

11

Money Growth and Inflation

PRINCIPLES OF
MACROECONOMICS
FOURTH CANADIAN EDITION

N. GREGORY MANKIW
RONALD D. KNEEBONE
KENNETH J. MCKENZIE
NICHOLAS ROWE

PowerPoint® Slides
by Ron Cronovich
Canadian adaptation by Marc Prud'Homme

© 2008 Nelson Education Ltd.

In this chapter, look for the answers to these questions:

- How does the money supply affect inflation and nominal interest rates?
- Does the money supply affect real variables like real GDP or the real interest rate?
- How is inflation like a tax?
- What are the costs of inflation? How serious are they?

© 2008 Nelson Education Ltd.

1

THE CLASSICAL THEORY OF INFLATION

- Inflation is an increase in the overall level of prices.
- Hyperinflation is an extraordinarily high rate of inflation.

© 2008 Nelson Education Ltd.

2

THE CLASSICAL THEORY OF INFLATION

- Inflation: Historical Aspects
 - Over the past 60 years, prices have risen on average about 4 percent per year.
 - Deflation, meaning decreasing average prices, occurred in Canada in the twentieth century.
 - Hyperinflation refers to high rates of inflation such as Germany experienced in the 1920s.

© 2008 Nelson Education Ltd.

3

THE CLASSICAL THEORY OF INFLATION

- Inflation: Historical Aspects
 - In the 1970s prices rose by 7 percent per year.
 - During the 1990s, prices rose at an average rate of 2 percent per year.

© 2008 Nelson Education Ltd.

4

THE CLASSICAL THEORY OF INFLATION

- The *quantity theory of money* is used to explain the long-run determinants of the price level and the inflation rate.
- Inflation is an economy-wide phenomenon that concerns the value of the economy's medium of exchange.
- When the overall price level rises, the value of money falls.

© 2008 Nelson Education Ltd.

5

The Value of Money

- P = the price level
(e.g., the CPI or GDP deflator)
 P is the price of a basket of goods, measured in money.
- $1/P$ is the value of \$1, measured in goods.
- Example: basket contains one candy bar.
 - If $P = \$2$, value of \$1 is 1/2 candy bar
 - If $P = \$3$, value of \$1 is 1/3 candy bar
- Inflation drives up prices, and drives down the value of money.

© 2008 Nelson Education Ltd.

6

Money Supply, Money Demand, and Monetary Equilibrium

- The money supply is a policy variable that is controlled by the Bank of Canada.
 - Through instruments such as open-market operations, the Bank of Canada controls the quantity of money supplied.

© 2008 Nelson Education Ltd.

7

Money Supply, Money Demand, and Monetary Equilibrium

- Money demand reflects how much wealth people want to hold in liquid form
 - has several determinants, including interest rates and the average level of prices in the economy.
- People hold money because it is the medium of exchange.
 - The amount of money people choose to hold depends on the prices of goods and services.

© 2008 Nelson Education Ltd.

8

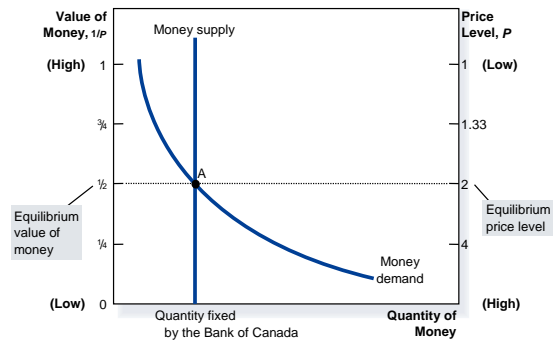
Money Supply, Money Demand, and Monetary Equilibrium

- In the long run, the overall level of prices adjusts to the level at which the demand for money equals the supply.

© 2008 Nelson Education Ltd.

9

Figure 11.1



© 2008 Nelson Education Ltd.

10

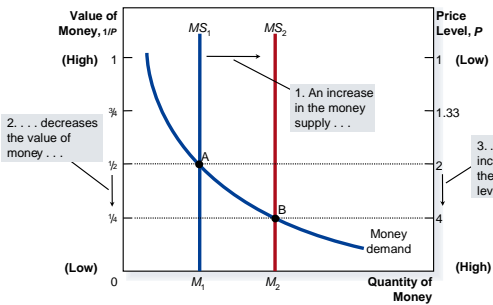
The Effects of a Monetary Injection

- Consider a change in monetary policy.
- The Bank of Canada decides to double the amount of money in the economy.
- How does the new equilibrium compare to the old one?

