Class Notes

Intermediate Macroeconomics

January 2009

Li Gan

What is economics?

1. It is about making choices under scarcity

For individuals:

(1) Budget constraint
Example: money is scarce or limited: choose between apple and burgers

(2) Time constraint:
Example: play computer games or study.

(3) Overtime optimization (via both time and money):

- Work more right now, enjoy more later (retirement decision).
- Spend more right now (borrowing against future income) and pay back later – going to college.

For government: Budget constraint is its tax revenue.
Government may engage "overtime optimization" by borrowing money to spend right now. In this case, deficit if spending > tax revenue.

How to make choices under constraint:

Key: respond to economic incentives:
Basic assumptions: people make choices that they think are best for themselves (optimization).

A natural question: is self-interest consistent with social interest?

Examples:

- Privatization – powerful evidence that they are mostly consistent.
- Co-pay in medical expenditure – under free medical service system, the total cost of medical expenditure is out-of-control. However, with a co-pay system, the total cost may significantly come down.

- Globalization: overall social interest is optimized. However, not necessarily all individuals in the process are gainers.
- The economic response to 9/11: simple self-interest doesn't work any more. An intervention is necessary.
- The currently financial crisis – self-interest without proper regulation can be dangerous. The main problem: information asymmetry.

2. The economic way of thinking:

- Tradeoff: The big societal trade-off is equity *vs* efficiency.
- The opportunity cost: the highest alternative that we give up to get something. Example: attending colleges: goods and services foregone from paying fro tuition and textbooks and from having a full-time job.
- Choosing at margin.
- Responding to incentives.

3. The biggest problem of economic research: causality is difficult to test.

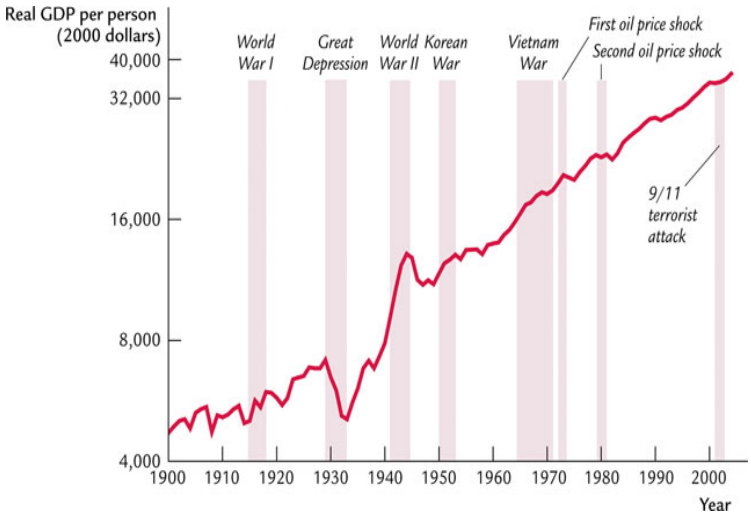
Positive statement: what it is.
Normative statement: what ought to be.

Example: demand/supply. In December 2008, retail prices have dropped but the total retail sales have also dropped. So does a lower price cause a lower demand? This is obviously NOT true.

In this example, both retail prices and total sales are endogenous variables. They both are caused by declining of total income from consumers, or the uncertainty of the future income from consumers.

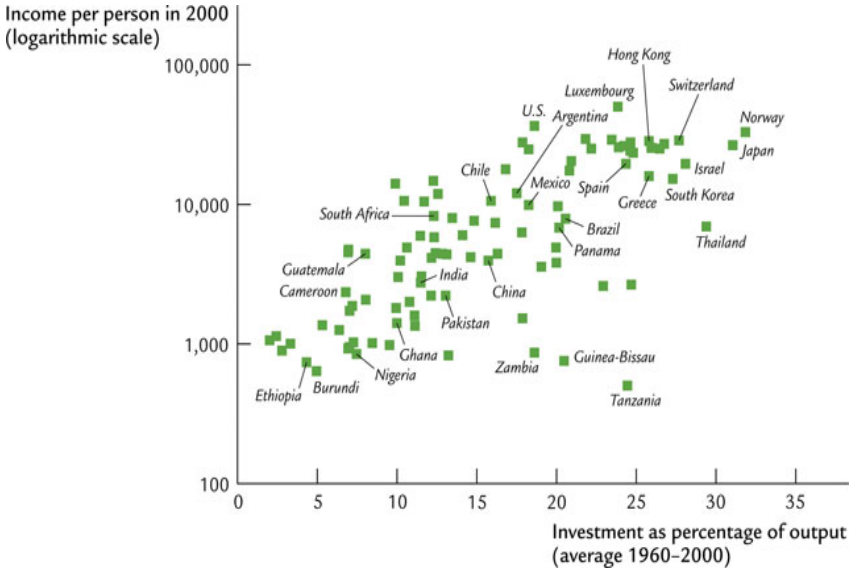
Graphs in Economics: Graphs used to illustrate facts:

