Chapter 2 – Measurement

2/5/2013 1:26:00 PM

Understand how macroeconomic variables are measured.

Measuring GDP

- Chief aim on national income accounting is to obtain a measure of the total quantity of goods and services produced for the market in a given country over a period of time.
- Gross Domestic Product (GDP) – dollar value of final value of output produced during a given period of time within the borders of Canada.
- National Income and Expenditure Accounts (NIEA) – where GDP is published on a quarterly basis.
- Three approaches to measuring GDP
    - Product Approach
    - Expenditure Approach
    - Income Approach

Intermediate Good – good that is produced then used as an input to another production process.
After Tax Profits = total revenue – wages – interest – cost of intermediate inputs – taxes

Product Approach

- "value added approach"
- The sum of value added to goods and services in production across all productive units in the economy.
- To calculate: add the value of all goods produced in the economy and subtract all the intermediate goods used in production = total value added.
- If we didn't subtract intermediate goods we would be double counting.

GDP = good produced – intermediate goods used in production

The Expenditure Approach

- Total spending on all final goods and services production in the economy.

$$Total Expenditure (GDP) = C + I + G + NX$$

- C – consumption expenditure
- I – investment expenditure (expenditure on goods that are produced but not consumed during the period under consideration)
- G – government expenditure
- NX – net exports (total exports – total imports)

The Income Approach

- Add up all incomes received by economic agents contributing to production.
- Incomes include profits made by firms, employee compensation, corporate profits, net interest, etc. Anything coming into the company.

Why do they all yield same GDP result?

- because the quantity of output, or value, added in the economy is ultimately sold, thus showing up as expenditure, and what is spent on all output produced is income, in some form or other, for someone in the economy.
- Let Y be GDP in economy
- Y is total aggregate output and also total aggregate income.

$$Aggregate Income = Aggregate Expenditure$$

$$Y = C + I + G + NX$$

* Sometimes referred to as the income-expenditure identity. The quantity on the left side of the identity is the aggregate income and the right side is the sum of the components of aggregate expenditure.

Gross National Product (GNP)

- At one time was used in Canada as the official measure of aggregate production.

- However, measures the value of output produced by domestic factors of production, whether or not production takes place within or outside of Canada.
- Makes big difference in Canada compared to other countries because a significant fraction of productive plant and equipment in Canada is foreign owned.

What does GDP leave out?

- GDP per person is invalid because does not take into account how income is distributed across the individuals in the population.
- Also leaves out all non market activity.
- Underground economy is not measured. Includes all unreported economic activity.
- Invalid values on products. How much really worth.

Components of Aggregate Expenditure

- Consumption
  - Accounts for 55% of GDP
  - Is the expenditure on consumer goods and services during the current period, and the components of consumption are durable goods, semi durable goods and non durable goods.
- Investment
  - Accounts for 20.3% of GDP
  - Is the expenditure on goods that are produced but not consumed during the current period.
  - Two typed:
    - Fixed – production of capital, such as plant, equipment and housing
    - Inventory – good hat are essentially put in storage.
  - Smaller than consumption because much more variable and plays a large role in the business cycle.
- Net Exports
  - Accounts for 1.9% of GDP
- Government
  - Accounts for 22.7%

- Consists of expenditures by federal, provincial or territorial, and municipal goods and services.
- Mainly of government consumption and government investment.

Nominal and Real GDP and Price Indices

A Price Index – a weighted average of the prices of a set of the goods and services produced in the economy over a period of time. If the price index includes prices of all goods and services, then that price index is a measure of the general price level (the average level of prices across all goods and services)

Inflation Rate – rate of change in the price level from one period of time to another.

>> Use to determine if the change in GDP from one period to another is real or nominal.

- Nominal Change – change in GDP that occurred only because the price level changed.
- Real Change – increase in the physical quantity of output.

