 60 percent of Canadian exports. Nevertheless, Canada has important export strength in machinery, equipment, and automotive products.

	Exports by destination	Imports by source
United States	76.9	54.2
Japan	2.2	3.8
United Kingdom	3.1	2.8
Other EU economies	5.2	9.3
Other OECD economies ¹	4.3	9.1
Others ²	8.4	20.8
Total	100.0	100.0

Table 15.1: Canada’s merchandise trade patterns 2008

1. OECD, excluding United States, Japan, United Kingdom, and other EU economies.

2. Economies not included in the EU or the OECD.

Source: Adapted from Statistics Canada CANSIM Database, <http://cansim2.statcan.gc.ca>, Tables 228-0001 and 228-0002.

Sector	Percentage of total
Agriculture and fishing	9.0
Energy	24.5
Forestry	4.9
Industrial goods and materials	25.5
Machinery and equipment	17.6
Automotive products	12.9
Other consumer goods	3.6
Total	100.0

Table 15.2: Canadian goods exports 2012

Source: Adapted from Statistics Canada CANSIM Database, <http://cansim2.statcan.gc.ca>, Table 376-0007.

15.3 Comparative advantage: the gains from trade

In the opening chapter of this text we emphasized the importance of opportunity cost and differing efficiencies in the production process as a means of generating benefits to individuals through trade in the marketplace. The simple example we developed illustrated that, where individuals differ in their efficiency levels, benefits can accrue to each individual as a result of specializing and trading. In that example it was assumed that individual A had an absolute advantage in producing one product and that individual Z had an absolute advantage in producing the second good. This set-up could equally well be applied to two economies that have different efficiencies and are considering trade, with the objective of increasing their consumption possibilities. Technically, we could replace Amanda and Zoe with Argentina and Zambia, and nothing in our analysis would have to change in order to illustrate that consumption gains could be attained by both Argentina and Zambia as a result of specialization and trade.

Remember: The opportunity cost of a good is the quantity of another good or service given up in order to have one more unit of the good in question.

So, let us now consider two economies with differing production capabilities, as illustrated in Figures 15.1 and 15.2. In this instance we will assume that one economy has an absolute advantage in both goods, but the degree of that advantage is greater in one good than the other. In international trade language, there exists a comparative advantage as well as an absolute advantage. It

is frequently a surprise to students that this situation has the capacity to yield consumption advantages to both economies if they engage in trade, even though one is absolutely more efficient in producing both of the goods. This is what is called the **principle of comparative advantage**, and it states that even if one country has an absolute advantage in producing both goods, gains to specialization and trade still materialize, provided the opportunity cost of producing the goods differs between economies. This is a remarkable result, and much less intuitive than the principle of absolute advantage. We explore it with the help of the example developed in Figures 15.1 and 15.2.

Principle of comparative advantage states that even if one country has an absolute advantage in producing both goods, gains to specialization and trade still materialize, provided the opportunity cost of producing the goods differs between economies.

The two economies considered are the US and Canada. Their production possibilities are defined by the *PPFs* in Figure 15.1. Canada can produce 5 units of V or 35 units of F , or any combination defined by the line joining these points. The US can produce 8 V or 40 F , or any combination defined by its *PPF*¹. Let Canada initially consume 3 V and 14 F , and the US consume 5 V and 15 F . These combinations lie on their respective *PPFs*. The opportunity cost of a unit of V in Canada is 7 F (the slope of Canada's *PPF* is $5/35 = 1/7$). In the US the opportunity cost of one unit of V is 5 F (slope is $8/40 = 1/5$). In this set-up the US is more efficient in producing V than F relative to Canada, as reflected by the opportunity costs. Hence we say that the *US has a comparative advantage in the production of V* and that *Canada has therefore a comparative advantage in producing F*.

¹Note that we are considering the *PPFs* to be straight lines rather than concave shapes. The result we illustrate here carries over to that case also, but it is simpler to illustrate with the linear *PPFs*.

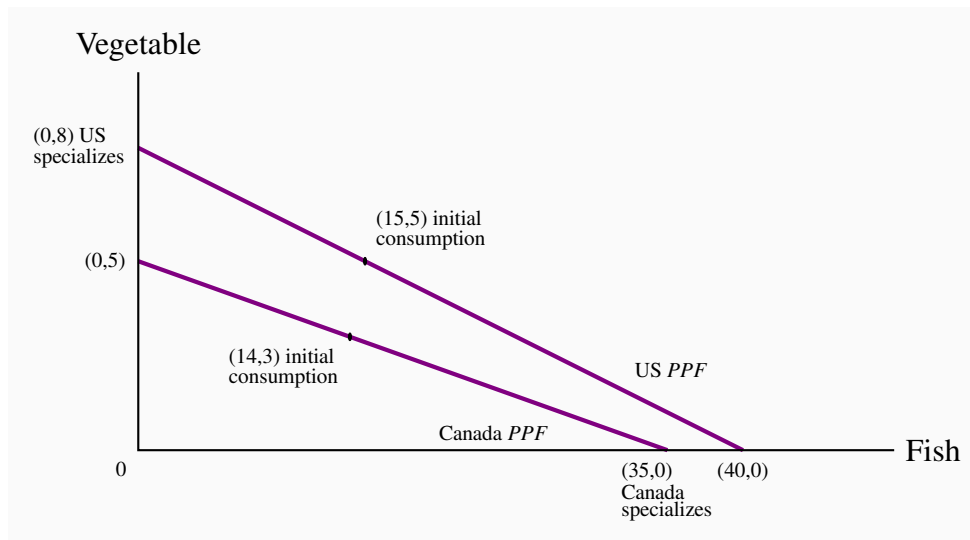


Figure 15.1: Comparative advantage – production

Canada specializes completely in Fish at (35,0), where it has a comparative advantage. Similarly, the US specializes in Vegetable at (0,8). They trade at a rate of 1:6. The US trades 3V to Canada in return for 18F.

Prior to trade each economy is producing all of the goods it consumes. This no-trade state is termed **autarky**.

Autarky denotes the no-trade situation.

The gains from trade

We now permit each economy to specialize in producing where it has a comparative advantage. So Canada specializes completely by producing 35F and the US produces 8V. Having done this the economies must now agree on the terms of trade. The **terms of trade** define the rate at which the two goods will trade post-specialization. Let us suppose that a bargaining process leads to agreement that one unit of V will trade for six units of F. Such a trading rate, one that lies between the opportunity costs of each economy, benefits both economies. By specializing in F, Canada can now obtain an additional unit of V by sacrificing six units of F, whereas pre trade it had to sacrifice seven units of F for a unit of V. Technically, by specializing in F and trading at a rate of 1:6 Canada's consumption possibilities have expanded and are given by the consumption possibility frontier (CPF) illustrated in Figure 15.2. The **consumption possibility frontier** defines what an economy can consume after production specialization and trade.

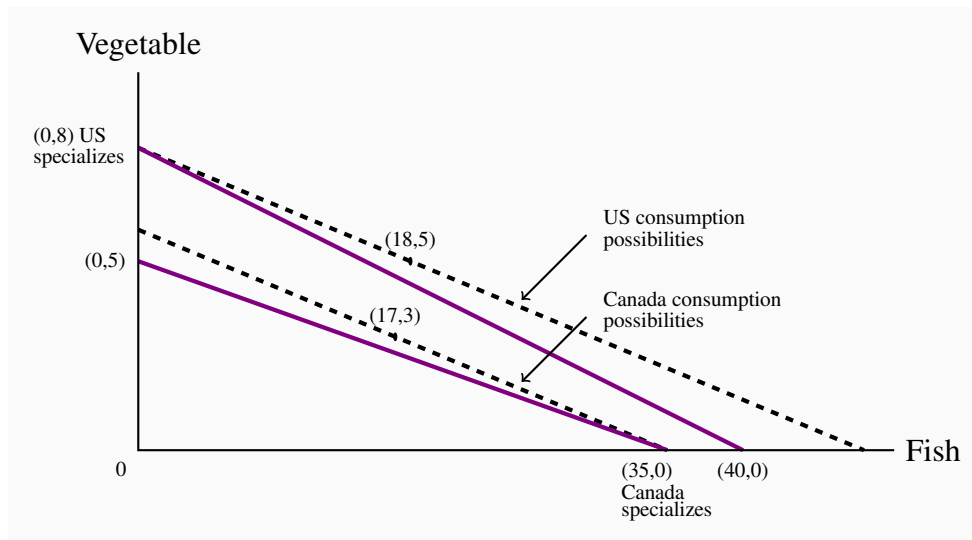


Figure 15.2: Comparative advantage – consumption

Post specialization the economies trade $1V$ for $6F$. Total production is $35F$ plus $8V$. Hence once consumption possibility would be $(18,5)$ for the US and $(17,3)$ for Canada. Here Canada exchanges $18F$ in return for $3V$.

