Topic 1: Economic Growth

Economic Growth and Standards of Living

- Economic growth is the most important factor when it comes to determining standards of living and national incomes.
- One of the measures we use to compare standards of living between different countries is GDP per capita, indexed to a inflation accounted US dollar rate.
  GDP per capita:
- Why is there such a monumental difference between the average weekly food consumption of a n average family in Sudan compared to say a country like Germany?
- Looking at average GDP growth rates over a long period of time, like 100 years, we see that a small difference in the growth rate amongst different countries can be the difference between a rich country and a poor country.
- A small difference in the growth rate over a long period of time will have a substantial difference in the amount of GDP per capita.
- Case in point: Argentina. Argentina was one of the most well off countries 100 years ago. However, in the last 100 years Argentina has failed to keep growing, and has thus fallen out of place as a first world country.

Economic Growth and Standards of Living

- We use GDP per capita as an economic indicator, however there are a lot of short comings with this. GDP per capita doesn't give a picture of say the quality of life in a country.
- In the data set "Parade of the World" we see that the average GDP per capita rate of the world is $8,630. From this we see that roughly 20% of the world's population lives above this average, and that there lies a large inequality between well off countries and poor countries.
- Is GDP per capita an accurate indicator when it comes to standards of living?

Working with Growth Rates

- Compound Interest Formula:

$$X_{t+n} = X_t(1+g)^n$$

IMPORTANT!
The 'g' term in this formula is NOT in percentage terms!

- Rule of 72:

$$\text{Doubling Time} \approx \frac{72}{g}$$

- This rule comes in handy if we want to approximate the time it takes to roughly double a value, such as a country's output. Note that g is in percentage terms.

Problems with Using GDP per capita

- There lies a few problems with GDP per capita (pegged to a US dollar value): The biggest one being that the market exchange rate changes constantly, and thus can misrepresent data. For example, if the US dollar depreciates by 10%, a country's standard of living wont increase by 10%.
- Secondly, the relative pricing of goods are different between countries. GDP per capita fails to address this issue.
- To compensate for some of these factors, we use the Purchasing Power Parity (PPP) Exchange Rate. Using a market exchange rate tends to understate the standards of living in poor countries and overstates the standards of living in rich countries.

Purchasing Power Parity

- PPP is an artificial exchange rate, theorised by economists. It allows us to compare a common basket of goods or output between two countries.
- This implies that we assume that the quality of goods of two countries (e.g. Cars and food) are the same in order to allow us to setup a PPP exchange rate—this reliability of such an assumption is clearly debatable.
- PPP exchange rates help us to avoid the pitfalls of market exchange rates, which are constantly exposed to demand/supply changes.
- Example - Production and Prices in Richland and Poorland (Weil, p27):

Country	**Production of TV's per capita**	**Production of haircuts per capita**	**Price of TV's in local currency**	**Price of haircuts in local currency**	**GDP per capita in local currency**
Richland	4	40	10	2	120
Poorland	1	10	10	1	20

- We take a standardised basket of goods, in this case 1 TV and 10 haircuts (as these are the ratios in which these goods are produced). This basket would cost 30 dollars in Richland and 20 in Poorland. The PPPER suggests a rate of 2 Poorland dollars for every 3 Richland dollars. Using this exchange rate we can conclude that Poorland's GDP per capita (20 Poorland dollars) is actually 30 Richland dollars, and that Poorland's GDP per capita would be one-quarter of Richland's.
- If we use the market exchange rate however, the rate would be 1 Richland dollar per 1 Poorland dollar. This is derived from the law of one price, which assumes that the exchange rate will change to ensure that the price of traded goods is equal amongst different countries. Here, TV's are traded and so we assume a 1:1 exchange rate.

Growth Verses Business Cycles

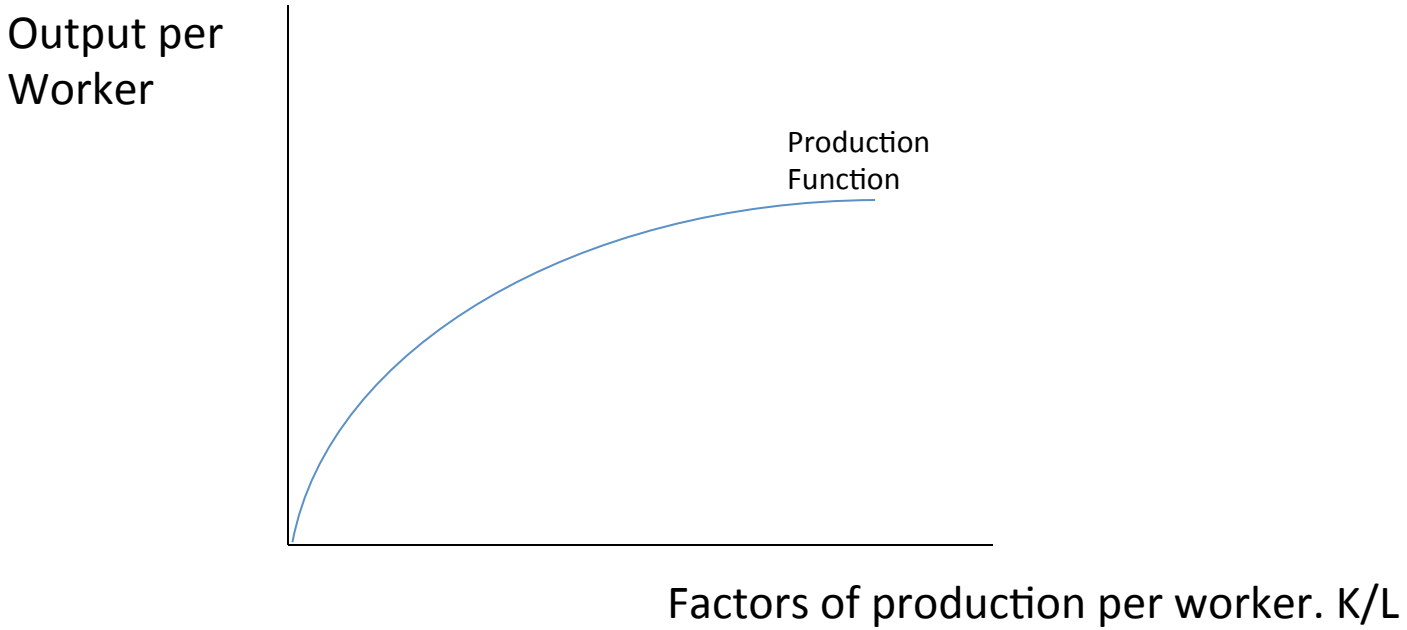
- There needs to be a distinction between growth and swings in the business cycle. Growth is defined by economists as a long run phenomenon.
- Growth can still occur in the midst of a recession, as we look at the average growth rate over a long period of time.
- For example; Is the recession in Japan just a short term recession (a trend in the business cycle) or the beginning of a long term slow down in growth?
- Focusing on growth makes it easier to compare countries to one another. For example, the US during a recession is still much better off than India during a boom year.

Growth and Factors to Growth

- Pg.30 of Economic Growth focuses on two hypothetical countries as to why there lies such a large difference in incomes, and brings up the topic of investment rates and productivity.
- We know that to increase productivity, we have to increase capital investments, which requires high savings rates. We then need an increase in the quality of capital to achieve increased efficiency and productivity. But how do we go about doing this exactly? And, what are some of the factors that cause a difference in incomes between countries?
- Proximate Factors - An event that is immediately responsible for causing an observed result.
- Ultimate Factors – Something that affects an observed result through a chain of intermediate events:
  - The quality of institutions (Competitive markets, property rights, political stability, openness to international trade and open financial markets).
  - And geography.
- The current debate is whether or not geography is more important than quality of institutions. But that is not the focus of this course...

The Production Function

- The Production Function – A representation of the relationship between inputs and outputs:



- Output is increasing at a decreasing rate, so curve shape is due to diminishing returns to the use of capital stock. Observe that the ratio of K/L assumes that the amount of workers stays constant as you increase K.

The Production Function

- The Production Function:

$$Y = F(K,L)$$

- Assumptions:

  - **Constant Returns to Scale**. E.g. $F(2K,2L) = 2F(K,L) = 2Y$

    $F(aK,aL) = aY$

  - **Diminishing Marginal Product**; increasing the use of capital per worker, holding the number of workers fixed, output will increase but by a smaller amount than the previous increase in capital.

- Following constant returns to scale:

$$(\frac{1}{L})Y = (\frac{1}{L})F(K,L) = F(\frac{K}{L},\frac{L}{L})$$

- $k = (K/L)$ as quantity of capital per worker

  $y = (Y/L)$ output per worker

- Therefore : $\frac{Y}{L} = F(\frac{K}{L},1) \Rightarrow y = F(k,1) \Rightarrow y = f(k)$

This implies that output per worker is only a function of capital per worker

The Production Function

- Marginal Product of Capital (MPK):

$$MPK = f(k,1) - f(k)$$

The difference between the two terms is the marginal product

- The Cobb-Douglas Production Function:

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

A = Productivity level.

α = Percentage share of capital used in production as opposed to labour. Economists have estimated this value to be roughly ⅓ throughout the world. However this is just a rough approximation.

- Cobb-Douglas PF with constant returns to scale:

$$\begin{aligned} F(2K,2L) &= A(2K)^{\alpha}(2L)^{1-\alpha} \\ &= 2^{\alpha+1-\alpha}AK^{\alpha}L^{1-\alpha} \\ &= 2AK^{\alpha}L^{1-\alpha} \end{aligned}$$

- MPK = The derivative of output with respect to capital.

$$MPK = \frac{dY}{dK} = \alpha AK^{\alpha-1}L^{1-\alpha}$$

We can also take the marginal product of labour

The Production Function

- To prove that the production function has diminishing returns, we take the derivative of the marginal product of capital (MPK):

$$\frac{\partial \text{MPK}}{\partial \text{K}} = \alpha A(\alpha - 1)K^{\alpha-1-1}L^{1-a}$$

This term is <0 due to the (α-1) being a negative term.

- We can derive the Cobb-Douglas PF in per worker terms:

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

$$y = F(k,1) = AK^{\alpha}L^{1-\alpha}L^{-1} = AK^{\alpha}L^{-\alpha}$$

$$= \frac{AK^{\alpha}}{L^{\alpha}} = A\left(\frac{K}{L}\right)^{\alpha}$$

$$= Ak^{\alpha}$$

The Production Function

- We can also prove that α is the capital share in income.
- In a competitive economy, MPK is equal to the rental rate per unit of capital. Therefore the total amount paid out to capital is = MPK * K
- The capital share of income =

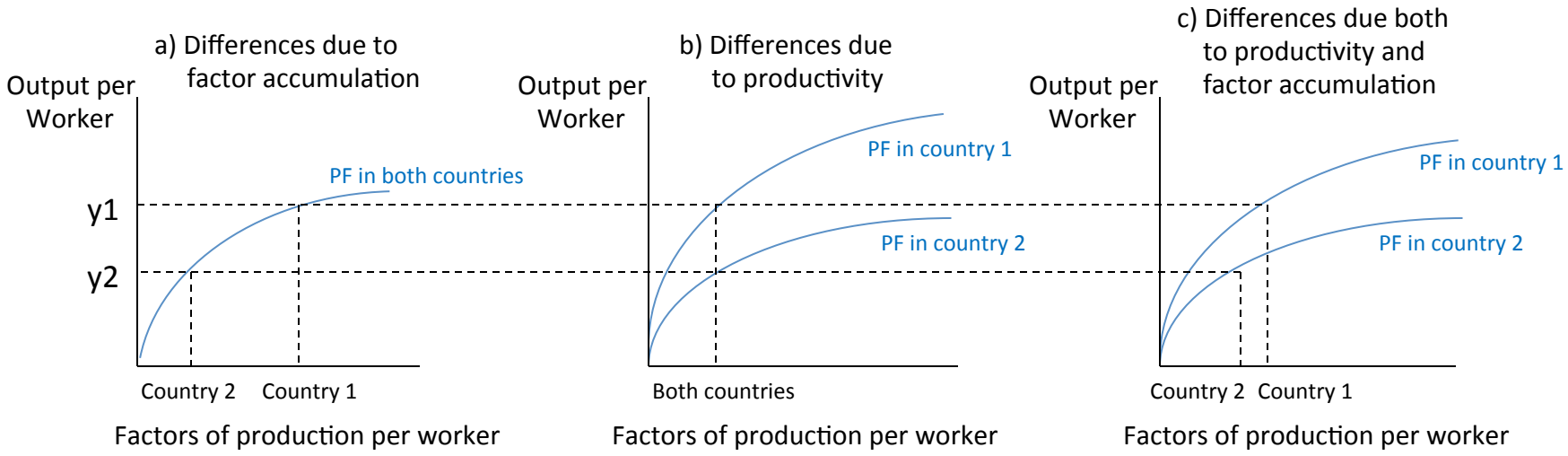
$$\frac{\text{MPK}*\text{K}}{\text{Y}} = \frac{\left(\alpha \text{AK}^{\alpha-1}\text{L}^{1-\alpha}\right)*\text{K}}{\text{AK}^{\alpha}\text{L}^{1-\alpha}}$$

$$= \frac{\alpha \text{AK}^{\alpha-1+1}\text{L}^{1-\alpha}}{\text{AK}^{\alpha}\text{L}^{1-\alpha}}$$

$$= \alpha$$

- ...and economists have a rough estimate that alpha is around 33.3%.

The Production Function – Possible Sources of Differences in Output per Worker



Output per capita in Country 1, y1, is higher than output per worker in country 2, y2. Each of the three panels of the figure shows a possible explanation for why the two countries differ in output. In panel a), the two countries have the same production function, but country 1 has a higher level of factors of production per worker, and thus higher output. In panel b), the two countries have the same quantities of factors of production, but the production function of country 1 lies above that of country 2, so for any quantities of factors of production, country 1 produces more output than country 2. In panel c), country 1 has more factors of production and higher productivity than country 2.

Definition of Capital Goods

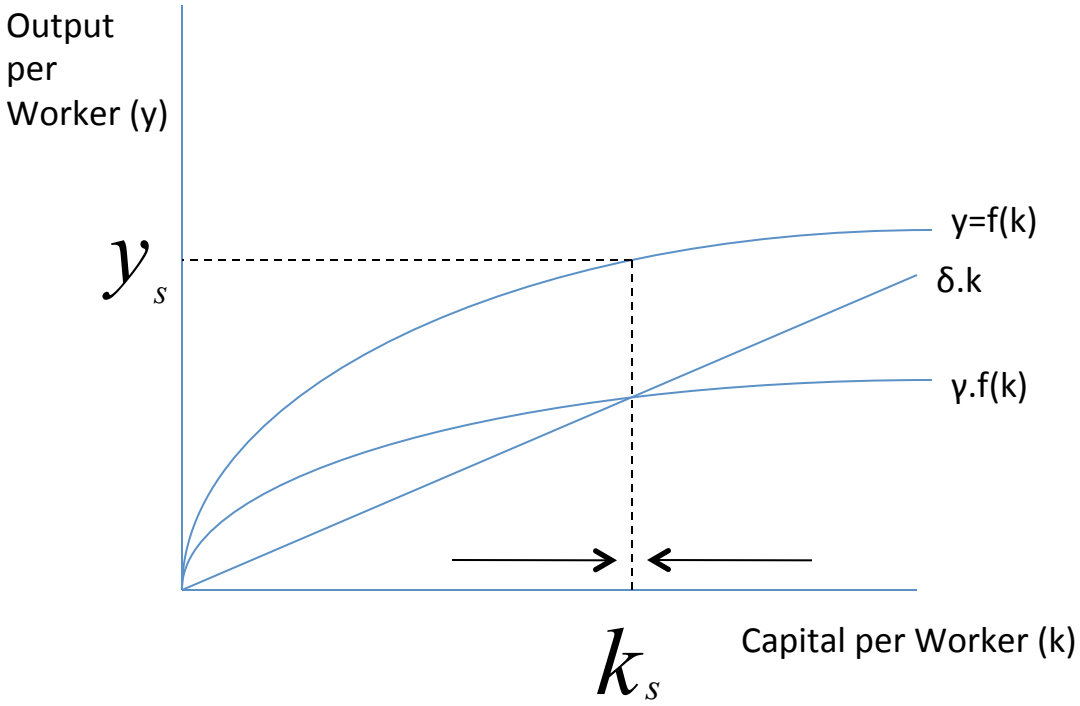
- There are 5 characteristics of capital goods:
  - Produced by something.
  - It is productive.
  - It has limited uses; it has rivalry in its use that being a certain number of people can use it at once.
  - It earns a return; hence why firms invest in capital goods.
  - Capital requires maintenance. E.g. firms accounting for depreciation.

The Solow Model

- The Solow model models the relationship between output and capital stock per worker.
- The model has a few assumptions:
  - The quantity of labour is held constant over time.
  - No technological change.
- Accumulation of capital:
  ΔK = Investment – Depreciation
  $\Delta K = I - D$, In per worker terms: $\Delta k = i - d$
  γ = the fraction of income invested, which is constant.
  $i = \gamma.y$
  $d = \delta.k$, where δ is the depreciation rate.
  $\Delta k = \gamma.y - \delta.k$
- An example:
  $y = f(k) = 50$, $k = 100$, $\gamma = 0.2$ and $\delta = 0.05$
  $\Delta k = 0.2*50 - 0.05*100 = 5$

The Solow Model

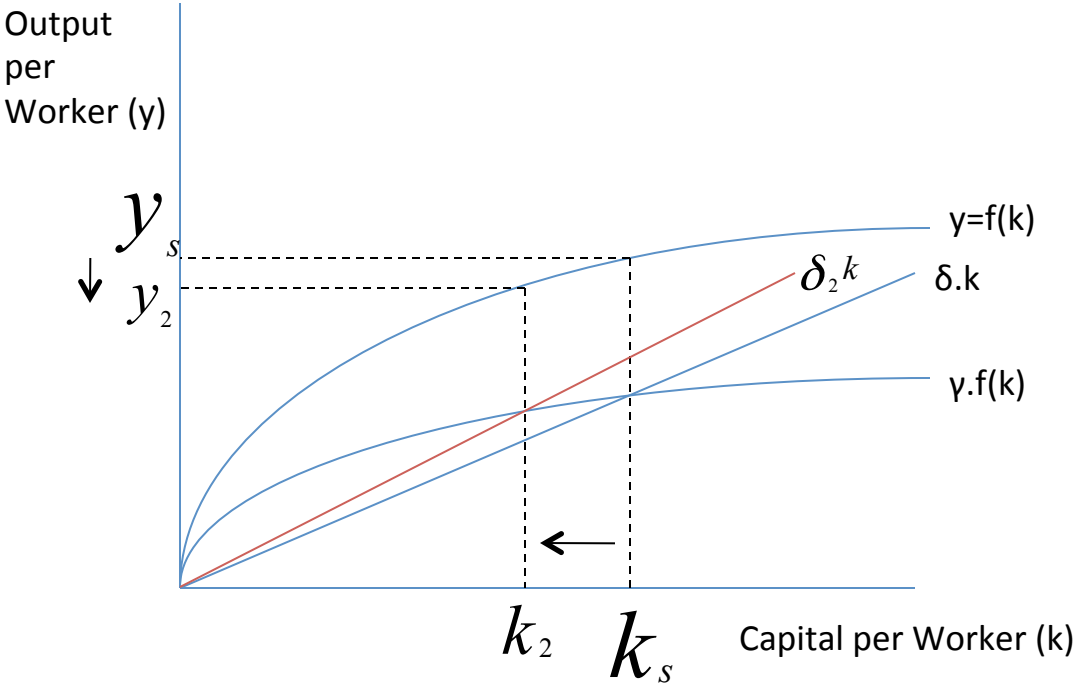
- The steady state:



- The steady state is a condition of the economy in which output per worker and capital per worker do not change over time. i.e. Investments on capital = Depreciation of capital.

The Solow Model

- A change in the depreciation rate – an increase:



The Solow Model

- Expressing the steady state mathematically using the Cobb-Douglas Production Function:

$$y = Ak^{\alpha}$$

$$\Delta k = \gamma . y - \delta . k$$

$$= \gamma Ak^{\alpha} - \delta . k$$

At the steady state $\Delta k = 0 = \gamma Ak^{\alpha} - \delta . k$

$$\gamma Ak^{\alpha} = \delta . k$$

$$\frac{\gamma Ak^{\alpha}}{k} = \delta$$

$$\gamma Ak^{\alpha} k^{-1} = \delta$$

$$\gamma Ak^{\alpha-1} = \delta$$

$$k^{\alpha-1} = \frac{\delta}{\gamma A}$$

$$k = \left(\frac{\delta}{\gamma A}\right)^{\frac{1}{\alpha-1}}$$

$$k_s = \left(\frac{\gamma A}{\delta}\right)^{\frac{1}{1-\alpha}}$$

$$y_s = Ak_s^{\alpha}$$

$$= A^{1+\frac{\alpha}{1-\alpha}} \left(\frac{\gamma A}{\delta}\right)^{\frac{\alpha}{1-\alpha}}$$

$$y_s = A^{\frac{1}{1-\alpha}} \left(\frac{\gamma}{\delta}\right)^{\frac{\alpha}{1-\alpha}}$$

This result shows us the relationship between the depreciation rate, the investment rate and output per worker. If for example the investment rate increases, the second term in this function will increase. If the depreciation rate increases, then the function value will decrease.

The Solow Model

- Using the Solow Model as a theory of income differences:
  - Consider 2 countries: i and j:

$$y_1^s = A^{\frac{1}{1-2}} \left(\frac{\gamma_i}{\delta} \right)^{\frac{\alpha}{1-\alpha}} \qquad y_1^s = A^{\frac{1}{1-2}} \left(\frac{\gamma_j}{\delta} \right)^{\frac{\alpha}{1-\alpha}}$$

- We assume that productivity and depreciation is the same in the two countries, however γ is different. For example; assume γ of country i is 50% and for country j is 5%. And α is ⅓.

$$\frac{y_i^s}{y_j^s} = \left(\frac{\gamma_i}{\gamma_j} \right)^{\frac{\alpha}{1-\alpha}}$$

$$\frac{y_i^s}{y_j^s} = \left(\frac{.50}{0.05} \right)^{\frac{1}{2}}$$

$$= 3.16$$

$$\approx 3.2$$

Therefore, we can derive that country i is roughly 3.2 times as much as country j

The Solow Model

- How accurate is the Solow Model in real life?
  - If we plot a scatter plot of the Solow Model predicted GPD per worker against real life statistics of GDP per worker (on a 45 degree line of equilibrium) relative to US GDP per worker, we find that the Solow Model isn't entirely accurate (except for Luxembourg and Saudi Arabia). See page 45 in text.
  - Does this mean that the Solow Model is useless? No, because we see that there indeed lies a positive relationship between Solow predicted statistics and real life statistics.
- Can we use the Solow Model to predict the difference in income growth between countries?
  - Yes: We look at transitional growth as countries grow towards a steady state. We use the Solow model as a theory of relative growth rates:

$$\Delta k = \gamma . y - \delta . k$$

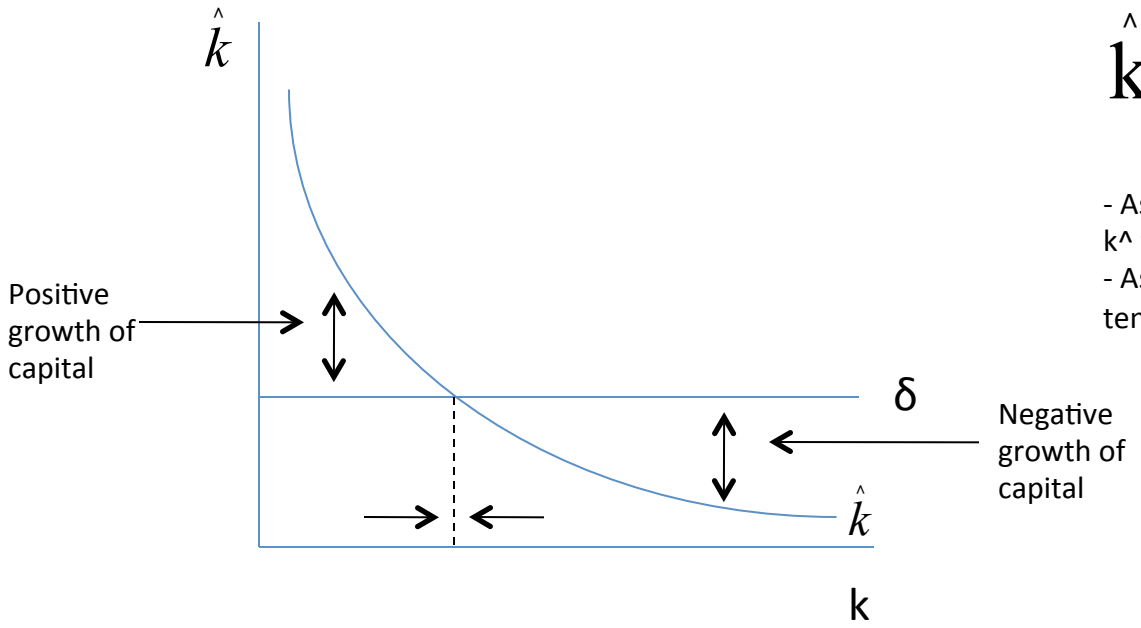
$$\frac{\Delta k}{k} = \frac{\gamma A k^{\alpha} - \delta . k}{k}$$

$$\hat{k} = \gamma A k^{\alpha - 1} - \delta$$

$$\hat{k} = \frac{\gamma A}{k^{1-\alpha}} - \delta$$

The Solow Model

- Speed of Convergence to the Steady State:



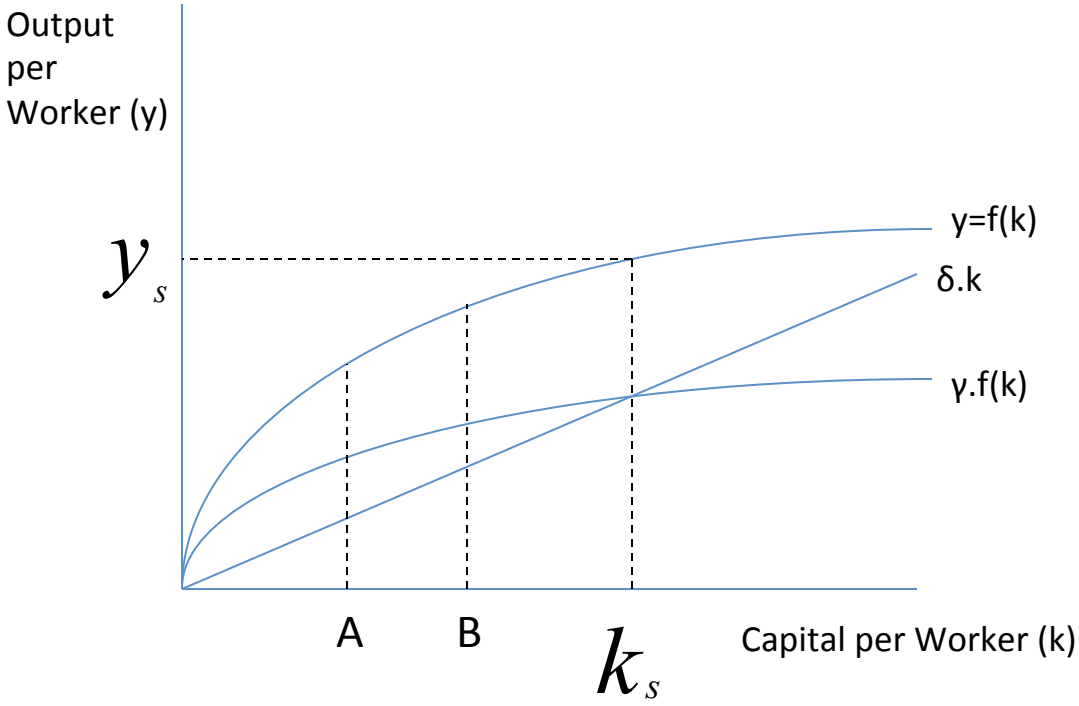
$$\hat{k} = \frac{\gamma A}{k^{1-\alpha}} - \delta$$

- As k tends to infinity, k^ tends to zero.
- As k tends to zero, k^ tends to infinity.

- The further from the steady state, the faster the growth/decay of capital stocks.

The Solow Model

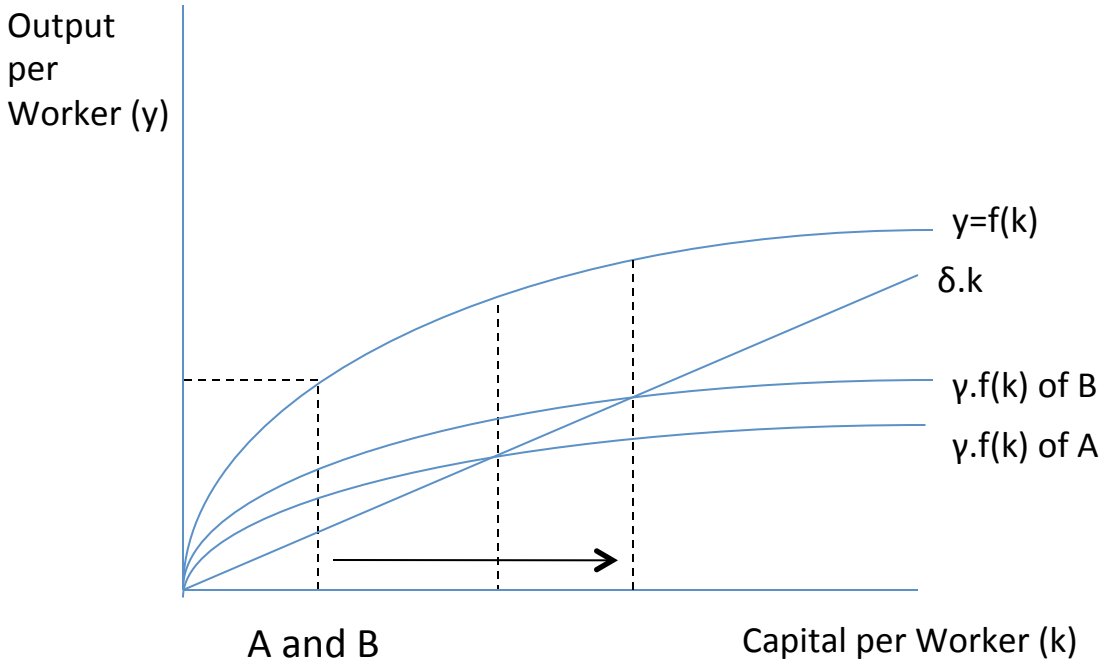
- We can now look at instances where we compare the transitional growth between two countries, using the Solow Model:
- When 2 countries have the same rate of investment but different levels of income:



  - A has a faster growth rate than B (steeper gradient on the income curve)
  - Conditional convergence – Countries will converge so long as you account for differing factors such as savings rates.

The Solow Model

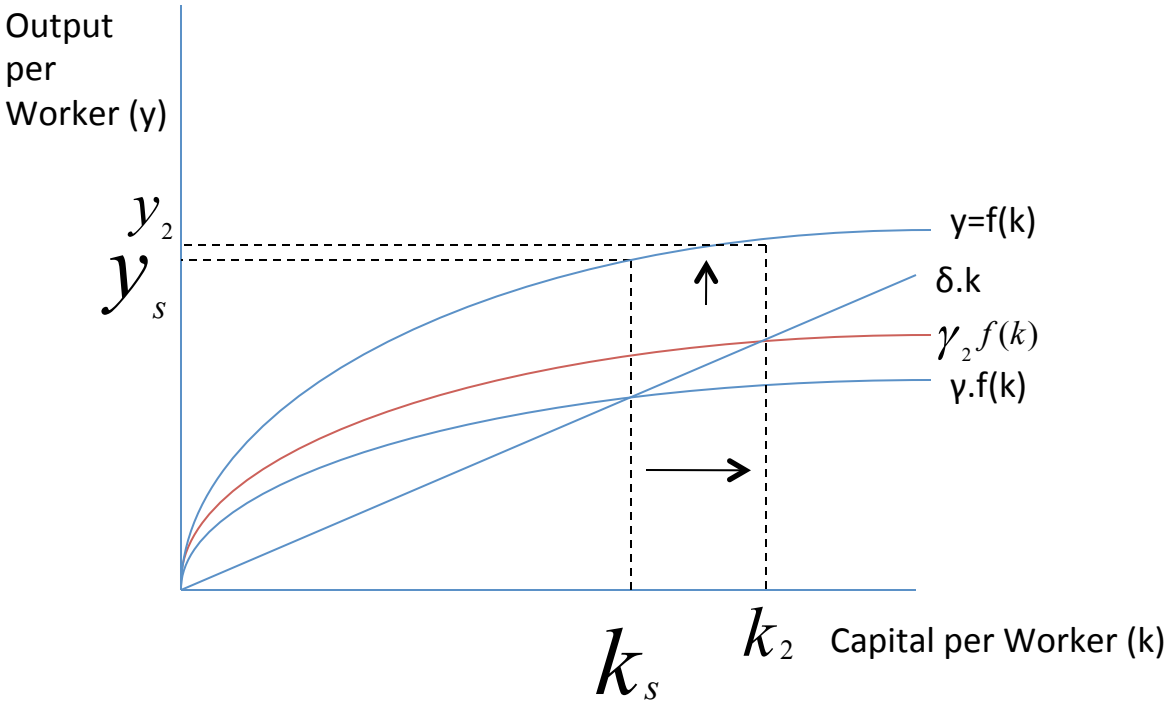
- If two countries have the same level of income but different rates of investment:



  - B has more potential to grow compared to A, due to the higher investment rate allowing a higher steady state.
  - B will also grow faster, due to the steady state being further away.