A Time Series Graph: per capita GDP over last 100 years in the US



A graph that illustrates relationships between two variables:

Example: Income per person and the investment as percentage of output are positively correlated.



Necessary mathematics in this class:

Consider a Cobb-Douglas production function, $Y = AK^{\alpha}L^{1-\alpha}$.

Partial differentiation:

$$MPL = \frac{\partial Y}{\partial L} = (1-\alpha)AK^{\alpha}L^{-\alpha}$$
$$MPK = \frac{\partial Y}{\partial K} = \alpha AK^{\alpha-1}L^{\alpha}$$

Total differentiation:

$$\Delta Y = \Delta K \cdot \frac{\partial Y}{\partial K} + \Delta L \cdot \frac{\partial Y}{\partial L}$$

In the case of Cobb-Douglas production function:

$$\Delta Y = \Delta K \cdot \alpha AK^{\alpha-1}L^{\alpha} + \Delta L \cdot (1-\alpha)AK^{\alpha}L^{-\alpha}$$

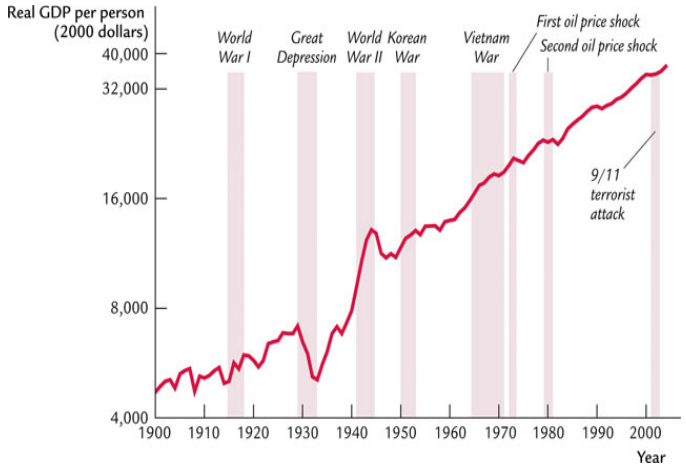
Furthermore,

$$\frac{\Delta Y}{Y} = \Delta K \cdot \frac{\alpha AK^{\alpha-1}L^{\alpha}}{Y} + \Delta L \cdot (1-\alpha)\frac{AK^{\alpha}L^{-\alpha}}{Y}$$
$$= \alpha \frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

The last equation represents the so-called Solow Residual.

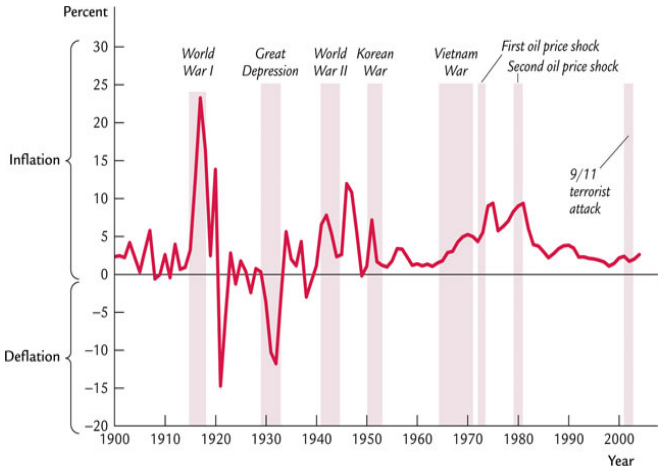
Basic Facts about Macro Economies

- It is amazing how much we have achieved.