Real GDP

Chain Weighted

Step 1: Calculate GDP using Year 1 Prices for BOTH years

$$GDP_1 = P_1^a Q_1^a + P_1^o Q_1^o$$
$$GDP_2 = P_1^a Q_2^a + P_1^o Q_2^o$$

$$G1 = \frac{GDP_2}{GDP_1}$$

Step 2: Calculate GDP using Year 2 prices for BOTH years

$$GDP_1 = P_2^a Q_1^a + P_2^o Q_1^o$$
$$GDP_1 = P_2^a Q_2^a + P_2^o Q_2^o$$

$$G2 = \frac{GDP_2}{GDP_1}$$

Step 3: Apply to ***FISCHER INDEX***

$$FV = \sqrt{G1xG2}$$

Step 4: Real GDP in Year 2 = FV x Year 1 Real GDP

GDP Deflator for Year 2 = $\frac{Nominal Y2}{ChainWeightedY2} x100$

*since the base is 100 in the GDP deflator answer this means there is a ___% increase in prices between the two years.
*this is not a real world example. Usually targeted between 1 & 3, targeted at 2)
*basically GDP2 in using Year 2 prices divided by answer (Real GDP in Year2)

Measures of the Price Level

- Implicit GDP Deflator = nominal GDP/real GDP x 100
  *is the price level of all new prices of domestically produced final goods in an economy.
  *current GDP/chain GDP

- Current Year CPI = (cost of base year quantities at current prices/cost of base year quantities at base year prices) x 100

*if year 1 is the base year assume that the CPI is 100 (base year always has CPI of 100) and if the CPI is 172.1 then the percentage increase in the CPI from year 1 to year to is 72.1%
*a measure of the average change over time in the prices paid by urban consumers for a **market basket** of consumer goods and services

Problems with measuring real GDP and the price level

- The measurement of real GDP and the measurement of price level are intimately related.
- Important problems:

- First, If a particular measure of GDP underestimates the growth of real GDP, the rate of inflation will be overestimated. Chain fixes this problem. It assumes that when price changes buyers don't change their buying habits which is clearly false. Therefore, goods with higher prices receive a higher weighting in the CPI than they should.

Savings, Wealth and Capital

- Aggregate productive capacity and how aggregate savings adds to this productive capacity.
- Flows vs. Stocks
  - Flow – rate per unit time
  - Stock – the quantity in existence of some object at a point in time.
  - GDP, C, I, G, NX are all flows.
  - To help: bathtub. Water flowing into bathtub. The quantity of water coming out of the faucet per minute is a flow, whereas the quantity of water in the bathtub at any point in time is a stock.

Savings – can mean very different things. Whether referring to private, government or nation as whole, etc.

- Private Sector
  - 1) Determine what private sector has available to spend, Private Disposal Income

$$Y^d = Y + NFP + TR + INT - T$$

  - *Y(GDP), NFP(Net factor payments from abroad to Canadian residents, TR(transfers from the government to the private sector), INT(interest on the government debt), T(taxes). Recall, GNP = Y + NFP.
  - What private sector saves is simply what it has available to spend minus what it consumes. SO…
  - 2) Determine Private Sector Savings

$$Y^d = Y + NFP + TR + INT - T$$

$$S^p = Y^d - C$$

- Government Saving
  - What the government has available to spend is its tax revenue, T, minus TR, minus INT, and what it consumes is government expenditures, G.

$$S^g = T - TR - INT - G$$

*Government saving is the government surplus. SO… the government deficit is the negative of the government surplus.

$$D = -S^g = -(T - TR - INT - G)$$

*If we add private saving and government saving we obtain national saving.

$$S = S^p + S^g = Y + NFP - C - G$$

*Can also substitute Y for C+I+G+NX. Which gives you..
CA – current account surplus.

$$S = I + CA$$

The Current Account Surplus is a measure of the balance of trade in goods with the rest of the world. Reflects the fact that any domestic savings not absorbed by domestic investment must be shipped outside the country in the form of goods and services.