© 2008 Nelson Education Ltd.

11

Figure 11.2



© 2008 Nelson Education Ltd.

12

The Quantity Theory of Money

- Developed by 18th century philosopher David Hume, and the classical economists.
- Advocated in more recent years by Nobel Prize Laureate Milton Friedman (1912-2006).
- Asserts that the quantity of money determines the value of money.

© 2008 Nelson Education Ltd.

13

A Brief Look at the Adjustment Process

Result from graph: Increasing MS causes P to rise.

How does this work? Short version:

- At the initial P , an increase in MS causes excess supply of money.
- People get rid of their excess money by spending it on g&s or by loaning it to others, who spend it. Result: increased demand for goods.
- But supply of goods does not increase, so prices must rise.

(Other things happen in the short run, which we will study in later chapters.)

© 2008 Nelson Education Ltd.

14

The Classical Dichotomy

- **Classical dichotomy:** the theoretical separation of nominal and real variables
- Hume and the classical economists suggested that monetary developments affect nominal variables, but not real variables.
- If central bank doubles the money supply, Hume & classical thinkers contend
 - all nominal variables – including prices – will double.
 - all real variables – including relative prices – will remain unchanged.

© 2008 Nelson Education Ltd.

15

Real vs. Nominal Variables

- **Nominal variables** are measured in monetary units.
examples: nominal GDP,
nominal interest rate (rate of return measured in \$)
nominal wage (\$ per hour worked)
- **Real variables** are measured in physical units.
examples: real GDP,
real interest rate (measured in output)
real wage (measured in output)

© 2008 Nelson Education Ltd.

16

Real vs. Nominal Variables

Prices are normally measured in terms of money.

- Price of a compact disc: \$15/cd
- Price of a pepperoni pizza: \$10/pizza

A **relative price** is the price of one good relative to (divided by) another:

- Relative price of CDs in terms of pizza:

$$\frac{\text{price of cd}}{\text{price of pizza}} = \frac{\$15/\text{cd}}{\$10/\text{pizza}} = 1.5 \text{ pizzas per cd}$$

Relative prices are measured in physical units, so they are real variables.

© 2008 Nelson Education Ltd.

17

Real vs. Nominal Wage

An important relative price is the real wage:

W = nominal wage = price of labour, e.g., \$15/hour

P = price level = price of g&s, e.g., \$5/unit of output

Real wage is the price of labour relative to the price of output:

$$\frac{W}{P} = \frac{\$15/\text{hour}}{\$5/\text{unit of output}} = 3 \text{ units output per hour}$$

© 2008 Nelson Education Ltd.

18

The Neutrality of Money

- **Monetary neutrality:** the proposition that changes in the money supply do not affect real variables
- Doubling money supply causes all nominal prices to double; what happens to relative prices?
- Initially, relative price of cd in terms of pizza is

$$\frac{\text{price of cd}}{\text{price of pizza}} = \frac{\$15/\text{cd}}{\$10/\text{pizza}} = 1.5 \text{ pizzas per cd}$$

- After nominal prices double,

$$\frac{\text{price of cd}}{\text{price of pizza}} = \frac{\$30/\text{cd}}{\$20/\text{pizza}} = 1.5 \text{ pizzas per cd}$$

The relative price is unchanged.

© 2008 Nelson Education Ltd.

19

The Neutrality of Money

- **Monetary neutrality:** the proposition that changes in the money supply do not affect real variables in the long run.
- Similarly, the real wage W/P remains unchanged, so
 - quantity of labour supplied does not change
 - quantity of labour demanded does not change
 - total employment of labour does not change
- The same applies to employment of capital and other resources.
- Since employment of all resources is unchanged, total output is also unchanged by the money supply.

© 2008 Nelson Education Ltd.

20

The Neutrality of Money

- Most economists believe the classical dichotomy and neutrality of money describe the economy in the long run.
- In later chapters, we will see that monetary changes can have important *short-run* effects on real variables.

© 2008 Nelson Education Ltd.

21

The Velocity of Money and the Quantity Equation

- Velocity of money:** the rate at which money changes hands
- Notation:
 - $P \times Y$ = nominal GDP
= (price level) x (real GDP)
 - M = money supply
 - V = velocity
- Velocity formula:

$$V = \frac{P \times Y}{M}$$

© 2008 Nelson Education Ltd.