The US also experiences an improved set of consumption possibilities. By specializing in V and trading at a rate of $1:6$ its CPF lies outside its PPF and this enables it to consume more than in the pre-specialization state, where its CPF was defined by its PPF .

Terms of trade define the rate at which the goods trade internationally.

Consumption possibility frontier defines what an economy can consume after production specialization and trade.

Evidently, the US and Canada CPFs are parallel since they trade with each other at the same rate: if Canada exports six units of F for every unit of V that it imports from the US, then the US must import the same six units of F for each unit of V it exports to Canada. To illustrate the gains numerically, let Canada import $3V$ from the US in return for exporting $18F$. Note that this is a trading rate of $1:6$. Hence, Canada consumes $3V$ and $17F$ (Canada produced $35F$ and exported $18F$, leaving it with $17F$). It follows that the US consumes $5V$, having exported $3V$ of the $8V$ it produced, and obtained in return $18F$ in imports. The new consumption bundles are illustrated in the figure: $(17F, 3V)$ for Canada and $(18F, 5V)$ for the US. Comparing these combinations with the pre-trade scenario, we see that each economy consumes more of one good and not less of the other. Hence the well-being of each has increased as a result of their increased consumption.

Comparative advantage constitutes a remarkable result. It indicates that gains to trade are to be

reaped by an efficient economy, by trading with an economy that may be less efficient in producing each good.

Comparative advantage and factor endowments

A traditional statement of why comparative advantage arises is that economies have different endowments of the factors of production – land, capital and labour endowments differ. A land endowment that facilitates the harvesting of grain (Saskatchewan) or the growing of fruit (California) may be innate to an economy. We say that wheat production is *land intensive*, that aluminum production is *power intensive*, that research and development is *skill intensive*, that auto manufacture is *capital intensive*. Consequently, if a country is well endowed with some particular factors of production, it is to be expected that it will specialize in producing goods that use those inputs. A relatively abundant supply or endowment of one factor of production tends to make the cost of using that factor relatively cheap: it is relatively less expensive to produce clothing in Hong Kong and wheat in Canada than the other way around. This explains why Canada's Prairies produce wheat, why Quebec produces aluminum, why Asia produces apparel. But endowments can evolve.

How can we explain why Switzerland specializes in watches, precision instruments, and medical equipment, while Vietnam specializes in rice and tourism? Evidently, Switzerland made a decision to educate its population and invest in the capital required to produce these goods. It was not naturally endowed with these skills, in the same way that Greece is endowed with sun or Saskatchewan is endowed with fertile flat land.

While we have demonstrated the principle of comparative advantage using a two-good example (since we are constrained by the geometry of two dimensions), the conclusions carry over to the case of many goods. Finally it is to be noted that the benefits to specialization that we proposed in Chapter 1 carry over to our everyday lives in the presence of comparative advantage: If one person in the household is more efficient at doing all household chores than another, there are still gains to specialization provided the efficiency differences are not all identical. This is the principle of comparative advantage at work in a microcosm.

In 2005 two young British Columbians embarked on what has famously become known as the one hundred mile diet—a challenge to eat and drink only products grown within this distance of their home. They succeeded in doing this for a whole year, wrote a book on their experience and went on to produce a TV series. They were convinced that such a project is good for humanity, partly because they wrapped up ideas on organic farming and environmentally friendly practices in the same message.

Reflect now on the implications of this superficially attractive program: If North Americans were to espouse this diet, it would effectively result in the closing down of the mid-west of the Continent. From Saskatchewan to Kansas, we are endowed with grain-producing land that is the envy of the planet. But since most of this terrain is not within 100 miles of any big cities, these deluded advocates are proposing that we close up the production of grains and cereals exactly in those locations where such production is extraordinarily efficient. Should we sacrifice grains and cereals completely in this hemisphere, or just cultivate them on a hillside close to home, even if the resulting cultivation were to be more labour and fuel intensive? Should we produce olives in greenhouses in Edmonton rather than importing them from the Mediterranean, or simply stop eating them? Should we sacrifice wine and beer in North Battleford because insufficient grapes and hops are grown locally?

Would production in temperate climates really save more energy than the current practice of shipping vegetables and fruits from a distance—particularly when there are returns to scale associated with their distribution? The one hundred mile diet is based on precepts that are contrary to the norms of the gains from trade. In its extreme the philosophy proposes that food exports be halted and that the world's great natural endowments of land, water, and sun be allowed to lie fallow. Where would that leave a hungry world?

Application Box 15.1: The one hundred mile diet

The role of exchange rates

What we have shown in the foregoing examples is that there exists a *potential for gain*, in the presence of comparative advantage, not that gains are actually realized. Such gains depend upon markets, not economic planners, and countries usually trade with each other using different currencies which themselves have a market. The rate at which one currency trades for another is the exchange rate. Citizens of Canada buy U.S. goods if these goods sell more cheaply in Canada than Canadian-produced goods, not because some economist has told them about the principle of comparative advantage! In recent years the Canadian dollar has traded more or less at parity with the US dollar: one Canadian dollar could buy one US dollar. But in the late nineteen nineties a Canadian dollar could only purchase seventy US cents – it was more costly for Canadians to buy American products with their Canadian dollars. When it is more costly for Canadians to purchase foreign products we buy less of them. Hence the *actual* trade flow between economies depends

upon both the efficiency with which goods are produced in the different economies and also the exchange rate between the economies.

15.4 Intra-industry trade

One of the reasons Canada signed the North America Free trade Agreement (NAFTA) was that economists convinced the Canadian government that a larger market would enable Canadian producers to be even *more efficient* than in the presence of trade barriers. This then is a slightly different justification for encouraging trade: rather than opening up trade in order to take advantage of existing comparative advantage, it was proposed that efficiencies would actually increase with market size. So this argument is easily understood if we think in terms of increasing returns to scale that lower costs as output is increased. Economists told the government that there were several sectors of the economy that were operating on the downward sloping section of their long-run average cost curve.

Increasing returns are evident in the world market place as well as the domestic marketplace. Witness the small number of aircraft manufacturers—Airbus and Boeing are the world’s two major manufacturers of large aircraft. Enormous fixed costs—in the form of research, design, and development—or capital outlays frequently result in decreasing unit costs, and the world marketplace can be supplied at a lower cost if some specialization can take place. What insights does comparative advantage offer here? In fact it is not at all surprising that these corporations, formed several decades ago, emerged in North America and Europe. The development of the end product requires enormous intellectual resources, and in the earlier days of these corporations Europe and North America certainly had a comparative advantage in scientific research.

The theories of absolute and comparative advantage explain why economies specialize in producing some products rather than others. But actual trade patterns are more subtle than this. In North America, we observe that Canadian auto plants produce different models than their counterparts in the U.S. Canada exports some *models* of a given manufacturer to the United States and imports other *models*. This is the phenomenon of **intra-industry trade** and **intra-firm trade**. How can we explain these patterns?

Intra-industry trade is two-way international trade in products produced within the same industry.

Intra-firm trade is two-way trade in international products produced within the same firm.

In the first instance, intra-industry trade reflects the preference of consumers for a choice of brands; consumers do not all want the same car, or the same software, or the same furnishings. The second element to intra-industry trade is that increasing returns to scale characterize many production

processes. Let us see if we can transform the returns to scale ideas developed in earlier chapters into a production possibility framework.

Consider the example presented in Figure 15.3. The hypothetical company Hunda Motor Corporation (HMC) currently has a large assembly plant in *each of* Canada and the US. Restrictions on trade in automobiles between the two countries make it too costly to ship models across the border. Hence Hunda produces both sedans and SUVs in each plant. But for several reasons, *switching between models is costly and results in reduced output*. Hunda can produce 40,000 vehicles of each type per annum in its plants, but could produce 100,000 of a single model in each plant. This is a situation of increasing returns to scale, and in this instance these scale economies are what determine the trade outcome rather than any innate comparative advantage between the economies.