The Solow Model

- A change in the investment rate – an increase:



- A country that increases its investment rate will increase its growth rate, as the steady state moves further away.

The Solow Model

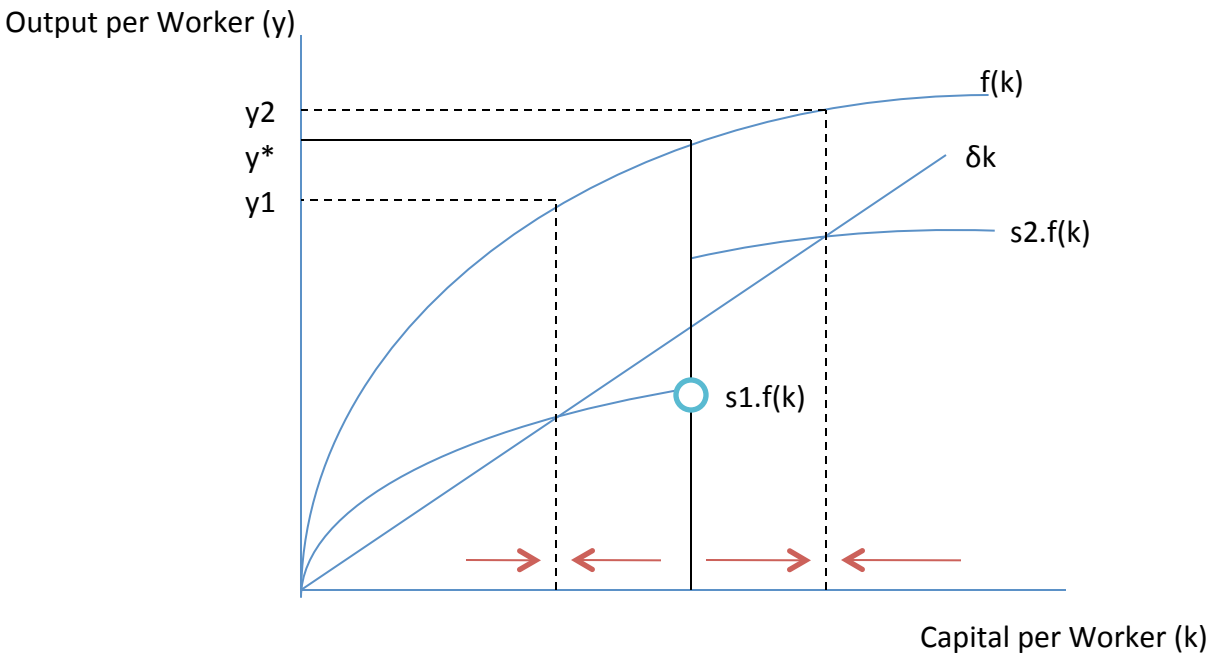
- There are a few caveats with the Solow Model:
  - The Solow Model doesn't represent long term growth—in the long run (assuming we use the Solow Model), growth will reach 0%. This is because once a country reaches the steady state, it ceases to grow, according to the Solow Model.
  - The Solow Model doesn't define how the investment rate comes about. The investment rate is given exogenously.
- We need to therefore look at what determines investments and savings:
  - Investment is funded by savings, which is sourced from either domestic sources or international sources.
  - Empirically, domestic savings are of higher interest, so we shall focus on what determines domestic savings.
- Possible Determinants of Savings:
  - Government policy
  - Function of income – and this presents a problem in the Solow model;
    - If savings depends on income then savings is endogenously determined in the model. The higher the savings the more you save, which increases investment, which increases the capital stock per worker which equals higher savings.

    This becomes a cycle, endogenously determined in the model.

The Solow Model

- Multiple Steady State Situation (Weil, p73):
  - The effect of income on savings (when savings is dependent on income):
    - One natural explanation for the low savings rates in poor countries is that people there simply cannot afford to save. In economic terms, people are in poor countries have living at subsistence levels and are devoting their entire income to consumption. While this explanation sounds reasonable for the poorest countries in the world, it doesn't explain why some of the less poverty stricken countries like Pakistan. One explanation for this is that even though the people in say Pakistan are living above subsistence levels, they're still poor and have little regard for the future. i.e. The net present value of saving money for the future is lower than consuming today.
    - This has implications in regard to the Solow Model. Assume that there are no flows of investment between countries, so that in every country, the investment rate is equal to the savings rate.
    - There now lies two possible savings rates; one high and one low, depending on the level of income. If income is below a certain point, then a country's savings rate will be the lower rate. If income is equal to or above a certain level, then the savings rate will be the higher rate.
    - This will cause two possible steady states. If a country's savings rate is the lower rate (due to initial income not being at or above a certain rate), then income will gravitate to a steady state that will cause a decrease in income. The opposite also occurs if the savings rate is the higher rate.
    - The following diagram illustrates the multiple steady state situation:

The Solow Model



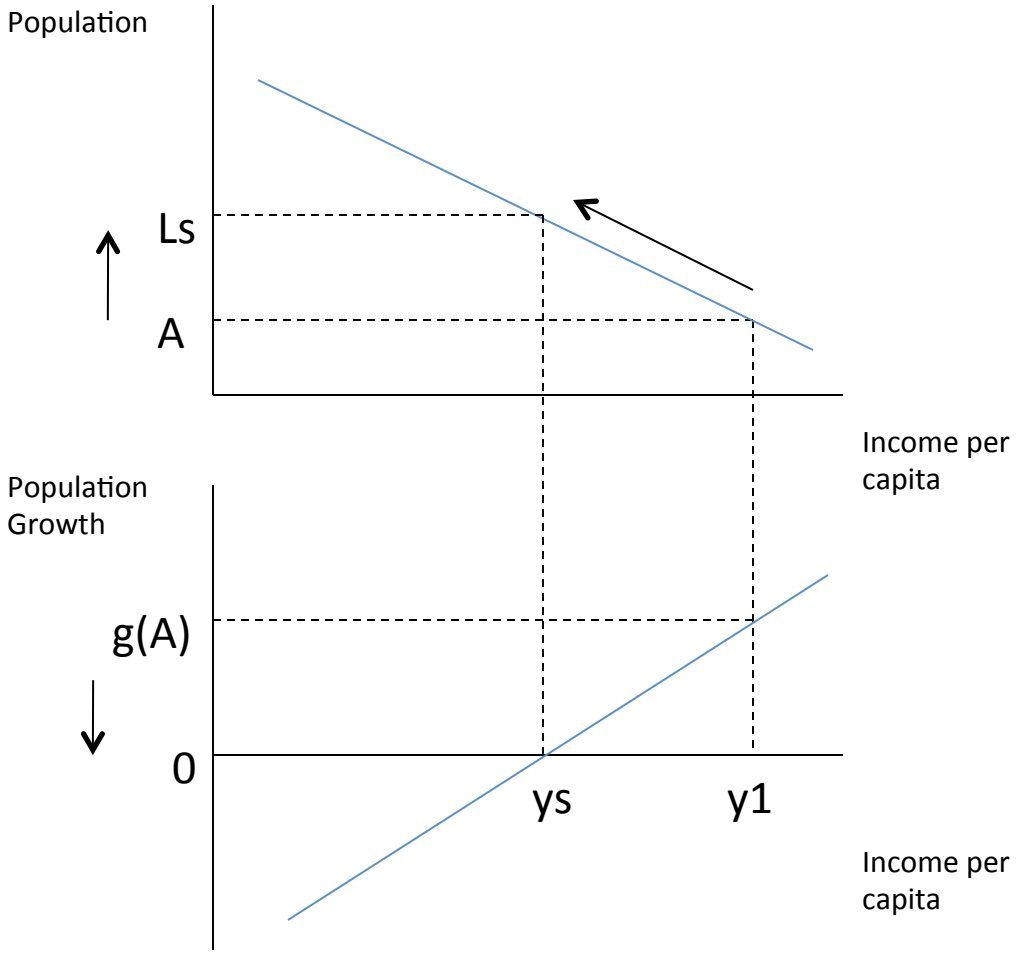
- The above diagram illustrates a multiple steady state scenario. If initial income per worker is below y*, then the country's savings rate is s1, and thus the steady state will occur y1. If a country's income is at or above y*, however, then the savings rate is s2 the steady state will occur at y2.

Population and Economic Growth

- The Malthusian Model (Essay on the Principle Population):
  - The smaller the population to available land, the better the standards of living;
  - The faster a population would grow;
  - The amount of land per person would then decrease (land/population would fall);
  - People would then become poorer;
  - This would then decrease population growth;
  - Eventually, a country reaches a level of income corresponding to a constant population (zero population growth).
- We can illustrate the Malthusian Model...

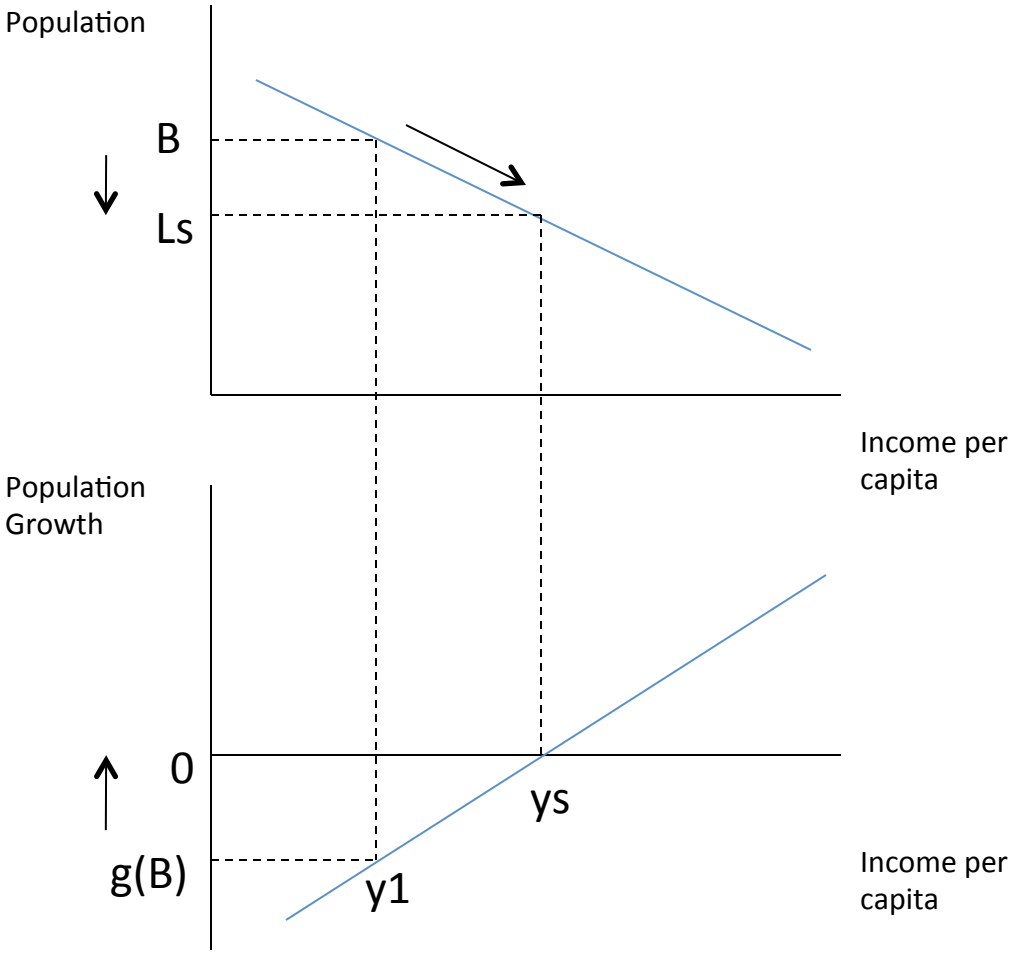
Population and Economic Growth

- Malthusian Model Illustrated (Below a steady state):



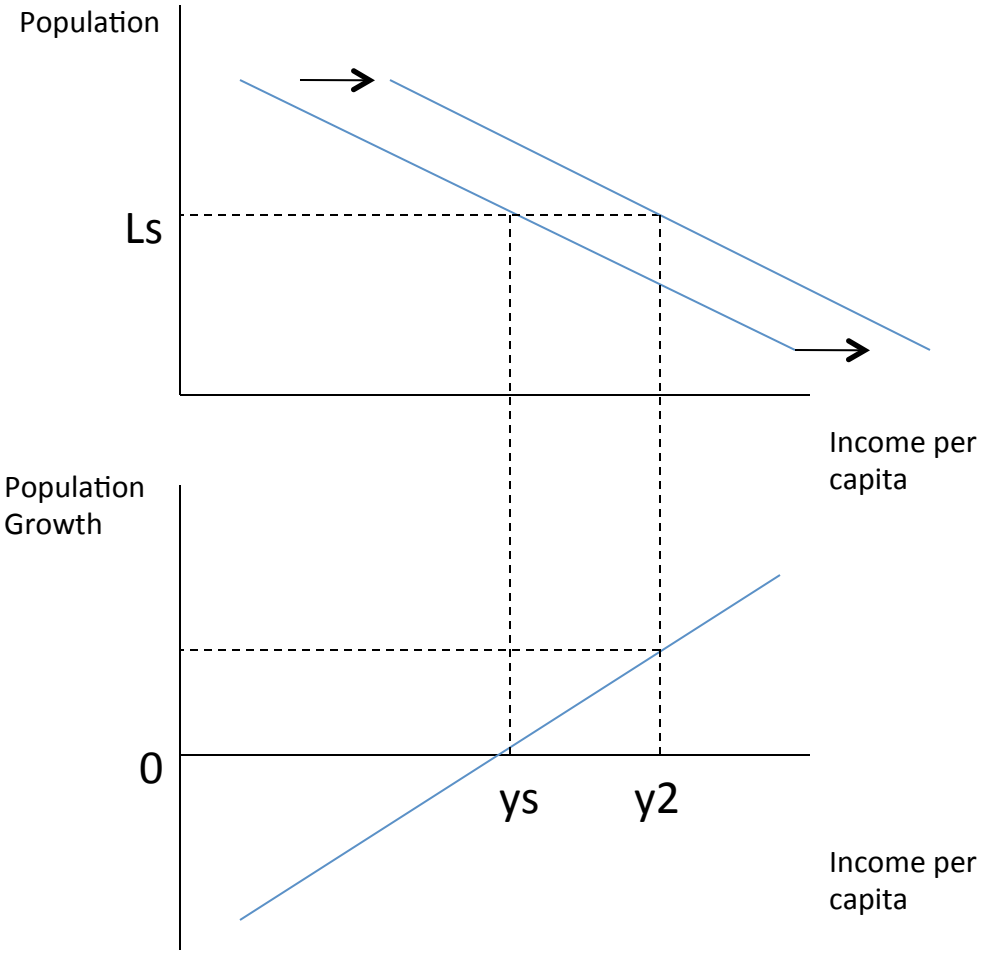
Population and Economic Growth

- Starting above the steady state:



Population and Economic Growth

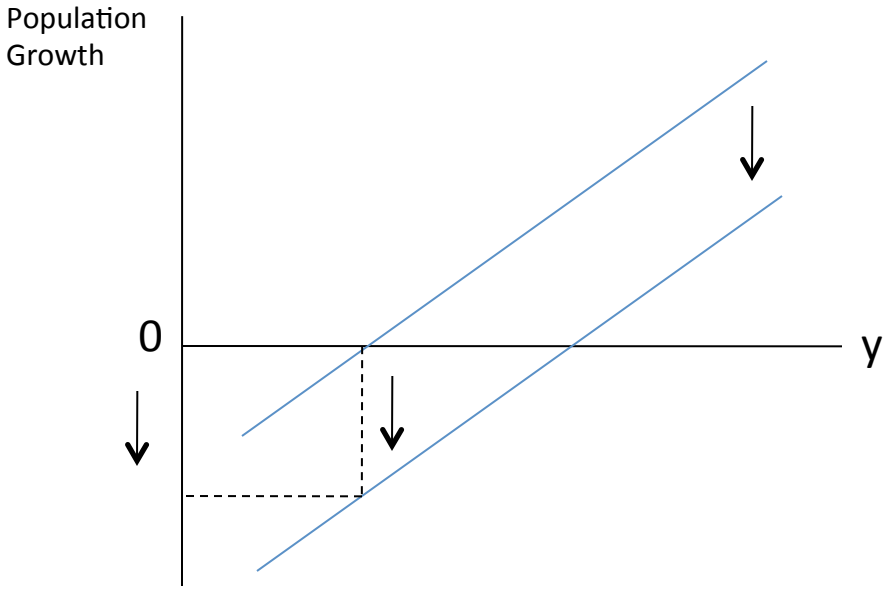
- An increase in technology:



An increase in technology will simply cause a larger population in the long run. However in the short-medium run, there will be a rise in the standard of living.

Population and Economic Growth

- The Malthus Model claimed that there were two types of checks that would cap the population of a country:
  - Positive Check: Should society fail in reducing population growth, then nature itself would put a limit to the population (e.g. Famine and disease).
  - Preventative Check: Society limits the growth rate by their means (e.g. Contraception and 'moral restraint').



Population and Economic Growth

- The Malthus Model does not hold today, however. Both models proposed by Malthus are obsolete today.
  - In today's economies, an increase in the rate of technology would outstrip the growth in capital.
  - Today, there lies a negative relationship between GDP per capita and population growth.
- The shortcomings in the Malthus Model are addressed with the Solow Model, when we incorporate population growth.
  - Capital Dilution: When we assume that the labour participation rate remains constant, an increase in the population will lead to a direct increase in the amount of workers. i.e. A 1%↑ in population will lead to a 1%↑ in workers. We also assume that the investment and depreciation rate does not change, and we get a decrease in the amount of capital per worker. Thus k↓ 1%.

$$\Delta k = \gamma . f(k) - \delta . k$$

$$\Delta k = \gamma . f(k) - \delta . k - n . k$$

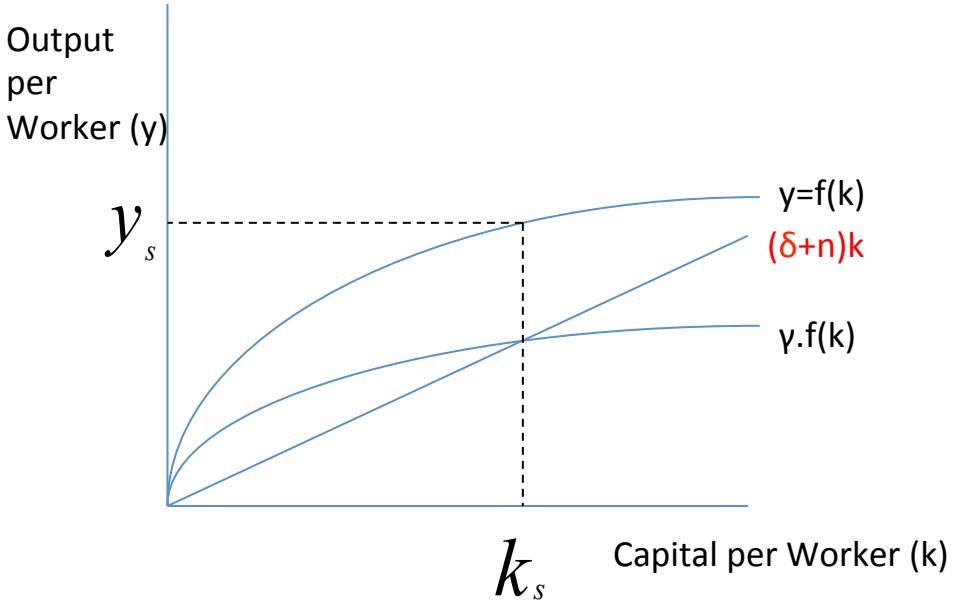
$$= \gamma . f(k) - (\delta + n) k$$

$$\Delta k = 0 \quad \text{In the steady state}$$

$$\gamma . f(k) = (\delta + n) k$$

The Solow Model

- We now incorporate population growth to the Solow Model:



  - An increase in the population growth rate will increase the gradient of the (δ+n)k line. A decrease will lower the gradient. This will also cause a new steady state to exist.

Population and Economic Growth

- Deriving k in the steady state using the Cobb-Douglas production function:

$$y = Ak^{\alpha}$$

$$\Delta k = \gamma . Ak^{\alpha} - (\delta + n)k$$

In the steady state $\Delta k = 0$

$$0 = \gamma Ak^{\alpha} - (\delta + n)k_S$$

$$\gamma Ak_s^{\alpha} = (\delta + n)k_S$$

$$\frac{\gamma Ak_s^{\alpha}}{k_s} = \frac{(\delta + n)k_s}{k_s}$$

$$\gamma Ak_s^{\alpha - 1} = (\delta + n)$$

$$k_s^{\alpha-1} = \frac{(\delta + n)}{\gamma A}$$

$$k_s = \left[\frac{(\delta + n)}{\gamma A}\right]^{\frac{1}{\alpha - 1}}$$

$$\therefore k_s = \left[\frac{\gamma A}{(\delta + n)}\right]^{\frac{1}{1-\alpha}}$$

Here, we observe that ↑n will lead to a ↓k

$$y_S = A\left[\left(\frac{\gamma A}{(\delta + n)}\right)^{\frac{1}{1-\alpha}}\right]^{\alpha}$$

$$y_S = A\left[\frac{\gamma A}{(\delta + n)}\right]^{\frac{\alpha}{1-\alpha}}$$

$$y_S = A^{\frac{1}{1-\alpha}}\left(\frac{\gamma}{(\delta + n)}\right)^{\frac{\alpha}{1-\alpha}}$$

Population and Economic Growth

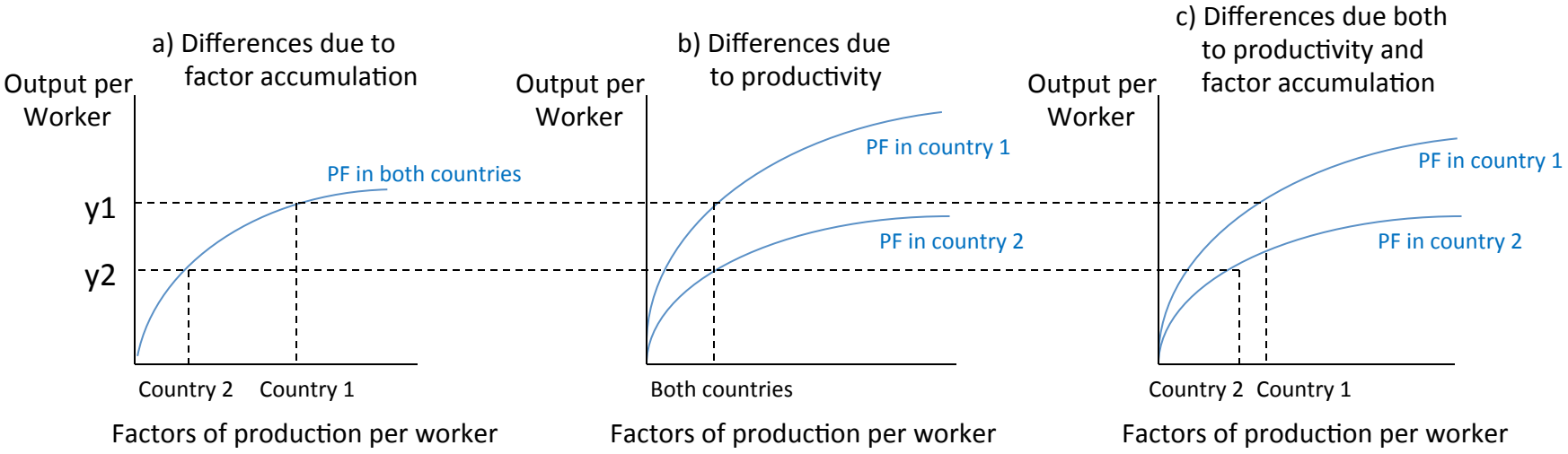
- Explaining Population Growth:
  - Demographic Transition - The process in which a county's mortality and fertility rates decline as it develops.
  - Demographic transition is a relationship between:
    - Mortality rate
    - Fertility rate
  - Fertility Transition:
    - Total fertility rate (TFR) is the number of children a woman will have, if she lives through all of her child bearing years, and experiences the amount of age specific fertility rate at each age.
    - E.g. If a woman aged between 20 and 39, gave birth to an average of 0.2 children per year, and women outside this age group did not have any children then:
      TFR = 20 years * 0.2 = 4
- The Interaction of Fertility and Mortality:
  - NRR = Net Rate of Reproduction
    The number of daughters that each girl who is born can be expected to give birth to, assuming that she goes through her life with mortality and fertility rates of the current population.
  - E.g. NRR = 0.5 * 4 * 0.5 = 1, where (Mortality rate of females) * TFR * (Ratio of males born)
  - E.g.2. Assume an increase in medicine:
    NRR = 1 * 4 * 0.5 = 2

Population and Economic Growth

- Explaining Fertility Trends (Weil, p111):
  - Families care about the wellbeing of their child (that is, they consider the mortality rate of children). So if mortality rates fall, fertility rates also fall as families care for children until they reach adulthood.
  - Income and Substitution effects - As income increases, people can afford more goods and services. Children become relatively more expensive as the wage of workers increase. i.e. The opportunity cost of spending time with children is increasing wages.
  - Quality and Quantity Trade-offs – Parents care most about the quality of a child's life, and so they choose to devote their resources in improving the quality of a single or a couple children, rather than spreading resources thinly over a number of children.
  - Resource Flows between Parents and Children – As a country develops, the cost in raising children increases.

Productivity

- Recall that in the Solow Model, when a country reaches the steady state, it stops growing because investment opportunities dry up.
- So what drives and accounts for economic growth in developed countries?
- Measuring Productivity:



- In graphs a) and b), measuring the differences in y was quite easy. However in graph c), it becomes more difficult to find out how much of the difference in y is due to productivity and how much is due to capital accumulation.

Productivity

- We measure productivity differences using the Cobb-Douglas Production Function:

$$Y = AK^{\alpha}(hL)^{1-\alpha}$$

h is human capital, defined as the number years of education

$$\frac{Y}{L} = y = AK^{\alpha}(h)^{1-\alpha}L^{1-\alpha-1}$$

$$= AK^{\alpha}(h)^{1-\alpha}L^{-\alpha}$$

$$= \frac{AK^{\alpha}(h)^{1-\alpha}}{L^{\alpha}}$$

$$= A\left(\frac{K}{L}\right)^{\alpha}h^{1-\alpha}$$

The final equation gives us 'A' the productivity level multiplied by the factors of production

$$\therefore y = Ak^{\alpha}h^{1-\alpha}$$

Productivity

- Consider 2 countries: $y_1 = A_1 k_1^{\alpha} h_1^{1-\alpha}$ $y_2 = A_2 k_2^{\alpha} h_2^{1-\alpha}$

Ratio of output per worker → $\left(\frac{y_1}{y_2}\right) = \left(\frac{A_1}{A_2}\right)\left(\frac{k_1^{\alpha} h_1^{1-\alpha}}{k_2^{\alpha} h_2^{1-\alpha}}\right)$ ← Ratio of factors of production In Country 1 relative to Country 2

Ratio of productivity in Country 1 compared to Country 2

- Ratio of y = Ratio of productivity * Ratio of FoP
- Rearranging we get the **Development Accounting Equation**:

> Ratio of Productivity = Ratio of Output per Worker / Ratio of Factors of Production

  - E.g. $\frac{A_1}{A_2} = \frac{6}{2} = 3$
  - => Country 1 is 3 times more productive than Country 2.

Productivity

- E.g.2.

Country	y	k	h
1	24	27	8
2	1	1	1

$$\frac{A_1}{A_2} = \frac{\frac{24}{1}}{\left(\frac{27^{\frac{1}{3}}8^{\frac{2}{3}}}{1^{\frac{1}{3}}1^{\frac{2}{3}}}\right)} = \frac{24}{3*4} = \frac{24}{12} = 2$$

Recall that $\alpha \approx \frac{1}{3}$

- Therefore, only 2 times more productive.

Productivity

- Problems with the DAE:
  - Productivity measured by the DAE is a residual. We do not take into account productivity factors from k or h. E.g. Cultural difference, government policy...
  - Mismatched measurement of physical and human capital.
    E.g.1. For developing countries, k can be overstated.
    E.g.2. We do not take into account the quality of education amongst different countries. i.e. One year of tertiary education in a developing country does not equal one year of education in a developed country. i.e. We do not take into account the difference in quality amongst different institutions.

Productivity

- The Contribution of Productivity to Income Differences Among Countries:

$$\frac{y_{US}}{y_{rich}} = \frac{A_{US}}{A_{rich}} * \frac{FP_{US}}{FP_{rich}}$$

$$\frac{y_{US}}{y_{rich}} = \frac{1}{.86} * \frac{1}{.94} = 1.63 * 1.01$$

Productivity is important in explaining the difference in incomes.

$$\frac{y_{US}}{y_{poor}} = \frac{A_{US}}{A_{poor}} * \frac{FP_{US}}{FP_{poor}}$$

$$\frac{y_{US}}{y_{poor}} = 4.167 * 6.25$$

Factors of Production are more important in explaining the difference in incomes.

Productivity

- Differences in the Growth Rate of Productivity Among Countries:
  - The Growth Accounting Framework:

$$y = Ak^{\alpha}h^{1-\alpha}$$

$$\ln y = \ln Ak^{\alpha}h^{1-\alpha}$$

$$= \ln A + \alpha \ln k + (1-\alpha)\ln h$$

We want to look at a change over time:

$$\frac{d}{dt}\ln y = \frac{d}{dt}\left(\ln A + \alpha \ln k + (1-\alpha)\ln h\right)$$

$$\left(\frac{1}{y}\frac{dy}{dt}\right) = \left(\frac{1}{A}\frac{dA}{dt}\right) + \alpha\left(\frac{1}{k}\frac{dk}{dt}\right) + (1-\alpha)\left(\frac{1}{h}\frac{dh}{dt}\right)$$

$$\text{Let } \hat{y} = \frac{dy}{dt} \qquad \hat{y} = \hat{A} + \alpha\hat{k} + (1-\alpha)\hat{h}$$

  - **This is the Growth Accounting Equation.**

Productivity

- The Growth Accounting Equation (example; data from Pan World Data):

$$t = 26$$

$$\hat{y} \approx y_t = y_o(1+g)^t$$

$$30{,}312 = 21{,}246(1+g)^{26}$$

$$\frac{30{,}312}{21{,}246} = (1+g)^{26}$$

$$\left(\frac{30{,}312}{21{,}246}\right)^{\frac{1}{26}} = 1+g$$

$$g = 1.0137 - 1 = 0.0137$$

$$\therefore y = 1.37\%$$

Australia

Time	y	k	h
1965	21,246	20,249	8.94
1990	30,312	37,854	10.12
	1.37%	2.44%	0.48%

  - Repeat this process to attain percentage changes for k and h. Once we have the figures we can than substitute them into the GAE:

Productivity

- GAE example cont...

$$\hat{A} = \hat{y} - \alpha\hat{k} - (1-\alpha)\hat{h}$$

$$= 0.0137 - \frac{1}{3}(0.0244) - \frac{2}{3}(0.0048)$$

$$= 0.0137 - 0.0080 - 0.0032$$

$$= 0.0025$$

$$\therefore \approx 0.25\% \text{ p.a. Growth Rate of Productivity}$$

$$0.0137 = 0.0025 + (0.0080 + 0.0032)$$

$$0.0137 = 0.0025 + 0.0112$$

$$\%\ \text{growth} = \text{Productivity Growth} + \text{FP growth}$$

  - Productivity accounts for 0.0025/0.0137 = 18.1% of output growth.
    - The implication of having most of growth accounted for by FP accumulation is that capital stocks will depreciate over time and that growth in the future will slow due to higher costs of capital replacement. Also, increases FP's suffer diminishing returns to scale. Thus its important to attribute most growth to productivity and not factor accumulation.