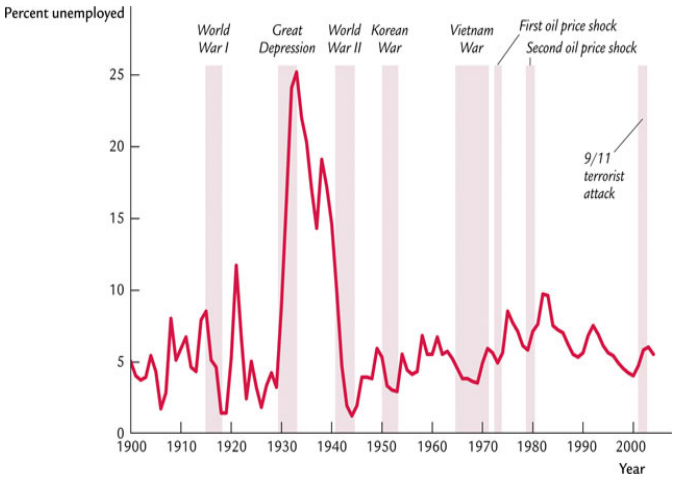


But our growth is not a smooth one. Both prices and unemployment rates have varied substantially overtime.

- Prices varied over time. Inflation:



- Unemployment rate: a large variation in unemployment rates



The objectives of this course and for the macroeconomics are to understand:

(1) Underlying reasons for the long run economic growth.
(2) Are there anything that can be done to reduce the short run variations in prices and unemployment rates.

Chapter 2: The Data of Macroeconomics

GDP – Gross domestic product
CPI
Unemployment Rate

GDP: Total expenditure on domestically-produced final goods and services.
Total income earned by domestically-located factors of production.

Expenditure = Income:
Because every dollar spent by a buyer becomes income to the seller.

- Market value:
  100 apples and 200 oranges in 2008: 100 * $1 + 200 * $0.75 = $250.

  Question: what about "stay home mom"? no
  Mom working and day care: yes
- Rent: yes
  Housing services: yes (needs to be imputed)

- Final goods and services
  Intermediate good (or service) not part of the GDP
  Sam's Club: sale to individuals: yes
  Sale to business: no
  SUV: yes
  Tire of SUV: no

- Product within a country:
- Newly produced in a given period:
  - New home: yes
  - Old home: no

Real GDP *vs* Nominal GDP

	Apple	Oranges	Nominal GDP	Real GDP in 2007
2008:	$1	$0.75	$250	100*$.9+200*$.8=$250
	100	200		
2007:	$.9	$0.8	$250.5	250.5
	105	195		

GDP Deflator: Suppose only one product

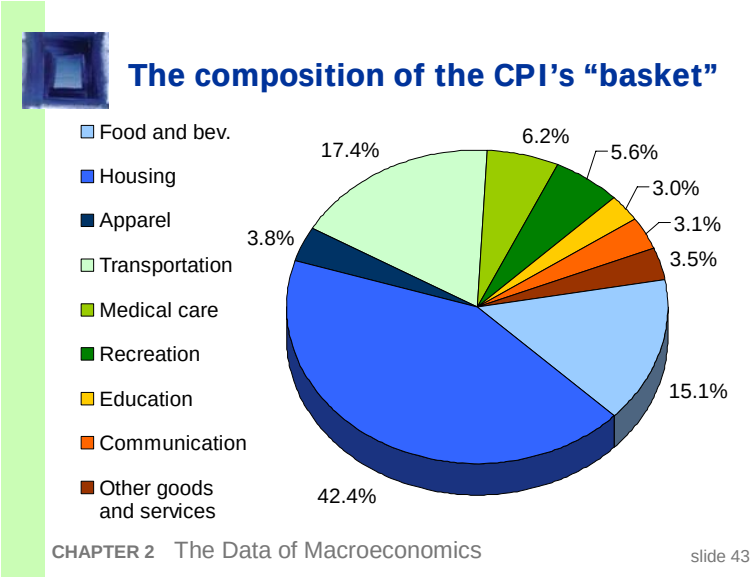
$$\text{GDP Deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} = \frac{250}{250} = 1$$

Question: Five years ago, there is no IPhone. How to deal with that?

Chain-weighted measures of Real GDP.

The Consumer Price Index: measures the level of prices at a given utility level.

It calculates how much it cost for a fixed of the basket of consumer goods.



Food and beverage: 15.1%
Housing: 42.4%
Apparel: 3.8%
Transportation: 17.4%
Medical care: 6.2%
Recreation: 5.6%
Education: 3.0%
Communication: 3.1%
Other goods and services: 3.5%

For example, suppose the basket includes 3 apples and 2 oranges. Suppose 2007 is the base year.