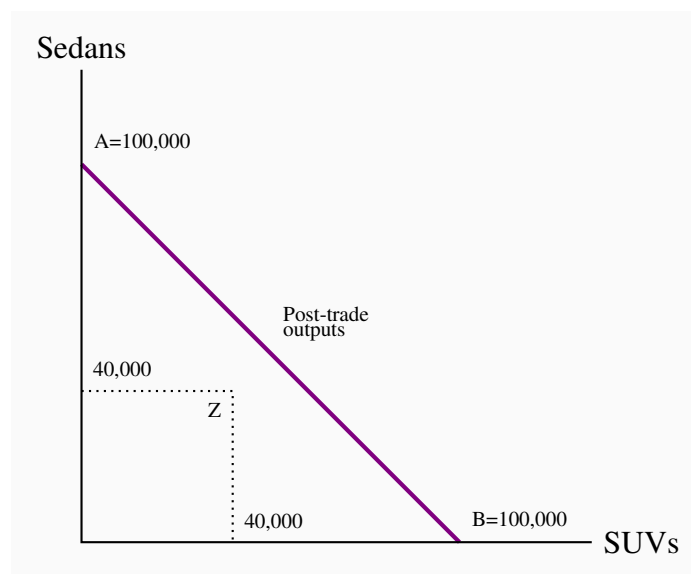


Figure 15.3: Intra industry trade

Hunda can produce either 100,000 of each vehicle or 40,000 of both in each plant. Hence production possibilities are given by the points A, Z, and B. Pre-trade it produces at Z in each economy due to trade barriers. Post-trade it produces at A in one economy and B in the other, and ships the vehicles internationally. Total production increases from 160,000 to 200,000 using the same resources.

15.5 Trade barriers: tariffs, subsidies and quotas

A **tariff** is a tax on an imported product that is designed to limit trade in addition to generating tax revenue. It is a barrier to trade. There also exist **quotas**, which are quantitative restrictions on imports; other **non-tariff barriers**, such as product content requirements; and **subsidies**. By rais-

ing the domestic price of imports, a tariff helps domestic producers but hurts domestic consumers. Quotas and other non-tariff barriers have similar impacts.

A **tariff** is a tax on an imported product that is designed to limit trade in addition to generating tax revenue. It is a barrier to trade.

A **quota** is a quantitative limit on an imported product.

A **trade subsidy** to a domestic manufacturer reduces the domestic cost and limits imports.

Non-tariff barriers, such as product content requirements, limit the gains from trade.

In Canada, tariffs were the main source of government revenues, both before and after Confederation in 1867 and up to World War I. They provided incidental protection for domestic manufacturing. After the 1878 federal election, tariffs were an important part of the National Policy introduced by the government of Sir John A. MacDonald. The broad objective was to create a Canadian nation based on east-west trade and growth.

This National Policy had several dimensions. Initially, to support domestic manufacturing, it increased tariff protection on foreign manufactured goods, but lowered tariffs on raw materials and intermediate goods used in local manufacturing activity. The profitability of domestic manufacturing improved. But on a broader scale, tariff protection, railway promotion Western settlement, harbour development, and transport subsidies to support the export of Canadian products were intended to support national economic development. Although reciprocity agreements with the United States removed duties on commodities for a time, tariff protection for manufactures was maintained until the GATT negotiations of the post-World War II era.

Application Box 15.2: Tariffs – the national policy of J.A. MacDonald

Tariffs

Figure 15.4 describes how tariffs operate. We can think of this as the Canadian wine market—a market that is heavily taxed in Canada. The world price of Cabernet Sauvignon is \$10 per bottle, and this is shown by the horizontal world supply curve at that price. It is horizontal because our domestic market accounts for only a small part of the world demand for wine. International producers can supply us with any amount we wish to buy at the world price. The Canadian demand for this wine is given by the demand curve D , and Canadian suppliers have a supply curve given by S (Canadian Cabernet is assumed to be of the same quality as the imported variety in this example). At a price of \$10, Canadian consumers wish to buy Q_D litres, and domestic producers

wish to supply Q_S litres. The gap between domestic supply Q_S and domestic demand Q_D is filled by imports. This is the *free trade equilibrium*.

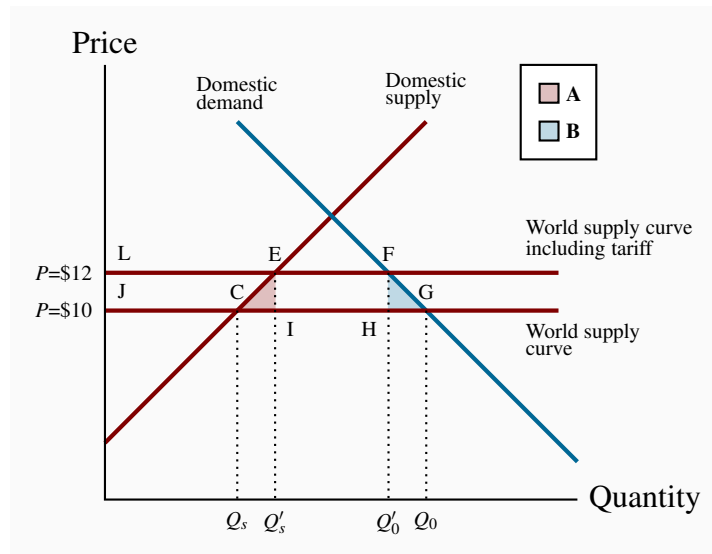


Figure 15.4: Tariffs and trade

At a world price of \$10 the domestic quantity demanded is Q_0 . Of this amount Q_s is supplied by domestic producers and the remainder by foreign producers. A tariff increases the world price to \$12. This reduces demand to Q'_0 ; the domestic component of supply increases to Q'_s . Of the total loss in consumer surplus (LFGJ), tariff revenue equals EFHI, increased surplus for domestic suppliers equals LECJ, and the deadweight loss is therefore the sum of the triangular areas A and B.

If the government now imposes a 20 percent tariff on imported wines, foreign wine sells for \$12 a bottle, inclusive of the tariff. The tariff raises the domestic ‘tariff-inclusive’ price above the world price, and this shifts the supply of this wine upwards. By raising wine prices in the domestic market, the tariff protects domestic producers by raising the domestic price at which imports become competitive. Those domestic suppliers who were previously not quite competitive at a global price of \$10 are now competitive. The total quantity demanded falls from Q_D to Q'_D at the new equilibrium F. Domestic producers supply the amount Q'_S and imports fall to the amount $(Q'_D - Q'_S)$. Reduced imports are partly displaced by domestic producers who can supply at prices between \$10 and \$12. Hence, imports fall both because total consumption falls and because domestic suppliers can displace some imports under the protective tariff.

Since the tariff is a type of tax, its impact in the market depends upon the elasticities of supply and demand, (as illustrated in *Microeconomics* Chapters 4 and 5). The more elastic is the demand curve, the more a given tariff reduces imports. In contrast, if it is inelastic the quantity of imports declines less.

Costs and benefits of a tariff

The costs of a tariff come from the higher price to consumers, but this is partly offset by the tariff revenue that goes to the government. This tariff revenue is a benefit and can be redistributed to consumers or spent on goods from which consumers derive a benefit. But there are also efficiency costs associated with tariffs—deadweight losses, as we call them. These are the real costs of the tariff, and they arise because the marginal cost of production does not equal the marginal benefit to the consumer. Let us see how these concepts apply with the help of Figure 15.4.

Consumer surplus is the area under the demand curve and above the equilibrium market price. It represents the total amount consumers would have been willing to pay for the product but did not have to pay at the equilibrium price. It is a measure of consumer welfare. The tariff raises the market price and reduces this consumer surplus by the amount LFGJ. This area measures by how much domestic consumers are worse off as a result of the price increase caused by the tariff. But this is not the net loss for the whole domestic economy, because the government obtains some tax revenue and domestic producers get more revenue and profit.

Government revenue accrues from the domestic sales of imports. On imports of $(Q'_D - Q'_S)$, tax revenue is EFHI. Then, domestic producers obtain an additional profit of LECJ—the excess of additional revenue over their cost per additional bottle. If we are not concerned about who gains and who loses, it is clear that there is a net loss to the domestic economy equal to the areas A and B.

The area B is the standard measure of deadweight loss. At the quantity Q'_D , the cost of an additional bottle is less than the value placed on it by consumers; and, by not having those additional bottles supplied, consumers forgo a potential gain. The area A tells us that when supply by domestic higher-cost producers is increased, and supply of lower-cost foreign producers is reduced, the corresponding resources are not being used efficiently. The sum of the areas A and B is therefore the total deadweight loss of the tariff.

Production subsidies

Figure 15.5 illustrates the effect of a subsidy to a domestic supplier. As in Figure 15.4, the amount Q_D is demanded in the free trade equilibrium and, of this, Q_S is supplied domestically. With a subsidy per unit of output sold, the government can reduce the supply cost of the domestic supplier, thereby shifting the supply curve downward from S to S' . In this illustration, the total quantity demanded remains at Q_D , but the domestic share increases to Q'_S .