Technology

- The Solow Model with Technological Progress:

$$Y = AK^{\alpha}L^{1-\alpha}$$

$$Y = K^{\alpha}(AL)^{1-\alpha}$$

Labour augmenting neutral technological progress.

$$\frac{Y}{AL} = \frac{K^{\alpha}(AL)^{1-\alpha}}{AL}$$

$$y = \frac{K^{\alpha}}{(AL)^{\alpha}} = \left(\frac{K}{AL}\right)^{\alpha} = k^{\alpha}$$

  - Here, A is defined as the number of effective workers per actual worker. Thus, increasing A and L has the same effect on total output. The product of A and L (AL) is total number of effective workers in the economy.

Technology

- The Solow Model with Technological Change cont...

$$\Delta k = \gamma . y - (\delta + \hat{L} + \hat{A}) k$$

In the steady state where the change in Δk = 0

$$0 = \gamma . y - (\delta + \hat{L} + \hat{A}) k$$

$$\gamma . y = \gamma . k^{\alpha} = (\delta + \hat{L} + \hat{A}) k$$

$$k^{1-\alpha} = \frac{\gamma}{(\delta + \hat{L} + \hat{A})}$$

$$k_s = \left(\frac{\gamma}{(\delta + \hat{L} + \hat{A})} \right)^{\frac{1}{1-\alpha}}$$

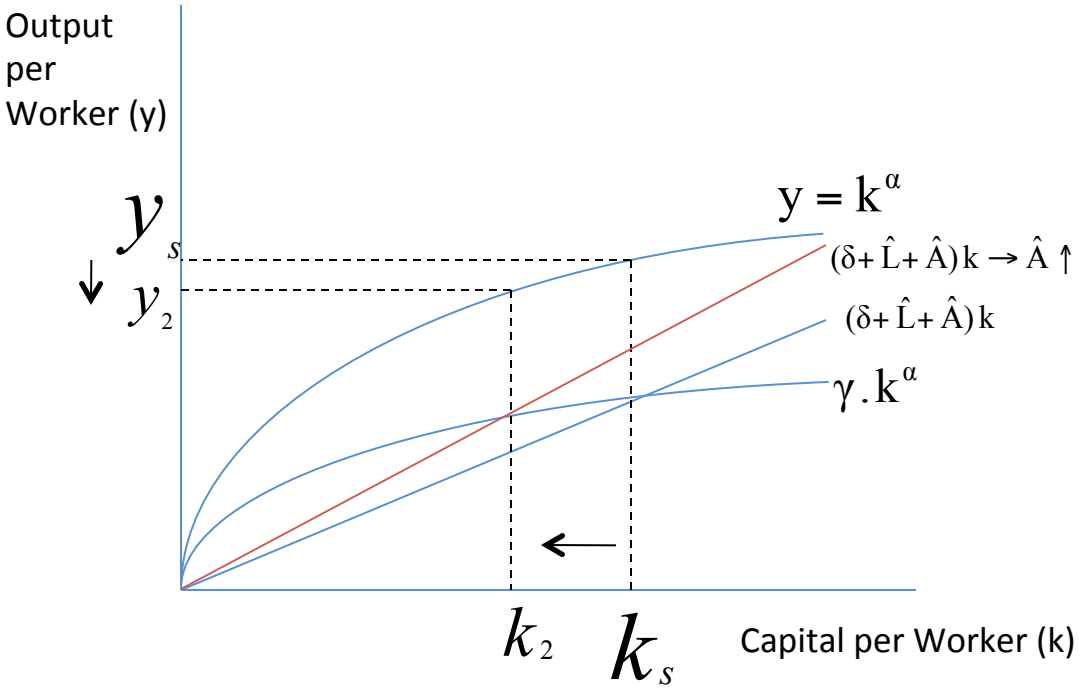
When we look at the final equation if Â↑ then y↓. This seems counter intuitive.

$$y_s = k_s^{\alpha} = \left(\frac{\gamma}{(\delta + \hat{L} + \hat{A})} \right)^{\frac{\alpha}{1-\alpha}}$$

We now factor in capital depreciation, labour force growth (population growth assuming the participation rate remains constant) and technology growth.

Technology

- The Solow Model with an increase in technology: $\frac{Y}{A \uparrow L} \downarrow$



$$\ln\left(\frac{Y}{AL}\right) = \ln Y - \ln A - \ln L$$

$$\ln y = \ln Y - \ln A - \ln L$$

$$\frac{d}{dt}\ln y = \frac{d}{dt}\ln Y - \frac{d}{dt}\ln A - \frac{d}{dt}\ln L$$

$$\left(\frac{1}{y}\frac{dy}{dt}\right) = \left(\frac{1}{Y}\frac{dY}{dt}\right) - \left(\frac{1}{A}\frac{dA}{dt}\right) - \left(\frac{1}{L}\frac{dL}{dt}\right)$$

$$\hat{y} = \hat{Y} - \hat{A} - \hat{L}$$

- The first thing to realise is that k is capital per effective worker, and not just capital per worker.
- Further, in the long run, we usually make the assumption that $\hat{L}$ is equal 0. However, realistically, this assumption doesn't hold in real life. Be careful when choosing to use or ignore this assumption.

Technology

- The result of an increase in technological growth:
  - The initial effect of a rise in the growth of technology by some amount $\Delta\hat{A}$ will result in a change in the growth rate of output per worker, $\hat{y}$, by $\Delta\hat{A}$. However, as the economy moves to a new steady state, y will fall and $\hat{y}$ will approach zero. In the long run, at the new steady state, the growth rate of total output $\hat{Y}$ will have risen by the full amount $\hat{A}$.
  - The following graphs illustrate all these results together. It shows the time paths of A, y and Y for a country that starts in a steady state and then experiences a rise in $\hat{A}$.
    NB: The graphs use a ratio scale on each vertical axis, so a variable growing at a constant rate will appear as a straight line.

In the long run for the Solow Model:

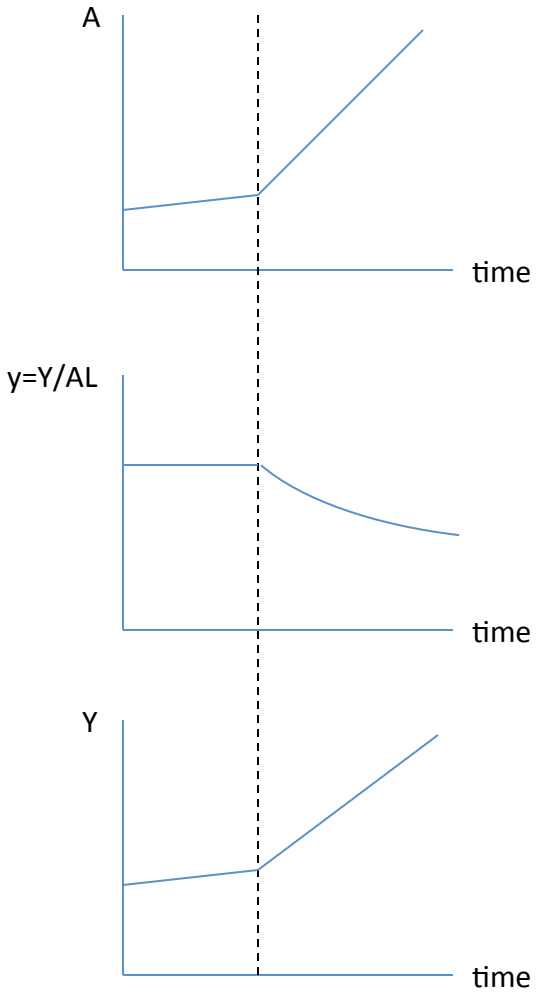
$$\hat{y} = \hat{Y} - \hat{A}$$

$$0 = \hat{Y} - \hat{A}$$

$$\hat{Y} = \hat{A}$$

Technology

- Effect of an Increase in Technological Progress:



Time at which technological progress speeds up

Readings

- Incomes of less than $1 US per day, are classed as absolute poverty by the UN. $2 US per day is classified as “poor”.
- WDI – World Development Indicator is an online database of countries, which can be compared with over 200 economic variables. Can be accessed through the library.
- An unconventional way to measure growth or to compare countries to one another, would be to view the countries from space during night. Typically, well developed countries feature brightly lit cities. Thus, it shouldn’t be inaccurate to conclude that bright countries are well developed countries.

Readings

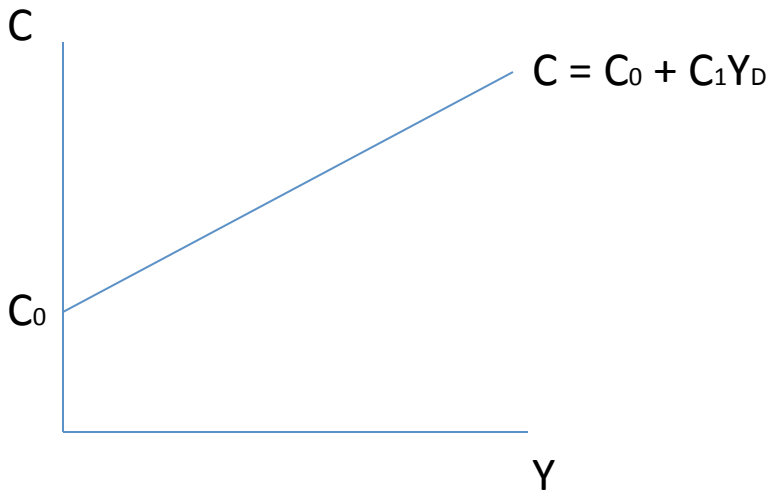
Topic 2: The Goods Market

The Goods Market

- Timeframes in macroeconomics:
  - Short run – 1 to 3 years;
  - Medium run – Roughly 5 to 10 years;
  - Long run – Roughly 50 years.
- The goods market, money market and IS-LM model will be looked at from a short run point of view.
- A quick revision of the goods market:
  - $Z=C + I + G + (X-M)$
  - If we ignore net exports, then we shall focus on a closed economy.

The Goods Market

- Consumption: A function of disposable income (Y_D).
  - $C = C(Y_D)$
  - $C = C_0 + C_1Y_D$ ←A linear consumption function consisting of autonomous consumption and the MPC to consume.



$Y_D = Y - T$

$C = C_0 + C_1(Y - T)$

The Goods Market

- Investment: $I = \bar{I}$
  - We assume I is exogenously given. Later we shall relax this assumption.
- Government spending: $G = \bar{G}$, $T = \overline{T}$
  - We also assume government spending and tax is exogenously given. That is, levels of G and T are determined by the government itself.
- $Z = C + I + G$
  $Z = C_0 + C_1(Y-T) + \bar{I} + G$
- Equilibrium in the goods market. The production Y is equal to the demand for goods Z:
  $Y = Z$
  (Assume no inventory investment)

The Goods Market

- The goods market equilibrium:

$$Y = Z = C_0 + C_1(Y - T) + \bar{I} + G$$

$$Y = C_0 + C_1 Y - C_1 T + \bar{I} + G$$

$$Y - C_1 Y = C_0 - C_1 T + \bar{I} + G$$

$$Y(1 - C_1) = C_0 - C_1 T + \bar{I} + G$$

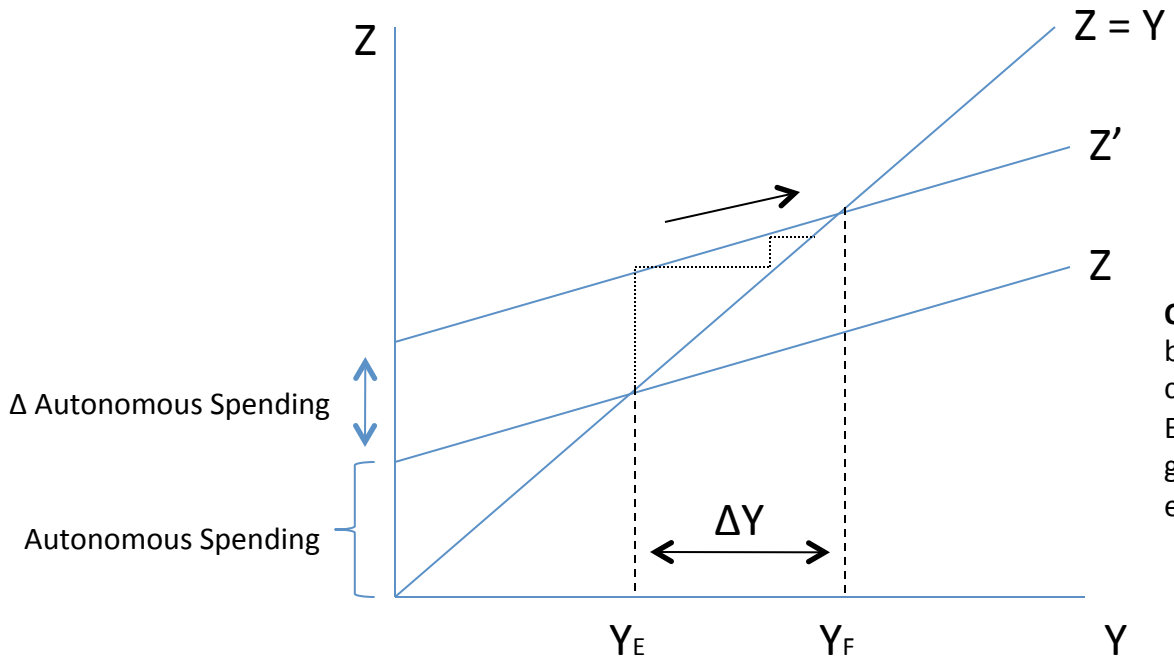
$$Y^* = \frac{C_0 - C_1 T + \bar{I} + G}{(1 - C_1)}$$

$$\text{or } Y^* = \frac{1}{(1 - MPC)}\left[C_0 - C_1 T + \bar{I} + G\right]$$

- ...above, we can see the Keynesian multiplier.

The Goods Market

- Assume that C_0↑ $1
  - This immediately causes Z↑ $1 and Y↑ $1. This causes a multiplier effect, which can be summarised as:
    ΔZ = ΔY = 1/(1 – MPC) * Δ Autonomous spending



Okun's Law: Gives the relationship between the growth of GDP and the change in the unemployment rate. E.g. Every 2% increase in the GDP growth rate leads to a 1% increase in employment.

- ΔY > ΔZ (Autonomous Spending)

The Goods Market

- Investment = Saving
  - $S = Y_D - C$
    $S = Y - T - C$, S = Private Saving
    Goods Market Equilibrium:
    $Y = C + I + G$
    $Y - T = C + I + G - T$
    $Y - T - C = I - G - T$
    $\therefore S = I + G - T$
    $I = S + (T - G)$
- What is private saving?
  - $S = (Y - T) - C$
    $S = (Y - T) - (C_0 + C_1(Y - T))$
    $S = (Y - T) - C_0 - C_1(Y - T)$
    $S = (Y - T)(1 - C_1) - C_0$ ←i.e.
    Disposable income * MPS take away autonomous consumption is equal to saving.

The Goods Market

- Deriving the original formulation by Keynes:

$$\text{Substitute S into } I = S + (T - G)$$

$$I = [(Y - T)(1 - C_1) - C_0] + (T - G)$$

$$I = Y - C_1 Y - T + C_1 T - C_0 + T - G$$

$$I = Y - C_1 Y + C_1 T - C_0 - G$$

$$I = Y(1 - C_1) + C_1 T - C_0 - G$$

$$Y(1 - C_1) = I - C_1 T + C_0 + G$$

$$\therefore Y = \frac{1}{(1 - C_1)}\left[C_0 + I + G - C_1 T\right]$$

The Goods Market

- The Paradox of Saving:
  - A decrease in consumption in the short run will lead to:
    $\uparrow S = (1 - C_1)(Y = T) - C_0\downarrow$
  - If you reduce consumption, then it will lead to a fall in the equilibrium income.
  - So if autonomous consumption lowers by $1, this will lead to an increase in savings by $1. If the MPC is 0.5, then the fall in equilibrium income will fall by $2.
- The Long Run:
  - In the long run, according to the Solow Model, an increase in savings will lead to a higher steady state and thus increase output and capital.
    However, if there is a fall in consumption or increase in savings, then there will be a fall in income in the short run. This is something that made the Great Depression much more worse—consumers saved all their income, and thus the multiplier effect had a profound effect on incomes.

Readings

Topic 3: The Money Market

The Money Market

- We assume there to be two different types of financial assets:
  - Money (M1)
  - Bonds
- The Demand for Money:
  - Medium of exchange;
  - Unit of account;
  - A store of value;
- Money Demand Equation:

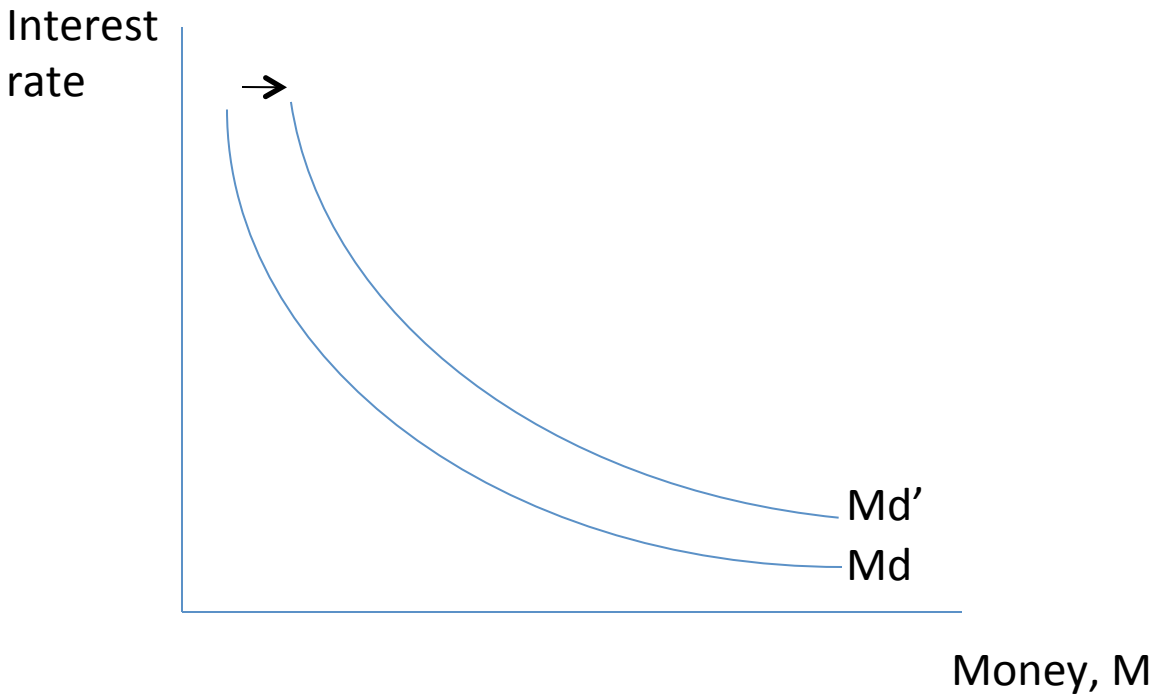
$$M^d = \$Y.L(i)$$

Nominal Income – Level of transaction

Function of interest

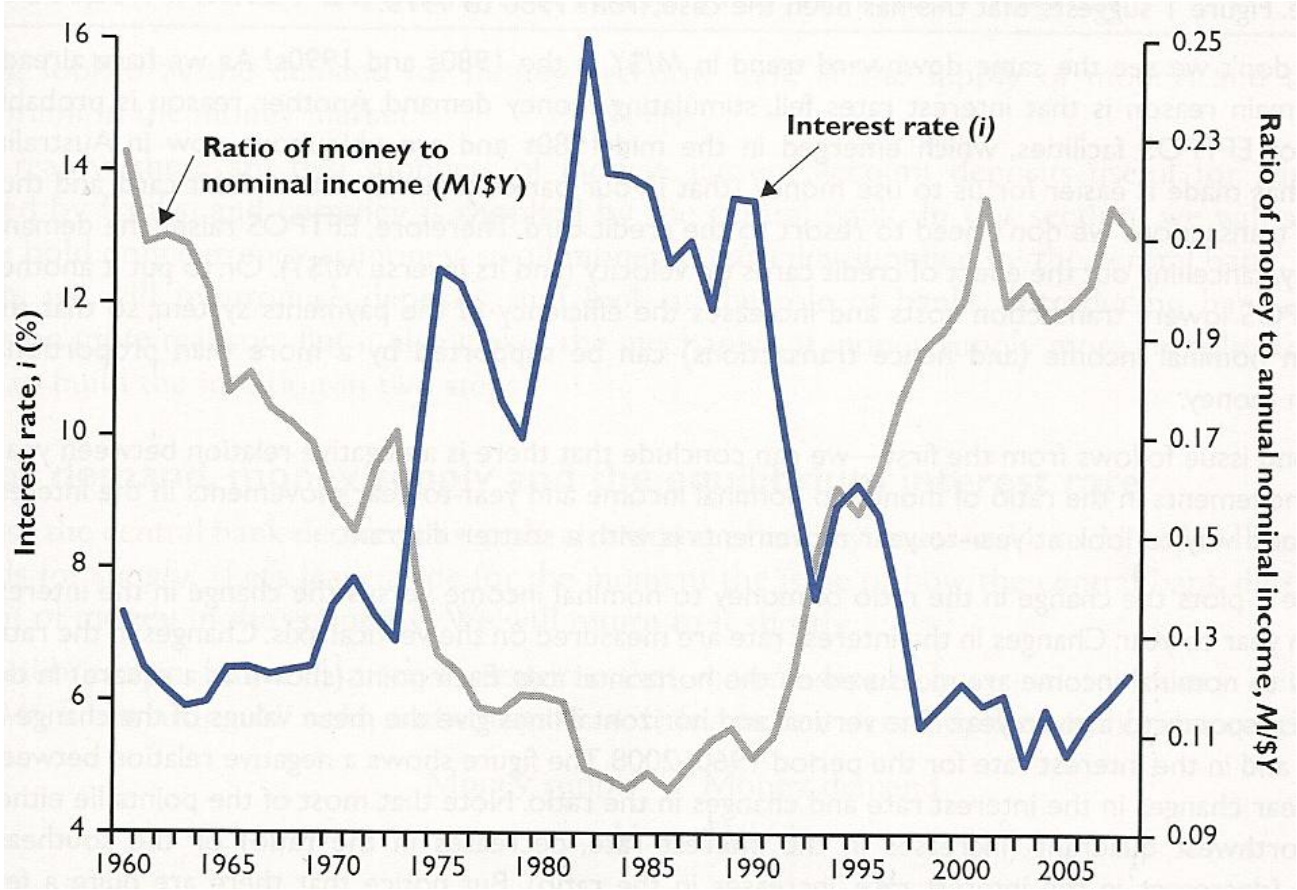
The Money Market

- A diagram between the interest rate and money:
  - The effect of an increase in nominal income:



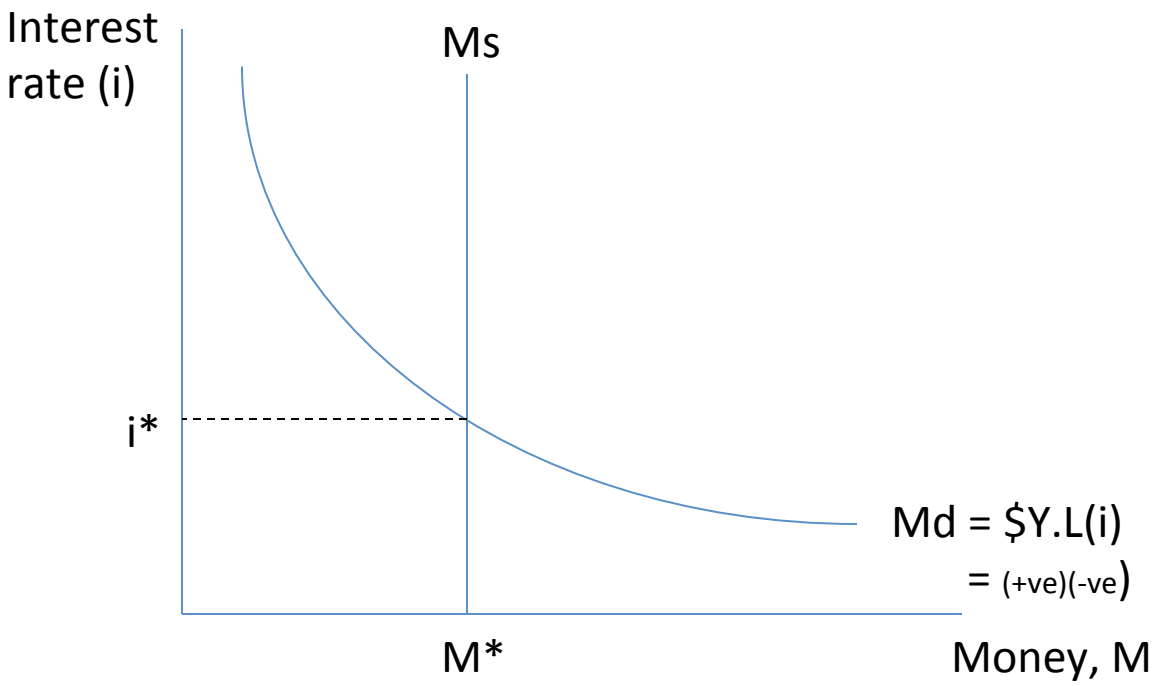
The Money Market

- Historically, we can see that there lies an inverse relation between money demand and interest rates.
- M/$Y – Ratio of money to nominal income
  $Y/M – Velocity of money; the number of transactions for a given quantity of money.



The Money Market

- The Money Market Equilibrium:



- Ms is exogenously given as it is controlled by the central bank.

The Money Market

- An increase in $Y (showing an increase in Md):
  - Assume there is an increase in nominal income ($Y). An increase in $Y will increase the level of transactions, which increases the demand for money at any interest rate. The money demand curve shifts to the right from Md to Md'. The equilibrium moves out to the right, the equilibrium interest rate increases.
  - i.e. An increase in nominal income leads to an increase in the interest rate. The reason is that at the initial interest rate the demand for money exceeds the unchanged supply of money. An increase in the interest rate is needed to decrease the amount of money people want to hold and re-established equilibrium.
- An increase in the money supply (Ms)
  - An increase in the money supply will push the Ms curve out to the right. The equilibrium interest rate decreases.
  - i.e. An increase in the supply of money leads to a decrease in the interest rate. The decrease in the interest rate increases the demand for money so it equals the larger money supply.
- Examples:
  - $Y↑ → Md↑ → Pb (Price of bonds)↓ → i↑
  - Ms↑ → Pb↑ → i↓

The Money Market

- Determination of the Ms and i:
  - The central bank can manipulate the Ms to change the interest rate. In Australia, the RBA conducts Open Market Operations (OMO's), which mainly deal with the buying/ selling of Treasury bills (T bills or Commonwealth Government Securities).
  - This is due to the inverse relationship between the price of a bond and the interest that the bond pays. If bonds prices increase, then the interest rate of the bond decrease. The opposite also occurs:

$$i = \frac{C_B - P_B}{P_B}$$

Where i is the interest payment of the bond upon maturity, C is the coupon of the bond and P is the price of the bond.

  - To summarise:
    - The interest rate is determined by the equality of the supply of money and the demand for money;
    - By changing the supply of money, a central bank can affect the interest rate;
    - The central bank changes Ms through OMO's;

The Money Market

- An example with expansionary OMO's:

T account of RBA

Assets	Liabilities
Bonds	Money (Currency)

The effect of an expansionary OMO:

T account of RBA

Assets		Liabilities	
Bonds	+1,000,000	Money (Currency)	+1,000,000

T account of Public

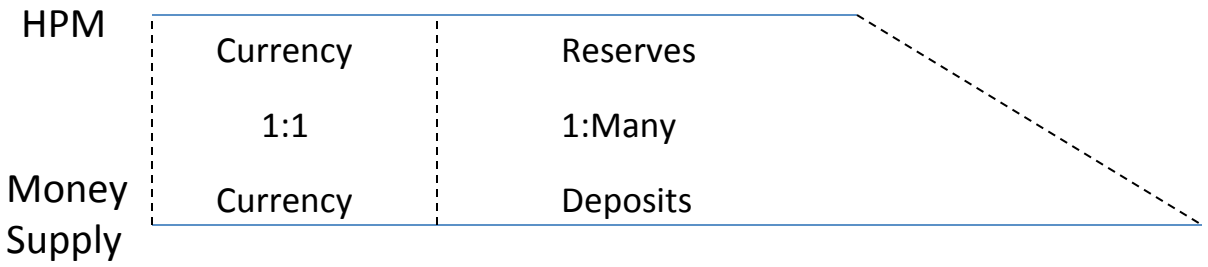
Assets		Liabilities
Bonds	-1,000,000	
Cash +1,000,000		

The Money Market

- The creation of commercial banks:
  - Modern economies are characterised by the existence of many types of financial intermediaries, institutions that receive funds from people and firms, and use these funds to buy bonds or stocks or to make loans to other people and firms. Their liabilities are what they owe to the people and firms from whom they have received funds. Their assets are the stocks and bonds they own and the loans they have made.
  - Banks are one type of financial intermediary. What makes banks special—and the reason we focus on banks here, rather than financial intermediaries in general—is that their liabilities are money, People can pay for transactions by writing cheques or using EFTPOS up to the amount of their bank account balance.
  - Because people can withdraw up to the full deposit in their bank accounts. Thus the liabilities of the banks are equal to the value of current account deposits.
  - Banks keep reserves of the deposits that have received. These reserves are reserves of central bank money, on which they can draw if they need to.
    - On any given day, withdraws can outweigh deposits (i.e. Sometimes deposits ≠ withdrawals), so banks must keep some cash on hand.
    - Money flows between different banks can outweigh in "favour" to one bank over another. For this reason also, banks keep cash on hand.
    - Some banks are legally required to keep a certain reserve : deposit [reserve] ratio.

The Money Market

- Different types of circulation and money:
- Higher Powered Money (H/HPM/Money Base):
  - Currency in circulation + Reserves kept by banks
- Money Supply/Stock:
  - Currency in circulation + Deposits in banks
- For high powered money, banks must keep a certain reserve ratio of all deposits, which they have to keep as a reserve with central banks.
- Illustrating bother H and the Money Supply:



- Increasing H by increasing the currency will increase the money supply by the increase in H. Increasing the reserve component of H however will lead to a multiple increase in deposits.

The Money Market

- Open Market Operations and Commercial Banks:
- If the RBA purchases $1 million worth of Government bonds from the public.

RBA			
Bonds	+1,000,000	Reserve	+1,000,000
Public			
Bonds	-1,000,000		
Deposit	+1,000,000		
Commercial Bank			
Reserve	+1,000,000	Deposit	+1,000,000

- This will now cause a series of transactions under the fractional reserve banking system.
  - Assume the public doesn't hold cash;
  - Assume the reserve : deposit ratio is 10%.

The Money Market

The Consolidated Commercial Bank			
Reserve	+1,000,000	Deposit	+1,000,000
1st Round:			
Reserve	100,000	Deposit	1,000,000
Loan	900,000		
End of 1st Round:			
Reserve	1,000,000	Deposit	1,900,000
Loan	900,000		
R:D ratio is 1/1.9 = 0.526 → Too high			
2nd Round			
Reserve	190,000	Deposit	1,900,000
Loan	900,000 + 810,000		

The Money Market

End of 2nd Round:			
Reserve	1,000,000	Deposit	1,900,000+810,000
Loan	1,710,000		
R:D ratio: 1/2.71 = 37% → Too high			
3rd Round:			
Reserve	271,000	Deposit	2,710,000
Loan	1,710,000+729,000		
End of 3rd Round:			
Reserve	1,000,000	Deposit	2,710,000
Loan	2,439,000		
R:D ratio 1/3.439 = 29% → Too high			
Final Round End:			
Reserve	$1,000,000	Deposit	$10,000,000
Loan	$9,000,000		

The Money Market

- Money Multiplier: 1/Θ, where c = 0 (no cash holding) and Θ is the reserve ratio.
- Bank Deposit = Bank Reserve / Desired Reserve to Deposit Ratio
  Bank Deposit = 1,000,000 / 0.1 = $10,000,000

$$\text{Money Multiplier} = \frac{1}{C + (1 - C)\theta}$$

Where C is the ratio of cash holdings to deposits.