National Savings represents additions to the national wealth.
Accumulated in two ways:

- Wealth is accumulated through investment, I, which is the addition to the nations capital stock. The stock is the amount of plants, equipment, housing, etc. that the economy has at one time.
- Wealth is accumulated through current account surpluses, CA, since a current account surplus implies that Canadian residents are accumulating claims on foreigners.

Labour Market Measurement

- Employed – those who work part time or full time during the past week.
- Unemployed – those who were not employed during the past week but actively searched for work at some point during the last 4 weeks.
- Not in the labour force – those who are neither employed or unemployed.
- The labour force is then equal to the employed + unemployed.

Analyzing tools

- Unemployment rate = number unemployed/labour force
- Participation rate = labour force/total working age po
- Employment/Population ratio = employment/total working age pop

Labour market tightness

- The unemployment rate is a useful measure of this.
- It is the degree of difficulty forms face in hiring workers.
- There are two ways in which the unemployment rate may mimeasure the tightness.
    - Discouraged workers(stopped searching for work but want to be employed), are not counted.
    - Does not adjust according to how hard the unemployed are searching for work.

Chapter 3 – Business Cycle Measurement 2/5/2013 1:26:00 PM

Business cycles are quite irregular and therefore somewhat unpredictable. Some difficulty forecasting ups and downs.

Regularities in GDP Fluctuations

- Primary function of business cycle is that they are fluctuations abut trend in real gross domestic product.
- **Peaks** and **troughs** (+/- deviations from trend) → **Turning points.**
- **Amplitude**, difference between real GDP and trend line.
- Number of peaks is the **frequency**.
- **Boom** large number of positive trends.
- **Recessions** large number of negative trends.
- **Persistent** is when it stays consistently above or below trend.
- **Comovement** is when macroeconomic variables fluctuate together in patterns that exhibit strong regularities.
- Measured in **time series.**
- **Positive** vs. **Negative Correlation.**

How they are correlated?

- **Procyclical** – deviations from trend are positively correlated with the deviations from trend in real GDP.
- **Countercyclical** – if its deviations from trend are negatively correlated with the deviations from trend in real GDP.
- **Acyclical** – no correlation at all.

The measure of correlation between two variables is the **correlation coefficient**. (Between -1 and 1)
If the correlation is…

- **1 – perfectly positively correlated**
- **-1 – perfectly negatively correlated**
- **0 – uncorrelated**

Leading and Lagging Relationships

- **Leading Variable** if the variable tends to aid in predicting the future path of real GDP (x is behind)
- **Lagging Variable** if real GDP helps predict the future path of a particular variable (x is in front)

- **Coincident Variable** neither lags or leads.

Composite index of business leading indicators

- Economists argue that forecasting can be done simply by exploiting past statistical relationships among macroeconomic variables to project into the future.

Standard Deviation

- also measures GDP

Phillips Curve

- The negative relationship between the rate of change in money wages and the unemployment rate.
- Stable and reverse relationship.
- Simply says lower the unemployment the higher the inflation and vise versa.
- Inflation – level of prices in an economy.

Real Wage

- Purchasing power of the wage earned per hour.
- Measured from the data as average money wage for all workers, divided by price level.
- Average Money Wage/Prive Level

Average Labour Activity

- Measure of productivity.
- Y/N
- Where Y is the aggregate real output and N is total labour input.
- For some, Y is real GDP and N is total employment.

Seasonal Adjustment

- In most macroeconomic time series there exists a predictable seasonal component.
- I.e. GDP tends to be lower in summer months when workers are on vacation, Investment lower in winter months when building roads, bridges and other types of structures are harder to build.

Chapter 4 – Consumer and Firm Behaviour2/5/2013 1:26:00 PM

The construction and analysis of a particular macroeconomic model.
We focus on the behaviour of consumers and firms in a simple model environment with ***only one time period.***

One period decision making for consumers and firms will limit the kinds of macroeconomic issues we can address with the resulting model.