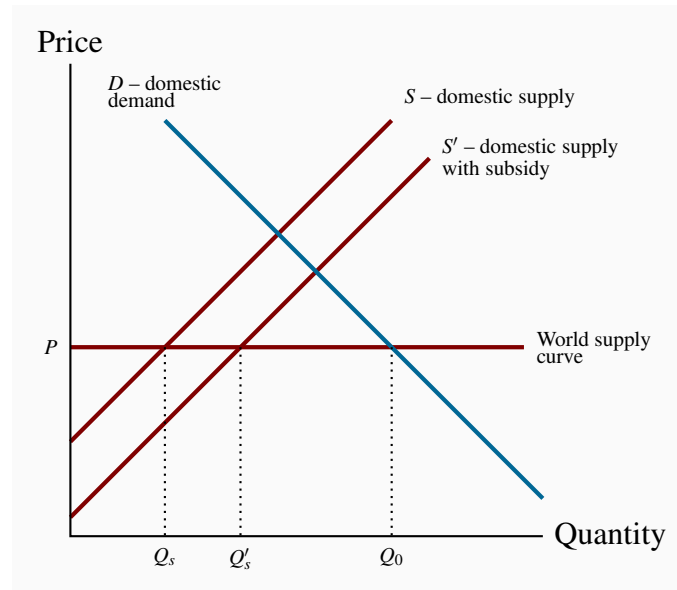


Figure 15.5: Subsidies and trade

With a world supply price of P , a domestic supply curve S , and a domestic demand D , the amount Q_0 is purchased. Of this, Q_s is supplied domestically and $(Q_0 - Q_s)$ by foreign suppliers. A per-unit subsidy to domestic suppliers shifts their supply curve to S' , and increases their market share to Q'_s .

The new equilibrium represents a misallocation of resources. When domestic output increases from Q_s to Q'_s , a low-cost international producer is being replaced by a higher cost domestic supplier; the domestic supply curve S lies above the international supply curve P in this range of output.

Note that this example deals with a subsidy to domestic suppliers who are selling in the domestic market. It is not a subsidy to domestic producers who are selling in the international market – an export subsidy.

Quotas

A quota is a limit placed upon the amount of a good that can be imported. Consider Figure 15.6, where again there is a domestic supply curve coupled with a world price of P . Rather than imposing a tariff, the government imposes a quota that restricts imports to a physical amount denoted by the distance *quota* on the quantity axis. The supply curve facing domestic consumers then has several segments to it. First it has the segment RC , reflecting the fact that domestic suppliers are competitive with world suppliers up to the amount C . Beyond this output, world suppliers can supply at a price of P , whereas domestic suppliers cannot compete at this price. Therefore

the supply curve becomes horizontal, but only *up to the amount permitted under the quota*—the quantity CU corresponding to *quota*. Beyond this amount, international supply is not permitted and therefore additional amounts are supplied by the (higher cost) domestic suppliers. Hence the supply curve to domestic buyers becomes the supply curve from the domestic suppliers once again.

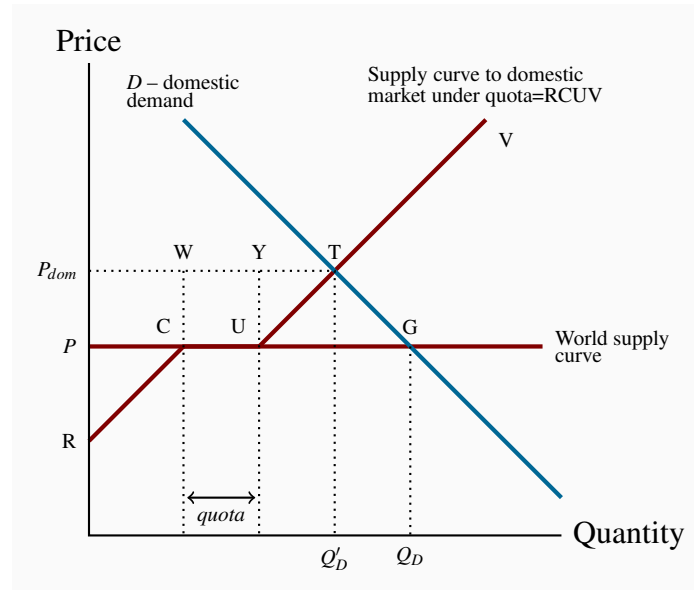


Figure 15.6: Quotas and trade

At the world price P , plus a *quota*, the supply curve becomes RCUV. This has three segments: (i) domestic suppliers who can supply below P ; (ii) *quota*; and (iii) domestic suppliers who can only supply at a price above P . The quota equilibrium is at T, with price P_{dom} and quantity Q'_D ; the free-trade equilibrium is at G. Of the amount Q'_D , *quota* is supplied by foreign suppliers and the remainder by domestic suppliers. The quota increases the price in the domestic market.

The resulting supply curve yields an equilibrium quantity Q'_D . There are several features to note about this equilibrium. First, the quota pushes the domestic price above the world price because low-cost international suppliers are partially supplanted by higher-cost domestic suppliers. Second, if the quota is chosen ‘appropriately’, the same domestic market price could exist under the quota as under the tariff in Figure 15.4. Third, in contrast to the tariff case, the government obtains no tax revenue from the quotas. Fourth, there are inefficiencies associated with the equilibrium at Q'_D : consumers lose the amount $PGTP_{dom}$ in surplus. Against this, suppliers gain $PUTP_{dom}$ (domestic suppliers gain the amount $PCWP_{dom} + UYT$, which represents the excess of market price over their “willingness to supply” price. Importers are limited by the quota but can still buy CU at price P , sell at P_{dom} , and therefore gain a surplus equal to CUYW). Therefore the deadweight loss of the quota is the area UTG—the difference between the loss in consumer surplus and the gain in supplier surplus.

In 1978 the federal government set a cheese import quota for Canada at just over 20,000 tonnes. This quota was implemented initially to protect the interests of domestic suppliers. Despite a strong growth in population and income in the intervening decades, the import quota has remained unchanged. The result is a price for cheese that is considerably higher than it would otherwise be. The quotas are owned by individuals and companies who have the right to import cheese. The quotas are also traded among importers, at a price. Importers wishing to import cheese beyond their available quota pay a tariff of about 250 percent. So, while the consumer is the undoubted loser in this game, who gains?

First the suppliers gain, as illustrated in Figure 15.5. Canadian consumers are required to pay high-cost domestic producers who displace lower-cost producers from overseas. Second, the holders of the quotas gain. With the increase in demand for cheese that comes with higher incomes, the domestic price increases over time and this in turn makes an individual quota more valuable.

Application Box 15.3: Cheese quota in Canada

15.6 The politics of protection

Objections to imports are frequent and come from many different sectors of the economy. In the face of the gains from trade which we have illustrated in this chapter, why do we observe such strong rejections to imported goods and services?

Structural change and technology

In a nutshell the answer is that while consumers in the aggregate gain from the reduction of trade barriers, and there is a net gain to the economy at large, some *individual sectors of the economy lose out*. Not surprisingly the sectors that will be adversely affected are vociferous in lodging their objections. Sectors of the economy that cannot compete with overseas suppliers generally see a reduction in jobs. This has been the case in the manufacturing sector of the Canadian and US economies in the most recent two decades, as manufacturing and assembly has flown off-shore to Asia and Mexico where labour costs are lower. Domestic job losses are painful, and frequently workers who have spent decades in a particular job find reemployment difficult, and rarely get as high a wage as in their displaced job.

Such job losses are reflected in calls for tariffs on imports from China in order to ‘level the playing field’ – that is, to counter the impact of lower wages in China. Of course it is precisely because of lower labour costs in China that the Canadian consumer benefits.

In Canada we deal with such dislocation first by providing ‘unemployment’ payments to workers and second by furnishing retraining allowances from Canada’s Employment Insurance program. Of course, such support does not guarantee an equally good alternative job. But structural changes in the economy, due to both internal and external developments, must be confronted. For example, the information technology revolution made tens of thousands of ‘data entry’ workers redundant. Should producers have shunned the technological developments which increased their productivity dramatically? If they did, would they be able to compete in world markets?

While job losses feature heavily in protests against technological development and freer trade, most modern economies continue to grow and create more jobs in the service sector than are lost in the manufacturing sector. Developed economies now have many more workers in service than manufacture. Service jobs are not just composed of low-wage jobs in fast food establishments – ‘Mcjobs’, they are high paying jobs in the health, education, legal, financial and communications sectors of the economy.