- The previous example highlighted a bank's ability to make money out of an initial deposit of $1,000,000. The money multiplier process has increased the bank's deposits, reserves and loans (assets) by a factor of 10.

The Money Market

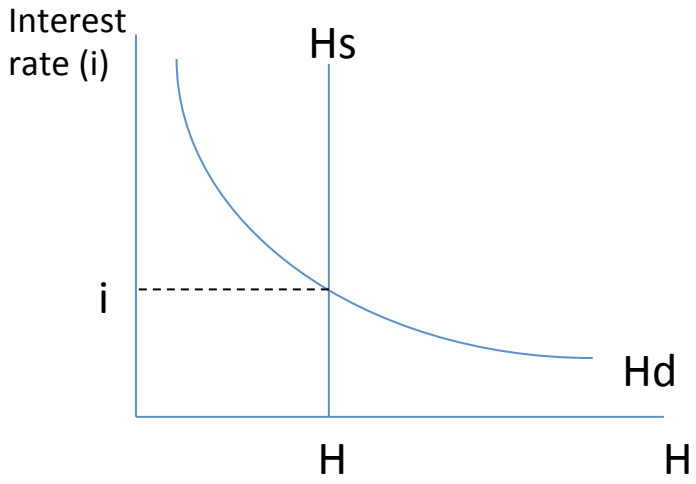
- The Determination of i:

T account of RBA

Assets	Liabilities
Government Bonds	Money (Currency in circulation)
	Reserve

HPM

- Demand for central bank money = demand for currency and demand for reserves by commercial banks.
  Supply of central bank money = directly controlled by the central bank.



The Money Market

- Deriving the Equilibrium and the Money Multiplier Mathematically:

$$\text{Demand for } H = H^d = CU^d + R^d$$

$$CU^d = CM^d$$

$$D^d = (1-C)M^d$$

$$\text{What is } R^d \text{ (demand for reserves)? } \quad R^d = \theta * \text{Deposits}$$

$$H^d = CU^d + R^d$$

$$H^d = CM^d + \theta(1-C)M^d$$

$$H^d = [C+\theta(1-C)]M^d$$

$$M^d = ? = \$Y.L(i)$$

$$H^d = [C+\theta(1-C)]\$Y.L(i)$$

The Money Market

$$\text{The equilibrium interest rate}: H^s = H^d$$

$$H^* = [C + \theta(1-C)]\$Y.L(i)$$

$$\text{When } C = 0,\ H = \theta\$Y.L(i)$$

$$\text{Supply is equal to demand, for } H = \theta^*100\% \text{ of the demand for deposits}$$

$$\text{When } C = 1,\ H = (1)\$Y.L(i)$$

$$\text{Supply is equal to demand, for } H = \text{demand for money}$$

$$\text{At equilibrium}: M^d = M^s = \$Y.L(i)$$

$$\text{Thus, we have}: H = [C + \theta(1-C)]\$Y.L(i)$$

$$\text{Rearranging we can get the Money Multiplier}: MM = \frac{1}{[C + \theta(1-C)]}$$

$$\ldots \text{and } \$Y.L(i) = \frac{1}{[C + \theta(1-C)]} * H$$

The Money Market

- An example:

$$\text{Assume:}$$
$$\Delta H = \$10m$$
$$C = 0.2$$
$$\theta = 0.1$$

$$\Delta M^s = \frac{1}{[C + \theta(1 - C)]} * \Delta H$$

$$\Delta M^s = \frac{1}{[0.2 + 0.1(0.8)]} * \$10m$$

$$\text{If } C = 1, \Delta M^s = \frac{1}{1} * \$10m$$

$$\text{If } C = 0, \Delta M^s = \frac{1}{[0.1]} * \$10m$$

Readings

Readings

Topic 4: The IS-LM Model

The IS-LM Model

- Brief history on the IS-LM Model:
  - John Hicks and Alvin Hansen in the late 1930's/early 1940's, after reading Keynes' *General Theory,* co-developed a model to display what they believe Keynes really meant in his thesis.
- Deriving the IS curve:
  - Recall that: $AD = Z = C + \bar{I} + G$
    $Z = C_0 + C_1(Y - T) + \bar{I} + G$
  - So when the goods market is in equilibrium: $Y = Z$
    $Y = C_0 + C_1(Y - T) + \bar{I} + G$,
    Note that this identity contains a linear consumption function. This doesn't have to always be the case:
    $Y = C(Y - T) + \bar{I} + G$,
    The consumption function in this identity isn't necessarily linear.
  - This model focused on a tight assumption that changes in the interest rate would not affect aggregate demand (in particular; Investment). In the IS-LM Model, we shall relax this assumption.

The IS-LM Model

- Investment:
  - From what we know in real life, investment undertaken by firms is far from constant (exogenous). Investment depends on two primary factors:
    - The level of sales – A firm facing an increase in sales needs to increase production. To do so, it may need to buy additional machines, or to build an additional plant. A firm facing low sales will feel no such need and will spend little, if anything, on investment.
    - The interest rate – Consider a firm deciding whether to buy a new machine. Suppose that, to buy the new machine, the firm must borrow. The higher the interest rate, the less attractive it is to borrow and buy the machine. At a high enough interest rate, the additional profits from using the new machine wont cover the interest payments, and the new machine won't be worth buying.
  - We can capture these two effects:

$$I = \underset{(+,-)}{I(Y, i)}$$

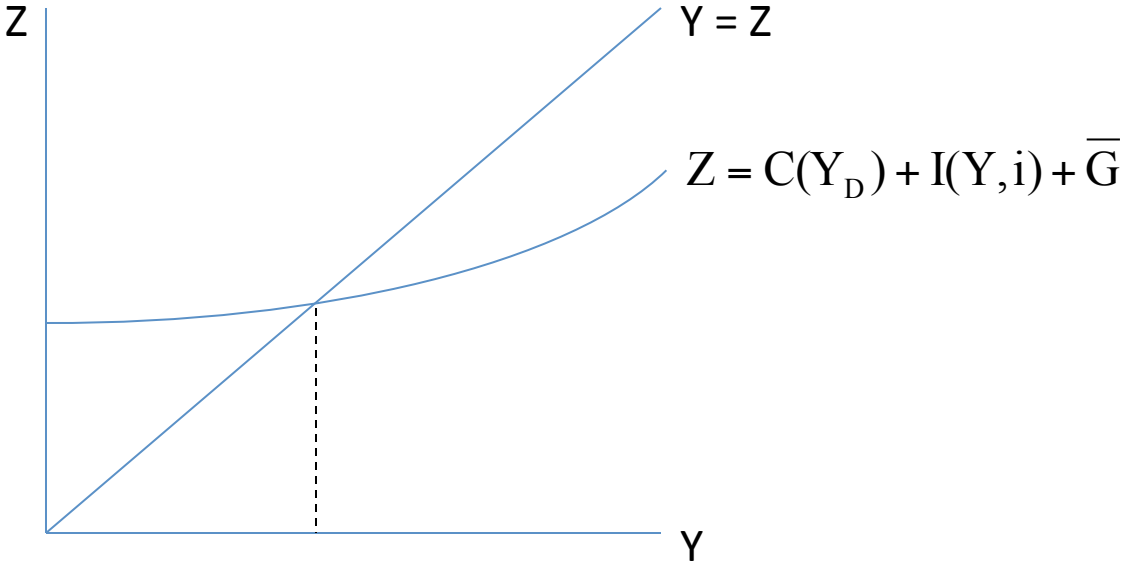
  - The above shows that investment is a function of income, Y, and the interest rate, i. The positive and minus signs below show the relationship between the variables. If Y increase, I is expected to increase. If interest rates increase, then I will decrease.

The IS-LM Model

- The determination of output:

$$Y = C(Y_D) + I(Y, i) + \overline{G}$$

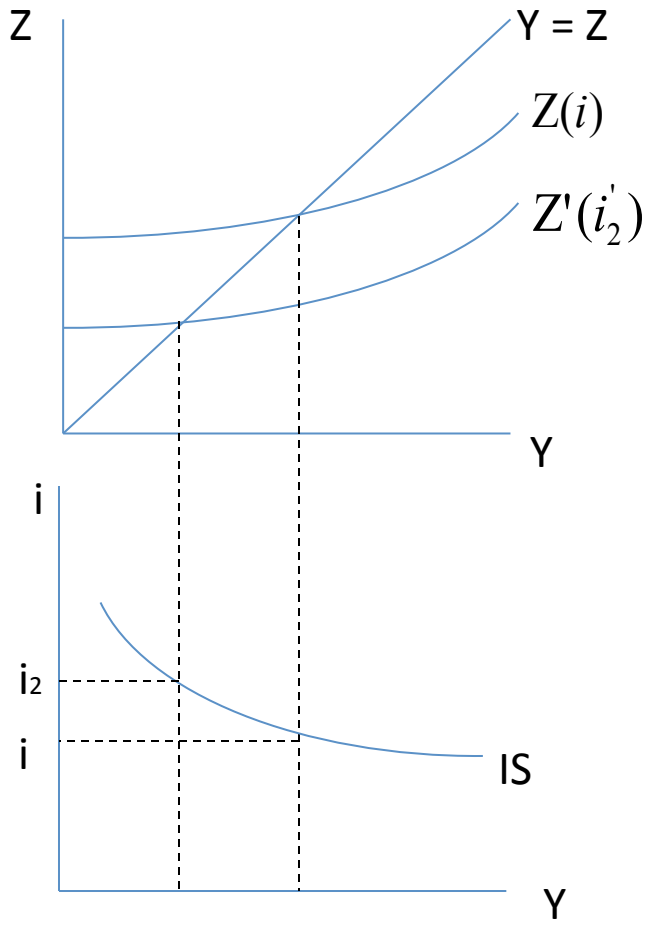
This is our IS relation.



- The above function is shaped as a general convex function, to show that the consumption function component isn't exactly linear.

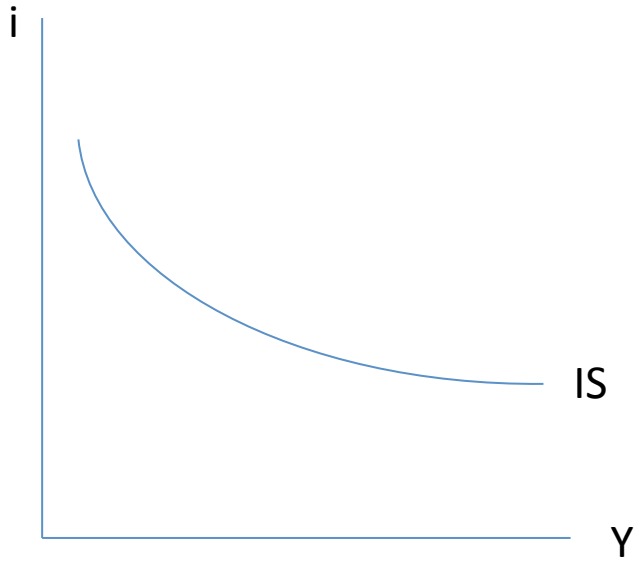
The IS-LM Model

- Deriving the IS curve:
  - When i↑ → I↓ → Z↓ → Y↓, so:



The IS-LM Model

- The IS curve:



- Any point above the IS curve reflects excess supply (inventories accumulate), due to i being too high. Any point below reflects excess demand. In both cases, output will equalise after firms change levels of output.
- G↑, T↓ and C_0↑ will shift the IS curve outward. The reverse also occurs.

The IS-LM Model

- Mathematical derivitation of the IS curve (here we assume a linear consumption function):

I_0 is autonomous Investment.

$$C = C_0 + C_1(Y - T)$$

$$I = I_0 + b_1 Y - b_2 i$$

Where b_1 is the responsiveness of I w.r.t. Y. And b_2 is the responsiveness of I w.r.t. i. b_2 also determines the gradient of the IS curve.

$$Z = C_0 + C_1(Y - T) + I_0 + b_1 Y - b_2 i + G$$

$$\text{In equlibrium } Y = Z:$$

$$Y = C_0 + C_1(Y - T) + I_0 + b_1 Y - b_2 i + G$$

$$Y = C_0 + C_1 Y - C_1 T + I_0 + b_1 Y - b_2 i + G$$

$$Y - C_1 Y - b_1 Y = C_0 - C_1 T + I_0 - b_2 i + G$$

$$Y(1 - C_1 - b_1) = C_0 - C_1 T + I_0 - b_2 i + G$$

$$Y = \frac{1}{(1 - C_1 - b_1)}\left[C_0 - C_1 T + I_0 + G - b_2 i\right]$$

$$\text{Let } A = C_0 - C_1 T + I_0 + G = \text{Autonomous Demand}$$

$$Y = \frac{1}{(1 - C_1 - b_1)}\left[A - b_2 i\right]$$

The IS-LM Model

- We can rearrange to get:

$$Y = \frac{1}{(1 - C_1 - b_1)}\left[A - b_2 i\right]$$

$$Y(1 - C_1 - b_1) = A - b_2 i$$

$$A - b_2 i = Y(1 - C_1 - b_1)$$

$$b_2 i = A - Y(1 - C_1 - b_1)$$

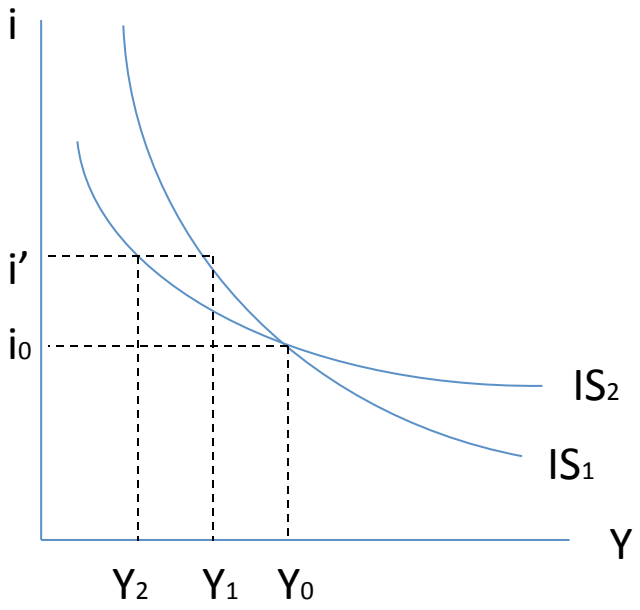
$$i = \frac{A - Y(1 - C_1 - b_1)}{b_2}$$

$$i = \frac{A}{b_2} - \frac{Y(1 - C_1 - b_1)}{b_2} \quad \text{or} \quad i = \frac{A}{b_2} - \frac{1}{b_2\left(\frac{1}{1 - C_1 - b_1}\right)} * Y$$

- Consider a large b_2: The slope of the IS curve will flatten out, and thus changes in income arising from changes in the interest rate will be very large for changes in i. The opposite can also occur for small values of b_1.

The IS-LM Model

- Consider two IS relations (and an increase in i):



$$i = \frac{A}{b_2} - \frac{1}{b_2\left(\frac{1}{1 - C_1 - b_1}\right)} * Y$$

The multiplier.

- Where IS_2 has a larger b_2 term.

The IS-LM Model

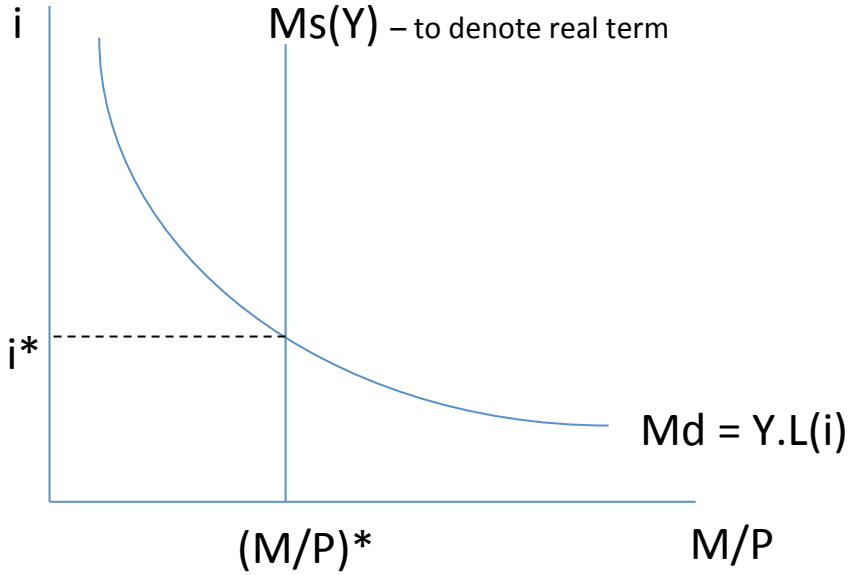
- When the multiplier is large:

$$i = \frac{A}{b_2} - \left(\frac{1}{\left[b_2 \, \alpha \right] \uparrow} \right) \downarrow * Y$$

- ...and this makes the IS curve more flat. Hence why b2 determines the gradient of the IS curve.
- i.e. When the responsiveness of investment wrt to a change in interest rates is large, a small change in the interest rate will lead to a proportionally bigger change in income.

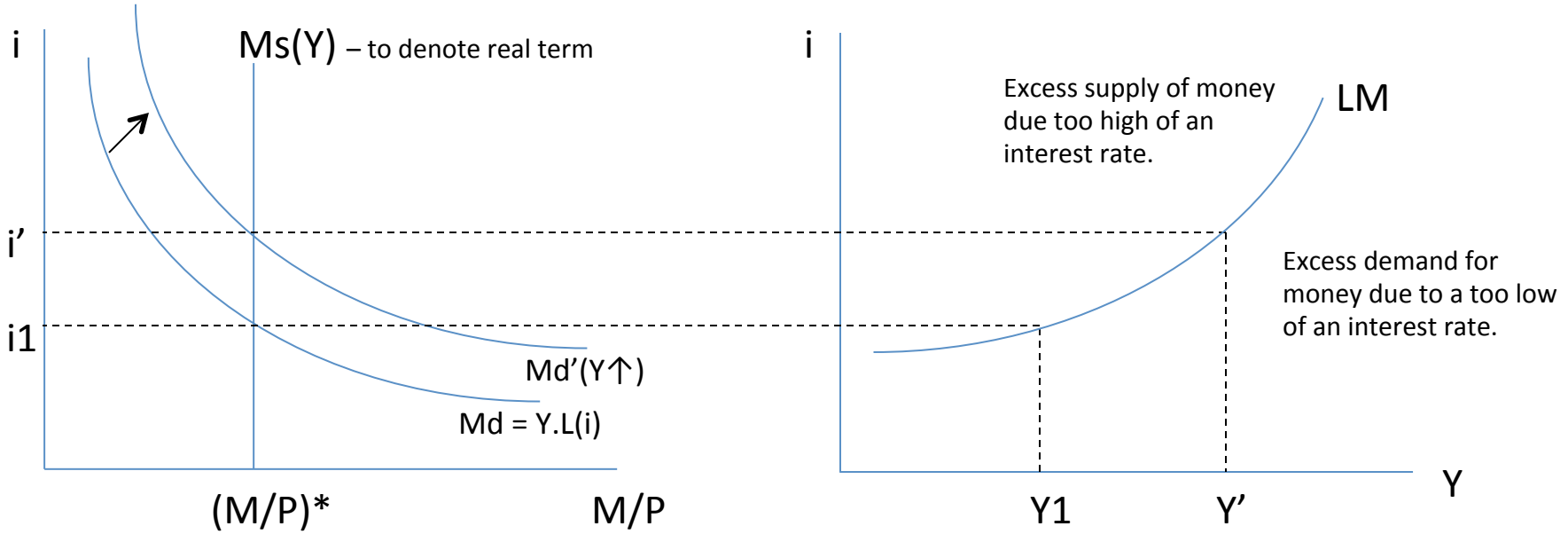
The IS-LM Model

- The LM (Liquidity-Money) Relation:
- Recall that Md = $Y.L(i), and that this function is given in nominal terms. Also, in equilibrium: Money Supply = Money Demand.
- To begin with our derivitation of the LM relation, we must first convert the money demand function into real terms:
  M/P = [$Y.L(i)]/P
- This gives us the following real money demand equation:
  M/P = Y.L(i)
  In the money market equilibrium, real money demand = real money supply.



The IS-LM Model

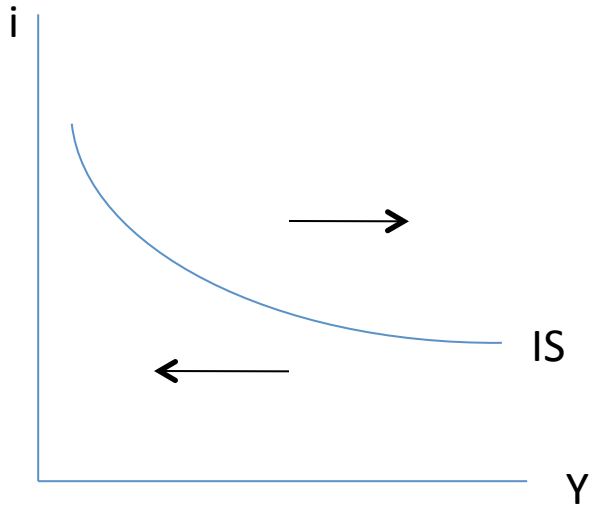
- Deriving the LM curve:
- Let's assume an increase in real income in the money market:

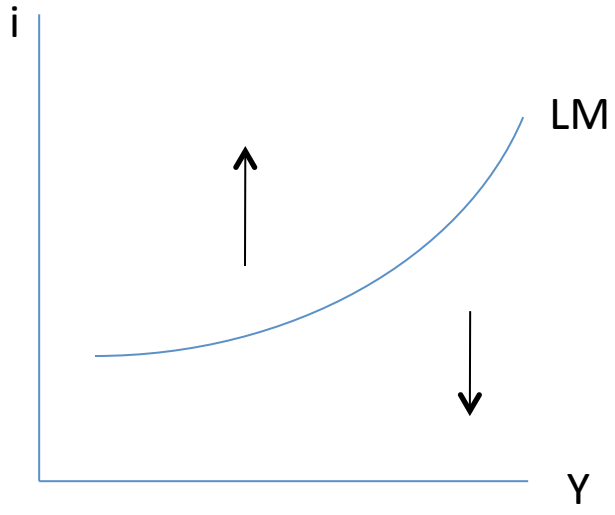


- Equilibrium in financial markets implies that, for a given money stock, the interest rate is an increasing function of the level of income. Changes in the money stock, will shift the LM curve either **upwards** or **down**. The LM curve is upward sloping.

The IS-LM Model

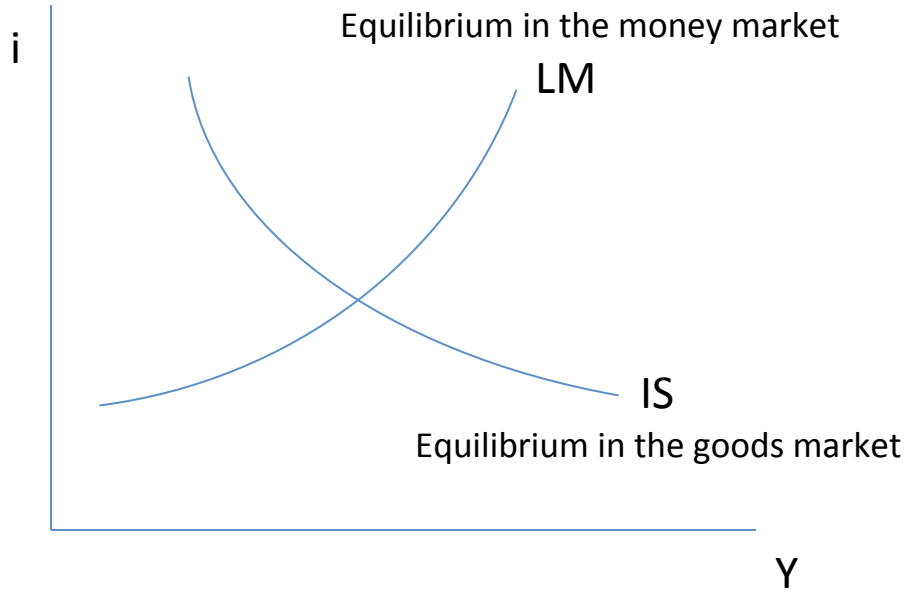
- Notes to the IS and LM curves:
- Why do we think about shifts of the IS curves as being to the left and right, while the LM curve shifts up or down? We think of the goods market as determining Y for a given i; so we want to know what happens to Y when an exogenous variable changes. Y is on the horizontal axis and moves right or left.
  We think of financial markets as determining i for a given Y; so we want to know what would need to happen to i when exogenous variable changes. i is on the vertical axis and moves up or down.





The IS-LM Model

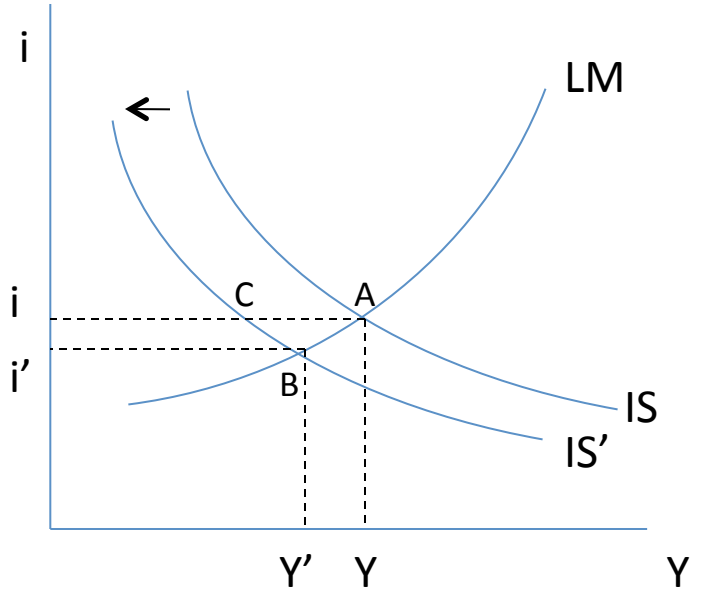
- Putting the IS and LM relations together:



- Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output. This is represented by the IS curve. Equilibrium in the money market implies that an increase in output requires an increase in the interest rate, given the money stock. This is represented by the LM curve. The intersection of the IS and LM curves represents the point at which the goods market and financial market are in equilibrium.

The IS-LM Model

- Analysing policy changes with the IS-LM Model:
- A fiscal contraction (in this case an increase in taxes):



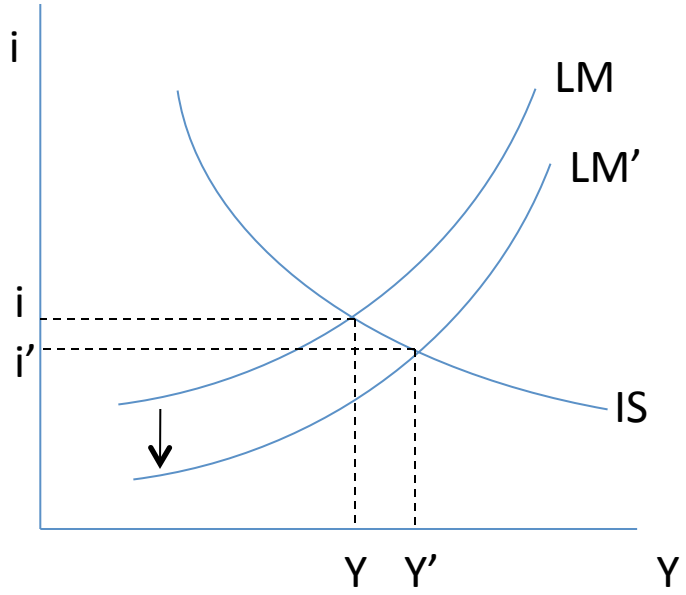
- Assume, we start in the short term equilibrium, i, Y;
- Fiscal contraction: T↑, (Y – T)↓, C↓, Z↓, Y↓;
- The IS curve shifts to the left, causing a movement towards the left on the LM curve;
- The decrease in Y also affects the money demand, which affects the LM relation: Y↓, Md↓, i↓

The IS-LM Model

- Notes to this example:
- It's ambiguous whether or not the investment level is higher or lower at point B compared to point A:
  $I = I_0 + b_1Y - b_2i$
- We can't show that point B is better than point C. The reduction in the interest rate at point B from point C has a much better effect on income. If interest rates are capped at point C, than income would to a greater magnitude compared to the equilibrium at point B.
- i.e. If investment is more reliant on sales, than surely investment will go down in the preceding scenario. However, if investment is more responsive to a change in the interest rate; a reduction in the interest rate will lead to an increase in investment.

The IS-LM Model

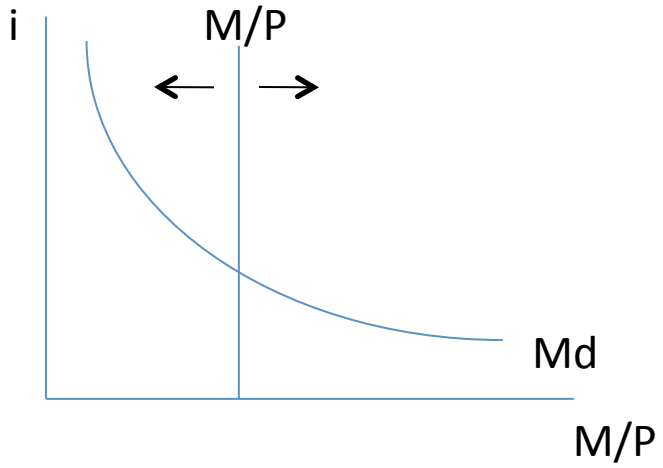
- Monetary Policy (an expansion):



- Because the price level is fixed, an increase in nominal money supply will lead to a one for one increase in the real money supply.
- Money doesn't appear in the IS relation, therefore money doesn't shift the IS curve. However the LM relation does shift when money supply changes. An increase in the money supply shifts the LM curve down; at a given level of income, an increase in money supply will lead to a reduction in the interest rate.

The IS-LM Model

- Effectiveness of monetary policy changes:



$$M^d = d_1 Y - d_2 i$$

$$i = \frac{d_1}{d_2} Y - \frac{1}{d_2} M^d$$

- Where d_1 and d_2 , like b_1 and b_2 , measure sensitivity. d_1 and d_2 measure the responsiveness of Md to changes in Y and i, respectively.