Given that there is only one time period, consumers and firms will make static, as opposed to dynamic, decisions.
Dynamic decision making involves planning over more than one period, i.e. when individuals make decisions concerning how much to spend today and how much to save for the future.

The Representative Consumer

- Consider the behaviour of a single representative consumer.
- Act as a stand in for all of the consumers in the economy.
- Show how to represent a consumers preferences over the available goods in the economy and how to represent the consumers budget constraint.

The Representative Consumer's Preferences

- Suppose there are two goods that the consumer desires.
  - 1) **Consumption good** – a physical good, which we can think of as an aggregation of all consumer goods in the economy, or measured aggregate consumption.
  - 2) **Leisure** – any time not spent working. Could include recreational activities, sleep and work at home (i.e. cleaning, cooking, yard work, etc.)
  - Assume all consumers are equal and identical and therefore, the economy behaves as if there is only one consumer.

To determine how the consumer makes choices is to show how we can capture the preferences of the consumer over leisure and consumption goods is by a **Utility Function.**

Where U is the utility function, $U(C,l)$

C is the quantity of consumption and L is the quantity of leisure.

Refer to (C,L) – c being the particular consumption quantity and l being the particular leisure quantity as **Consumption Bundle.**

The utility represents how a consumer ranks the particular consumption bundle. I.e.

$$(C_1 l_1) > (C_2 l_2)$$

This means that the consumer values and/or gets more satisfaction from bundle 1 than 2.

Note: the actual level of utility is irrelevant; all that matters for the consumer is what the level of utility is from a given consumption bundle relative to another one.

Three Properties

- More is always preferred to less.
- The consumer likes diversity in his/her bundle. (has choices within)
- Consumption and leisure are normal goods.
    - Normal – quantity of good purchased increases as income increases.
    - Inferior – purchases less of a good when income increases; hot dog vs. steak.

Portray Graphically

- Indifference map – family of indifference curves.
- Indifference curve – connects a set of points of the same utility. These points representing consumption bundles in which the consumer is indifferent.

An Indifference Curve has two key properties:

- An indifference curve slopes upward
- An indifference curve is convex; bowed in towards the origin.

Marginal Rate of Substitution

- of leisure for consumption, denoted MRSi,c is the rate at which the consumer is just willing to substitute leisure for consumption goods.

$$MRS_{l,C} = -Slope$$

*the slope passing through (C,L)

Why is minus the slope of the indifference curve MRS?

- the rate at which the consumer is willing to substitute leisure for consumption in moving from A to B is the ratio: $\frac{C_1 - C_2}{L_2 - L_1}$

Stating that an indifference curve is convex is identical to stating that the MRS is diminishing.

Budget Constraint

- Assume that the consumer behaves competitively.
- Competitive Behaviour – means that the consumer is a **price taker;** he or she treats the market prices as being given and acts as if his or her behaviour has no effect on these prices.
- If the consumer is small in comparison to the market.
- Assume there is no money in this economy.
- An economy without monetary exchange is a **barter** economy. All trades involves exchanges or goods for goods.
- There are only two goods here: consumption goods and time (time spent at home; leisure)
- Any trades in this economy must involve exchanges of labour time for consumption goods, or vise versa.
- The consumer is assumed to have, h, hours of time available, which can be allocated between leisure time, l, and time spent working (or labour supply) denoted by N_S
- The **time constraint** for the consumer is then

$$l + N_S = h$$

- Which states that leisure plus time spent working is equal to total hours.