Successful lobbying and concentration

While efforts to protect manufacture have not resulted in significant barriers to imports of manufactures, objections in some specific sectors of the economy seem to be effective worldwide. One sector that stands out is agriculture. Not only does Canada have very steep barriers to imports of dairy products such as milk and cheese, the US and the European Union have policies that limit imports and subsidize their domestic producers. Europe has had its ‘wine lakes’ and ‘butter mountains’ due to excessive government intervention in these sectors; the US has subsidies to sugar producers and Canada has a system of quotas on the domestic supply of dairy products and corresponding limits on imports.

Evidently, in the case of agriculture, political conditions are conducive to the continuance of protection and what is called ‘supply management’ – domestic production quotas. The reason for ‘successful’ supply limitation appears to rest in the geographic concentration of potential beneficiaries of such protection and the scattered beneficiaries of freer trade on the one hand, and the costs and benefits of political organization on the other: Farmers tend to be concentrated in a limited number of rural electoral ridings and hence they can collectively have a major impact on electoral outcomes. Second, the benefits that accrue to trade restriction are heavily concentrated in the economy – keep in mind that about three percent of the population lives on farms, or relies on farming for its income. By contrast the costs on a per person scale are small, and are spread over the whole population. Thus, in terms of the costs of political organization, the incentives for consumers are small, but the incentives for producers are high.

In addition to the differing patterns of costs and benefits, rural communities tend to be more successful in pushing trade restrictions based on a ‘way of life’ argument. By permitting imports that might displace local supply, lobbyists are frequently successful in convincing politicians that long-standing way-of-life traditions would be endangered, even if such ‘traditions’ are accompanied by monopoly purchase – as was the case under the Canadian Wheat Board until 2012, or tariffs as

high as 250% – as is the case on cheese above a specific import quota.

Valid trade barriers: infant industries and dumping?

An argument that carries both intellectual and emotional appeal to voters is the ‘infant industry’ argument. The argument goes as follows: new ventures and sectors of the economy may require time before that can compete internationally: scale economies may be involved for example, and time may be required for producers to expand their scale of operation, at which time costs will have fallen to international (i.e. competitive) levels. In addition learning by doing may be critical in more high-tech sectors, and once again, with the passage of time costs should decline for this reason also.

There are two problems with this stance: first, is that these infants would have insufficient incentive to grow up and become competitive; the second is why the private sector cannot invest sufficiently in promising young sectors. A protection measure that is initially intended to be temporary can become permanent because of the potential job losses associated with a cessation of the protection to an industry that fails to become internationally competitive. Furthermore, employees and managers in protected sectors have insufficient incentive to make their production competitive if they realize that their government will always be there to protect them. As for the need for protection rather than private sector investment: if the industry is such a good idea in the long run, society should begin by asking why private firms cannot borrow the money to see them through the early period when they are losing out to more efficient foreign firms. If private lenders are not prepared to invest or lend, should the government be willing to step in? Does the government know more than the private sector about long-term investment returns?

In contrast to the infant industry argument, economists are more favourable to restrictions that are aimed to prevent ‘dumping’. **Dumping** is a predatory practice, based on artificial costs aimed at driving out domestic producers.

Dumping is a predatory practice, based on artificial costs aimed at driving out domestic producers.

Dumping may occur either because foreign suppliers choose to sell at artificially low prices (prices below their marginal cost for example), or because of surpluses in foreign markets resulting from oversupply. For example, if, as a result of price support in its own market, a foreign government induced oversupply in butter and it chose to sell such butter on world markets at a price well below the going (‘competitive’) world supply price, such a sale would be a case of dumping. Alternatively, an established foreign supplier might choose to enter our domestic market by selling its products at artificially low prices, with a view to driving domestic competition out of the domestic market. Having driven out the domestic competition it would then be in a position to raise prices. Such behaviour differs from a permanently lower price on the part of foreign suppliers. This latter

may be welcomed as a gain from trade, whereas the former may generate no gains and serve only to displace domestic labour and capital.

15.7 Institutions governing trade

In the nineteenth century, world trade grew rapidly, in part because the leading trading nation at the time—the United Kingdom—pursued a vigorous policy of free trade. In contrast, US tariffs averaged about 50 percent, although they had fallen to around 30 percent by the early 1920s. As the industrial economies went into the Great Depression of the late 1920s and 1930s, there was pressure to protect domestic jobs by keeping out imports. Tariffs in the United States returned to around 50 percent, and the United Kingdom abandoned the policy of free trade that had been pursued for nearly a century. The combination of world recession and increasing tariffs led to a disastrous slump in the volume of world trade, further exacerbated by World War II.

The WTO and GATT

After World War II, there was a collective determination to see world trade restored. Bodies such as the International Monetary Fund and the World Bank were set up, and many countries signed the General Agreement on Tariffs and Trade (GATT), a commitment to reduce tariffs successively and dismantle trade restrictions.

Under successive rounds of GATT, tariffs fell steadily. By 1960, United States tariffs were only one-fifth their level at the outbreak of the War. In the United Kingdom, the system of wartime quotas on imports had been dismantled by the mid-1950s, after which tariffs were reduced by nearly half in the ensuing 25 years. Europe as a whole moved toward an enlarged European Union in which tariffs between member countries have been abolished. By the late 1980s, Canada's tariffs had been reduced to about one-quarter of their immediate post-World War II level.

The GATT Secretariat, now called the World Trade Organization (WTO), aims both to dismantle existing protection that reduces efficiency and to extend trade liberalization to more and more countries. Tariff levels throughout the world are now as low as they have ever been, and trade liberalization has been an engine of growth for many economies. The consequence has been a substantial growth in world trade.

NAFTA and the EU

In North America, recent trade policy has led to a free trade area that covers the flow of trade between Canada, the United States, and Mexico. The Canada/United States free trade agreement

(FTA) of 1989 expanded in 1994 to include Mexico in the North American Free Trade Agreement (NAFTA). The objective in both cases was to institute free trade between these countries in most goods and services. This meant the elimination of tariffs over a period of years and the reduction or removal of non-tariff barriers to trade, with a few exceptions in specific products and cultural industries. Evidence of the success of these agreements is reflected in the fact that Canadian exports have grown to more than 30 percent of GDP, and trade with the United States accounts for the lion's share of Canadian trade flows.

The European Union was formed after World War II, with the prime objective of bringing about a greater degree of *political* integration in Europe. Two world wars had laid waste to their economies and social fabric. Closer economic ties and greater trade were seen as the means of achieving this integration. The Union was called the “Common Market” for much of its existence. The Union originally had six member states, but as of 2009 the number is 27, with several other candidate countries in the process of application, most notably Turkey. The European Union (EU) has a secretariat and parliament in Bruxelles. You can find more about the EU at <http://europa.eu>.

KEY CONCEPTS

Autarky denotes the no-trade situation.

Principle of comparative advantage states that even if one country has an absolute advantage in producing both goods, gains to specialization and trade still materialize, provided the opportunity cost of producing the goods differs between economies.

Terms of trade define the rate at which goods trade internationally.

Consumption possibility frontier defines what an economy can consume after production specialization and trade.

Intra-industry trade is two-way international trade in products produced within the same industry.

Intra-firm trade is two-way trade in international products produced within the same firm.

Tariff is a tax on an imported product that is designed to limit trade in addition to generating tax revenue. It is a barrier to trade.

Quota is a quantitative limit on an imported product.

Trade subsidy to a domestic manufacturer reduces the domestic cost and limits imports.

Non-tariff barriers, such as product content requirements, limits the gains from trade.

Dumping is a predatory practice, based on artificial costs aimed at driving out domestic producers

EXERCISES FOR CHAPTER 15

Exercise 15.1. The following table shows the labour input requirements to produce a bushel of wheat and a litre of wine in two countries, Northland and Southland, on the assumption of constant cost production technology – meaning that the production possibility curves in each are straight lines.

Labour requirements per unit produced		
	Northland	Southland
Per bushel of wheat	1	3
Per litre of wine	2	4

- Which country has an absolute advantage in the production of both wheat and wine?
- What is the opportunity cost of wheat in each economy? Of wine?
- What is the pattern of comparative advantage here?
- Suppose the country with a comparative advantage in wine reduces wheat production by one bushel and reallocates the labour involved to wine production. How much additional wine does it produce?
- Which country, if either, gains from this change in production and trade, and what is the gain?
- If the country with the comparative advantage in wheat reduced wine production enough to increase wheat production by one bushel, how much wine could it get by selling the additional bushel of wheat to the other country at that economy's opportunity cost?

Exercise 15.2. Canada and the United States can produce two goods, xylophones and yogourt. Each good can be produced with labour alone. Canada requires 60 hours to produce a ton of yogourt and 6 hours to produce a xylophone. The United States requires 40 hours to produce the ton of yogourt and 5 hours to produce a xylophone.