Previous example:

	Apple	Oranges		Real GDP in 2007
2008:	$1	$0.75	$250	100*$.9+200*$.8=$250
	100	200		
2007:	$.9	$0.8	$250.5	250.5
	105	195		

Suppose the basket includes 2 apple and 3 oranges. The CPI is given by:

$$\text{CPI} = \frac{\text{current price}}{\text{base year price}} = \frac{2*1+3*0.75}{2*0.9+3*0.8} = \frac{4.25}{4.2} > 1$$

Problems of CPI:

(3) The fixed of basket of goods does maintain the same utility level, but it ignores the substitutions that consumers are most likely to take.
(4) It measures how much an average consumer would consume. It may differ tremendously for different individuals because of the differences in their consumption patterns.
(5) It is difficult to measure the effect of new goods.
(6) It is difficult to measure changes in quality.

Now consider the substitution effect of CPI.

Consider the utility $U_0(c_{10}, c_{20})$ at time t = 0. Obviously at time t = 1, if c_{10} and c_{20} do not change, the utility level remains the same, regardless of price changes.

However, at $t = 1$, when the relative price changes, c_{10} and c_{20} will no longer be the optimal choices. To maintain the same utility level, we can draw, under the new relative prices, a budget line that is tangent to the same utility level. One can also draw a budget line that intersects with (c_{10}, c_{20}) with the new prices. The tangent line would lie at the left side (lower side) of the intersected budget line. Therefore, it will cost less to reach the same utility level because of the optimization.

The Unemployment Rate: fraction of workers who are unemployed.

The unemployment rate comes from a survey of about 60,000 households, called the Current Population Survey. Each person (over 16 years old) is placed into one of three categories:

(1) Employed.
(2) Unemployed: those who were not employed, were available for work, and had tried to find employment during the previous four weeks.
(3) Not in the labor force: include those who fit neither of the above.

December 2008:

Overall unemployment rate: 7.2%
Adult women: 5.9%
Adult men: 7.2%
Teenagers: 20.8%

Whites: 6.6%
Blacks: 11.9%
Hispanics: 9.2%
Asians: 5.1%

Civilian labor force (in thousand): 154,557
Employment: 143,388
Unemployment: 11,108
Unemployment rate: 7.19%

Not in the labor force: 80,588 (34.3% of the population over age 16))

December 2007

Civilian labor force (in thousand): 153,836
Not in the labor force: 66.0%

Employed: 146,294
Unemployed: 7,541
Unemployment rate: 4.9%

Chapter 3 National Income: Where it comes from and where it goes

Production Function:

$$Y = F(K, L) = K^{\alpha} L^{1-\alpha}$$

Constant Return to Scale: $zY = F(zK, zL)$

Suppose a country as a whole, K and L are constant. Then the supply curve is constant.

How to determine the demand curve (for either K or L)? A similar question is: what is the optimal level of K and L that a firm would hire?

Firms are assumed to maximize their profits by selecting optimal amount of K and L:

max Profit = Revenue – Labor Costs – Capital Costs
= Y -- WL - RK
= $F(K, L)$ – WL - RK
= $K^{\alpha} L^{1-\alpha}$ – WL - RK

To solve any maximization problem, it is necessary to solve for the first order conditions:

First order conditions:

$$\frac{\partial \pi}{\partial K} = MPK - R = \alpha K^{\alpha-1} L^{1-\alpha} - R = 0$$
$$\frac{\partial \pi}{\partial L} = MPL - R = (1-\alpha) K^{\alpha} L^{-\alpha} - W = 0$$

Now we have:

$$MPK = R, \qquad MPL = W$$

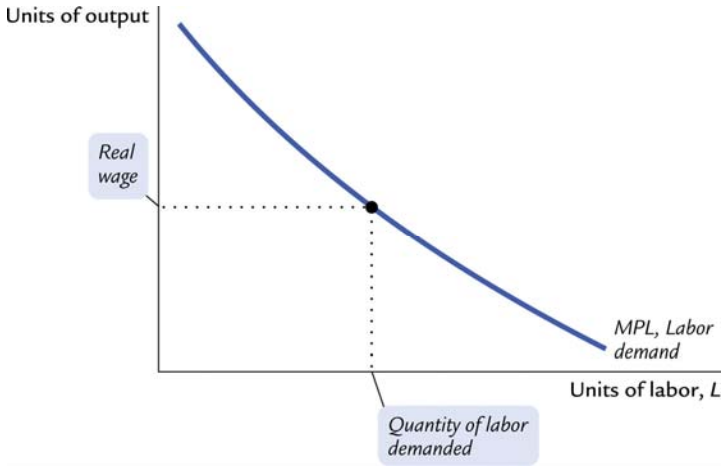
In other words, real interest rate is MPK, and real wage is W.