22

The Velocity of Money

Velocity formula: $V = \frac{P \times Y}{M}$

Example with one good: pizza.

In 2006,

Y = real GDP = 3000 pizzas

P = price level = price of pizza = \$10

$P \times Y$ = nominal GDP = value of pizzas = \$30,000

M = money supply = \$10,000

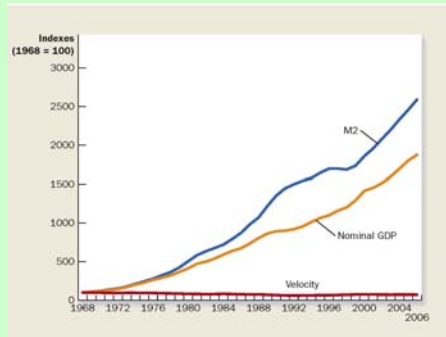
V = velocity = \$30,000/\$10,000 = 3

The average dollar was used in 3 transactions.

© 2008 Nelson Education Ltd.

23

FIGURE 11.3: Nominal GDP, the Quantity of Money, and the Velocity of Money



The Quantity Equation

Velocity formula: $V = \frac{P \times Y}{M}$

- Multiply both sides of formula by M :

$$M \times V = P \times Y$$

- Called the **quantity equation**

© 2008 Nelson Education Ltd.

25

The Quantity Theory in 5 Steps

Start with quantity equation: $M \times V = P \times Y$

1. V is stable.
2. So, a change in M causes nominal GDP ($P \times Y$) to change by the same percentage.
3. A change in M does not affect Y :
money is neutral,
 Y is determined by technology & resources
4. So, P changes by same percentage as $P \times Y$ and M .
5. Rapid money supply growth causes rapid inflation.

© 2008 Nelson Education Ltd.

26

ACTIVE LEARNING 1: Exercise

One good: corn. The economy has enough labour, capital, and land to produce $Y = 800$ bushels of corn. V is constant. In 2005, $MS = \$2000$, $P = \$5/\text{bushel}$.

- a. Compute nominal GDP and velocity in 2005.

For 2006, the Fed increases MS by 5%, to $\$2100$.

- b. Compute the 2006 values of nominal GDP and P .
Compute the inflation rate for 2005-2006.

- c. Suppose tech. progress causes Y to increase to 824 in 2006. Compute 2005-2006 inflation rate.

27

ACTIVE LEARNING 1: Answers

Given: $Y = 800$, V is constant,
 $MS = \$2000$ and $P = \$5$ in 2005.

- a. Compute nominal GDP and velocity in 2005.

$$\text{Nominal GDP} = P \times Y = \$5 \times 800 = \$4000$$

$$V = \frac{P \times Y}{M} = \frac{\$4000}{\$2000} = 2$$

28

ACTIVE LEARNING 1: Answers

Given: $Y = 800$, V is constant,
 $MS = \$2000$ and $P = \$5$ in 2005.

For 2006, the Fed increases MS by 5%, to $\$2100$.

- b. Compute the 2006 values of nominal GDP and P .
Compute the inflation rate for 2005-2006.

$$\begin{aligned} \text{Nominal GDP} &= P \times Y = M \times V \text{ (Quantity Eq'n)} \\ &= \$2100 \times 2 = \$4200 \end{aligned}$$

$$P = \frac{P \times Y}{Y} = \frac{\$4200}{800} = \$5.25$$

$$\text{Inflation rate} = \frac{\$5.25 - \$5.00}{\$5.00} = 5\% \text{ (same as MS!)}$$

29

ACTIVE LEARNING 1: Answers

Given: $Y = 800$, V is constant,
 $MS = \$2000$ and $P = \$5$ in 2005.

For 2006, the Fed increases MS by 5%, to $\$2100$.

- c. Suppose tech. progress causes Y to increase 3% in 2006, to 824. Compute 2005-2006 inflation rate.