- Describe the state of absolute advantage between these economies in producing goods.
- In which good does Canada have a comparative advantage? Does this mean the United States has a comparative advantage in the other good?
- Draw the production possibility frontier for each economy to scale on a diagram, assuming that each economy has an endowment of 240 hours of labour.

- (d) On the same diagram, draw Canada's consumption possibility frontier on the assumption that it can trade with the United States at the United States rate of transformation.
- (e) Draw the US consumption possibility frontier under the assumption that it can trade at Canada's rate of transformation.

Exercise 15.3. The domestic demand for bicycles is given by $P = 36 - 0.3Q$. The foreign supply is given by $P = 18$ and domestic supply by $P = 16 + 0.4Q$.

- (a) Illustrate the market equilibrium on a diagram, and compute the amounts supplied by domestic and foreign suppliers.
- (b) If the government now imposes a tariff of \$6 per unit on the foreign good, illustrate the impact geometrically, and compute the new quantities supplied by domestic and foreign producers.
- (c) In the diagram, illustrate the area representing tariff revenue and compute its value.

Exercise 15.4. In Exercise 15.3, illustrate the deadweight losses associated with the imposition of the tariff, and compute the amounts.

- (a) Compute the additional amount of profit made by the domestic producer as a result of the tariff. [Hint: refer to Figure 15.4 in the text.]

Exercise 15.5. The domestic demand for office printers is given by $P = 40 - 0.2Q$. The supply of domestic producers is given by $P = 12 + 0.1Q$, and international supply by $P = 20$.

- (a) Illustrate this market geometrically.
- (b) Compute total demand and the amounts supplied by domestic and foreign suppliers.
- (c) If the government gives a production subsidy of \$2 per unit to domestic suppliers in order to increase their competitiveness, calculate the new amounts supplied by domestic and foreign producers. [Hint: The domestic supply curve becomes $P = 10 + 0.1Q$].
- (d) Compute the cost to the government of this scheme.

Exercise 15.6. The domestic demand for turnips is given by $P = 128 - (1/2)Q$. The market supply of domestic suppliers is given by $P = 12 + (1/4)Q$, and the world price is \$32 per bushel.

- (a) First graph this market and then solve for the equilibrium quantity purchased.
- (b) How much of the quantity traded will be produced domestically and how much will be imported?
- (c) Assume now that a quota of 76 units is put in place. Illustrate the resulting market equilibrium graphically.

- (d) Compute the domestic price of turnips and the associated quantity traded with the quota in place. [Hint: you could shrink the demand curve in towards the origin by the amount of the quota and equate the result with the domestic supply curve].

Exercise 15.7. The domestic market for cheese is given by $P = 108 - 2Q$ and $P = 16 + 1/4Q$. These are the demand and supply conditions. The good can be supplied internationally at a constant price $P = 20$.

- (a) Illustrate the domestic market in the absence of trade and solve for the equilibrium price and quantity.
- (b) With free trade illustrate the market graphically and compute the total amount purchased, and the amounts supplied by domestic and international suppliers.
- (c) Suppose now that the government implements a price floor in the domestic market equal to \$28. Illustrate the market outcome graphically.
- (d) For the outcome with a price floor, compute the quantity supplied by domestic and international suppliers respectively.

Exercise 15.8. The following are hypothetical production possibilities tables for Canada and the United States. For each line required, plot any two or more points on the line.

	Canada					United States			
	A	B	C	D		A	B	C	D
Peaches	0	5	10	15	Peaches	0	10	20	30
Apples	30	20	10	0	Apples	15	10	5	0

- (a) Plot Canada's production possibilities curve by plotting at least 2 points on the curve.
- (b) Plot the United States' production possibilities curve by plotting at least 2 points on the curve on the graph above.
- (c) What is each country's cost ratio of producing Peaches and Apples?
- (d) Which economy should specialize in which product?
- (e) Plot the United States' trading possibilities curve (by plotting at least 2 points on the curve) if the actual terms of the trade are 1 apple for 1 peach.
- (f) Plot the Canada' trading possibilities curve (by plotting at least 2 points on the curve) if the actual terms of the trade are 1 apple for 1 peach.
- (g) Suppose that the optimum product mixes before specialization and trade were B in the United States and C in Canada. What are the gains from specialization and trade?

AD/AS model: a framework used to explain the behaviour of real output and prices in the national economy. (5.1)

Aggregate Demand: planned aggregate expenditure on final goods and services at different price levels, all other conditions remaining constant. (5.1)

Aggregate expenditure (AE): the sum of planned expenditure in the economy. (6.2)

Aggregate expenditure function (AE): the relationship between planned expenditure in the total economy and real national income or GDP. (6.4)

Aggregate Supply: the output of final goods and services businesses would produce at different price levels, all other conditions held constant. (5.1)

Autarky: no-trade situation. (15.3)

Automatic stabilizers: tax and transfer programs that reduce the size of the multiplier and the effects of transitory fluctuations in autonomous expenditures on equilibrium GDP. (7.5)

Autonomous expenditure: expenditure not related to current income. (6.2)

Balance of payments accounts: a record of trade and financial transactions between residents of one country and the rest of the world. (14.1)

Balance of payments: the sum of the balances in current accounts and capital accounts, minus the change in the holdings of official reserves. (14.1)

Bank of Canada: Canada's central bank. (8.3)

Bank rate: the interest rate the central bank charges on its loans to commercial banks. (10.2)

Bank reserves: cash (legal tender) held by banks to meet possible withdrawals by depositors. (8.1)

Bankers risk: the risk that customers may demand cash for their deposits. (8.3)

Bond coupon: the annual fixed money payment paid to a bond holder. (9.2)

Bond price: the present value of future payments of interest and principal. (9.2)

Bond: a financial contract that makes one or more fixed money payments at specific dates in the future. (9.2)

Boom: a period of high growth that raises output above normal capacity output. (1.6)

Business and investment income (BI): the sum of profit, interest, investment, and business income. (4.3)

Business cycles: fluctuations in real GDP, employment and the price level that involve recessions, recoveries, booms. (11.5)

Business cycles: short-term fluctuations of actual real GDP. (5.4)

Capital account: the record of purchases and sales of real and financial assets. (14.1)

Capital Consumption Allowance (CCA): measured depreciation of the capital stock. (4.3)

Capital deepening: investment that increases in the capital/worker ratio. (13.4)

Capital gain or loss: the change in the price of an asset between the date of purchase and the date of sale. (9.2)

Capital stock: the buildings, machinery, equipment and software used in producing goods and services. (1.6)

Capital widening: investment that provides capital to workers entering the labour force. (13.4)

Central bank intervention: purchases or sales of foreign currency intended to manage the exchange rate. (14.3)

Central bank: the government institution that conducts monetary policy using its control of monetary base and interest rates. (10.1)

Change in official international reserves: the change in the Government of Canada's foreign currency balances. (14.1)

Circular flow diagrams: show the flows of money payments real resources, and goods and services between households and businesses. (4.3)

Commercial paper: short term 30-day and 60-day notes designed and created to pay buyers the interest generated by bundled accounts receivable and loans of different types during the term to maturity. (8.4)

Comparative advantage (principle of): even if one country has an absolute advantage in producing both goods, gains to specialization and trade still materialize, provided the opportunity cost of producing the goods differs between economies. (15.3)

Comparative static analysis compares an initial equilibrium values with a new equilibrium values, where the difference is due to a change in one of the conditions that lies behind the initial equilibrium. (3.4)

Complementary goods: when a price reduction (rise) for a related product increases (reduces) the demand for a primary product, it is a complement for the primary product. (3.4)

Consumer Price Index (CPI): a measure of the cost of living in any one year to the cost of living in a base year. (2.2) (4.1)

Consumption expenditure (C): spending by households on currently produced final goods and services. (4.3)

Consumption function: planned consumption expenditure at each level of disposable income. (6.2)

Consumption possibility frontier: what an economy can consume after production specialization and trade. (15.3)

Convergence hypothesis: higher rates of growth in lower per capita income countries than in higher per capita income countries leads to the convergence of per capita incomes across countries. (13.4)

Convertible currency: a national currency that can be freely exchanged for a different national currency at the prevailing exchange rate. (14.3)

Cost of credit: the cost of financing expenditures by borrowing at market interest rates. (9.6)

Credit easing: the management of the central bank's assets designed to support lending in specific financial markets. (10.4) (12.6)

Credit money: the debt of a private business or individual. (8.1)

Cross-section data: values for different variables recorded at a point in time. (2.2)