Discussions:

(1) Look at the equation: $MPL = W$. In the case of the Cobb-Douglas function,

$$(1-\alpha) K^{\alpha} L^{-\alpha} = W$$

Therefore, at the given level of K, a higher number of workers would lead to a lower wage. The following graph shows the negative relationship between W and L.

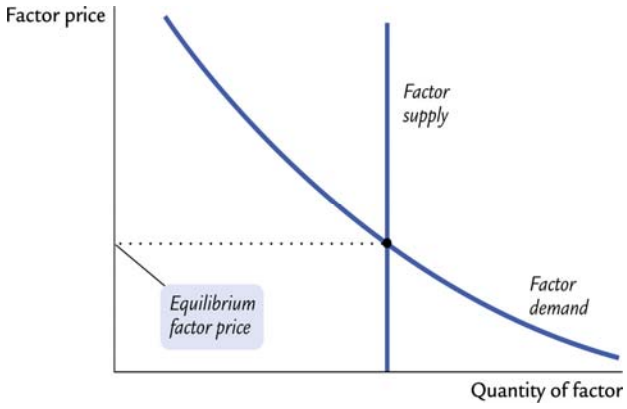


(2) Similarly, if we consider capital stock, K, and MPK = R, we have:

$$\alpha K^{\alpha-1} L^{1-\alpha} = R$$

Since $\alpha - 1 < 0$, we must have: at any given level of L, a higher K would lead to a lower interest rate.

Combine the supply and demand together, we have:



Although this graph is simple enough, it is a powerful tool to analyze economy.

To understand this graph, we must first understand endogenous variables and exogenous variables. The endogenous variables in the graph are factor prices and quantity of factor.

If it is labor demand and supply, then the endogenous variables are wage W and number of workers in the economy, L. Note in this case, the capital stock is exogenous.

If it is capital demand and supply, then endogenous variables are rental price (real interest rate) *R* and total level of capital stock in the economy. Note in this case, the number of workers L is exogenous.

Now we have two very basic predictions of the relationship between wage and number of employees at given level of capital stock, and between the interest rate and the capital stock, at given number of workers. These two basic predictions are:

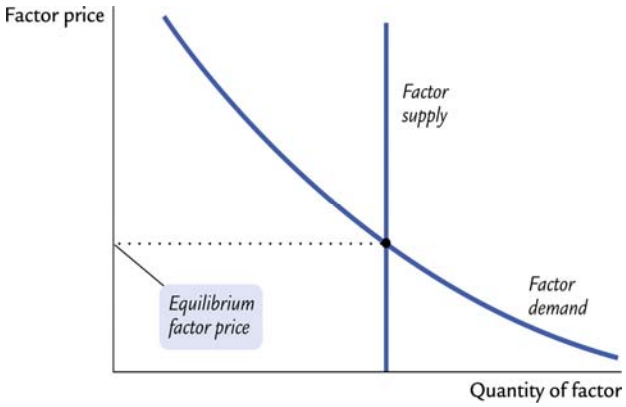
(i) At any given level of *L*, a higher *K* would lead to a lower interest rate.
(ii) At any given level of *K*, a higher number of workers would lead to a lower wage.

However, verifying these two predictions are very difficult. How economists do this: natural experiment.

*Two example*s

Example 1: the Black Death. The outbreak of the bubonic plague – the Black Death in 1348 reduced the population in Europe by about one-third within a few years. Note at the time, the capital stock mainly consisted of land. The total amount of land did not vary much. What would happen?

Factor market:



Factor supply curve moves to the left ➔ higher wages.

Is it true? Yes – the real wage almost doubled.

Example 2: The Mariel Boatlift, began 4/15/1980, and ended 10/31/1980. More than 125,000 Cubans arrived at Southern Florida, mostly in Miami.

Factor supply curve should move to the right ➔ lower wages.

However, the wages were not much affected.

Possible reason: they also bring capitals with them. As a consequence, the factor demand also increased.

Other examples: (1) 911 destroyed a lot of capital stock, in particular, a lot of office spaces in New York. So what would you expect? ➔ Office space rental price would go up. (2) In the summer, there will be a lot of students who want to get part time jobs ➔ lower wages.