The IS-LM Model

- Deriving the LM curve's equation with sensitivity:

$$M^d = d_1 Y - d_2 i$$

In equilibrium: $\frac{M}{P} = M^d$

$$\frac{M}{P} = d_1 Y - d_2 i$$

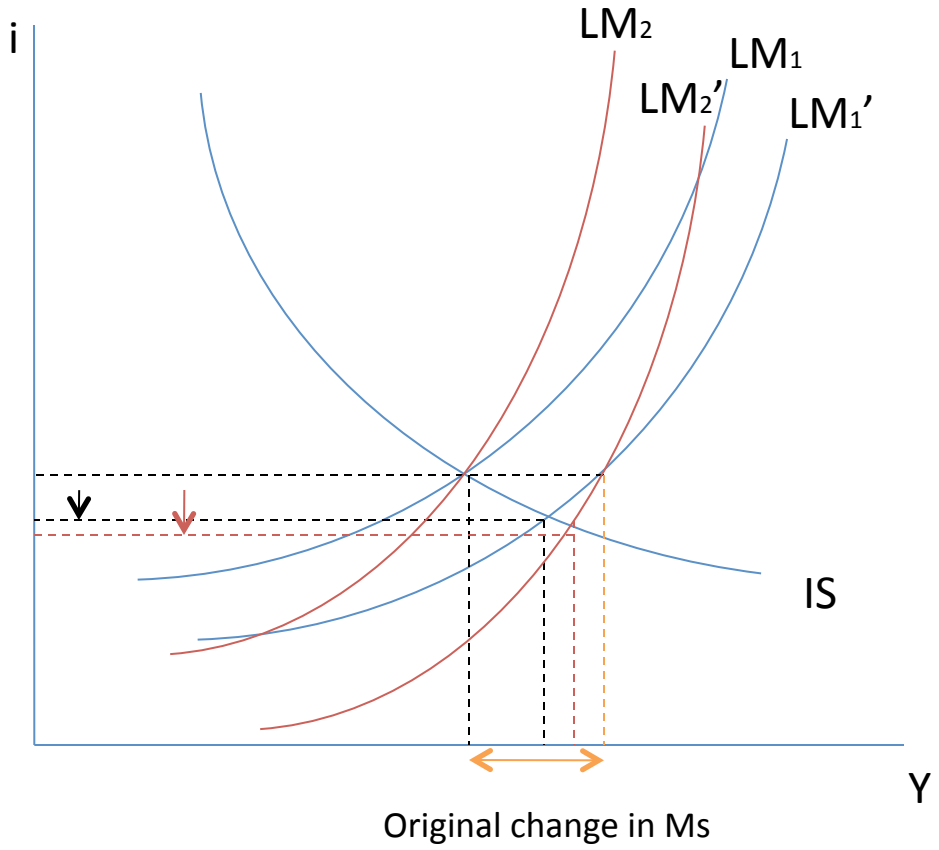
$$i = \frac{-1}{d_2}\frac{M}{P} + \frac{d_1}{d_2} Y$$

Monetary policy is most effective when the LM curve is steep. When d_2 is small, LM is steep.

$$\left(\frac{d_1}{d_2 \downarrow} Y\right) \uparrow$$

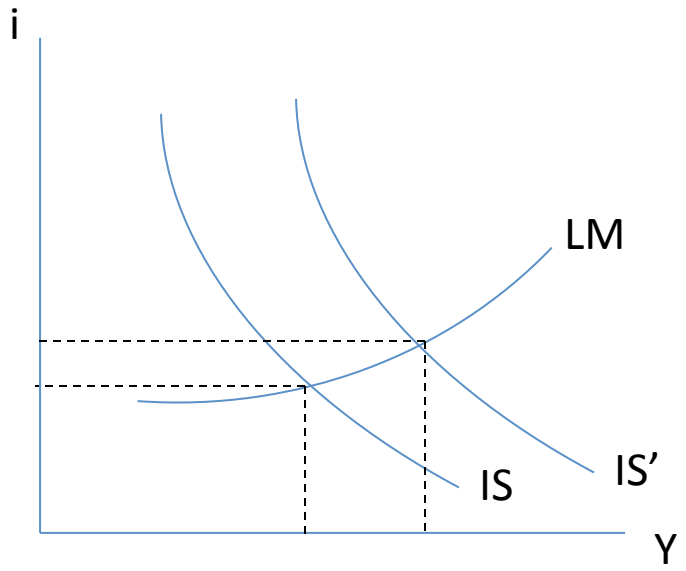
The IS-LM Model

- Modelling different responsiveness:



The IS-LM Model

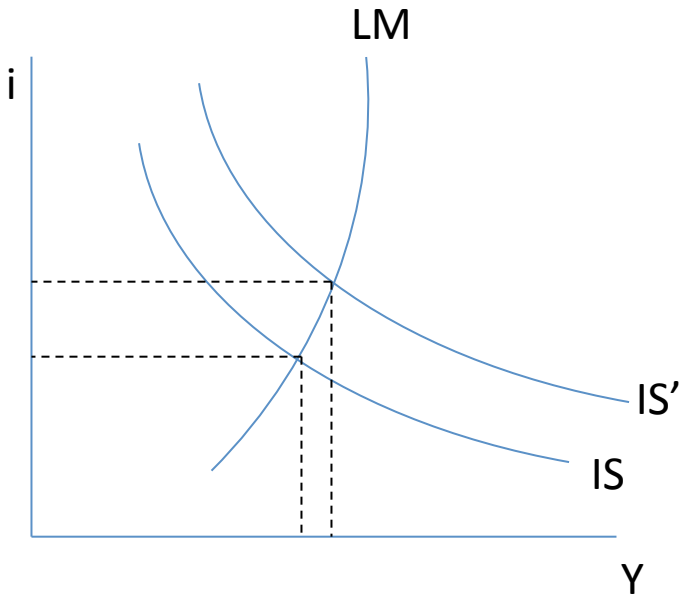
- The Liquidity Trap (policy responses to a LT):



- Fiscal changes (in this case an expansion) have little crowding out effects, and thus does not lead to a large increase in the interest rate. But it does have a profound effect on income, increasing it largely in the short run. A liquidity trap occurs when there is little demand for assets such as bonds, but a large demand for cash. This is usually occurs when the interest rate is close to 0%, and there is little point in holding bonds.

The IS-LM Model

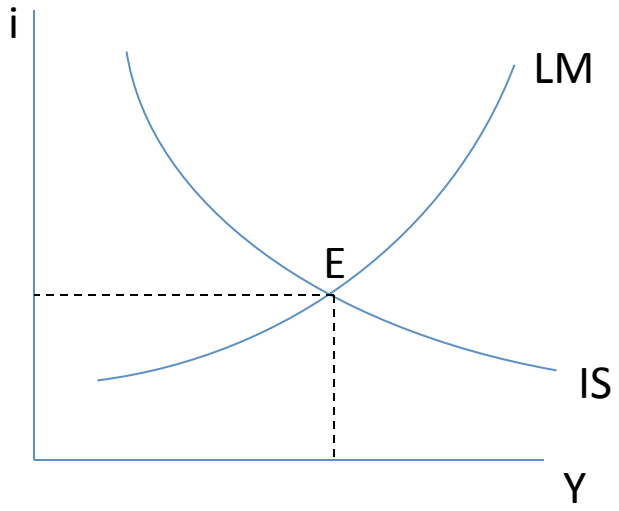
- The Classical Case:



- This illustrates when fiscal policy (expansion) is not very effective, as it leads to a crowding out effect. An increase in government expenditure leads to a small increase in Y, but a large increase in i. This occurs when d2 is small. i.e. Money demand is not sensitive to changes in the interest rate.

The IS-LM Model

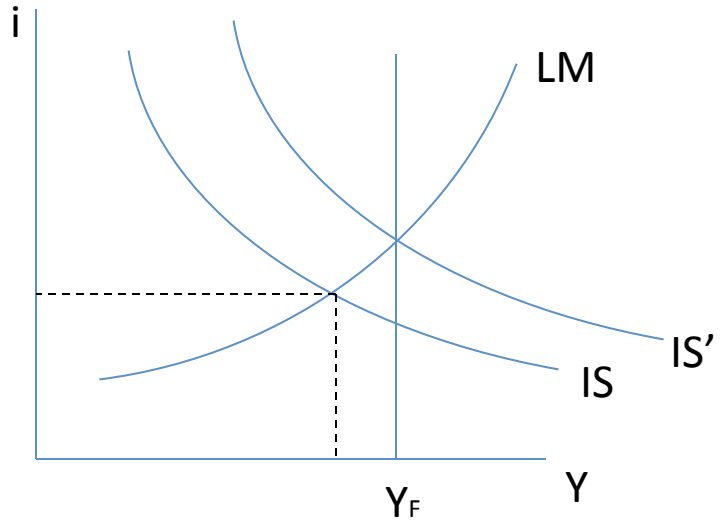
- A Policy Mix in the Short Run:



- This model represents the short run equilibrium. It may not show the optimal level of economic activity.

The IS-LM Model

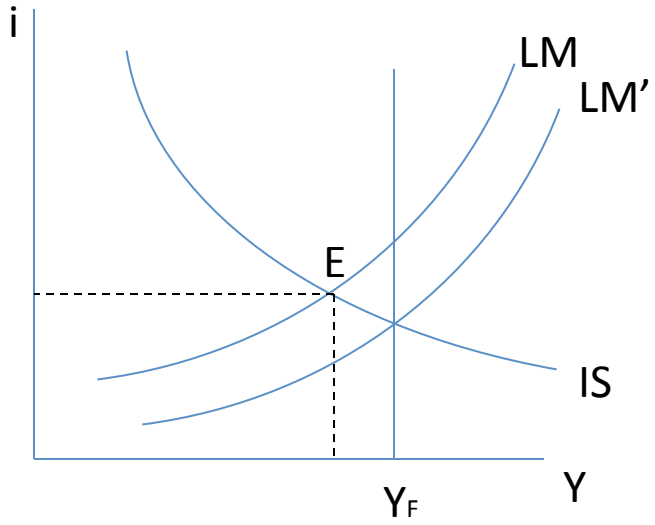
- The Full Employment Level of Output:



- Government using fiscal policy , attempting to move to the full employment level of output.

The IS-LM Model

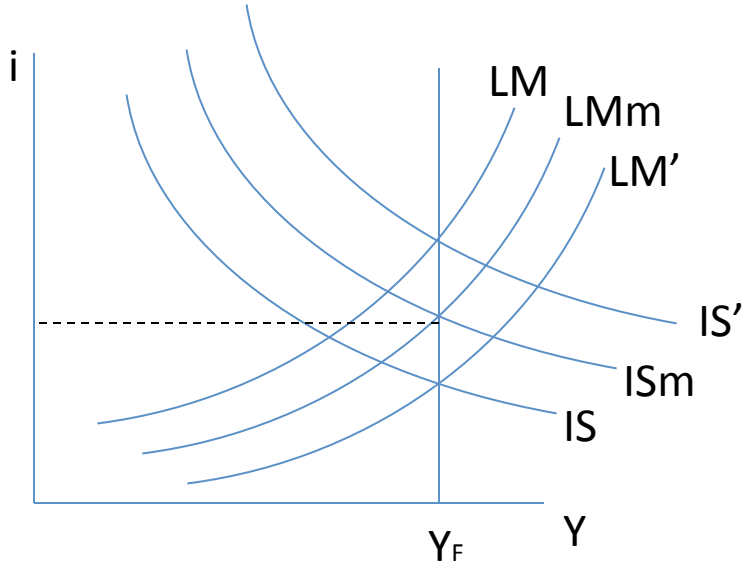
- Cont...



- Monetary policy expansion to achieve full employment level of output.

The IS-LM Model

- Cont...



- Using a policy mix, ISm and LMm represent expansions by both fiscal and monetary policy to achieve the full employment level of output.

The IS-LM Model

- The effects of changes in fiscal and monetary policy:

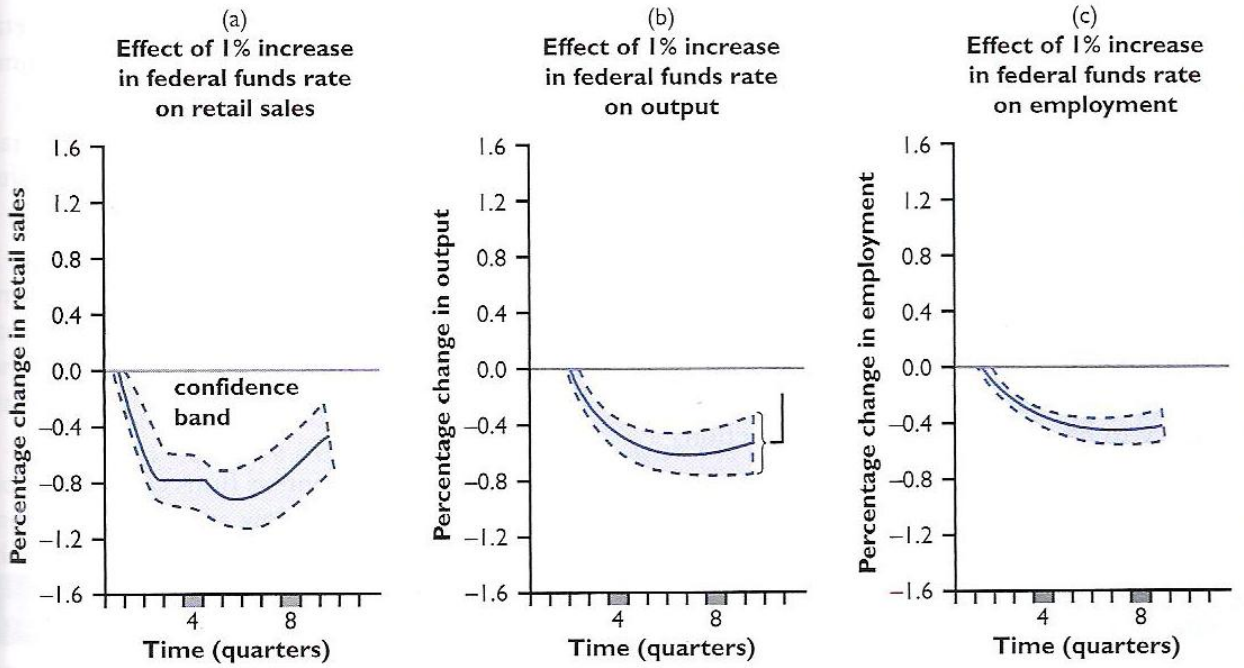
	Shift of IS	Shift of LM	Movement in output	Movement in interest rate
Increase in taxes	Left	None	Down	Down
Decrease in taxes	Right	None	Up	Up
Increase in spending	Right	None	Up	Up
Decrease in spending	Left	None	Down	Down
Increase in money	None	Down	Up	Down
Decrease in money	None	Up	Down	Up

The IS-LM Model

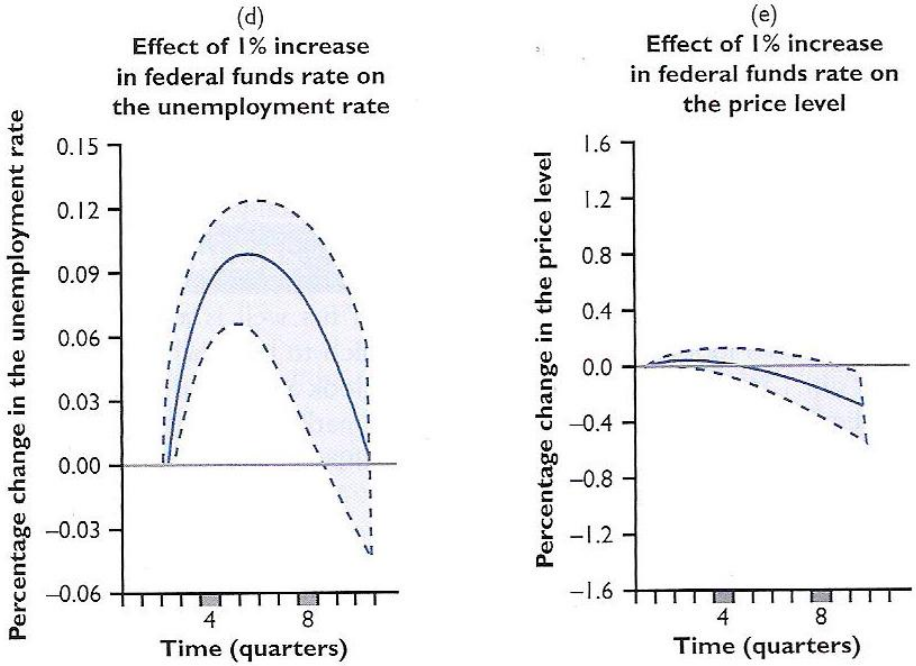
- Summary of the IS-LM Model:
  - The IS-LM Model characterises the implications of equilibrium in both the goods market and the financial markets;
  - The IS relation and the IS curve show the combinations of the interest rate and the level of output that are consistent with equilibrium in the goods market. An increase in the interest rate leads to a decline in output. The IS curve is downward sloping;
  - The LM relation and the LM curve show the combinations of the interest rate and the level of output consistent with equilibrium in the financial markets. Given real money supply, an increase in output requires an increase in the interest rate. The LM curve is upward sloping;
  - A fiscal expansion shifts the IS curve to the right, leading to an increase in output. A fiscal contraction shifts the IS curve to the left, leading to a decrease in output and the interest rate;
  - A monetary expansion shifts the LM curve down, leading to an increase in output and a decrease in the interest rate. A monetary contraction shifts the LM curve up, leading to a decrease in output and an increase in the interest rate;
  - The combination of using monetary policy and fiscal policy is called a policy mix;
  - Monetary policy can be implemented by keeping either the money supply of the interest rate fixed. Most central banks opt for the latter. The effect of fiscal policy on output is greater when the interest rate is kept fixed;
  - The IS-LM model best describes the characteristics of the economy in the short run. In particular, the effects of monetary policy appear to be similar to those implied by the IS-LM model once dynamics (time) are introduced to the model. Effects of monetary policy are strongest after about 8 quarters.

Readings

- Chapter 5, page 116 introduces the concept of whether or not the IS-LM model fits the facts found by econometrics (Not examinable, but shows that IS-LM fits the short run).



The empirical evidence looking at the effects of an increase in the federal funds rate.



- In the short run, an increase in the federal funds rate leads to a decrease in output in output and to an increase in unemployment, but has little effect on the price level.

Topic 5: The Labour Market

The Labour Market

- This is the start of studying the medium run economy.
- So far we have ignored the medium run effects of changes in income, by assuming that the price level is held constant:
  - Higher production leads to higher employment;
  - Higher employment leads to lower unemployment;
  - Lower unemployment leads to higher wages;
  - Higher wages increases production costs, leading firms to increase prices;
  - Higher prices lead workers to ask for higher wages;
  - And so on...

The Labour Market

- Quick review of the labour market:
- The components of the labour market:
  - Labour Force (LF) = Employed + Unemployed (U)
  - The Unemployment Rate (u) = U ÷ LF
  - The Participation Rate (PAP) = LF ÷ Working Age Population
- There are however biases in the unemployment rate:
  - It hides regional unemployment;
  - Hides the different unemployment rates amongst different age groups;
  - Does not reflect underemployment;
  - It also fails to account for other factors such as discouraged workers.
- The different types of unemployment:
  - Cyclical unemployment;
  - Frictional unemployment;
  - Structural unemployment;
  - At any one time, there will always be unemployed workers. Either workers who cannot find jobs due to a downswing in economic activity or workers who are moving between jobs during times of high economic activity.

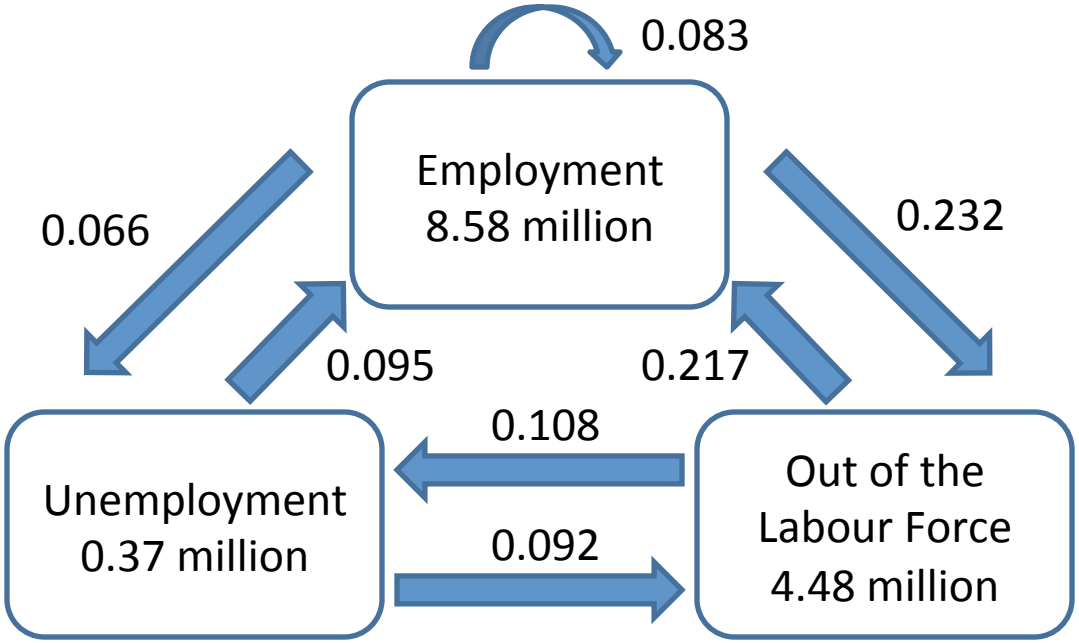
The Labour Market

- The Labour Force Survey (LFS):
- The Australian Bureau of Statistics (ABS) conducts a monthly survey of the Australian labour markets. This is the main source of statistics on the labour force, employment, participation and earnings in Australia. Each LFS consists of roughly 42,000 people across Australia (reduced from 55,000 in July 2008 due to government cost cutting).
  Economists use the data collated in the LFS to deduce two things:
  - The first is to get a snapshot of how things are at various points in time, to answer questions such as: What is the distribution of wages for workers with only primary education, and how does it compare with the same distribution 10 or 20 years ago?
  - The second is by exploiting the fact that the survey follows people through time. By looking at those who are in the sample in two adjacent months, economists can find out, for example, how many of those who were unemployed last month are employed this month. This number gives them an estimate of the probability of finding a job for those who were unemployed last month.

The Labour Market

- The Flows of Unemployment:

Average monthly flows (millions). August 2007 to July 2008.



- The flows of labour are very large, and economists are not very concerned with changes in the unemployment flows, unless there's an increase in the number of long term unemployed persons—people who have been looking for work for over 12 months.
- We must look at the net inflows of unemployed persons when creating policy.

The Labour Market

- Duration of unemployment:
  - The average length of time people stay unemployed—roughly 2 months during August 2007 to July 2008.

$$\text{The average duration of unemployment} = \frac{1}{\text{Outflow Ratio}} = \frac{1}{\frac{\text{Outflow of U per month}}{\text{U}}}$$

$$= \frac{\text{U}}{\text{Outflow of U per month}}$$

e.g. 0.48/0.199 = 2.38 months

The Labour Market

- Wage Determination:
- Wages are set in a number of ways. In Australia, they are set in collective bargains, in legal awards and in individual agreement.
  - Collective bargaining is between one or more firms and trade unions.
  - Awards are legally enforceable determinations made by federal or state industrial tribunals that set the terms of employment, including pay.
  - Bargaining power of a worker is set by two things: The first is how costly it would be for the firm to replace the worker. The second is how hard it would be for the worker to find another job. The more costly it is for the firm to replace the worker and the easier it is for the worker to find another job, the more bargaining power the worker has.
  - Efficiency wages are based on how productive a worker is, and is also aimed at reducing the turnover of workers. Turnover are the number of workers that arrive and leave a job. Typically, incompetent workers populate high turnover jobs.
    Efficiency wage theories link the productivity of a worker to the wage that they receive.
    - Some firms—such as high tech firms—that see employee's morale and commitment as essential to the quality of their work will pay more than firms in sectors where worker's activity is a routine operation.
    - Labour market conditions will affect the wage. A low unemployment rate makes it more attractive for employed workers to quit. When unemployment is low, it is easy to find another job. This means that, when unemployment decreases, a firm that wants to retain its workers will have to increase wages to induce workers to stay with the firm. Thus, lower unemployment will lead to higher wages.

The Labour Market

- We capture our discussion of wage determination by the following equation:

$$W = P^{e}F(\underset{-}{u}, \underset{+}{z})$$

- The aggregate nominal wage W depends on:
  - The expected price level
  - The unemployment rate, u
  - A catch-all term, z, that stands for all other variables that may affect the outcome of wage setting.
- Focus on each factor in the equation:
  - Ignoring the difference between the expected price level and the actual price level, why is the price level in the wage equation? The reason is because both firms and workers care about the real wage. Workers don't care about the nominal wage but of what goods they can actually buy with their real wage. Firms also care about what wage they pay to workers in relation to the sale price of their output, so firms also care about the real wage, W/P.
    So if both workers and firms expect a doubling of the price level, wages will increase two fold.
  - Also affecting the aggregate wage equation is u (through the function F). As previously explained, when u↑ → W↓.
  - The catch all term, z, stands for all other factors that influence the nominal wage given the expected price level and unemployment rate. In short let's summarise the effect of z as: z↑ → W↑.
    For example, z can be factors such as unemployment insurance, minimum wages, employment protection and etc.

The Labour Market

- Deriving the Price Setting Relation:
- We start with the Cobb-Douglas production function:

$$Y = AK^{\alpha}L^{1-\alpha}$$

- Assume that labour is the only input into production:

$$Y = AL$$

$$\frac{Y}{L} = A \quad \text{Assume A = 1}$$

Then; $Y = L$ or $Y = N$

$$P = W$$

$$P = (1+\mu)W$$

- The production function Y = N implies that the cost of producing one more unit of output is the cost of employing one more worker, at wage W.
i.e. Marginal Cost of Production is equal to W.
- If there were perfect competition in the goods market, the price of a unit of output would be equal to its marginal cost: P would equal W. This would mean that firms would be making neither profit or losses. But this isn't the case. To capture this we create a 'mark up' term that captures imperfect competition.

- μ represents firms finding opportunities (e.g. Lack of competition) to raise prices.
- The price, P, set by firms (equivalently the price level) is equal to the nominal wage, W, times 1 plus the mark-up.

The Labour Market

- Cont...

$$\frac{P}{W} = (1+\mu)$$

The implied real wage: $$\frac{W}{P} = \frac{1}{(1+\mu)}$$

- Next we derive the Wage Setting Relation:

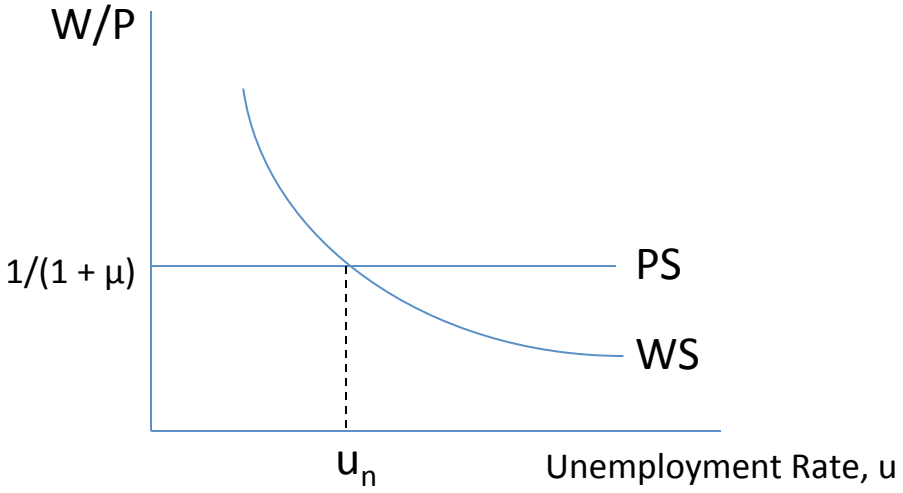
$$W = P^e F(\underset{-}{u}, \underset{+}{z})$$

Assume that $P^e = P$: $$\frac{W}{P} = F(\underset{-}{u}, \underset{+}{z})$$

- The WS and PS relations help show the relationship between firm mark ups, unemployment and z, and how they all affect the real wage. When the mark-up increase, then real wages fall. The function F shows that when the unemployment rate increases, the real wage falls as wage setters choose a lower wage. Further, the more bargaining power the worker has, the higher the real wage.

The Labour Market

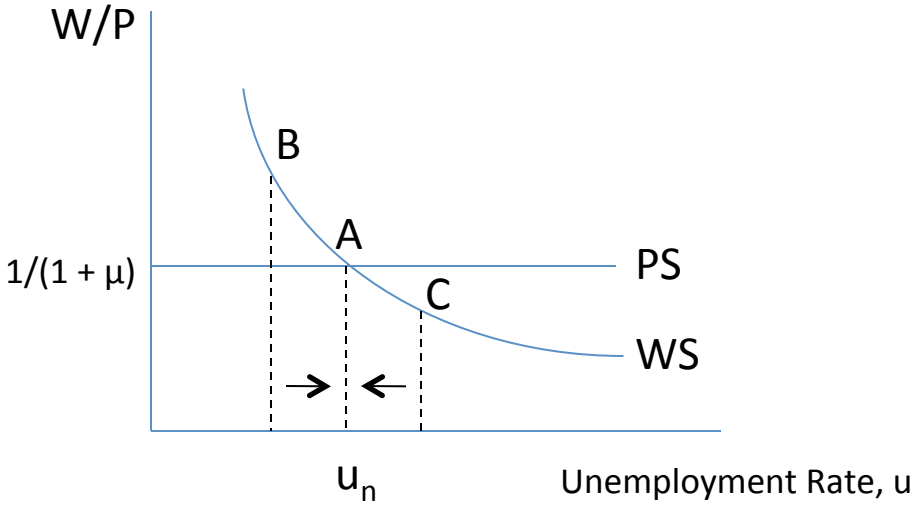
- The Natural Rate of Unemployment:



- The NRU is the equilibrium unemployment rate in the medium run, that satisfies both workers and firms (from a real wage setting point of view). i.e. The real wage chosen in wage setting = real wage chosen by price setting.

The Labour Market

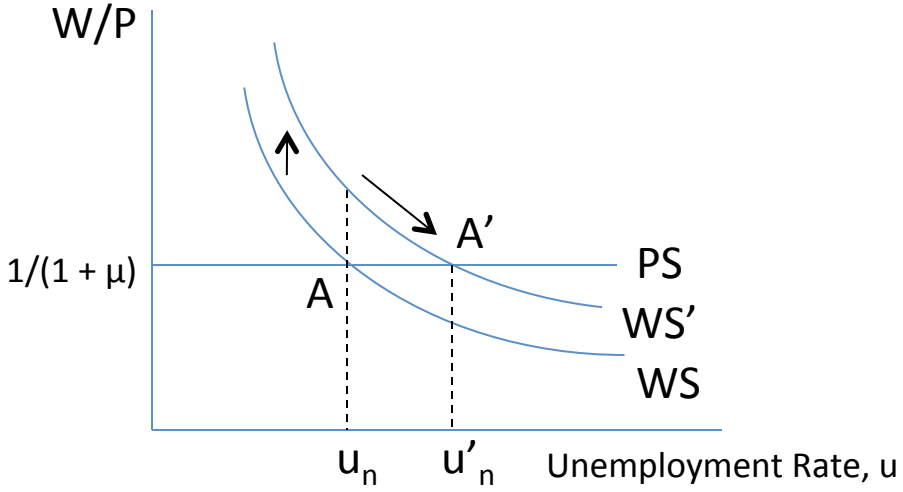
- Cont...



- At point B, workers are asking for a wage higher than the NRU's level at A. Firms knock back the demands, and some workers accept this decision. Other workers however leave work looking for a higher wage, and thus the unemployment rises to the NRU. This also pushes the real wage that was asked by workers to point A.
  At point C, the real wage that workers are asking or getting is lower than the natural rate at A. Some workers however will enter the workforce seeking a higher wage, which firms are happy to pay. This increases the real wage and lowers unemployment.

The Labour Market

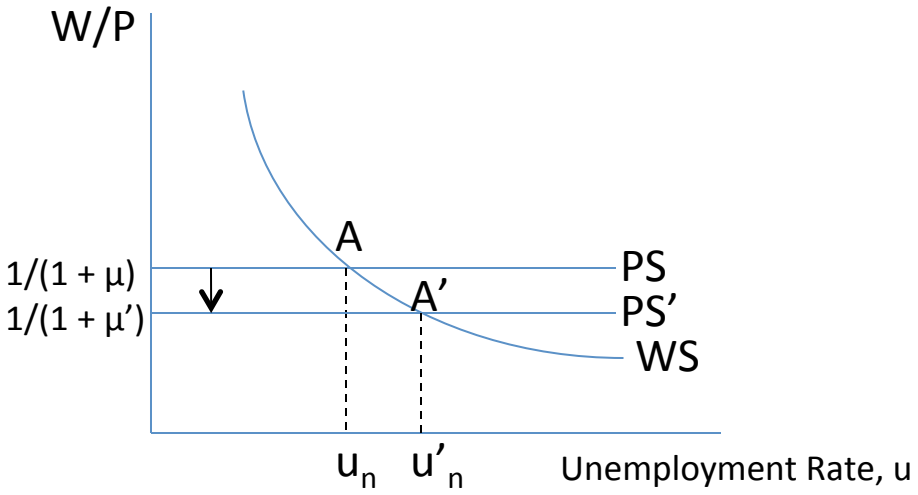
- The WS and PS relation (examples):
- An increase in unemployment benefits. i.e. z↑



- Since an increase in unemployment benefits makes unemployment seem less painful, it increases the wage set by wage setters at a given unemployment rate. So it shifts the wage setting relation up, from WS to WS'. The economy moves along the PS line, from A to A'. The natural rate of unemployment from u_n to u'_n .
- At a given unemployment rate, higher unemployment benefits lead to a higher real wage. A higher unemployment rate is needed to bring the real wage back to what firms are willing to pay.