Crowding out (in): the change in interest sensitive expenditures caused by the price and interest rate effects of a change in autonomous expenditure. (11.5)

Currency appreciation: a rise in external value of the domestic currency that lowers the domestic currency price of foreign currency. (14.2)

Currency depreciation: a fall in external value of the domestic currency that raises domestic currency price of foreign currency. (14.2)

Currency ratio (*cr*): the ratio of cash balances to deposit balances. (8.4)

Current account: a record of trade in goods, services, and transfer payments. (14.1)

Cyclical unemployment: unemployment that would be eliminated if output were at potential output. (4.1)

Data: recorded values of variables. (2.2)

Deflation: a persistent fall in the general price level. (11.6)

Deflation rate: the annual percentage decrease in the consumer price index. (2.2) (12.6)

Demand: the quantity of a good or service that buyers wish to purchase at each possible price, with all other influences on demand remaining unchanged. (3.2)

Demand curve: a graphical expression of the relationship between price and quantity demanded, with other influences remaining unchanged. (3.3)

Depreciation of the national currency: a decline in the value of the currency relative to other national currencies, which results in a rise in the domestic price of foreign currencies. (9.5)

Devaluation (revaluation): a reduction (increase) in the international value of the domestic currency. (14.3)

Discretionary fiscal policy: changes in net tax rates and government expenditure intended to offset persistent autonomous expenditure shocks and stabilize aggregate expenditure and output. (7.5)

Disposable income (*YD*): national income minus net taxes. (7.2)

Disposable income: income net of taxes and transfers. (6.2)

Domestic Income: total income earned by factors of production. (4.3)

Dumping: a predatory practice, based on artificial costs aimed at driving out domestic producers. (15.6)

Econometrics: the science of examining and quantifying relationships between economic variables. (2.3)

Economic equity: concerns the distribution of well-being among members of the economy. (2.4)

Economic growth: an increase in real GDP. (4.1) (13.1)

Economic growth rate: the annual percentage change in real GDP or per capita real GDP. (4.1)

Economy-wide PPF: the set of goods combinations that can be produced in the economy when all available productive resources are in use. (1.5)

Effective lower bound (ELB): a small positive number below which the central bank's policy interest rate cannot be set. (10.4)

Employment income (W): the sum of all wages, salaries, and benefits paid to labour. (4.3)

Employment rate: percent of the population 15 years of age and over that is employed. (4.1)

Employment: number of adults employed full-time and part-time and self-employed. (4.1)

Endogenous growth: growth determined economic behaviour and policy within the model. (13.5)

Equation of exchange: the identity between total money expenditure and nominal GDP: $MV = PY$. (10.5)

Equilibrium price: the price at which quantity demanded equals the quantity supplied. (3.2)

Equilibrium real GDP: $AD=AS$, planned expenditure equals current output and provides business revenues that cover costs including expected profit. (5.1)

Excess demand: the amount by which the quantity demanded exceeds quantity supplied at the going price. (3.2)

Excess supply: the amount by which quantity supplied exceeds the quantity demanded at the going price. (3.2)

Exchange rate regime: the policy choice that determines how foreign exchange markets operate. (14.3)

Exchange rate target: the fixed price for foreign currency in terms of domestic currency pursued by monetary policy. (10.3)

Exogenous variable: a variable with a value determined outside the model. (13.5)

Exports (X): purchases of our domestic goods and services by residents of other countries. (4.3) (6.3)

Fiat money: money the government has declared as legal tender. (8.1)

Final goods and services: goods and services are purchased by the ultimate users. (4.3)

Financial intermediary: a business that specializes in bringing borrowers and lenders together. (8.3)

Financial panic: a loss of confidence in banks and rush to withdraw cash. (8.4)

Fiscal policy: government expenditure and tax changes designed to influence AD. (5.7) (7.4)

Fixed exchange rate: an exchange rate set by government policy that does not change as a result of changes in market conditions. (14.3)

Flexible exchange rates: an exchange rate regime in which supply and demand in the foreign exchange market determine exchange rate without central bank intervention. (14.3) (14.3)

Foreign exchange rate: the domestic currency price of a unit of foreign currency. (6.3) (9.5)

Forward guidance: information on the timing of future changes in the central banks interest rate setting. (10.4)

Frictional unemployment: a result the time involved in adjusting to changing labour force and employment opportunities. (4.1)

Full employment output: $Y_c = (\text{number of workers at full employment}) \times (\text{output per worker})$. (1.6)

GDP at basic price: Domestic Income + Capital Consumption Allowance. (4.3)

GDP at market price: Domestic Income + Capital Consumption Allowance + Net Indirect Tax. (4.3)

GDP deflator: index of current final output prices relative to base year prices. (4.4)

Government budget balance: $BB = NT - G$. (7.3)

Government budget: a plan for government spending and revenue. (7.3)

Government expenditure (G): spending by government on currently produced final goods and services. (4.3) (7.2)

Growth accounting: measurement of the contributions of labour, capital, and technology to growth in output. (13.1)

High (low) frequency data: series with short (long) intervals between observations. (2.2)

Imports (*IM*): purchases of goods and services produced by other countries. (4.3) (6.3)

Index number: value for a variable, or an average of a set of variables, expressed relative to a given base value. (2.2)

Induced expenditure: expenditure determined by national income that changes if national income changes. (6.2)

Inferior good: one for which demand falls in response to higher incomes. (3.4)

Inflation: a persistent rise in the general price level. (4.1)

Inflation rate: annual percentage change in a general price index such as the CPI. (2.2)

Inflation rate target: monetary policy objective defined as an announced target inflation rate. (10.3)

Inflationary gap: a measure of the amount by which actual GDP is greater than potential GDP. (5.4)

Innovation: the application of new knowledge into production techniques. (13.3)

Intra-industry trade: two-way international trade in products produced within the same industry. (15.4)

Intra-firm trade: two-way international trade in products produced within the same firm. (15.4)

Intercept of a line: height of the line on one axis when the value of the variable on the other axis is zero. (2.4)

Interest and investment income: income earned from financial assets. (4.3)

Interest parity: interest rate differentials between countries are offset expected exchange rate changes. (14.1)

Interest rate effect: the changes in expenditure caused by interest rates changes. (5.1)

Interest rate: the current market rate paid to lenders or charged to borrowers. (9.2)

Intermediate inputs: services, materials, and components purchased from other businesses and used in the production of final goods. (4.3)

Invention: the discovery of new knowledge. (13.3)

Investment (*I*): spending by business on currently produced final goods and services. (4.3) (6.2)

Investment function, $I = I(i)$: explains the level of planned investment expenditure at each interest rate. (9.6)

Labour force: adults employed plus those not employed but actively looking for work. (4.1)

Legal tender: money that by law must be accepted as a means of payment. (8.1)

Liquidity: the cost, speed, and certainty with which asset values can be converted into cash. (8.3)

Longitudinal data: follow the same units of observation through time. (2.2)

Macroeconomics: the study of the economy as system in which feedbacks among sectors determine national output, employment and prices. (1.1)

Marginal product: the change in total output caused by a change of one unit in the input of that factor to production. (13.2)

Marginal propensity to consume (MPC): the change in consumption expenditure caused by a change in income. (6.2)

Marginal propensity to import (MPM): the change in imports caused by a change in national income. (6.3)

Marginal propensity to save (MPS): the change in saving caused by a change in income. (6.2)

Market demand: the horizontal sum of individual demands. (3.8)

McCallum Rule: central bank monetary base settings based on inflation and output targets. (11.7)

Means of payment: a commodity or token generally accepted in payment for goods and services or the repayment of debt. (8.1)

Microeconomics: the study of individual behavior in the context of scarcity. (1.1)

Mixed economy: goods and services are supplied both by private suppliers and government. (1.1)

Model: a formalization of theory that facilitates scientific enquiry. (1.2)

Monetary base: legal tender comprising notes and coins in circulation plus the cash held by the banks plus reserve balances in the central bank. (8.2) (8.5)

Monetary policy indicators: variables that provide information about the stimulus or restraint coming from the central bank's policy. (10.6)

Monetary policy instrument: the monetary variable the central bank manipulates in pursuit of its

policy target. (10.3)

Monetary policy: central bank action to control money supply, interest rates, and exchange rates to change aggregate demand and economic performance. (10.1)

Monetary policy: changes in interest rates and money supply designed to influence AD. (5.7) (10.1)

Money illusion: confusion of nominal (money) and real variables. (12.2)

Money multiplier: the change in the money supply caused by a change in the monetary base. (8.5)

Money supply target: a central bank adjusts interest rates and the monetary base to control the nominal money supply, or the rate of growth of the nominal money supply. (10.3)