The Consumers **Real Disposable Income**
What the consumer has to spend on consumption goods

$$w + \prod - T$$

- Equal to: wage + dividend income – taxes
- Real Wage Rate - w
- Numeraire – good in which all prices and quantities will be denominated.
- First source of income: the amount of time working in exchange for wage. If the consumer works N_S hours then her real wage income becomes wN_S
- Second source of income: profits distributed as dividends from fims. We will let ∏ denote the quantity of profits that the consumer receives; dividend income.
- Third source: assume that the real quantity of taxes is a lump sum amount T. A lump sum tax that does not depend in any way on the actions of the economic agent who is being taxed.

Budget Constraint

- View the consumer as receiving his or her disposable income and spending it in the market for consumption goods.
- Since this is a one period economy and the consumer has no motive to save, and because the consumer prefers more to less, all disposable income is consumed, so we have…

$$C = wN_s + \prod - T$$

- Alternatively, we can substitute N_S for,

$$C = w(h - l) + \prod - T$$

- The interpretation for this equation is that the right hand side is real disposable income, while the left hand side is expenditure on consumption goods, so that total market expenditure Is equal to disposable income.
- If we add wl to each side, we get..

$$C + wl = wh + \prod - T$$

- This interpretation is that the right hand side is the real disposable income that the consumer has and the left side is the expenditure on the two goods, consumption and leisure.
- To graph… it is easy to write:

$$C = -wl + wh + \prod - T$$

Consumer Optimization

- Next step is to put preferences together with the budget constraint so as to analyze how the representative consumer will behave.
- Assume the consumer is **rational,** rationality in this context means that the representative consumer knows his or her own preferences and budget constraint and can evaluate which feasible consumption bundle is best for him or her.
- ONLY consider case T< ∏ (dividends are greater than taxes; kinked)
- Display where the curve is just tangent to the curve ABD; **Optimal Consumption Bundle –** the point representing a consumption-leisure pair that is on the highest possible indifference curve and is on or inside the consumers budget constraint.

- The consumer would never choose and bundle inside the budget constraint because the consumer prefers more to less.

Pure Income Effect

- As change in ∏-T could be caused by a change in either ∏ or T or both.
- Increase in ∏ could be caused by in an increase in the productivity of firms. Which increased the amount of dividends that are paid to consumers.
- Decrease in T could be caused by a tax cut for the consumer and disposable income increases.
- In either case, the increase in ∏-T is a pure income effect on the consumers choices since the prices remain the same (w stays constant) while disposable income increases.
- Change in indifference curve completely because increase in income.

Substitution Effect

- Increase/decrease in wage rate, w.
- Hold constant dividends and taxes. This removes the pure income effect.
- Substitution Effect is a substitution of one bundle for another on the same indifference curve.

Labour Supply Curve

- How much labour the consumer wants to supply given any real wage rate.
- l(w) is a function that tells us how much leisure the consumer wants to consume, given the real wage w.

$$N^s(w) = h - l(w)$$

Assume that the sub effect of an increase in the real wage rate dominates the income effect, so the labour supply curve is upward sloping.

Perfect Compliments

- if he or she wants to consume these goods in fixed proportions.
- If they are perfect compliments the consumer always want to have **C=aI**, meaning C is equal to some value of L, this is always fixed.
- More is not better unless have the correct fixed amount of both. No better off.

Perfect Substitutes

- One for other. MRS is constant and the indifference curves are downward sloping straight lines.

The Representative Firms

- The rep consumer supplies labour and demands consumption goods while the rep firms supply consumption goods and demand labour.

- Production Function – describe the production technology. Describes the technological possibilities for converting factor inputs into outputs.

$$Y = zF(k, N^d)$$

- Where, z is the **total factor of productivity,** Y is the output of consumption goods, K is the quantity of capital in production, N^d is the quantity of labour input measured in total hours worked by employees in the firm, and F is a function.
- Z captures the degree of sophistication of the production process. An increase in Z will make both factors of production, K and N more productive, in that, given factor inputs, higher Z implies that more output can be produced.