Shares of Income:

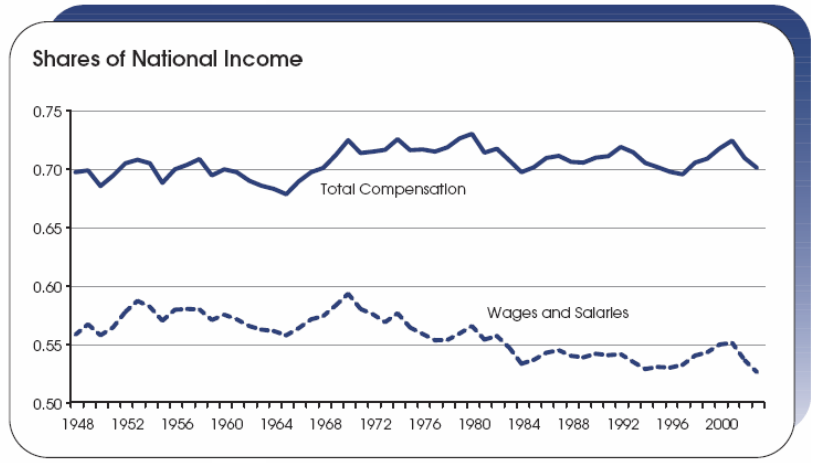
$$(1-\alpha)K^{\alpha}L^{-\alpha} = W$$

➔ $$(1-\alpha)K^{\alpha}L^{-\alpha} \times L = WL$$

➔ $$(1-\alpha)Y = WL$$

So the share of labor is 1-α

Similarly, the share of capital is α. This should not change:



Data source: St. Louis Fed.

The difference between the Total compensation and the wages and salaries is non-wage benefits, including health insurance and retirement benefits.

Demand of Goods and Services

Basic equation:

GDP = Consumption + Investment + Government Purchase + Net Exports
Y = C + I + G + NX

For the moment, assume we are in the closed economy, NX = 0.

Basic equation: $Y = C + I + G$

Consumption: It depends on the disposable income. Obviously a higher income would lead to a higher consumption.

$C = C(Y - T) = a + b * (Y - T)$

Example of consumption function: $C = 250 + 0.75\ (Y - T)$

In this case, the marginal propensity to consume (*MPC*): 0.75
One additional dollar of disposable income, only 0.75 cents are consumed. The rest of 0.25 cents are saved.

Investment: a higher cost or rental price would lead to a lower investment.

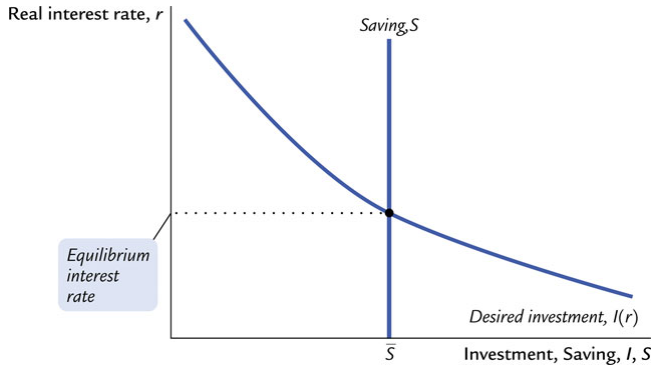
Example of investment function: $I = I(r) = 1{,}000 - 50$ r.

A higher interest means a higher cost of investing, therefore a lower amount of investment.

The equilibrium of supply and demand:

$Y = C + I + G = C(Y\text{-}T) + I(r) + G$

Rewrite this: $Y - C(Y\text{-}T) - G = S = I(r)$



Discussions:

(1)

Left hand side: $Y - C(Y\text{-}T) - G = S$, or national saving, this is the vertical line.
Right hand side: I(r), investment, the downward sloping line (investment line).

Note the vertical line includes three terms:

- The total output *Y*. This term is determined in the long run by capital stock *K* and labor *L*. If *K* and/or *L* increase, *Y* would increase, and the vertical line would shift to the right. It is possible that some of the fiscal policies (taxes or government spending) may have a consequence on increasing amount of K or L in the long run.

- The consumption *C*. An increase in *C* would shift the vertical curve left. When *C* increases, the society has less money available for investment so the interest rate is higher. The lower amount of investment compensates the amount of increase in consumption.
  However, if T is lowered, then consumption would increase. In this case, if not all lowered amount of taxes are consumed (assume marginal propensity to consume is lower than 1, i.e., the previous consumption function C = 250 + 0.75 (Y – T)), the saving may increase. As a consequence, it is possible that capital stock would increase to cause Y to increase.