Money supply: the means of payment in the economy, namely notes and coin outside the banks and bank deposits. (8.1)

Moral suasion: a central bank persuades and encourages banks to follow its policy initiatives and guidance. (10.4)

Multiplier ($\Delta Y/\Delta A$): the ratio of the change in equilibrium income Y to the change in autonomous expenditure A that caused it. (6.5)

NAIRU: the ‘non-accelerating inflation rate of unemployment’ that corresponds to N_F at Y_P . (12.2)

Natural unemployment rate: the unemployment rate that corresponds to potential GDP. (4.1) (5.2) (11.6)

Neoclassical growth theory: an exogenous growth theory. (13.5)

Net exports (NX): the difference between exports and imports. (4.3) (6.3)

Net indirect taxes (T_{IN}): sales and excise taxes minus subsidies. (4.3)

Net interest income: the excess of loan interest earned over deposit interest paid. (8.3)

Net taxes: taxes on incomes minus transfer payments. (7.2)

Neutrality of money: monetary policy can set prices and inflation rates in the long run, but not output and employment. (10.5)

Nominal earnings: earnings measured in current dollars. (2.2)

Nominal exchange rate (*er*): the domestic currency price of a unit of foreign currency. (14.1)

Nominal GDP: the output of final goods and services, the money incomes generated by the production of that output, and expenditure on the sale of that output in a specific time period. (4.3)

Nominal price index: the current dollar price of a good or service. (2.2)

Non-tariff barriers: provisions such as product content requirements that limit the volume and gains from trade. (15.5)

Normal good: one for which demand increases in response to higher incomes. (3.4)

Normative economics: recommendations that incorporate value judgments. (2.4)

Official exchange reserves: government foreign currency holdings managed by the central bank. (14.3)

Open market operation: central bank purchases or sales of government securities in the open financial market. (10.2)

Opportunity cost: the sacrifice involved when a choice is made. (1.3)

Output gaps: the differences between actual output and potential output. (5.4)

Overnight rate: the interest rate large financial institutions receive or pay on loans from one day until the next. (10.3)

Paradox of thrift: attempts to increase aggregate national saving cause changes in equilibrium GDP that leave saving unchanged. (6.5)

Participation rate: percent of the population that is either working or unemployed. (4.1)

Per capita real GDP: real GDP per person. (4.5)

Percentage change: $(\text{change in values})/(\text{original value}) \times 100$. (2.2)

Perfect capital mobility: when very small differences in expected returns cause very large international flows of funds. (14.1)

Positive economics studies: objective or scientific explanations of how the economy functions. (2.4)

Potential output (Y_P): the real GDP the economy can produce on a sustained basis with current labour, capital and technology without generating inflationary pressure on prices. (5.2) (11.6) (12.2)

Present value: the discounted value of future payments. (9.2)

Price controls: government rules or laws that inhibit the formation of market-determined prices. (3.7)

Price index: a measure of a price or prices in one year compared with a price or prices in a base year. (4.1)

Price level: a measure of the average prices of all goods and services produced in the economy. (4.1)

Price of a marketable bond: the current price at which the bond trades in the bond market. (9.2)

Prime lending rate: the base for setting the interest rates charged by banks on loans and lines of credit. (10.3)

Production function: outputs determined by technology and inputs of labour and capital. (12.2)

Production possibility frontier (PPF): the combination of goods that can be produced using all of the resources available. (1.4)

Productivity: output per unit of input. (12.2)

Productivity of labour: the output of goods and services per worker. (1.6) (12.2)

Profit and business income: the sum of corporate profit, small business income, and farm income. (4.3)

Public debt (PD): the outstanding stock of government bonds issued to finance government budget deficits. (7.6) (12.5)

Public debt ratio (PD/Y): the ratio of outstanding government debt to GDP. (7.6)

Purchasing power parity (PPP): a real exchange rate equal to one. (14.1)

Quantitative easing: a large scale purchase of government securities to increase the monetary base. (10.4) (12.6)

Quantity demanded: the amount purchased at a particular price. (3.2)

Quantity supplied: the amount supplied at a particular price. (3.2)

Quotas: quantity restrictions on output. (3.7)

Rate of economic growth: the annual percentage change in real GDP. (4.1)

Real earnings: earnings measure in constant dollars to adjust for changes in the general price level. (2.2)

Real exchange rate: the relative price of goods and services from different countries measured in a common currency. (14.1)

Real GDP: the quantity of final goods and services produced by the economy in a specified time period. (4.1)

Real interest rate: the nominal interest rate minus the rate of inflation. (12.1)

Real money supply (M/P): the nominal money supply M divided by the price level P . (9.4) (11.1)

Real price index: a nominal price index divided by the consumer price index, scaled by 100. (2.2)

Real wage rate: the quantity of goods and services the money wage rate will buy. (12.2)

Recession: decline in economic activity, often defined as two consecutive quarters of negative growth in real GDP. (1.6) (4.2)

Recessionary gap: a measure of the amount by which actual GDP is less than potential GDP. (5.4)

Regression line: representation of the average relationship between two variables in a scatter diagram. (2.3)

Required reserve ratio: a legal minimum ratio of cash reserves to deposits. (10.2)

Reserve ratio (rr): the ratio of cash reserves to deposit liabilities held by banks. (8.4)

Saving function: planned saving at each level of income. (6.2)

Scatter diagram: a plot of pairs of values simultaneously observed for two variables. (2.3)

Short side of the market: determines outcomes at prices other than the equilibrium. (3.2)

Short run: a time frame in which factor prices, supplies of factors of production, and technology are fixed by assumption. (5.1)

Short-run equilibrium output: Aggregate expenditure equals current output. (6.4)

Slope of a line: ratio of the change in the value of the variable measured on the vertical axis to the change in the value of the variable measured on the horizontal axis (i.e.: rise/run). (2.4)

Solow residual: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology. (13.1)

SPRA: a Bank of Canada purchase of securities one day combined with an agreed resale of the securities the next day. (10.3)

SRA: a Bank of Canada sale of securities one day combined with an agreed repurchase of the securities the next day. (10.3)

Standard of deferred payments: the units in which future financial obligations are measured. (8.1)

Steady state: when output, capital, and labour grow at the same rate. (13.4)

Store of value: an asset that carries purchasing power forward in time for future purchases. (8.1)

Structural budget balance (*SBB*): the government budget balance at potential output. (7.4)

Structural primary government balance (*SPBB*): the difference between net tax revenue at Y_P and government program expenditure. It excludes interest payments on the public debt and the effect of output gaps. (12.5)

Structural unemployment: caused by changes in economic structure relative to labour characteristics. (4.1)

Substitute goods: when a price reduction (rise) for a related product reduces (increases) the demand for a primary product, it is a substitute for the primary product. (3.4)

Substitution effect: the change in net exports caused by a change in relative national prices. (5.1)

Supply: the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged. (3.2)

Supply curve: a graphical expression of the relationship between price and quantity supplied, with other influences remaining unchanged. (3.3)

Tariff: a tax on an imported product that is designed to limit trade in addition to generating tax revenue. It is a barrier to trade. (15.5)

Taylor rule: central bank interest rate settings based on inflation and output targets. (10.4)

Terms of trade: the rate at which goods trade internationally. (15.3)

Theory: a logical view of how things work, and is frequently formulated on the basis of observation. (1.2)

Time series: a set of measurements made sequentially at different points in time. (2.2)

Token money: convertible claims on commodity money. (8.1)

Total factor productivity (TFP): output relative to the combined inputs of labour and capital, the total factor inputs to production. (13.1)

Trade subsidy: a payment to a domestic manufacturer that reduces domestic prices and limits imports. (15.5)

Transmission mechanism: links money, interest rates, and exchange rates through financial markets to output and employment and prices. (9.6)

Unemployment: number of adults not working but actively looking for work. (4.1)

Unit of account: the standard in which prices are quoted and accounts are kept. (8.1)

Value added: the difference between the market value of the output of the business and the cost of inputs purchased from other businesses. (4.3)

Variables: measures that can take on different values. (2.2)

Very long run: the time required for changes to occur in the stock of capital, the size of the labour force, and the technology of production. (13.1)

Wealth effect: the change in expenditure caused by a change in real wealth. (5.1) (9.6)

Wholesale deposits: large denomination short term 30-day and 60-day deposits that pay higher interest rates than retail deposits. (8.4)

Yield on a bond: the coupon plus any capital gain or loss from the change in price between the date of purchase and the date of maturity. (9.2)

Yield on a bond: the return to a bond holder expressed as an annual percentage. (9.2)