The Labour Market

- Examples cont...
- A decrease in competition (μ↑):



- The increase in μ implies a decrease in the real wage paid by firms, and so it shifts the PS relation down from PS to PS'. The economy moves along the WS curve, and equilibrium moves from A to A', and the natural rate of unemployment increases from u_n to u'_n.
- By letting firms increase their price given the wage, an increase in the mark up by firms leads to a decrease in the real wage. Higher unemployment is required to make workers accept this lower real wage, leading to an increase in the natural rate of unemployment.

The Labour Market

- From Unemployment to Employment:
- Associated with the natural rate of unemployment is the natural rate of employment., the level of employment that prevails when unemployment is equal to its natural rate.
- Let's review the relation between unemployment, employment and the labour force. Let U denote unemployment, N denote employment and L denote the labour force. Then:

$$u \equiv \frac{U}{L} = \frac{L - N}{L} = 1 - \frac{N}{L}$$

- Now, rearrange to get employment in terms of the labour force and the unemployment rate:

$$N = L(1 - u)$$

- So if the natural rate of unemployment is u_n , and the labour force is equal to L, the natural level of employment, N_n , is given by:

$$N_n = L(1 - u_n)$$

- For example, if the labour force is 10 million people and the unemployment rate is 5%, then the natural level of employment is 9.5 million.

The Labour Market

- From Employment to Output:
- Finally, associated with the natural level of employment is the natural rate of output, the level of production when employment is equal to the natural level of employment. Given the assumed production function used previously, Y = N, the relation takes a simple form: The natural level of Y_n is given by:

$$Y_n = N_n = L(1 - u_n)$$

- From the previous condition in the labour market that gave the natural level of unemployment:

$$\frac{W}{P} = \frac{1}{1+\mu}$$

$$F(u_n, z) = \frac{1}{1+\mu}$$

$$F(1 - \frac{Y_n}{L}, z) = \frac{1}{1+\mu}$$

- The natural level of output is such that, at the associated rate of unemployment ($u_n = 1 - Y_n/L$), the real wage chosen in wage setting—the left side of the equation—is equal to the real wage implied by price setting—the right side of the equation.

The Labour Market

- Quick summary from the WS and PS relations:
- The real wage chosen in wage setting is a decreasing function of the unemployment rate;
- The real wage implied by price setting is a constant, and thus independent of unemployment;
- Equilibrium in the labour market requires that the real wage chosen in wage setting be equal to the real wage implied by price setting. This determines the unemployment rate;
- This equilibrium unemployment rate is known as the natural rate of unemployment;
- Associated with the natural rate of unemployment are the natural level of employment and a natural rate of output.

- Where we go from here:
- We have derived the natural rate of unemployment, and the associated levels of employment and output, under two assumptions. First, we have assumed equilibrium in the labour market, Second, we have assumed that the price level was equal to the expected price level, which is a feature of the medium run.
- There is no reason for the second assumption to be true in the short run. The price level may well turn out to be different from what was expected by wage setters when nominal wages were set. Hence in the short run there is no reason for the unemployment rate to be at its natural rate, nor for output.
- But expectations are unlikely to be systematically wrong (say, always too high or always too low) forever. This is why, in the medium run, unemployment tends to return to the natural rate, and output tends to return to the natural level.

The Labour Market

- Summary of the labour market:
- The labour force is composed of those who are working (employed) or looking for work (unemployed). The unemployment rate is equal to the ratio of the number of unemployed to the number in the labour force. The participation rate is equal to the ratio of the labour force to the population of working age;
- The Australian labour market is characterised by large flows between employment, unemployment and the 'out of the labour force';
- Unemployment is high in recessions, low in expansions. During periods of high unemployment, the probability of losing a job increases, and the probability of finding a job if unemployed decreases;
- Wages are set unilaterally by firms, or by bargaining between workers and firms. They depend negatively on the unemployment rate, and positively on the expected price level. The reason why wages depend on the expected price level is that they are typically set in nominal terms for some period of time. During that time, even if the price level turns out to be different from what was expected, wages are typically nor readjusted;
- The price set by firms depends on the wage and markup of prices over wages. The higher the markup by firms, the lower the real wage implied by price setting decisions;
- Equilibrium in the labour market requires that the real wage chosen in wage setting be equal to the real wage implied by price setting. Under the additional assumption that the expected price level is equal to the actual price level, equilibrium in the labour market determines the unemployment rate. This unemployment rate is known as the natural rate of unemployment.
- The natural rate of unemployment will be affected by the degree of imperfect competition in goods markets (captured by the size of the markup), by factors affecting wage outcomes such as unemployment benefits and employment protection, and by taxes.
- In general the actual price level may turn out to be different from the price level expected by wage setters. Therefore, the unemployment rate needn't be equal to the natural rate.

Readings

- Chapter 6, page 141-142 includes a section on taxes and their effects on the natural rate of unemployment. Not examinable but quite important.

Readings

Topic 6: The AS-AD Model

The AS-AD Model

- The Aggregate Supply Relation:
- The aggregate supply relation captures the effects of output on the price level. It is derived from the behaviour of wages and prices.
- Recall the equations for wage determination and for price determination:

$$W = P^e F(u, z)$$

$$P = (1 + \mu) W$$

- In the WS and PS relations, we assumed that P was equal to Pe. Under this assumption we derived the natural rate of unemployment, natural rate of employment and natural rate of output. However, we will now relax this assumption. In the medium run, the price level is equal to the expected price level. This however, does not have to hold for the short run.
- Without this assumption, the PS and WS relations will give a new relation (which we will derive) between the price level, output level and the expected price level. The first step is to eliminate the nominal wage, W, between the two relations. Subbing in the W equation into P's equation gives:

$$P = P^e (1 + \mu) F(u, z)$$

- We now want to find a relationship between the price level and output. We do this by subbing in the unemployment rate that we defined in the previous topic:

$$u = 1 - \frac{Y}{L}$$

The AS-AD Model

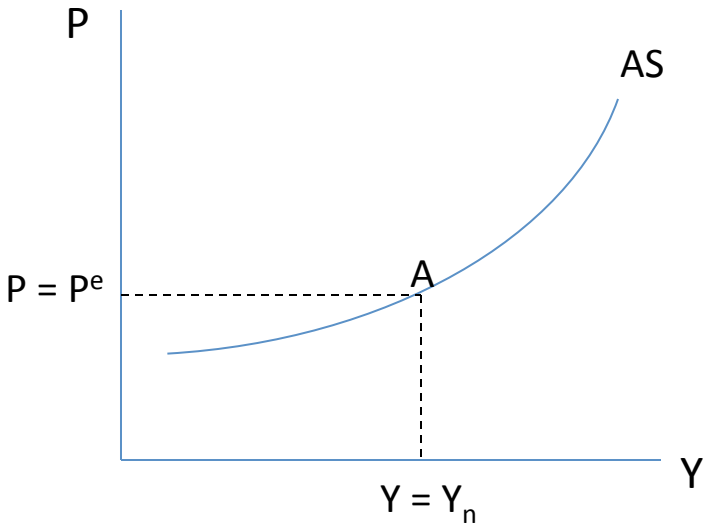
- Cont...
- We now have the AS relation:

$$P = P^e(1+\mu)F(1-\frac{Y}{L}, z)$$

- In words: The price level depends on the expected price level and the level of output (and also on the mark-up, labour force and z—however we assume to be held constant in this relation).
- The AS relation has two important properties:
  - An increase in output leads to an increase in the price level. This is because of the following steps:
    1. An increase in output leads to an increase in employment;
    2. The increase in employment leads to a decrease in unemployment (and thus the unemployment rate);
    3. The lower unemployment rate leads to an increase in the nominal wage;
    4. The increase in nominal wages leads to an increase in price set by firms—an increase in the price level.
  - An increase in the expected price level leads, one for one, an increase in the actual price level. i.e. If the expected price level doubles, then the actual price level will double. This is done through wages:
    1. If wage setters expect the price level to be higher, they set a higher nominal wage.
    2. The increase in nominal wages leads to an increase in costs, which leads to an increase in the price set by firms—a higher price level.

The AS-AD Model

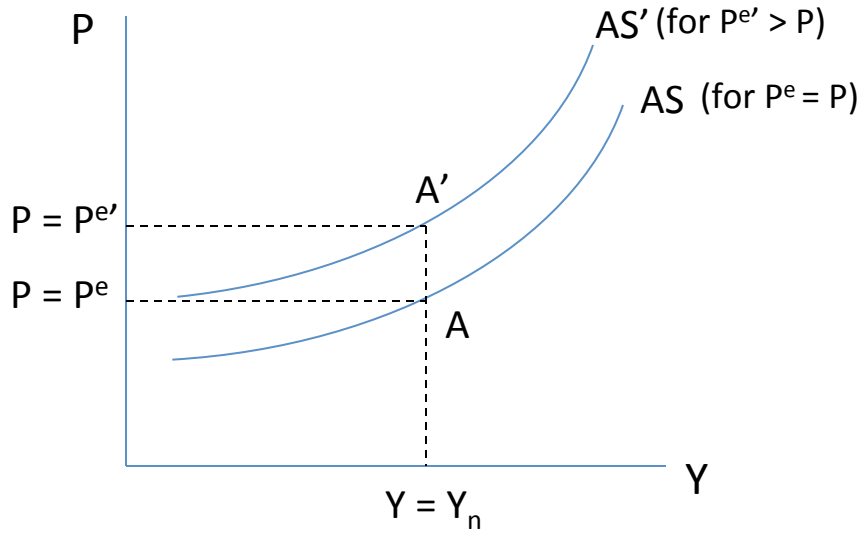
- The AS Curve:



- The AS curve is upward sloping. An increase in output leads to an increase in P—explained earlier.
- The AS curve goes through point A goes through point A, where output is equal to its natural level and price is equal to the expected price level. i.e. When output is at its natural level, the price level is equal to its expected level.

The AS-AD Model

- Shifts of the AS Curve:
- An increase in the expected price level shifts the AS curve up. Conversely, a decrease in the expected price level will shift the AS curve down.



- The effect of an increase in the expected price level on the AS curve.

The AS-AD Model

- The Aggregate Demand Relation:
- The AD relation captures the effect of the price level on output. It is derived from the equilibrium conditions in the goods and financial markets. At first we will assume that the central bank keeps the money supply fixed (instead of targeting the interest rate), but later we will derive the AD relation with interest rate targeting.
- Deriving the AD Curve with a Fixed Money Stock:
- We start with the IS and LM relations:

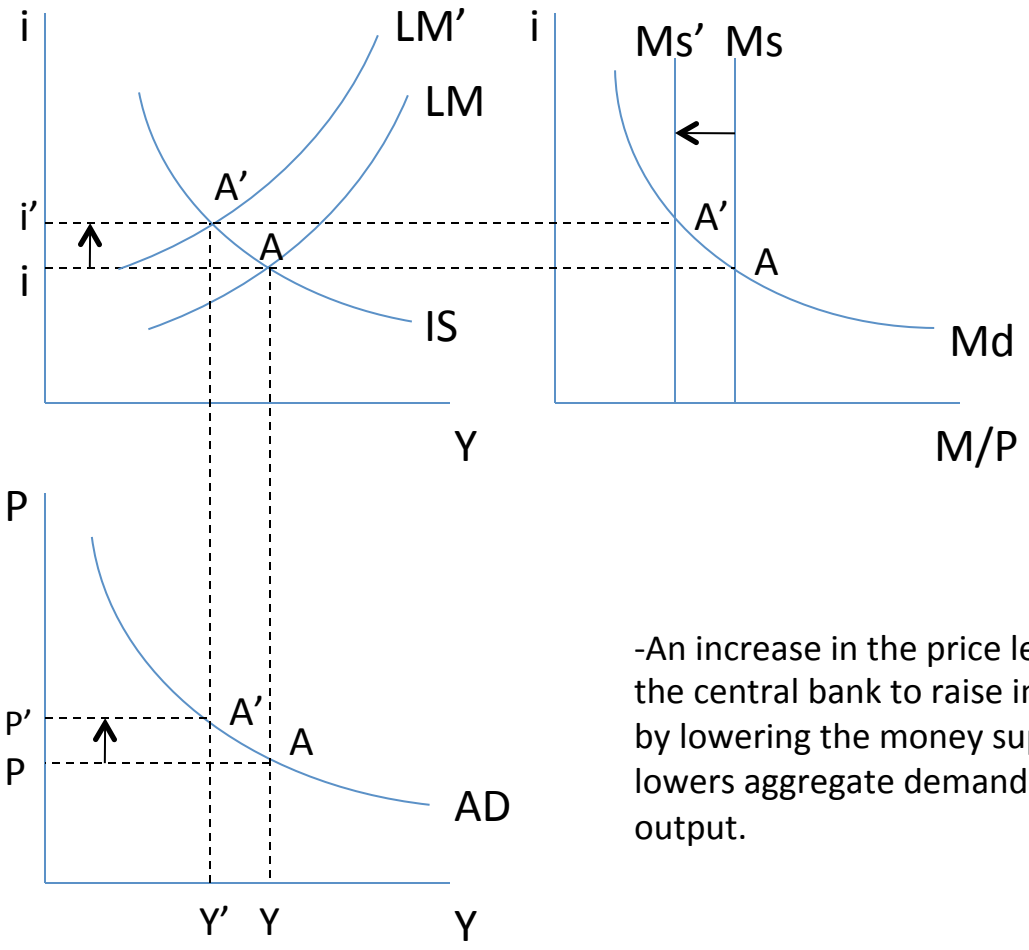
IS relation: $$Y = C(Y - T) + I(Y, i) + G$$

LM relation: $$\frac{M}{P} = Y \,.\, L(i)$$

- Equilibrium in the goods market requires output equal the demand for goods—the sum of consumption, investment and government relation. This is the IS relation.
- Equilibrium in the financial markets requires that the supply of money equal the demand for money. This is the LM relation. Here the central bank keeps the money stock fixed.
- We can derive a relationship in the goods and financial markets with price and output when we look at what happens to money supply, the interest and output for a given increase in the price level—which so far in the IS-LM model we have assumed to be fixed.

The AS-AD Model

- Deriving the AD Curve:



-An increase in the price level prompts the central bank to raise interest rates by lowering the money supply. This lowers aggregate demand and thus output.

The AS-AD Model

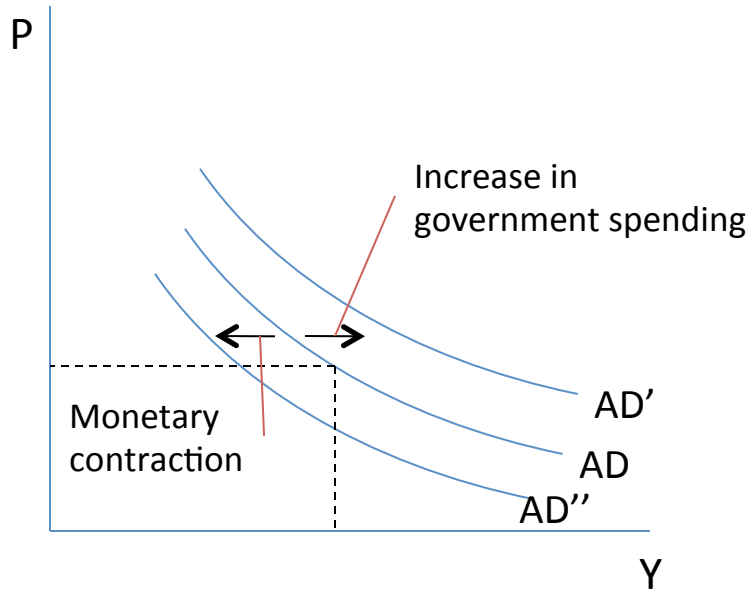
- Cont...
- The implied negative relation between output and price level is drawn as the downward sloping curve AD. This curve is called the aggregate demand curve. The underlying negative relation between output and the price level is called the aggregate demand relation.
- Furthermore, any variable other than the price level that shifts either the IS or LM relations will also shift the AD relation.
  - E.g. Taxes or government spending.
- We can represent the AD relation by:

$$Y = Y\left(\underset{+}{\frac{M}{P}}, \underset{+}{G}, \underset{-}{T}\right)$$

- Output is an increasing function of the real money stock, an increasing function of government spending and a decreasing function of taxes.
- Given monetary and fiscal policy (i.e. M, G and T). An increase in the price level will lead a decrease in the real money stock, which leads to a decrease in output. This was modelled in the previous diagram.

The AS-AD Model

- Shifts of the AD Curve:



- An increase in government spending increases output at a given price level, shifting AD to the right. A monetary contraction shifts the AD curve to the left.

The AS-AD Model

- Deriving the AD Curve with an Interest Rate Rule:
- We have derived the AD relation for the case where the central bank keeps the money supply fixed, allowing the interest rate to be determined by market equilibrium conditions. But in real life, this isn't usually the case.
- Suppose the central bank decides to have an interest rate $i = i_0$, but now the value of they choose for the interest rate depends on the value of the price level, P.
- Assume that the central bank now has a price level target (e.g. Like the 2-3% inflation band that the RBA adopts for Australian monetary policy). The price level target, P^T , which the central bank aims to achieve in the medium run. The central bank will adjust the interest rate whenever the current price level is different from its target price level . So if $P - P^T > 0$, the current price level is too high and the sensible thing to do would be to increase the interest rate. If $P - P^T < 0$, the price level is too low and the central bank will lower the interest rate.
  In the medium run equilibrium, the price will reach a constant value with $P = P^T$, and then the interest rate will also be written as its medium run value, which we call i_n. Thus, the central bank's interest rate rule can be written as:

Interest rate rule: $$i = i_n + a(P - P^t)$$

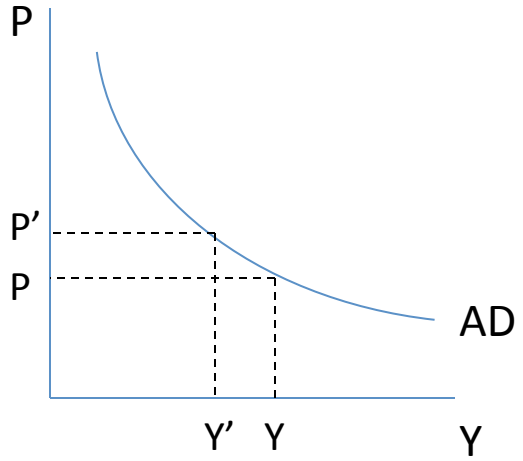
- The positive constant 'a' indicates how much the central bank pushes up the interest rate when the price level happens to rise. When the price level is at its target level, then the central bank will have an interest rate at its medium run value (i_n).

The AS-AD Model

- Cont...
- With the interest rate rule, we can now derive the AD relation with interest rate targeting:

$$Y = Y[(i_n + a(P - P^T)), G, T]$$

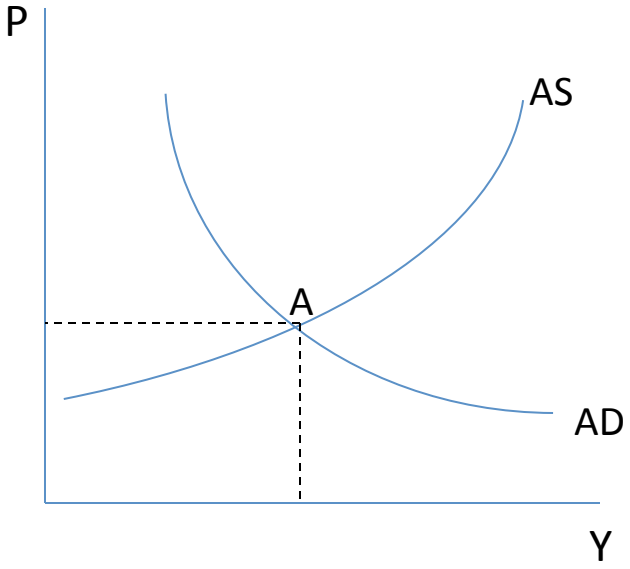
- Here, we don't need the LM relation to derive the AD relation. Once the central bank has chosen the interest rate based on its information about P, that interest rate feeds straight into the IS relation to determine Y. We retain the LM curve only because we want to keep track of the endogenous money supply. This will help us to demonstrate later the neutrality of money.
- E.g. P↑, $(P - P^T)$↑, $a(P - P^T)$↑, i↑, ZZ↓, Y↓.



- The interest rate rule and AD relation is far more applicable than money stock targeting.

The AS-AD Model

- Equilibrium in the short run:



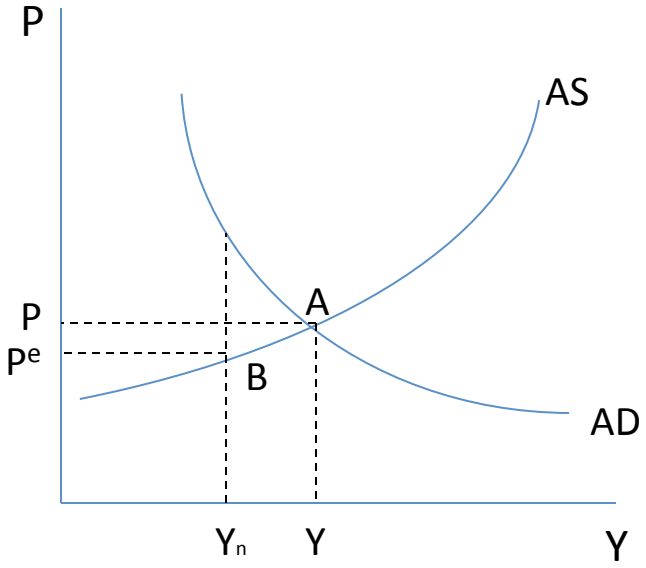
AS relation: $P = P^e(1+\mu)F(1-\frac{Y}{L}, z)$

AD relation: $Y = Y[(i_n + a(P - P^T)), G, T]$

- The equilibrium is given at point A, the intersection of AS and AD. By construction, the goods market, the financial markets and the labour market are all in equilibrium.

The AS-AD Model

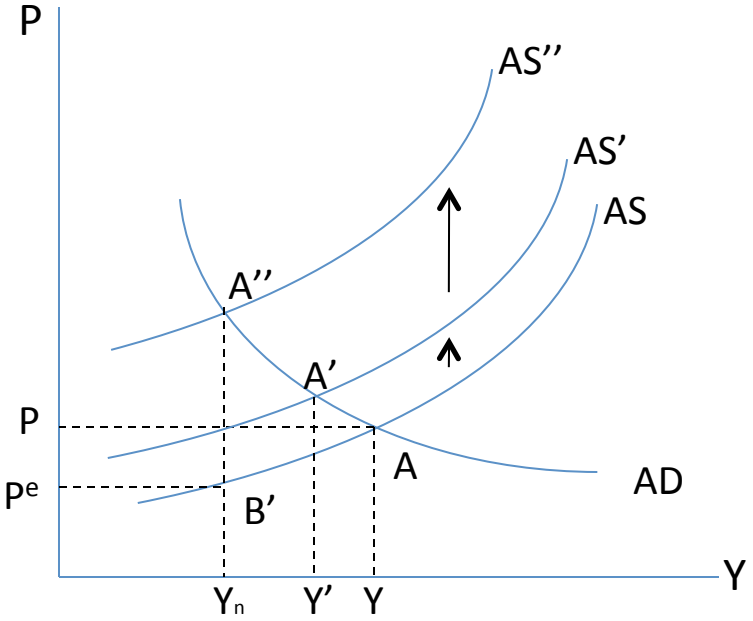
- The Natural Level of Output in the Short Run:



- There is no reason for the short run equilibrium (A) to be equal to the natural level of output. In this case, output is greater than the natural level of output.
- The economy will however move back to the natural rate in the medium run, because expectations of the price level are not equal to the actual price level.

The AS-AD Model

- From the Short Run to the Medium Run:
- To think about what happens over time, we will look at the previous representation of the economy, where output exceeded the natural level of output:
  - At point A, output exceeds the natural level of output. So we know that the price level is higher than the expected price level—higher than the price level wage setters expected when they set nominal wages.
  - The fact that the price level is higher than what was expected will lead to wage setters revising upwards their expectations of what the price level will be in the future.
- The adjustment of output over time:

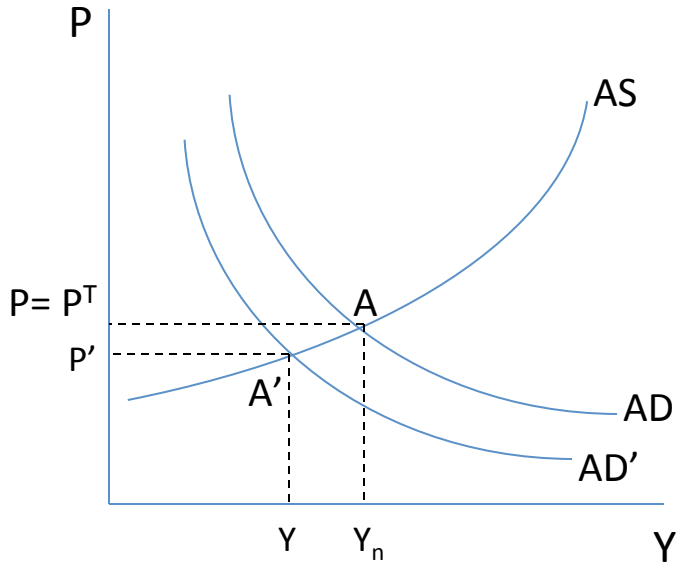


The AS-AD Model

- Cont...
- The next time wage setters set nominal wages, they are likely to make that decision based on a higher expected price level, say, based on $P^{e'}$, where $P^{e'} > P^{e}$. This increase in the expected price level implies that, next period, the aggregate supply curve shifts up from AS to AS'. The upward shift in the AS curve implies that the economy moves along the AD curve. The equilibrium moves from point A to point A'. Output decreases from Y to Y'.
- In words: The fact that output initially exceeds the natural level of output leads to an increase in the expected price level. This expectation leads to an increase in nominal wages, which leads to an increase in the price level. This higher price level leads to an increase in the interest rate, leading to a decrease in output.
- The adjustment doesn't end at point A' however. At point A', output still exceeds the natural level, so the price level is still higher than expected. Wage setters will continue to revise upwards their expectations of the price level.
- The adjustment comes to an end when the AS curve has shifted all the way to AS'', when equilibrium has moved all the way to A'', and the equilibrium level of output is equal to Y_n. At A'', equilibrium output is equal to the natural rate of output, so the price level is equal to the expected price level, which equals the target price level P^T. Wage setters have no reason to revise their expectations; the AS curve no longer shifts, and the economy stays at A''. The interest rate is then equal to i_n.
- We have looked at the dynamics of adjustment starting from a case where output is higher than the natural rate of output. A symmetrical case exists also when output is lower than the natural rate.

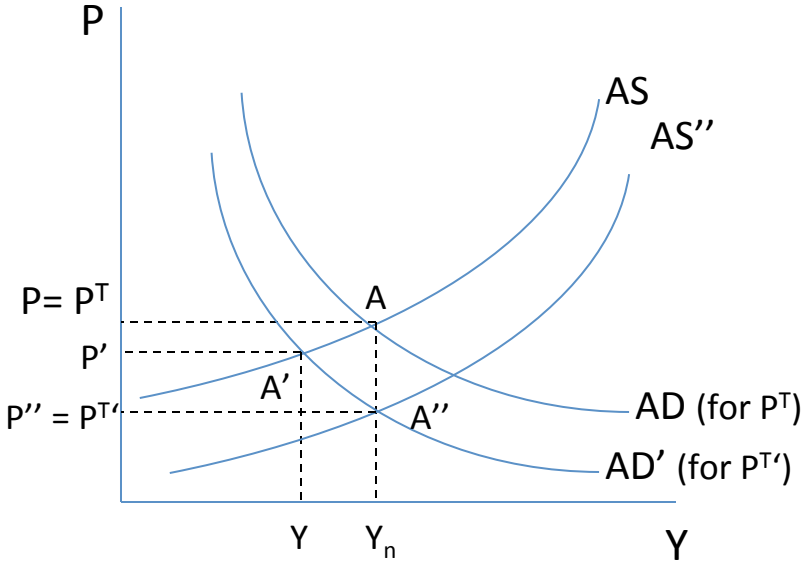
The AS-AD Model

- The Effects of a Monetary Policy Contraction:
- A reduction in the price level target P^T to P^T‘.
- For a given price level, P, the fall in the target P^T leads the central bank to immediately raise the interest rate, which reduces demand for goods and services and thus output. The AD curve shifts to the left, from AD to AD’. We get the short run equilibrium at A’.



The AS-AD Model

- Cont...
- Over time expectations come into play. As output is lower than the natural level of output, the price level is lower than what the wage setters expected. They revise their expectations, leading to the AS curve to shift down over time. The adjustment stops when the economy moves to point A'':

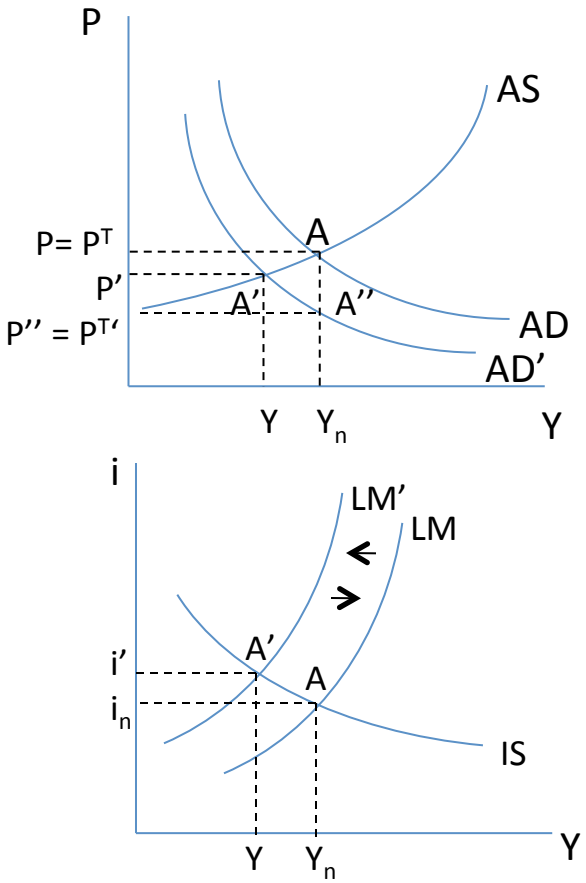


A monetary policy contraction (fall in the target price level) leads to a fall in output in the short run, but has no effect on output in the medium run.

- At that point, the price level is equal to the expected price level. In the medium run, the aggregate supply curve is given as AS'', and the economy is at point A''—output is back to Y_n, and the price level is equal to $P'' = P^{T'}$.
- We can pin down the actual decrease in the money stock. If output is back to the natural level of output than the money stock must be back to its original quantity. In other words, the proportional decrease in prices must be equal to the proportional decrease in the nominal money stock: If the target price level is lowered by 10% than the money supply ends up 10% lower than it was initially.

The AS-AD Model

- Cont...
- To get a better idea of what happens, we must look at not only the changes in output and price level, but also the interest rate:



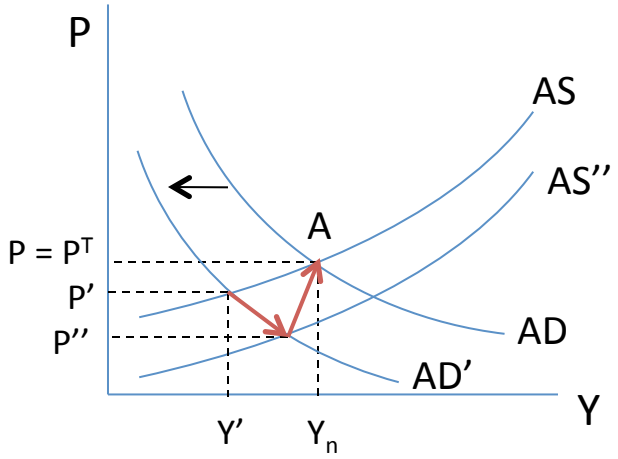
• The initial increase in the interest rate requires a decrease in nominal money, shifting the LM curve up and decreasing output. Over time, the price level decreases, thus allowing the central bank to begin lowering the interest rate, shifting the LM curve back down until output is back at the natural level of output.