Marginal Product

- Is the addition output that can be produced with one additional factor of input, holding constant the quantities of the other factor inputs.
- Two factor inputs: labour and capital.
- MP_N - marginal product of labour.
- MP_K - marginal product of capital

The production function has 5 key properties:

- 1) Exhibits **Constant Returns to Scale** – given any constant larger than zero, the following relationship holds:

$$zF(k, N^d) = zF(xk, xN^d)$$

- This means that if all inputs are changed by factor x, output changes by the same factor x.
- If input doubles, output doubles.
- Alternatives are Increasing RTS and Decreasing RTS
- Increasing RTS means that large firms are more productive than small firms and decreasing RTS means that small firms are more productive than large firms. With constant RTS large firms and small firms are equally efficient (means that a large firm produces many times over at the same rate a small firm produces)

- 2)Output increases when either capital input or labour input increases.
- 3) MPL decreases as the quantity of labour increases.
- 4) MPK decreases as the quantity of capital increases.
- 5) MPL increases as the quantity of capital increases. (Labour can be more productive when they have more capital (space) to work with)

Change in Total Factor Production

- An increase in Z arises out of any increase in either inputs.
- Shifts Up.

Profit Maximization Problem

- Goal of firm is to maximize profits, given by $Y - wN^d$
- Where Y is the total revenue the firm gets by selling its output and wNd is the total real cost of labour input. So basically total revenue-total costs.
- Then substituting for Y in the production function you get…

$$\prod = zF(K^*, N^d) - wN^d$$

K is fixed, pie is real profit.

Note: $MP_N = w$

Chapter 5 – A Close 1 Period Model

2/5/2013 1:26:00 PM

Closed Economy

- Single country that has no interaction with the rest of the world.
- It does not trade with other countries.

Open Economy

- International trade is allowed.

Government

- Behaviour: wants to purchase a given quantity of goods, G, and finances these purchases by taxing the representative consumer. They provide many things such as roads and bridges, defence, air traffic control, education, etc.
- Providing public goods, such as national defense that private sectors could never supply.
- Output is produced and the government purchases an exogenous amount G of this output, with the remainder consumed by the representative consumer.
- An **exogenous variable** is determined outside the model.
- An **endogenous variable** is determined by the model itself.
- The government must abide by the government budget constraint, which is written as… $G = T$
- Meaning that government purchases are equal to taxes, in real terms.
- Fiscal Policy – refers to the government's choices over its expenditures, taxes and borrowing. The government cannot borrow to finance government because there is no future to repay debt.

Competitive Equilibrium

- Construct model about consumer, firm and government and use it to make predictions about how the whole economy behaves in response to changes in the economic environment.
- Mathematically, the model takes the exogenous variables which are determined outside the system and determines variables for the endogenous variables we are modeling.

- The **Exogenous** variables are… G,z,K which are the government spending, total factor productivity, and the economy's capital stock
- The **Endogenous** variables are… C,N^s,N^d,T,Y,w which are consumption, the quantity of labour supplied, the quantity of labour demanded, taxes, aggregate output and wage rate.

- The Competitive Equilibrium is demand equal to supply.
- When demand equals supply in all markets we refer to this as market clearing.
- There is equilibrium when the following are satisfied
  - The consumer is optimizes given his or her budget constraint.
  - The firm chooses labour demanded to maximize profits, with maximized output and maximized profit. The profits that the firm earns must be equal to the dividend income that the consumer receives.
  - Supply = Demand of labour.
  - The government market constraint is satisfied – that is, G=T. The taxes paid by consumers are equal to the exogenous quantity of government spending.