First, use Quantity Eq'n to compute P :

$$P = \frac{M \times V}{Y} = \frac{\$4200}{824} = \$5.10$$

$$\text{Inflation rate} = \frac{\$5.10 - 5.00}{5.00} = 2\%$$

30

Hyperinflation

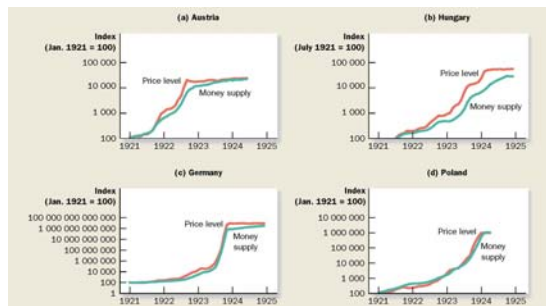
- Hyperinflation is generally defined as inflation exceeding 50% per month.
- Recall one of the Ten Principles from Chapter 1:
Prices rise when the government prints too much money.
- Excessive growth in the money supply always causes hyperinflation.



© 2008 Nelson Education Ltd.

31

FIGURE 11.4: Money and Prices during Four Hyperinflations



© 2008 Nelson Education Ltd.

32

The Inflation Tax

- When tax revenue is inadequate and ability to borrow is limited, govt may print money to pay for its spending.
- Almost all hyperinflations start this way.
- The revenue from printing money is the **inflation tax**: printing money causes inflation, which is like a tax on everyone who holds money.
- In Canada., the inflation tax today accounts for less than 1% of total government revenue.

© 2008 Nelson Education Ltd.

33

The Fisher Effect

- Rearrange the definition of the real interest rate:

$$\begin{array}{ccccccc} \text{nominal} & & \text{inflation} & & \text{real interest} \\ \text{interest rate} & = & \text{rate} & + & \text{rate} \end{array}$$

- The real interest rate is determined by saving & investment in the loanable funds market.
- Money supply growth determines inflation rate.
- So, this equation shows how the nominal interest rate is determined.

© 2008 Nelson Education Ltd.

34

The Fisher Effect

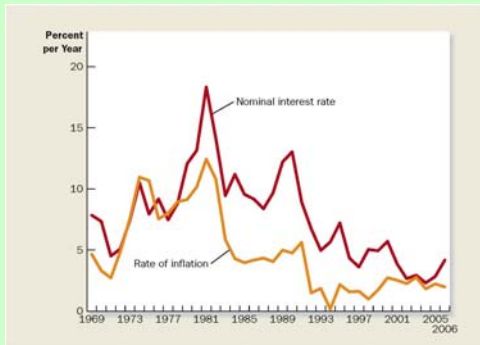
$$\begin{array}{ccccccc} \text{nominal} & & \text{inflation} & & \text{real interest} \\ \text{interest rate} & = & \text{rate} & + & \text{rate} \end{array}$$

- In the long run, money is neutral, so a change in the money growth rate affects the inflation rate but not the real interest rate.
- So, the nominal interest rate adjusts one-for-one with changes in the inflation rate.
- This relationship is called the **Fisher effect** after Irving Fisher, who studied it.

© 2008 Nelson Education Ltd.

35

FIGURE 11.5: The Nominal Interest Rate and the Inflation Rate



The Fisher Effect & the Inflation Tax

$$\text{nominal interest rate} = \text{inflation rate} + \text{real interest rate}$$

- The inflation tax applies to people's holdings of money, not their holdings of wealth.
- The Fisher effect: an increase in inflation causes an equal increase in the nominal interest rate, so the real interest rate (on wealth) is unchanged.

© 2008 Nelson Education Ltd.

37

THE COSTS OF INFLATION

- **The inflation fallacy:** most people think inflation erodes real incomes.
- But inflation is a general increase in prices, of the things people buy and the things they sell (e.g. their labour).
- In the long run, real incomes are determined by real variables, not the inflation rate.

© 2008 Nelson Education Ltd.

38

THE COSTS OF INFLATION

- **Shoeleather costs:** the resources wasted when inflation encourages people to reduce their money holdings
 - includes the time and transactions costs of more frequent bank withdrawals
- **Menu costs:** the costs of changing prices
 - printing new menus, mailing new catalogs, etc.

© 2008 Nelson Education Ltd.

39

THE COSTS OF INFLATION

- **Misallocation of resources from relative-price variability:** Firms don't all raise prices at the same time, so relative prices can vary... which distorts the allocation of resources.
- **Confusion & inconvenience:** Inflation changes the yardstick we use to measure transactions. Complicates long-range planning and the comparison of dollar amounts over time.

© 2008 Nelson Education Ltd.