- Government *G* spending. An increase in government spending would shift the vertical curve left. However, if some of the government spending is on improving the capital stock (such as improving the infrastructure of the country), then the K level would increase and the output Y would increase.

(2)

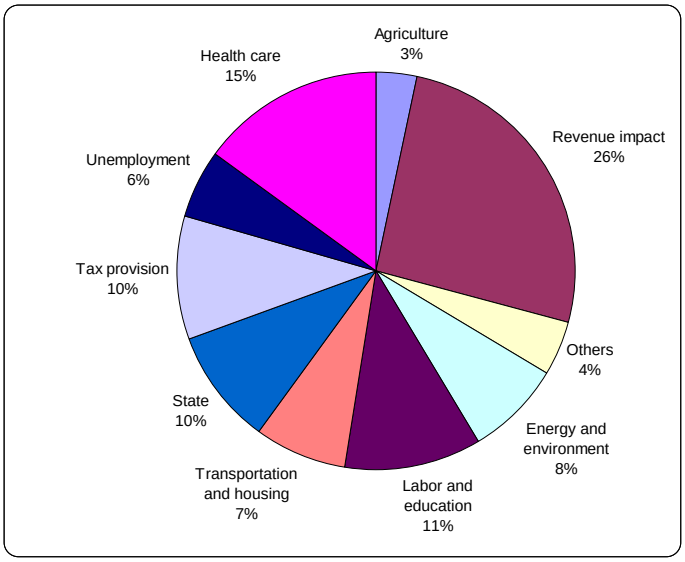
Public saving: $T - G$
Private saving: $Y - T - C$
National saving: $Y - T - C + T - G = Y - C - G$

<u>Examples</u>:

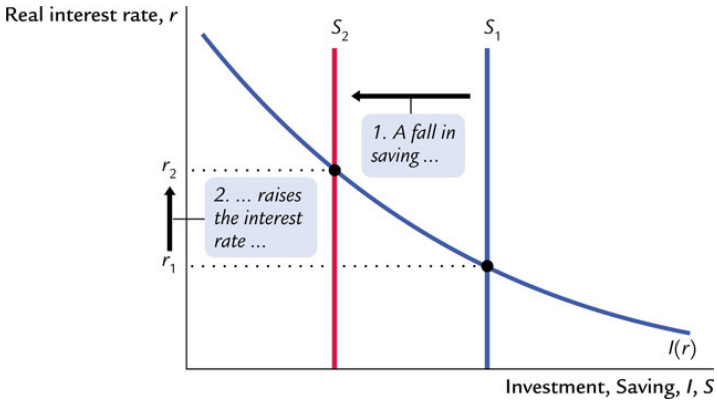
Case 1: an increase in government spending, *G*.

(i) FY 2001 – FY 2008, Congress has approved a total of about $864 billion of supplemental funding for the Iraq and Afghanistan wars. Among which, $657 billion are spent at Iraq. The Congressional Budget Office estimates the total cost would be 1.4 trillion to 1.7 trillion up to 2018 (assuming a gradually lowered level of troops).

(ii) The Obama stimulus package has an $820 billion price tag so far. The following table summarizes the Obama stimulus package (the House version).



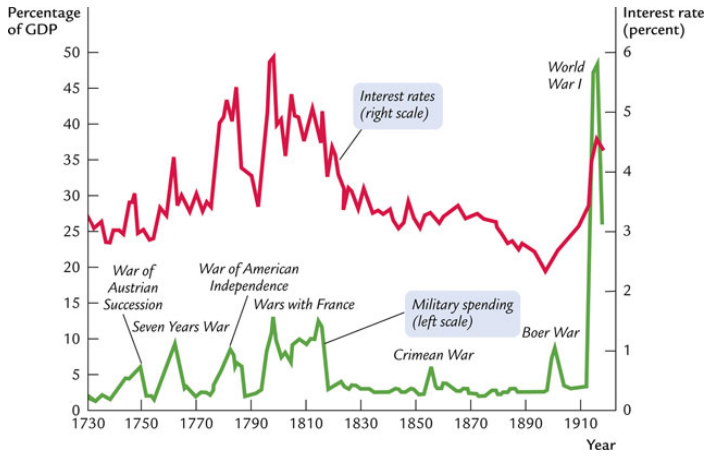
If in both situations, we assume for the time being that the government spending does not alter the levels of capital stock (K) and labor (L) in the long run.



$$Y - C(Y\text{-}T) - G = S = I(r)$$

An increase in G ➔ because $Y - T$ is unchanged, so C is unchanged ➔ interest rate has to increase to induce Investment to fall. This is the so-called crowding out effect: government purchase crowding out the private investment.