An important property of competitive equilibrium is… $Y = C + G$ which is the income expenditure identity… Think back to when income expenditure identity was Y=C+G+I+NX… however, in this economy there is no future and is closed so no I or NX.
So…. To show why the income expenditure identity holds in equilibrium, we start with the consumers budget constraint,

$$C = wN^s + \prod - T$$

(consumption expenditure equal to real wage income plus real dividend income minus taxes). In equilibrium… dividend income is equal to the firms maximized profits as well as the government budget constraint is satisfied..
So if we substitute.

$$C = wN^s + Y - wN^d - G$$

Refer to N as employment (because Ns=Nd=N)

The production function, output is given by…

$$Y = zF(K,N)$$

Note* since the consumer has a maximum number of h hours to spend N can never be larger than h.

Could also substitute (h-L) hours minus leisure as an equal to N(hours of employment) $$Y = zF(K,h-l)$$

IF we graph this relationship we are graphing the relationship between Y (output) and l (leisure). So… leisure will be on the horizontal and Y will be on the vertical creating a mirror image of the production function.

This shows that when the consumer uses all their time as leisure and leisure is maximized there is 0 output because nothing gets produced.

Now.. since in equilibrium C=Y-G (consumption equals total income minus government spending) we can get…

$$C = zF(K,h-l) - G$$

This is just the relationship between output and leisure shifted down by government spending. This relationship is called **production possibilities frontier (PPF).** It describes what the technological possibilities are for the economy as a whole, in terms of the production of consumption goods and leisure. All the points in the shaded area are technologically possible.
****The PPF captures the tradeoff between leisure and consumption that the available production technology makes available to the representative consumer in the economy.**
The slop of the PPF is –MPn… Another name for this is the marginal rate of transformation.
The Marginal Rate of Transformation is the rate at which one good can be converted technologically into another; in this case, the marginal rate of transformation is the rate at which leisure can be converted into the economy into consumption goods through work.

$$slope = MRT_{l,C} = -(Slope of PPF)$$

Next step: put together the PPF and the consumers indifference curves.

Analyzing how markets act to arrange production and consumption activities, and asking how this arrangement compares with some ideal or efficient arrangement.
The efficiency criterion that economists use in evaluating market outcomes is **Pareto-optimality –**a competitive equilibrium is Pareto Optimal if there is

no way to rearrange production or to reallocate goods so that someone is made better off without making someone else worse off.

Three Reasons why may not be in Pareto-Optimal

Externalities

- Activity for which an individual firm or consumer does not take account of all associated costs and benefits.
- Can be positive or negative.
- Negative: pollution. Government take approaches to try to stop these negative externalities. I.e. taxes and regulation rules.
- Positive: benefit other people receive for which no one is compensated. Attractive office which adds benefits, peoples viewing pleasure.

Distorting Taxes

- Depends on the actions of the person being taxed rather than a lump sum tax.
- An example: of government purchases were financed by a proportional wage income tax rather than by a lump sum tax. That is, for each unit of real wage income earned, the representative consumer pays t units of consumption goods to the government, so that t is the tax rate.
- This drives a wedge between the marginal rate of substitution and the marginal product of labour.

Firms may not be Price Takers

- If a firm is large relative to the market it can use its monopoly power to restrict output, raise prices and increase profits.

The Effect of the Changes in Government Purchase

- An increase shifts down the function.
- Consumption and leisure both decrease because they are normal goods.

Income Tax on Labour Income

- zh-G → z(1-t)h

Laffer Curve

- Tax Revenue that the government can collect if the income tax rate t is… $$REV = tz[h - l(t)]$$
- Where REV is total revenue from income tax.
- In equation t is the tax rate and z[h-l(t)] is the tax base which is the quantity traded in the market of the object being traded, which in this case is quantity of labour in units of consumption goods.

- When we ploy tax revenue against tax rate, taking into account the effects of the consumers choice concerning the quantity of labour supplied in response to the tax rate.
- **The Laffer Curve –** the relationship between income tax revenue and the income tax rate. Tax revenue must be zero when t=0(the tax rate is zero) and t=1 (because no one will work if all income is taxed away. So the government must maximize revenue somehow.
- **NOTE:** t* is where rev is maximized, t1 is good side, t2 is bad side.