The AS-AD Model

- The Neutrality of Money:
- In the short run, a monetary policy contraction leads to an increase in the interest rate, a decrease in output and a decrease in the price level.
- Over time, the price level decrease, and the effects of the monetary policy contraction on output and on the interest rate disappear. In the medium run, the decrease in the price level is reflected entirely in a proportional decrease in nominal money; the decrease in nominal money has no effect on output or on the interest rate. Economists refer to the absence of medium run effects of money on output, on any other real variables and on the interest rate by saying that money is neutral in the medium run.
- The neutrality of money in the medium run does not mean that monetary policy cannot or should not be used to affect output—an expansionary monetary policy can, for example, help the economy move out of a recession and return faster to the natural level of output. But it is a warning that monetary policy cannot sustain higher output forever.

The AS-AD Model

- A Decrease in the Budget Deficit:
- Suppose the government wishes to reduce its deficit by lowering government spending but keeps taxes constant. How will this affect the economy in the medium run?
- Assume we start at the natural level of output before the cut in government spending.
- As we know, the decrease in G will shift the AD curve to the left, causing output to be lower than the natural rate of output, the price level also decreases. With the price level falling, the central bank lowers the interest rate (perhaps very slightly in this case).
- However, over time, because output is below the natural rate and prices are lower than what was expected by wage setters. The AS curve shifts down over the medium run. However the AS curve won't shift down until output is back to the natural level of output. The reason is because the central bank hasn't changed its price level target parameter. Therefore the price level target remains the same, and so the new medium run equilibrium must return back to its original price and output level (the natural level). This implies that both the AD and AS curve must return to their original levels.



A decrease in the budget deficit leads initially to a decrease in output and price. Over time, output returns to the natural rate and price to the target price.

The AS-AD Model

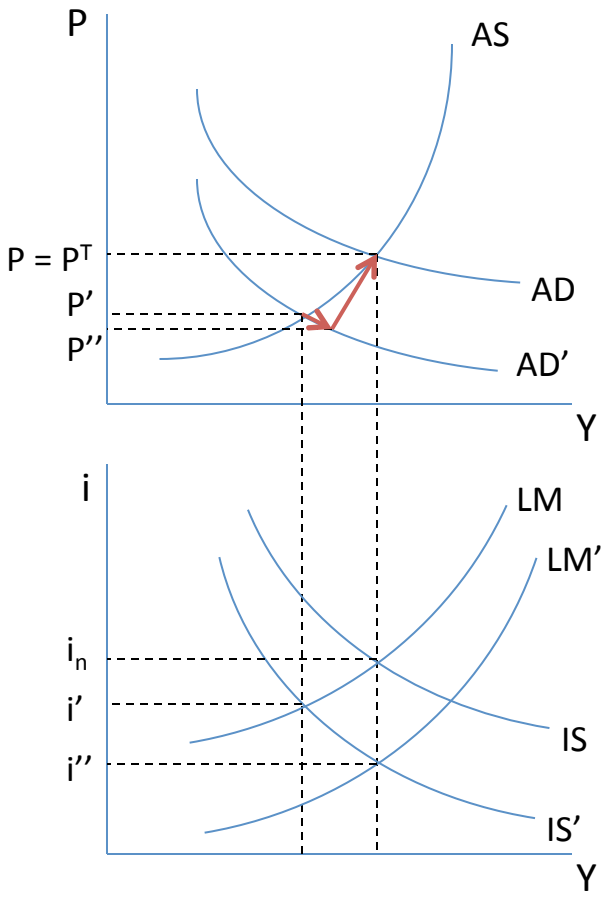
- Cont...
- To see how and why AD and AS returns back to their initial levels, we start with a rewritten IS relation:

$$Y_n = C(Y_n - T) + I(Y_n, i_n') + G'$$

- Output and consumption are exactly what they were in the original medium run equilibrium (when government expenditure was G). However, the new value G' is less than G. Therefore, investment, I, must be higher than before deficit reduction—higher by an amount exactly equal to the decrease in G.
- This can only happen if the medium run interest rate is lower than i_n'. i.e. In the medium run equilibrium, a reduction in the budget deficit unambiguously leads to a decrease in the interest rate to i_n'. If it failed to do this, the price level would continue to deflate , getting further and further away from the target price level. Therefore, a medium run equilibrium would require the central bank to lower the interest rate (not slowly but suddenly), and when it does this, the AD curve will shift back to its original position.

The AS-AD Model

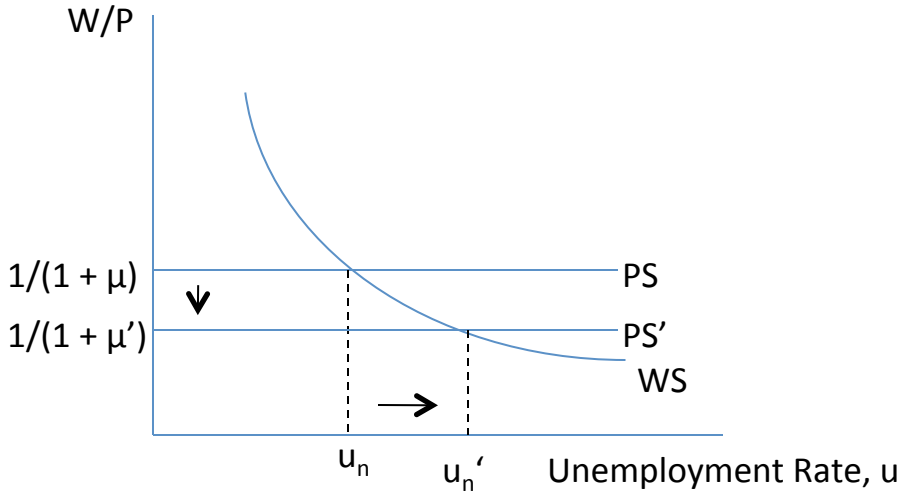
- Cont...



Deficit reduction leads in the short run to a decrease in output and price, and thus to a lower interest rate. In the medium run, output returns to the natural rate, while the interest rate declines further.

The AS-AD Model

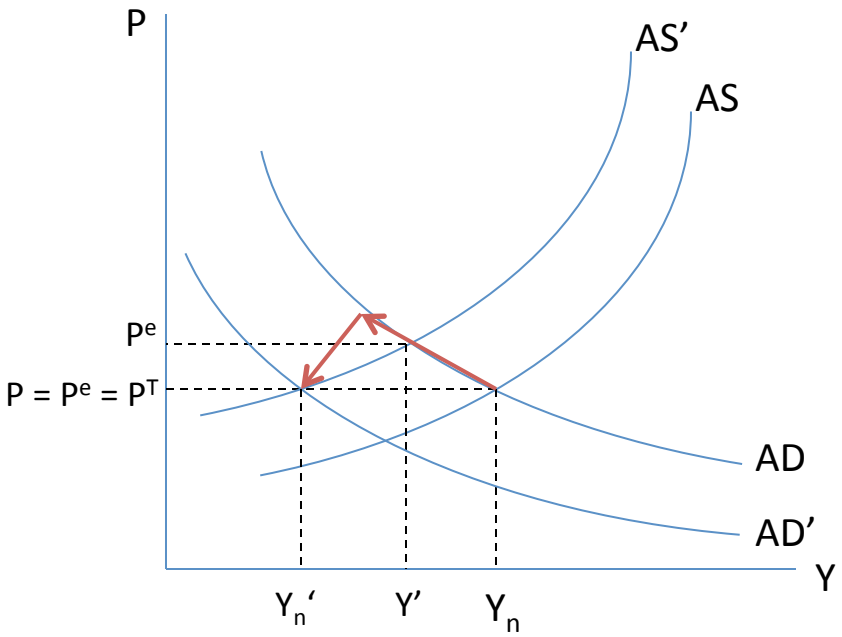
- An Increase in the Mark-Up (μ↑):
- When there is an increase in the mark-up then there implies that there's an increase in the price level. This increase in the price level implies a reduction in the real wage, which can be represented with the WS and PS relations:



- A higher mark-up leads to a lower real wage and a lower rate of natural unemployment.
- This has implications on the natural level of output and the price level...

The AS-AD Model

- Cont...
- The Dynamics of Adjustment:



• The increase in the mark-up will lead to a upward shift of the AS curve. This will result in the economy having a higher price level than the target price level. With interest rate targeting, the central bank will be forced to raise the interest rate to counteract the increased price level. The natural interest rate will increase, which means that the actual interest rate in the economy will increase.

• The higher interest rate will hit firms in their investments, which causes the AD curve to shift to the left (can use the IS-LM model to illustrate).

•The economy will then have a lower natural rate of output, higher natural rate of unemployment and a higher natural interest rate.. The price level target will remain the same.

The AS-AD Model

- Short-run and medium-run effects of a monetary policy contraction, a budget deficit reduction and an increase in the mark-up on out output, the interest rate and the price level:

		Short Run			**Medium Run**	
	Output	Interest Rate	Price Level	Output	Interest Rate	Price Level
Tighter Monetary Policy ($\downarrow P^T$)	$\downarrow$	$\uparrow$	$\downarrow$ (small)	$\leftrightarrow$	$\leftrightarrow$	$\downarrow$
Fiscal Deficit Reduction	$\downarrow$	$\downarrow$	$\downarrow$ (small)	$\leftrightarrow$	$\downarrow$	$\leftrightarrow$
Increase in the Mark-Up	$\downarrow$	$\uparrow$ (small)	$\uparrow$	$\downarrow$	$\uparrow$	$\leftrightarrow$

Readings

Topic 7: Openness in Goods and Financial Markets

Openness in Goods and Financial Markets

- Openness has three distinct dimensions:
  - **Openness in goods market**—the ability of consumers and firms to choose between domestic goods and foreign goods. In no country is this choice completely free of restrictions. Even countries most committed to free trade have tariffs and quotas on at least some foreign goods.
  - **Openness in financial markets**—the ability of financial investors to choose between domestic financial assets and foreign financial assets.
  - **Openness in factor markets**—the ability of firms to choose where to locate production, and the ability of workers to choose where to work.

Openness in Goods and Financial Markets

- Exports and Imports
- Determinant of Trade:
  - Geography;
  - Size of a country;
  - Policies that affect trade.

$X - IM > 0$
Trade Surplus

} Net demand for Australian dollar ↑.

$X - M < 0$
Trade Deficit

} Net demand for Australian dollar ↓.

Openness in Goods and Financial Markets

- The Nominal Exchange Rate and the Real Exchange Rate:
- The nominal exchange rate is observable and it is defined as the price of one country's currency in terms of another currency. E.g. AU $1 = US $0.85

E = US $0.85 / AU $1 } From the domestic country's point of view.

- E↑ would be an appreciation.
  E↓ would be a depreciation.

- The real exchange rate is not observable and is defined as the price of domestic goods in terms of foreign goods.

ε = Real exchange rate

ε = 1 would imply that 1 unit of foreign good in exchange for 1 unit of domestic good.
ε = 1.5 would imply that 1.5 units of foreign good in exchange for 1 unit of domestic good.
ε = 0.5 would imply 0.5 units of foreign good in exchange for 1 unit of domestic good.

Openness in Goods and Financial Markets

- An example:
- Buying a 10kg bag of rice in Hong Kong which costs HK $50. Assume that 10kg of rice in Australia costs $10.
  P = $10 AUD
  P*= HK$50 / E

1. We need to convert the Hong Kong price of rice into AUD. Assume that E = HK$6/AU$1
   HK $50 x AU $1/HK $6 = AU $8.33 per bag in Hong Kong.
2. Using the real exchange rate:
   ε = (AU $10 per bag in Aus) / (AU $8.33 per bag in HK)
   ε = 10/8.33 ≈ 1.20 bags in HK per bag in Australia.

- This implies that Australia is more expensive than Hong Kong.
- However Australia and Hong Kong produce more than just rice. We need a real exchange rate to compare prices for all goods and services in both economy. For that, we use the relative price levels in both countries. This gives the following real exchange rate formula:

$$\varepsilon = P \div \frac{P^*}{E}$$

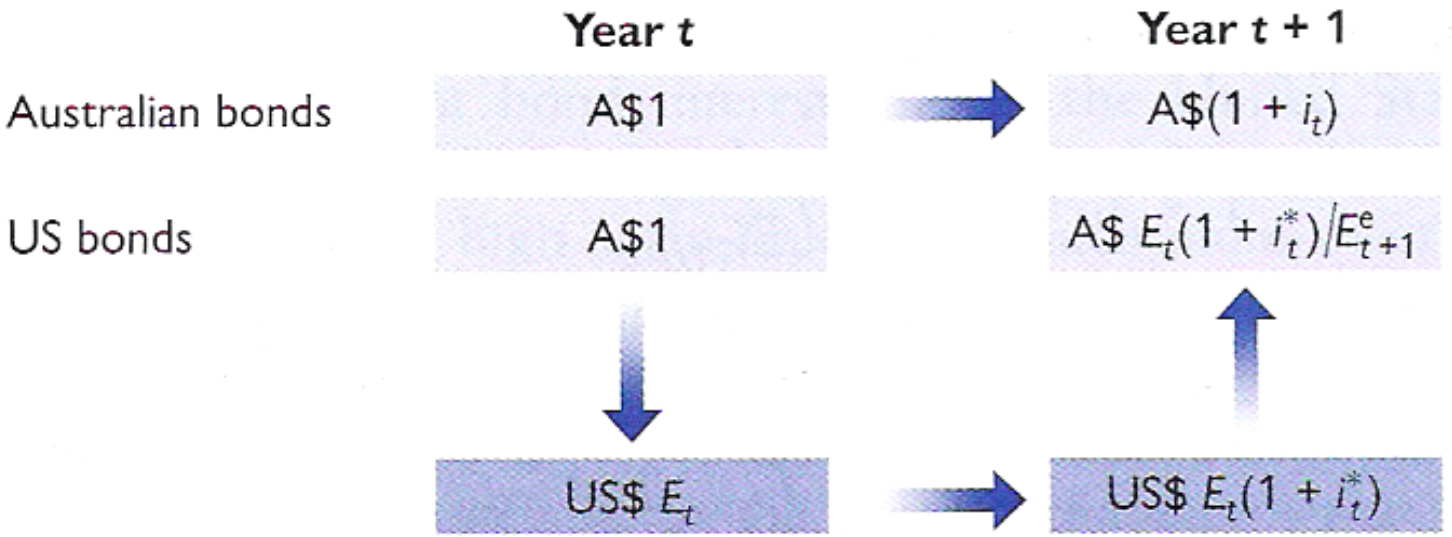
$$\varepsilon = P \times \frac{E}{P^*} = \frac{PE}{P^*}$$

Openness in Goods and Financial Markets

- The Balance of Payments:
  - The balance of payments will always balance under a flexible exchange rate.
  - Any entrance in the balance of payments that is denominated in domestic currency will be a positive figure.
- Current Account:
  - See textbook as well Macro 1102 notes for more info on the current account, the capital and financial account as well as the balance of payments.

Openness in Goods and Financial Markets

- The Uncovered Interest Parity Condition:
- The interest rate between two countries should be very similar after accounting for the movement in the nominal exchange rate.



Expected returns from holding one year Australian or US bonds.

Openness in Goods and Financial Markets

- If both US bonds and Australian bonds are to be held, they must have the same expected rate of return, so that the following arbitrage relation must hold:

$$1 + i_t = E_t(1 + i_t^*)\frac{1}{E_{t+1}^e}$$

- Reorganising the equation:

$$1 + i_t = (1 + i_t^*)\frac{E_t}{E_{t+1}^e}$$

- This equation is called the uncovered interest parity relation.
- The assumption that financial investors only hold the bonds with the highest expected return is obviously too strong, for two reasons:
  - It ignores transaction cost;
  - it ignores risk.
- But as a characterisation of capital movements among the major world financial markets, the assumption isn't too far off. Small changes in interest rates and rumours of impending appreciation or depreciation can lead to movements of tens of billions of dollars within minutes. For rich countries around the world with free financial markets, the IPR is quite accurate and applicable. But for smaller countries or countries with capital controls, they have more leeway in choosing their own interest rate.

Openness in Goods and Financial Markets

- Interest rates and exchange rates:
- Rewrite the uncovered IPR:

$$1+i_t = (1+i_t^*)\frac{1}{\frac{E_{t+1}^e}{E_t}}$$

$$= (1+i_t^*)\frac{1}{\left(1+\frac{E_{t+1}^e - E_t}{E_t}\right)}$$

- This gives the relation between the domestic interest rate, the foreign nominal interest rate and the expected rate of appreciation $(E^e_{t+1}-E_t)/E_t$. As long as interest rates or the expected appreciation isn't too large—say below 20% per year—a good approximation to this equation is given by:

$$i_t \approx i_t^* - \frac{E_{t+1}^e - E_t}{E_t}$$

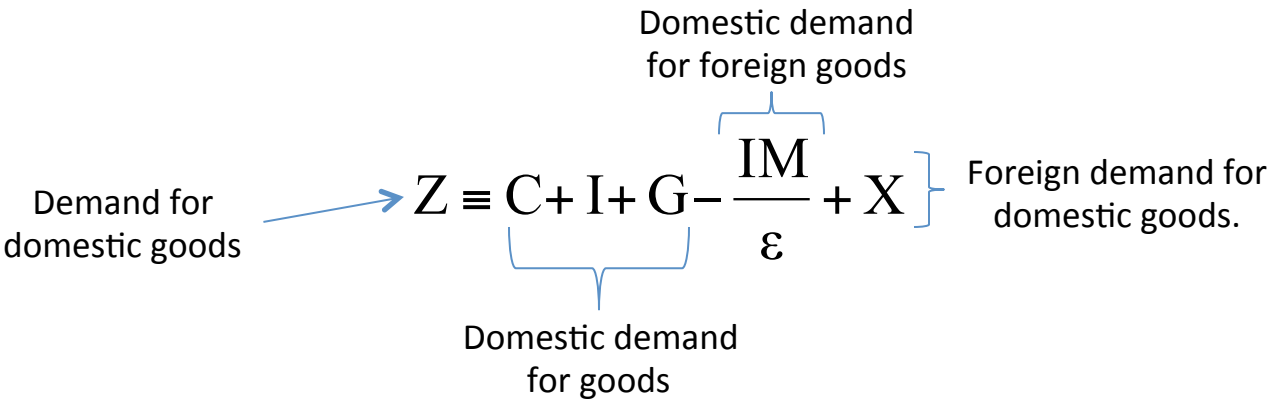
Arbitrage implies that the domestic interest rate must be approximately equal to the foreign interest rate minus the expected appreciation rate of the domestic currency.

Readings

Topic 8: The Goods Market in an Open Economy

The Goods Market in an Open Economy

- When we were assuming that the economy was closed from trade, there was no need to distinguish between the domestic demand for goods and the demand for domestic goods—they were clearly the same. Now, we must distinguish between the two. Some domestic demand falls on foreign goods, and some of the demand for domestic goods comes from foreigners.
- The demand for domestic goods:



The Goods Market in an Open Economy

- Domestic Demand for Goods:

Real interest rate.

$$C + I + G = C(Y - T) + I(Y, \underset{\downarrow}{r}) + \overline{G}$$

- Imports:
- The determinants of imports:

$$IM = IM(\underset{+}{Y}, \underset{+}{\varepsilon})$$

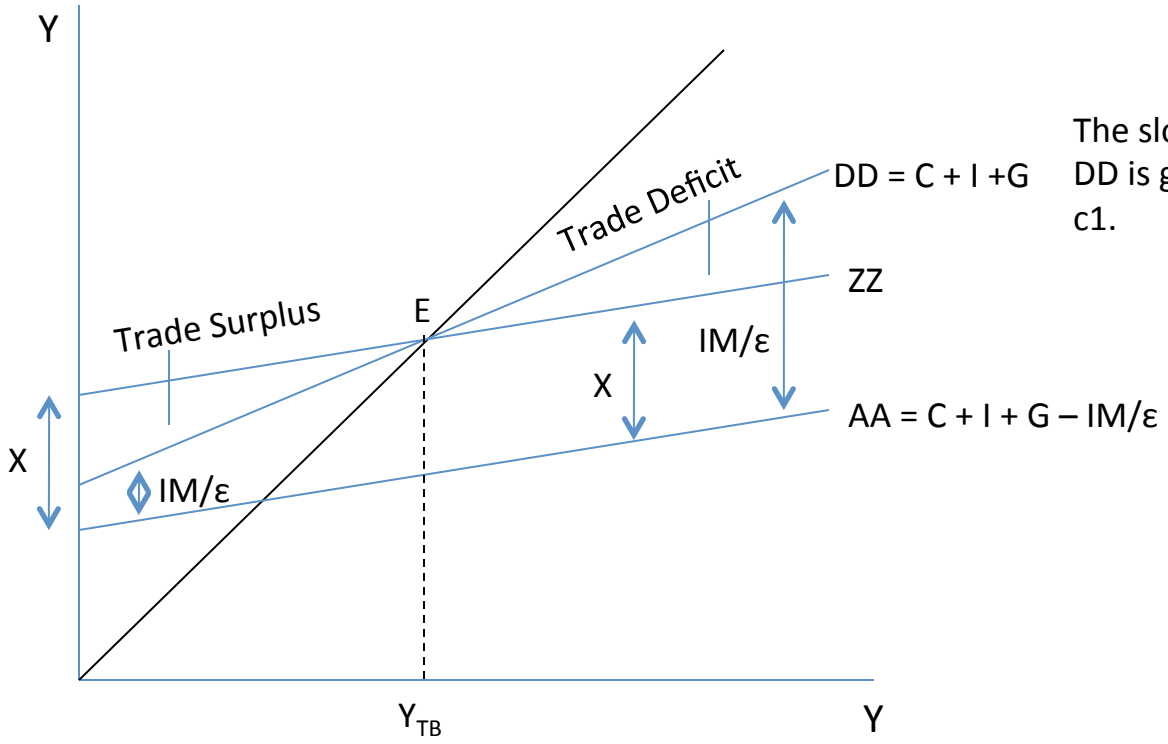
- Imports are a function of income (+ve) and the real exchange rate (+ve).
- Exports:
- The determinants of exports:

$$X = X(\underset{+}{Y^*}, \underset{-}{\varepsilon})$$

- Exports are an increasing function of foreign income and a decreasing function of the real exchange rate.

The Goods Market in an Open Economy

- The Goods Market Equilibrium with an Open Economy:
- $Y_E = Z$, Y_{TB} = Income that gives no trade deficit or surplus. i.e. IM/ε = X.



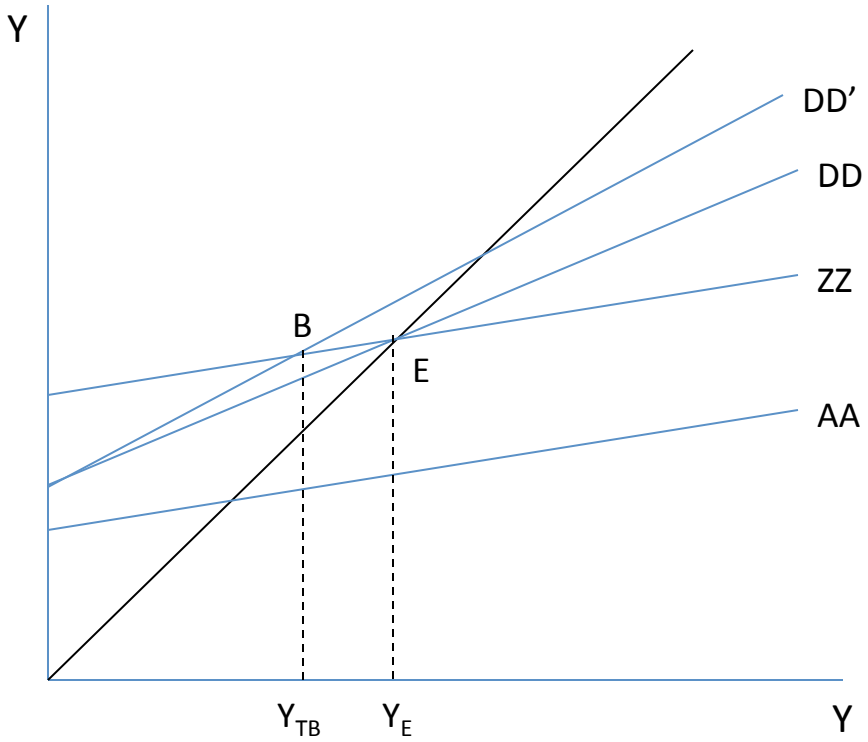
The slope of DD is given by c1.

The Goods Market in an Open Economy

- Definitions of the goods market in an open economy:
  - AA is defined as the domestic demand for domestic goods;
  - DD is defined as the domestic demand for goods;
  - ZZ is defined as demand for domestic goods.
  - AA + X = ZZ;
  - At point E, DD = ZZ => Y_{TB};
  - Goods Market Equilibrium => 45^{o} = ZZ
- The above diagram implies that:
  - Y = Z = Y_E = Y_{TB}, but this isn't always the case...

The Goods Market in an Open Economy

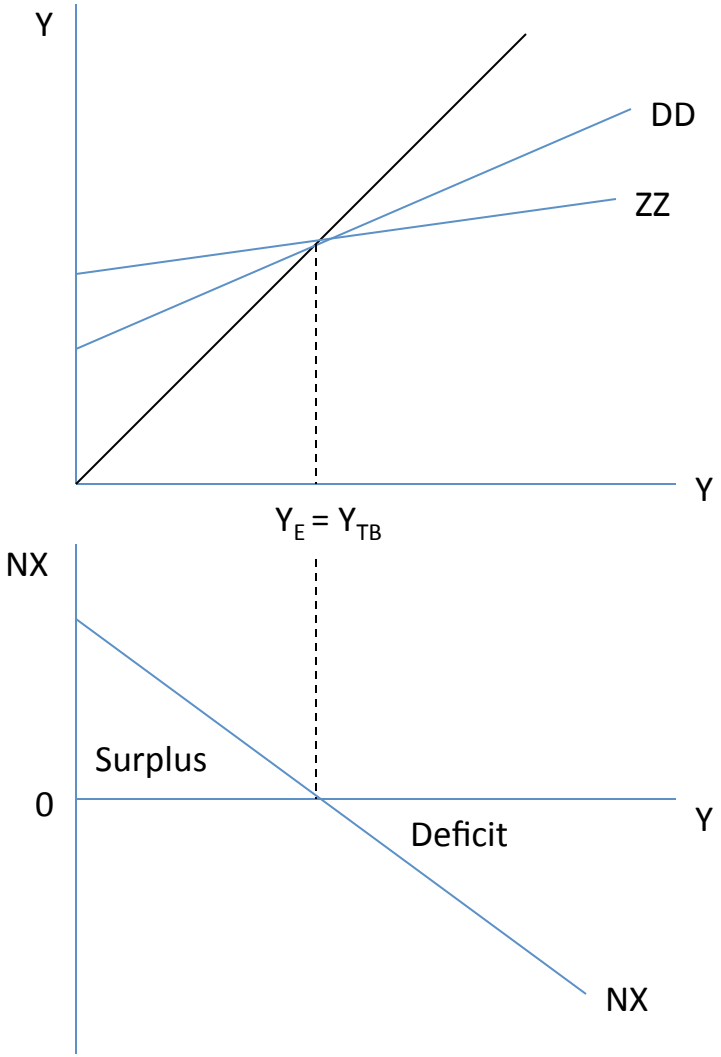
- When $Y_E \neq Y_{TB}$:



- Here equilibrium output is higher than the level of output that delivers a neutral trade balance. Thus, we have a trade deficit.
- A trade surplus can also exist when equilibrium output is less than the neutral trade balance output.

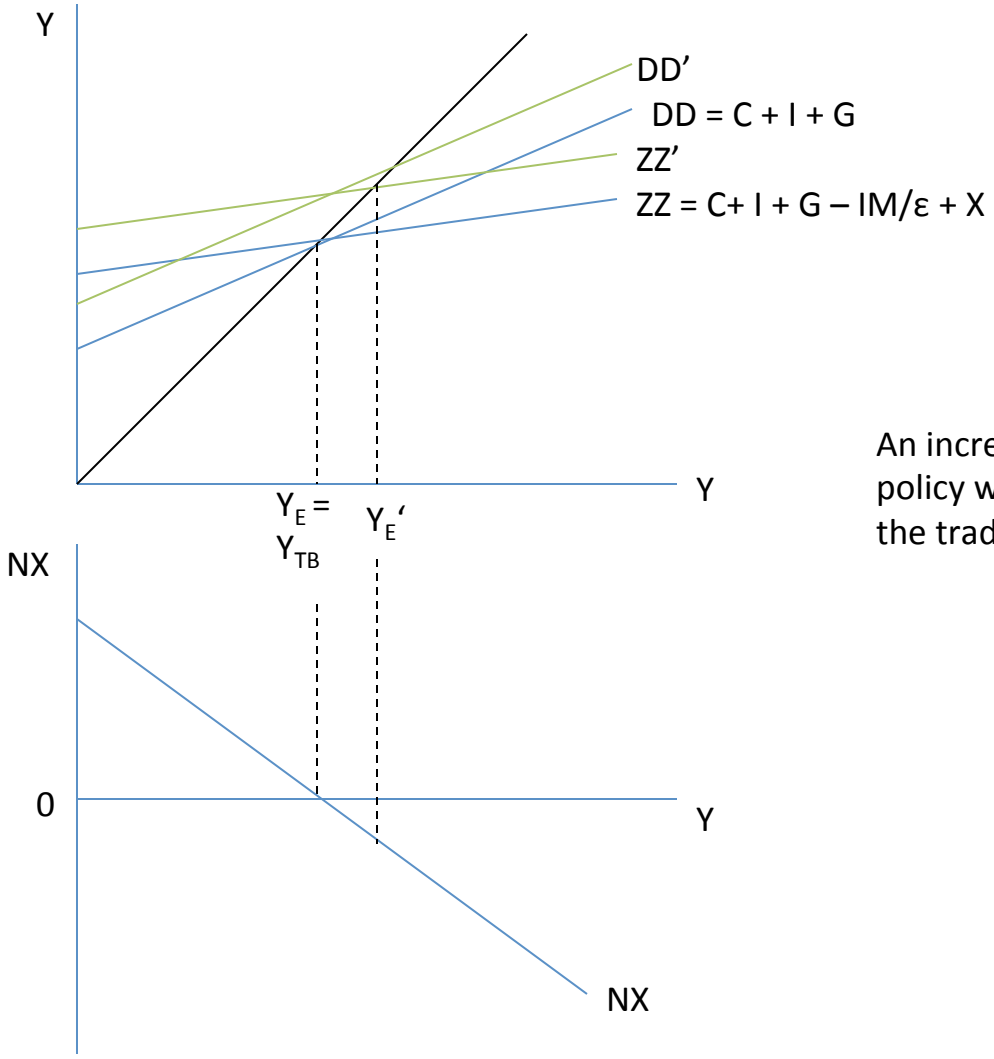
The Goods Market in an Open Economy

- ZZ and NX Model:



The Goods Market in an Open Economy

- A fiscal expansion (G↑):



An increase or expansion of fiscal policy will lead to a worsening of the trade account.

The Goods Market in an Open Economy

- The Multiplier in an Open Economy:
- In a closed economy we know that this is the multiplier:

$$\frac{1}{(1-(c_1+d_1))}$$

- In an open economy, this is the multiplier:

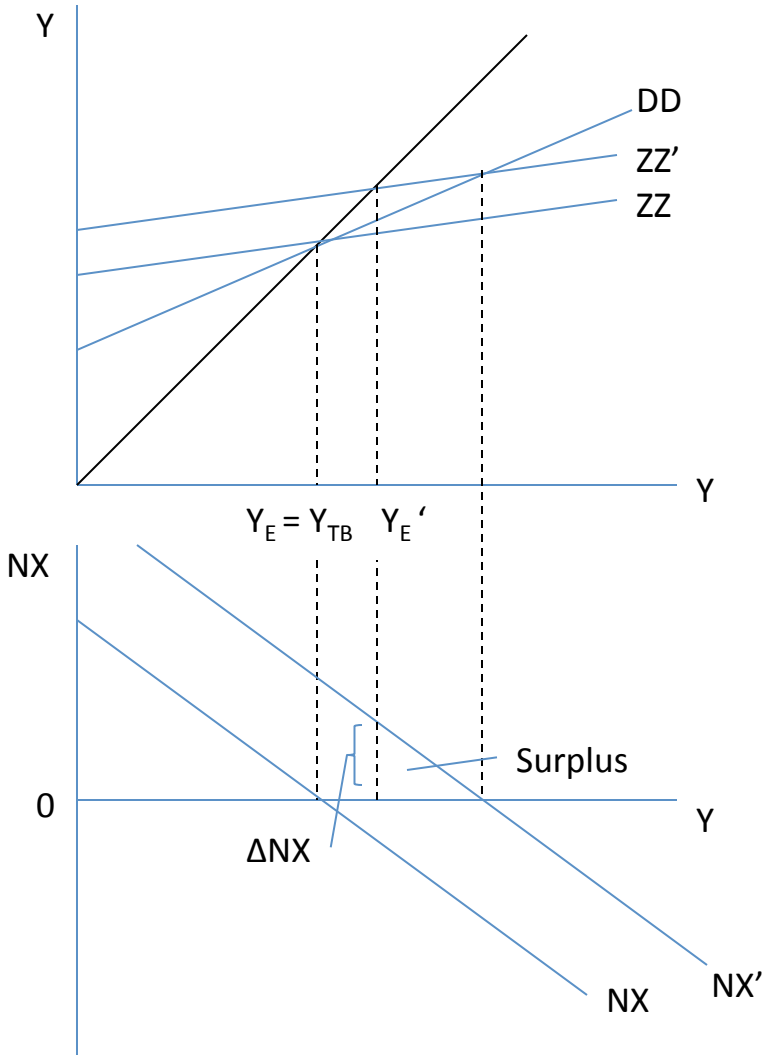
$$\frac{1}{(1-(c_1+d_1-im_1))}$$

Where im_1 is the marginal propensity to import.