Therefore, a higher government spending (and more likely to lead to a higher level of deficit) would lead to a higher interest rate. Is this the case?



Interest rate rises when military spends more.

This graph suggests a sudden increase (because of war) in government spending would most likely to cause the interest to rise.

However, a major difference between the Obama stimulus package and the supplemental funding in Iraq and Afghanistan wars is that: the Obama package has a large portion on tax cuts (next example) and, more importantly, a large portion will be used in investing nation's infrastructure system.

An investment in *K* would most likely to lead *Y* increase in the future. Therefore, the vertical curve may shift right.

Case 2: A decrease in taxes. Bush has two major tax cuts during his term: the 2001 tax cut (marginal income tax cut) and 2003 tax cut (capital gains tax cut). Obama's stimulus package also includes tax cut.

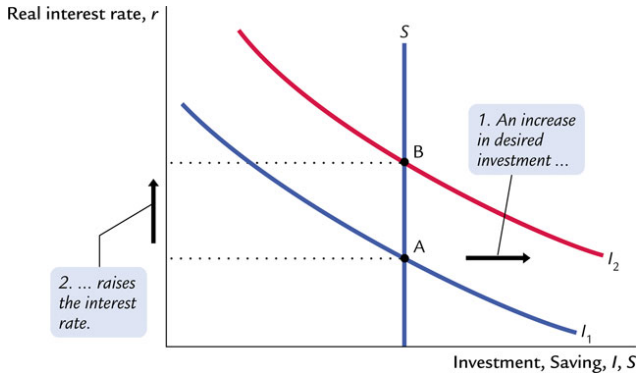
$$Y - C(Y\text{-}T) - G = S = I(r)$$

T decrease ➔ disposable income increases ➔ *C* increases ➔ *S* decreases (*G* remains the same) ➔ less money available to loan ➔ higher interest rate ➔ lower Investment.

(The reason here is the public saving decreases)

However, if $C(Y\text{-}T) = a + b * (Y\text{-}T)$, $0 < b < 1$. A tax cut would result additional consumption and saving. As a consequence of increased saving, more accumulation in capital stock in the long run ➔ long run *Y* may increase ➔ the vertical saving curve shifts right.

Case 3: Capital gains tax. Bush tax cut in 2003 mostly concentrated on lowering the capital gains tax.



Raise the interest rate, so equilibrium level of investment is unchanged. Under our assumption, the fixed level of saving determines the amount of investment.

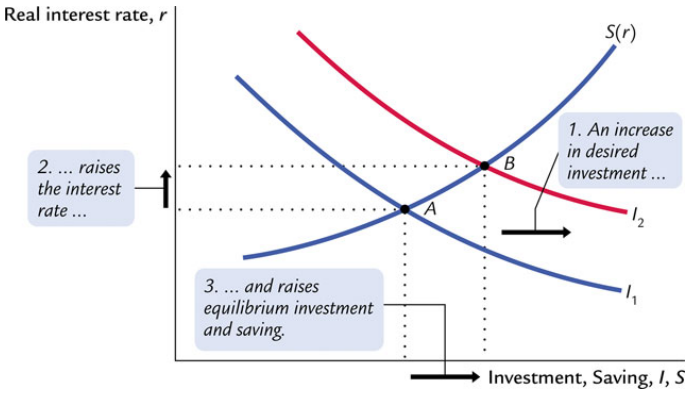
Case 4: if saving depends on interest rate. In this model, an increase in saving is achieved by a decrease in consumption.

To have the model correct, consumption must depend on interest rate.

$C = C(Y\text{-}T, r)$.

When r increases ➔ less consumption and more saving (This is true if a consumer optimizes overtime).

In this situation, we have:



Summary:

- Total output is determined by the economy's quantities of capital and labor (and technology). The key production function in this course is Cobb-Douglas production function:

$$Y = F(K, L) = K^{\alpha}L^{1-\alpha}$$

- Competitive firms hire both K and L until its marginal product equals its price. Profit is maximized when MPK = r and MPL = wage.

- If the production function has constant returns to scale, then labor income plus capital income equals total income (output).

- A closed economy's output is used for: $Y = C + I + G$

- In the long run, the equilibrium is reached when saving and investment are equal.