40

THE COSTS OF INFLATION

- **Tax distortions:**

Inflation makes nominal income grow faster than real income.

Taxes are based on nominal income, and some are not adjusted for inflation.

So, inflation causes people to pay more taxes even when their real incomes don't increase.

© 2008 Nelson Education Ltd.

41

TABLE 11.1: How Inflation Raises the Tax Burden on Saving

	Economy A (price stability)	Economy B (inflation)
Real interest rate	4%	4%
Inflation rate	0	8
Nominal interest rate (real interest rate + inflation rate)	4	12
Reduced interest due to 25 percent tax (.25 × nominal interest rate)	1	3
After-tax nominal interest rate (.75 × nominal interest rate)	3	9
After-tax real interest rate (after-tax nominal interest rate – inflation rate)	3	1

© 2008 Nelson Education Ltd.

42

ACTIVE LEARNING 2: Tax distortions

You deposit \$1000 in the bank for one year.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

- a. In which case does the real value of your deposit grow the most?

Assume the tax rate is 25%.

- b. In which case do you pay the most taxes?
- c. Compute the after-tax nominal interest rate, then subtract off inflation to get the after-tax real interest rate for both cases.

43

ACTIVE LEARNING 2: Answers

Deposit = \$1000.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

- a. In which case does the real value of your deposit grow the most?

In both cases, the real interest rate is 10%, so the real value of the deposit grows 10% (before taxes).

44

ACTIVE LEARNING 2: Answers

Deposit = \$1000. Tax rate = 25%.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

b. In which case do you pay the most taxes?

CASE 1: interest income = \$100,
so you pay \$25 in taxes.

CASE 2: interest income = \$200,
so you pay \$50 in taxes.

45

ACTIVE LEARNING 2: Answers

Deposit = \$1000. Tax rate = 25%.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

c. Compute the after-tax nominal interest rate,
then subtract off inflation to get the
after-tax real interest rate for both cases.

CASE 1: nominal = $0.75 \times 10\% = 7.5\%$
real = $7.5\% - 0\% = 7.5\%$

CASE 2: nominal = $0.75 \times 20\% = 15\%$
real = $15\% - 10\% = 5\%$

46

ACTIVE LEARNING 2: Summary & lessons

Deposit = \$1000. Tax rate = 25%.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

Inflation...

- raises nominal interest rates (Fisher effect) but not real interest rates
- increases savers' tax burdens
- lowers the after-tax real interest rate

47

A Special Cost of Unexpected Inflation

- **Arbitrary redistributions of wealth**

Higher-than-expected inflation transfers purchasing power from creditors to debtors: Debtors get to repay their debt with dollars that aren't worth as much.

Lower-than-expected inflation transfers purchasing power from debtors to creditors.

High inflation is more variable and less predictable than low inflation.

So, these arbitrary redistributions are frequent when inflation is high.

© 2008 Nelson Education Ltd.

48

THE COSTS OF INFLATION

- All these costs are quite high for economies experiencing hyperinflation.
- For economies with low inflation (< 10% per year), these costs are probably much smaller, though their exact size is open to debate.

© 2008 Nelson Education Ltd.

49

CONCLUSION

- This chapter explains one of the Ten Principles of economics:
Prices rise when the govt prints too much money.
- We saw that money is neutral in the long run, affecting only nominal variables.
- In later chapters, we will see that money has important effects in the short run on real variables like output and employment.



© 2008 Nelson Education Ltd.

50

CHAPTER SUMMARY

- To explain inflation in the long run, economists use the quantity theory of money. According to this theory, the price level depends on the quantity of money, and the inflation rate depends on the money growth rate.
- The classical dichotomy is the division of variables into real & nominal. The neutrality of money is the idea that changes in the money supply affect nominal variables, but not real ones. Most economists believe these ideas describe the economy in the long run.

© 2008 Nelson Education Ltd.

51

CHAPTER SUMMARY

- The inflation tax is the loss in the real value of people's money when the government causes inflation by printing money.
- The Fisher effect is the one-for-one relation between changes in the inflation rate and changes in the nominal interest rate.
- The costs of inflation include menu costs, shoeleather costs, confusion and inconvenience, distortions in relative prices and the allocation of resources, tax distortions, and arbitrary redistributions of wealth.

© 2008 Nelson Education Ltd.

52

End: Chapter 11

© 2008 Nelson Education Ltd.

53