- The multiplier is smaller in an open economy compared to a closed economy.
- Because ZZ is flatter than DD it implies a smaller multiplier. This is quite intuitive, because in an open economy, consumers will spend a portion of on imports.

The Goods Market in an Open Economy

- An increase in foreign income (Y*↑):



1. An increase in foreign income will lead to foreign consumers demanding more foreign goods. Empirical evidence shows that has income increase, the tendency to purchase imports increase (can see that from the ZZ diagram).
2. This increases the demand for our goods. Specifically, exports increase.
3. The increase in exports means that ZZ increases too.
4. The economy moves along the line of equality to Y_E '.
5. The increase in output will improve our trade balance, putting it in surplus, assuming we start at a neutral trade balance.

The Goods Market in an Open Economy

- Exchange Rate Policy.
- $\varepsilon = E \times (P/P^*)$
  - Assume (P/P^*) is held constant, then any change in E will have a one to one relationship in the change of ε.
  - As we know NX is a function of domestic income and the real exchange rate:

$$NX = X - \frac{IM}{\varepsilon} = X(Y^*, \varepsilon) - \frac{IM(Y, \varepsilon)}{\varepsilon}$$

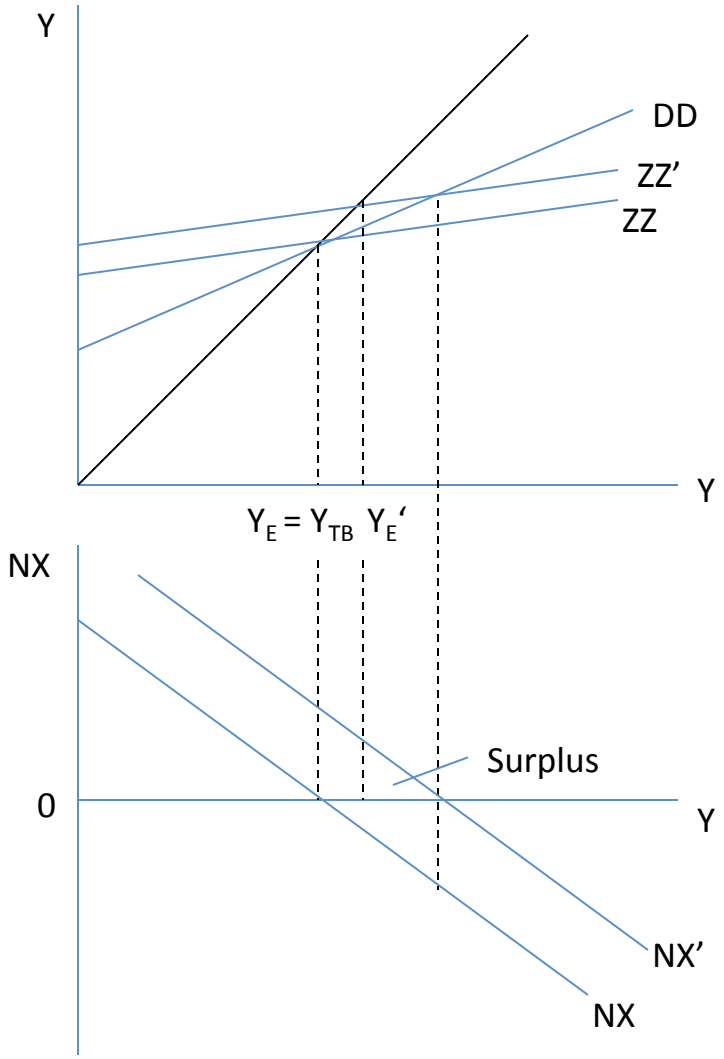
- What happens if the government or central bank deliberately depreciated or appreciated the nominal exchange rate? This will lead to a real depreciation or real appreciation.

1. ε↓, X↑, NX↑
   A real depreciation will affect exports, and since ε has a negative relationship with X, our exports will increase, due to being cheaper.
2. ε↓, IM↓, NX↑
3. 1/ε – the price of foreign goods in terms of domestic goods. (1/ ε↓)↑.
   Import bills will increase and thus NX↓, as we are paying more for our imports.

- 1) and 2) will dominate the effect of 3) over time (this is known as the Marshall-Lerner condition). This implies that NX increases when the real exchange rate falls.

The Goods Market in an Open Economy

- A decrease in the real exchange rate:



$\varepsilon\downarrow, Y_E\uparrow, TB\uparrow$

The Goods Market in an Open Economy

- The problem with depreciating the real exchange rate however is that the cost of foreign goods increase; which harms households. Despite the effects of depreciating the real exchange rate looks similar to foreign incomes increasing, government must be aware of the increased costs to households and firms.
- Because NX is a function of domestic incomes and the real exchange rate, a combination of fiscal and exchange rate policies can be used to target income and the real exchange rate, respectively.

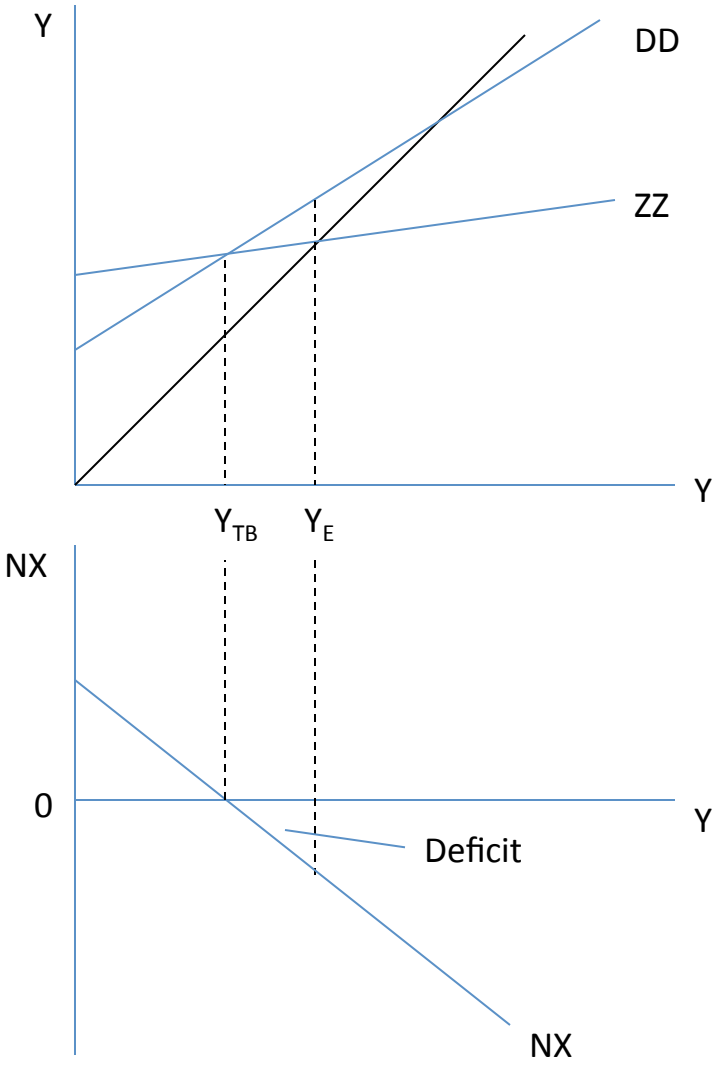
Policy	Effect on Income	Effect on Trade Balance
G↑	Y_E↑	TB↓
G↓	Y_E↓	TB↑
ε↑	Y_E↓	TB↓
ε↓	Y_E↑	TB↑

Initial Conditions	Trade Surplus	Trade Deficit
Low Output	G↑	ε↓
High Output	ε↑	G↓

- E.g. The economy is at equilibrium output, but is experiencing a trade deficit.
  Solution: Use a policy mix. In this case lower G and lower ε.

The Goods Market in an Open Economy

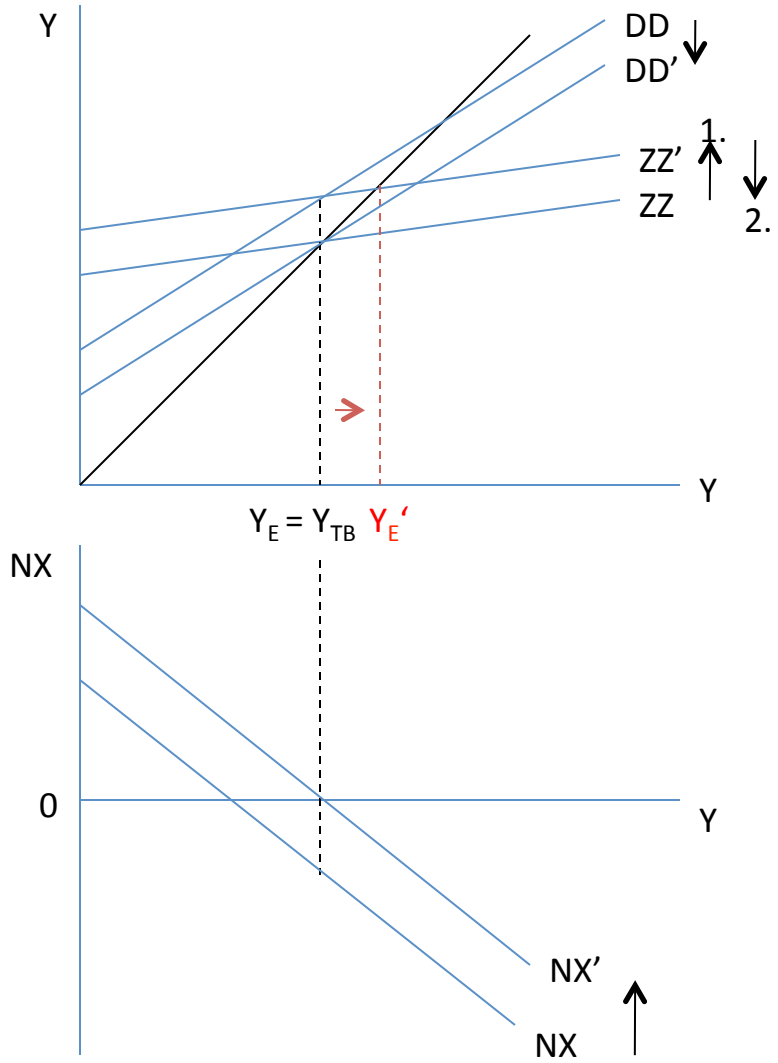
- Example illustrated:



Initially the economy is in a trade deficit when it's operating at the equilibrium level of output.
What policy combinations can the government take to eliminate the trade deficit?

The Goods Market in an Open Economy

- Cont...



1. **Depreciating the real exchange rate.**
   ε↓, NX↑, ZZ↑.
   The problem with this policy is that there could be an inflationary gap, due to the higher Y.
   We have eliminated the trade balance for now, however the economy will now moved toward a new equilibrium level of output at Y_E'. If the government wants to keep output at Y_E and not Y_E', what policy should they implement next?
2. **Fiscal contraction.**
   ΔG↓, DD↓, ZZ↓.
   After applying fiscal contraction, ZZ' falls back down to ZZ, and at the same time DD falls, causing output to return back to Y_E.

Conclusion: Using both exchange rate and fiscal policy, we have eliminated the trade deficit and kept output the same (no inflationary gap).

Readings

Topic 9: Output, the Interest Rate and the Exchange Rate

Output, the Interest Rate and the Exchange Rate

- Previously, we treated the exchange rate as if it was one of the policy instruments available to the government. But the exchange rate isn't a policy instrument. Rather, it is determined in the foreign exchange market. We will look at the relationship between output, the interest rate and the exchange rate, to see how policy makers can affect each variable.
- Equilibrium in the goods market:

$$Y \equiv Z$$

$$NX = X - IM$$

$$NX = X(Y^*, \varepsilon) - \frac{IM(Y, \varepsilon)}{\varepsilon}$$

We assume prices to be fixed in the short run (IS-LM assumption), and that P = P*.

$$\varepsilon = E\left(\frac{P}{P^*}\right)$$

$$\varepsilon = E$$

$$\therefore NX = X(\underset{+}{Y^*}, \underset{-}{E}) - \frac{IM(\overset{+}{Y}, \overset{+}{E})}{E} = NX(\underset{-}{Y}, \underset{+}{Y^*}, \underset{-}{E})$$

$$\Rightarrow Y = C(\underset{+}{Y} - T) + I(\underset{+}{Y}, \underset{-}{r}) + G + NX(\underset{-}{Y}, \underset{+}{Y^*}, \underset{-}{E})$$

The reason why we write r instead of i, is because in the short run $\pi^e = 0$.

Output, the Interest Rate and the Exchange Rate

- Equilibrium in the Money Market:

$$\frac{M}{P} = \underset{+}{Y}\ \underset{-}{L(i)}$$

- As always, equilibrium in the money market is occurs when the supply of money is equal to the demand for money.
- Slight changes to our understanding of the money market equilibrium is that the central bank will target the price level (and thus the interest rate):

$$i = i_n + a(P - P^T)$$ In the medium run.

$$i = i_n = i_0$$ In the short run.

- A downward pressure on i forces the central bank to sell government bonds to hold the level of i.
- An upward pressure on i forces the central bank to buy government bonds to hold the level of i.
- When a central bank targets the interest rate and the price level, the money supply will always be subject to change via OMO's. Money supply can now be considered endogenous.
- This also means that the exchange rate fluctuates too—part of the policy 'trillema'.

Output, the Interest Rate and the Exchange Rate

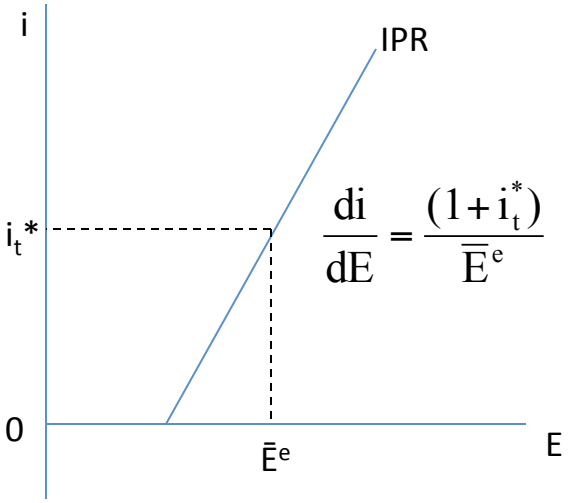
- What is the relationship between i and E?
- The Interest Parity Relation (IPR):

$$1+i_t = (1+i_t^*)\frac{E_t}{E_{t+1}^e}$$

- The relationship that we will derive between i and E will rely on two assumptions:
  - We have perfect capital mobility;
  - Perfect capital substitutability.
- Next we assume that E^e_{t+1} is $\bar{E}^e$ (fixed/constant), then:

$$E_t = \frac{(1+i_t)}{(1+i_t^*)}\bar{E}^e$$

$$i_t = \frac{(1+i_t^*)}{\bar{E}^e}E_t - 1$$



At $E = \bar{E}^e$, expected exchange rate is equal to the exchange rate and the interest rate is equal to the foreign interest rate.

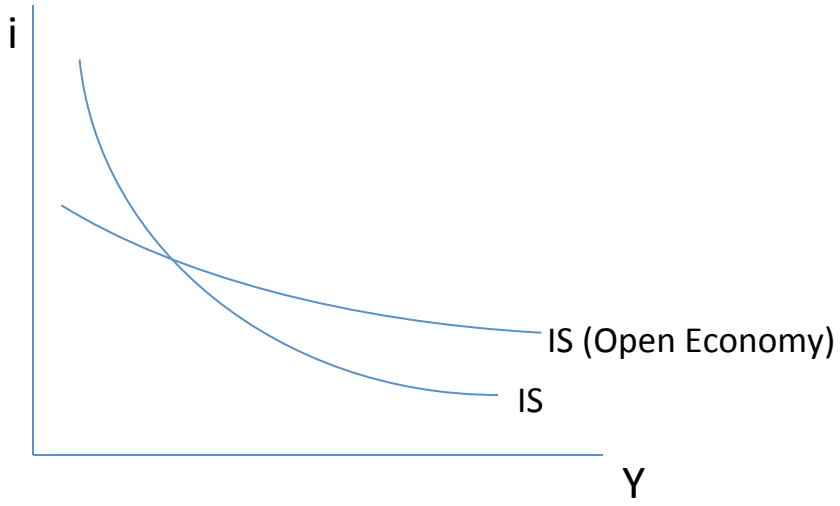
Output, the Interest Rate and the Exchange Rate

- Putting the Goods, Financial and Exchange Rate Markets Together:
- We can now rewrite the IS relation taking into account the open economy:

$$Y = Z$$

IS: $$Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, E)$$

$$Y = C(Y - T) + I(Y, i) + G + NX\left(Y, Y^*, \frac{(1 + i_t)}{(1 + i_t^*)}\bar{E}^e\right)$$



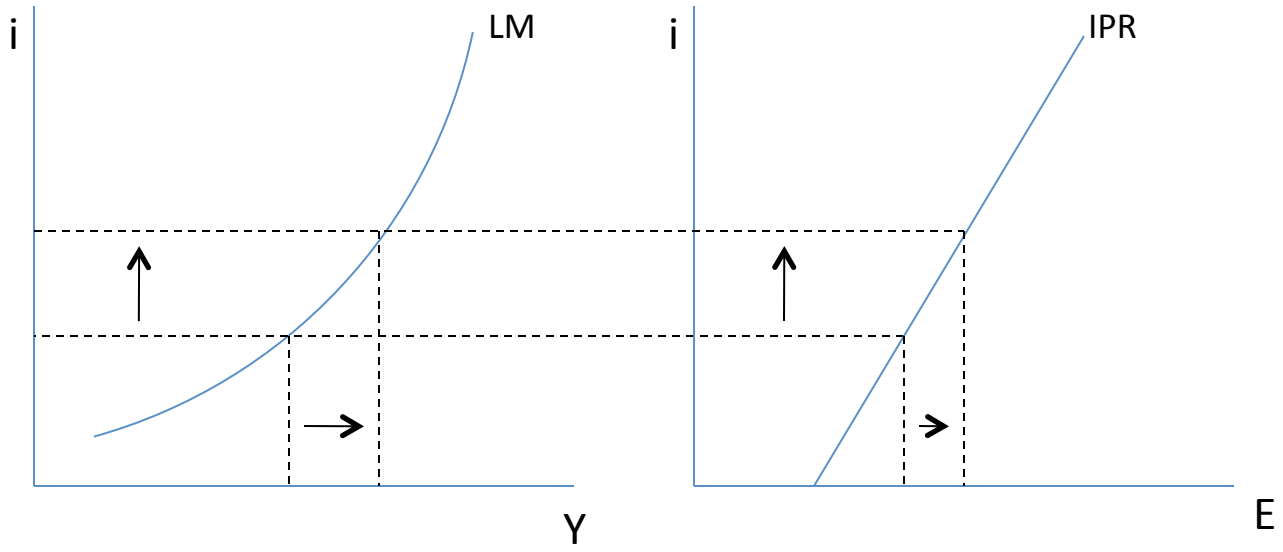
1. i↑, I↓, Z↓, Y↓
2. i↑, E↑, (X↓, IM↑ => NX↓), Y↓

- Changes in the interest rate now have a more profound effect on the economy, when it is open.

Output, the Interest Rate and the Exchange Rate

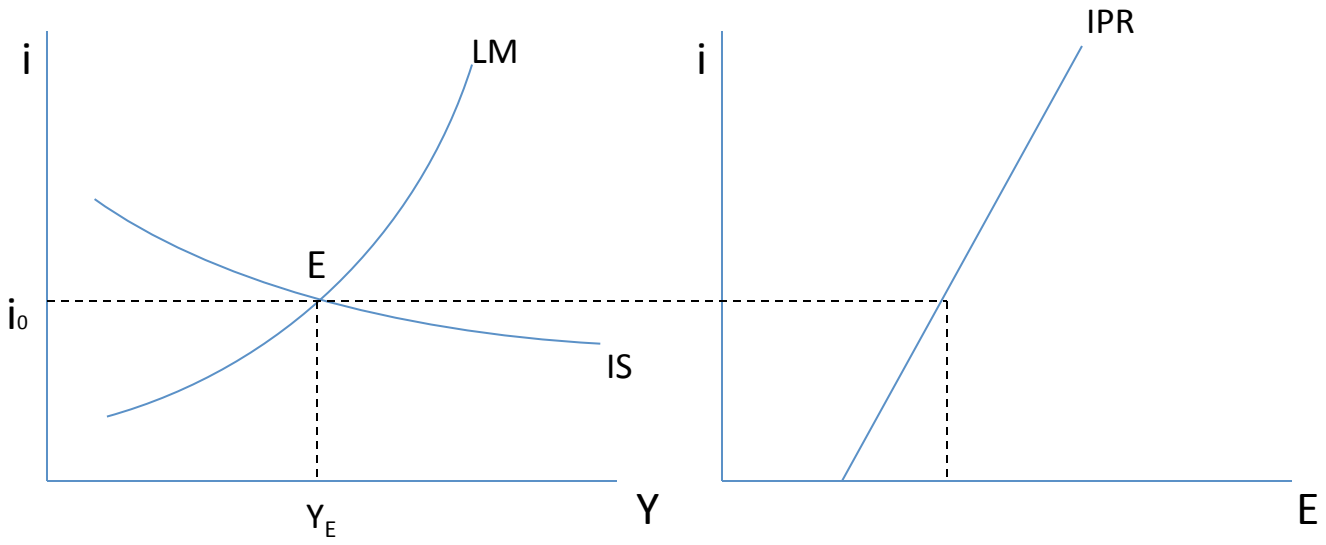
- Deriving the LM curve in an Open Economy:

$$\frac{M}{P} = Y.L(i),\ i = i_0$$



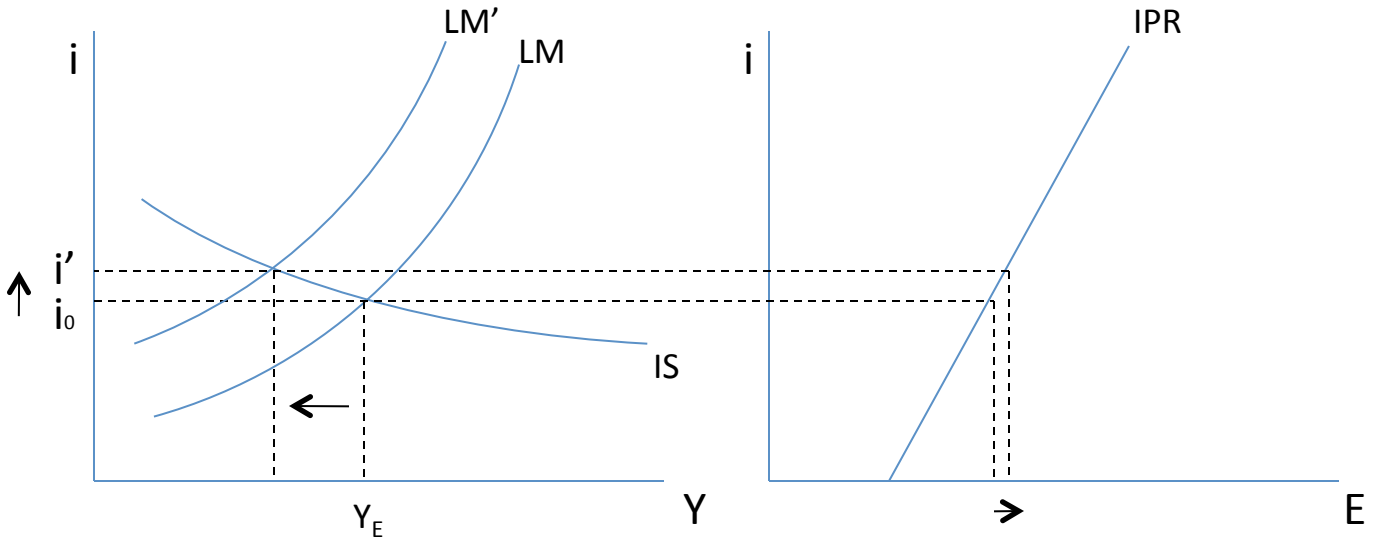
Output, the Interest Rate and the Exchange Rate

- The Open IS-LM Model:



Output, the Interest Rate and the Exchange Rate

- A Monetary Policy Contraction:



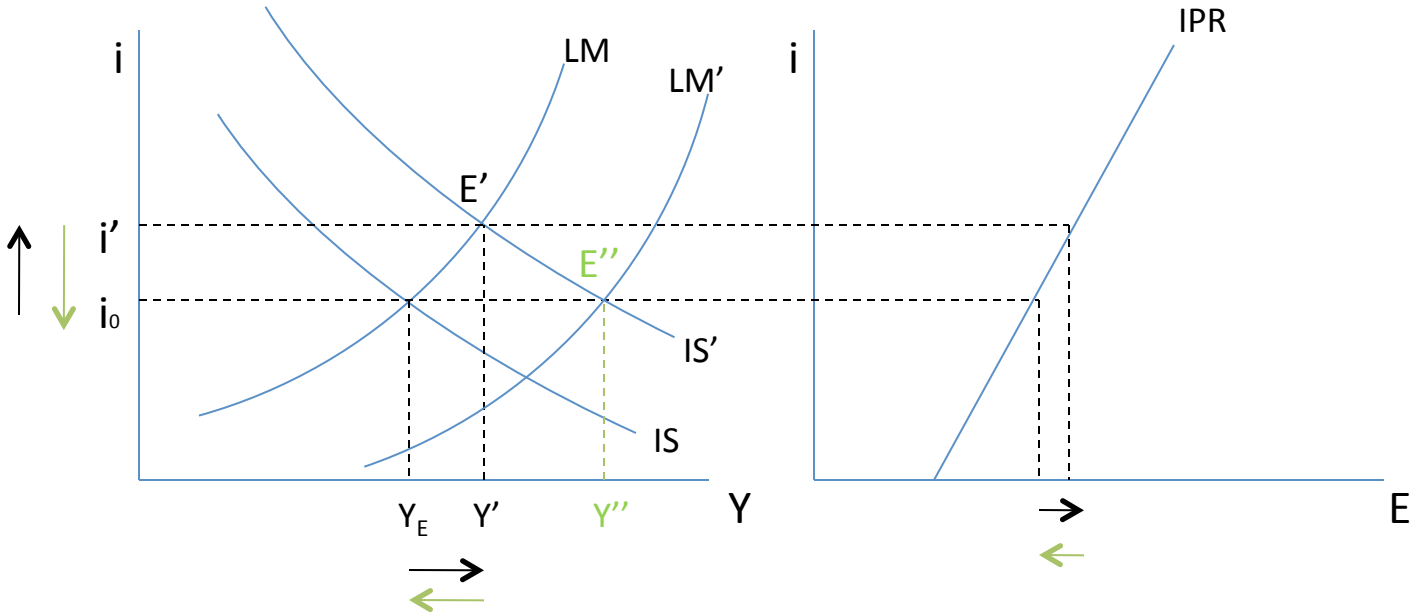
- Also assume that the TB is 0.

1. (M/P)↓, i↑, I↓, Z↓, Y↓, NX(Y,Y*,E)↑
2. i↑, E↑, NX(Y,Y*,E)↓

- Will the TB become negative? Not sure because of the opposing effects on NX.

Output, the Interest Rate and the Exchange Rate

- A Fiscal Expansion:



- Assume budget and TB is balanced.

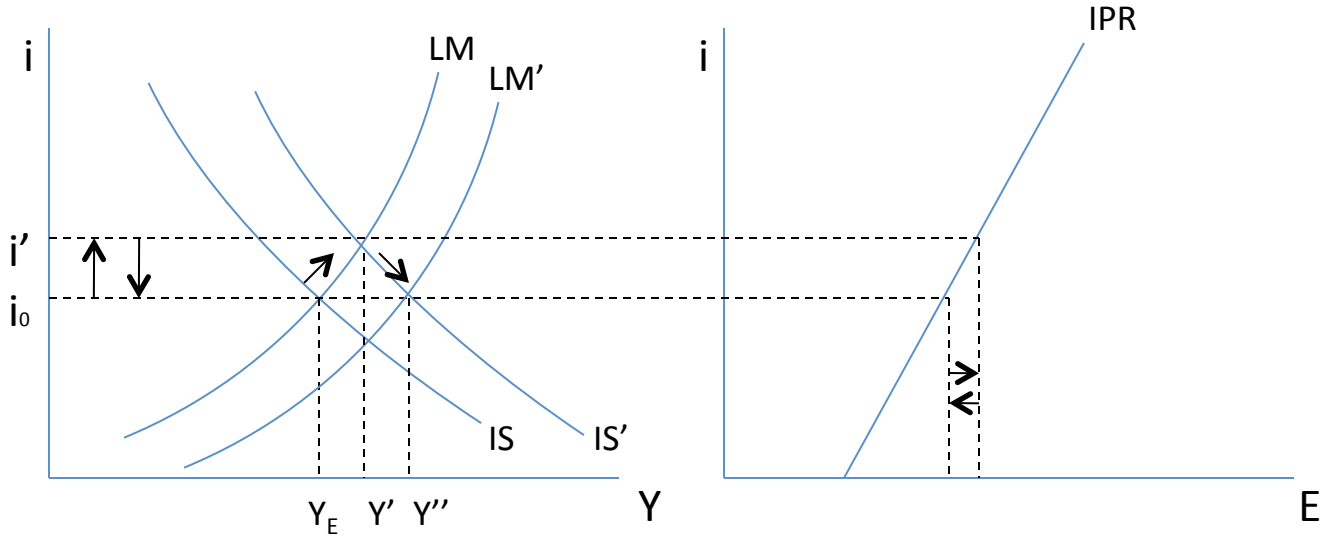
1. At E': G↑, Z↑, Y↑, IS↑. As a consequence: (i↑, E↑, NX↓)
2. At E': Y↑, Md↑, Ms(fixed), i↑, movement along LM.
3. The central bank can undertake monetary accommodation—to lower interest rates in response to fiscal expansion. Assume the central bank does do this. At point E'': $i = i_0$, Ms↑, i↓, E↓, NX↓.

Output, the Interest Rate and the Exchange Rate

- At the end of E'':
  Y↑, I(Y↑,i)↑, NX(Y↑,Y*,E)↓
- Twin Deficits:
  A budget deficit will lead to a trade deficit if the budget and trade account are originally balanced, as shown above.
- Without Monetary Accommodation:
  At E': Y↑, I(Y↑,i↑) net effect: ?, NX(Y↑,Y*,E↑)↓

Output, the Interest Rate and the Exchange Rate

- A Fixed Exchange Rate:



$$IPR: (1+i_t) = (1+i_t^*)\left[\frac{E_t}{E_{t+1}^e}\right]$$

Assume Y↑, then Md↑, Ms (fixed), i↑. This isn't suitable for a fixed E. It must be met with an increase in the money supply.

Under the fixed exchange rate system the central bank gives up the domestic interest rate target, giving up monetary policy independence.

$$E_t = \overline{E} = E_{t+1}^e$$

$$\left[\frac{E_t}{E_{t+1}^e}\right] = 1$$

$$\therefore i_t = i_{t+1}^*$$

THE END!

Readings

Readings