MACROECONOMIC MODELS

1. Introduction

By utilizing the models we can analyze what happens when the government increases consumption, when the central bank increases the target interest rate and when domestically produced goods do well in foreign markets. We can also understand important observations of the economy, such as cyclical fluctuations in growth, correlation between unemployment and inflation and the relationship between interest rates and foreign exchange rates.

Macroeconomics is not an exact science such as physics. No one knows exactly how the macroeconomic variables are related. Instead, there exist a number of models that try to explain various observations and relationships between macroeconomic variables. Unfortunately, not all of these models consistent - one model may predict that unemployment will fall if the central bank lowers the target interest rate while another may claim that such a change will not affect unemployment.

This type of problem is something you have to get used to and accept. Economics is not a subject where you can perform an experiment to find out what is really “true”. Observed phenomena may have different explanations in different models and different models will lead to different predictions of macroeconomic variables. If you conclude that “An increase in x will lead to an increase in y” you really should not think of this as a property of the real world but rather as the property of a particular model.

One model that is very popular in virtually all basic courses in macroeconomics all over the world is the so-called neo-classical synthesis. As the name suggests, this is a combination or a synthesis of two models, namely the classical model and the Keynesian model. In short, the neo-classical synthesis claims that the Keynesian model is correct in the short term while the classical model is correct in the long run. The rest of this book builds up the neo-classical synthesis. Note that there are actually many minor variations of the neoclassical synthesis. I try to present the most common version.

2. Common assumptions

All models require a number of assumptions to be able to say anything of interest.

2.1. Unemployment and hours worked are directly related

In all models we assume a negative relationship between the number of hours worked and Unemployment. If the number of hours worked increases, the unemployment will fall and vice versa. This assumption will be true if the workforce is constant and individuals in the labor force either work full time or not at all.

In reality, this relationship need not hold. We may see an increase in the labor force (for example from immigration) that is larger than the increase in employment which would lead to an increase in both hours worked and unemployment but we disregard this possibility.

2.2. The central bank has complete control over money supply

Remember that the money supply is equal to the money multiplier times the monetary base. We will assume that the money multiplier is constant and since the monetary base is completely under the control of the central bank, the central bank will control the money supply.

2.3. Monetary policy = change in money supply

The central bank actually has other monetary policy instrument apart from being able to determine the money supply. The most important one is the target interest rate for the overnight market. In this book we will not consider the possibility of changing the target interest rate. However, we know that there is a negative relationship between the target rate and the money supply. Therefore, if you want to investigate the effect of an increase in the target interest rate, you may just as well investigate a decrease in the money supply.

2.4. There is just one interest rate

Including different interest rates with different maturities would complicate the models but it would not buy you very much. Since interest rates with different maturities are highly correlated, they typically move in the same direction and the direction of a variable is typically what we are interested in. If you like, think of “the interest rate” as the one-year interest rate on government securities.

2.5. Exchange rate

In all models we will assume that the exchange rate is flexible.

Furthermore, we assume that the exchange rate is determined by the ratio of the domestic price level to the foreign price level. If, for example, domestic prices increase by 10% while foreign prices are constant, the domestic currency will depreciate by 10% against the foreign currency.

With this assumption, exports and imports may be assumed to be independent of the domestic price level. If domestic prices increase by 10% while the currency loose 10%, the price of domestically produced goods abroad will be unchanged.

2.6. Capital Flows

The domestic interest rate increase against the foreign interest rates, capital would flow into our country which would drive down the domestic interest rate again.

Most reasonable models in which the domestic interest rate is affected by foreign interest rates are more complicated. To understand such models, you must first understand the models where this complication does not arise. Also, the predictions from models where the domestic interest rate is not affected by foreign interest rates are fairly similar to the more realistic models wchich allows for capital flows.

3. The macroeconomic variables

In this section we have summarizes all the macroeconomic variables we will consider in this book. The first column indicates the symbol we use for the variable while column 2 shows the name of the variable.

Variable	Variable Name	Variable	Variable Name
Y	Real GDP	NT	Net tax (real)

P	Price level	X	Exports (real)
P.Y	Nominal GDP	Im	Imports (real)
U	Unemployment	NX	Net exports (real)
L	Hours worked	S_H	Household savings (real)
K	Amount of capital	S_G	Government savings (real)
W	Nominal wage	S R	Rest of the world savings (real)
W/P	Real wage	π	Inflation
M	Money supply (nominal)	π^e	expected inflation
R	Nominal interest rate	π_W	Wage inflation
r	Real interest rate	π_M	Growth in money supply
C	Private consumption (real)	E	Exchange rate
I	Investments (real)	π_E	Depreciation in exchange
G	Government expenditure (real)		

Two of the variables are stock variables: K and M. Prices cannot be characterized as a stock or flow variable. P, W, R, r and E apply at a given point in time while π, π^e, π_W and π_E apply over a period of time. π, π_W and π_E are changes in P, W and E during the previous time period while π^e is the expected change in P during the next time period. All the other variables are flow variables measured in some unit per unit of time (for example, L is the number of hours worked per year or per any other unit of time).

3.1. Supply and demand

In microeconomics, we are careful to distinguish between the demand, the supply and the observed quantity. The first two are hypothetical concepts which indicate the desired quantities from households and firms under various conditions. The observed quantity is the quantity that consumers actually end up buying from the firms.

The main difference is that demand and supply are functions - they depend on other variables – while observed quantities are variables. These functions are usually illustrated in a chart where we illustrate how demand and supply depend on other variables.

In macroeconomics, we also consider the demand and the supply of many of the variables. So far, each variable has represented an observed quantity. For example, L has been the symbol for the actual number of hours worked, a variable that we can measure. However, we have not made any distinction between the demand and the supply of labor which we need to do from now on. The variables for which we will consider the supply and the demand are: Y, L, K M, C, I, G, X and Im.

In order to separate the supply and the demand from the observed quantity, we use subscript S for supply and subscript D for demand. For example, L is still the observed amount of work (a variable) while LS and LD represent the supply of labour and the demand for labour.

4. Macroeconomic models- an overview:

Macroeconomics is not an exact science such as physics. No one knows exactly how the

Macro-economic variables are related. Instead, there exist several models that try to explain various observations and relationships between macroeconomic variables. Unfortunately, not all these models consistent - one model may predict that unemployment will fall if the central bank lowers the target interest rate while another may claim that such a change will not affect unemployment.

This type of problem is something you must get used to and accept. Economics is not a subject where you can perform an experiment to find out what is really “true”. Observed phenomena may have different explanations in different models and different models will lead to different predictions of macroeconomic variables. If you conclude that “An increase in x will lead to an increase in y” you really should not think of this as a property of the real world but rather as the property of a particular model.

4.1 Growth theory:

The classical growth theory: The production function will not provide us with a theory or explanation of growth. It is only a convenient tool which helps us breaking down growth into its components. However, there are many growth theories that try to go a step further. The oldest of these theories is the so-called classical growth theory which is primarily associated with Thomas Robert Malthus.

The classical growth theory should not be confused with the classical model that we will look at in the next chapter. Also, the classical growth theory, which was developed in the late 1700s, has little or no relevance today. We present it so that you can better understand more modern growth theories.

In short, the classical growth theory may be described as follows:

1. Due to technological development, the amount of capital increases and the marginal product of labor rises.

2. GDP per capita rises. With higher living standards, the population will increase.

3. As population increases, the labor productivity will fall (more individuals but the same amount of capital).

4. GDP per capita will fall again. When GDP per capita has fallen to a level just high enough to keep the population from starving, the increase in population will cease.

Destruction of capital, for example, through a war, works in the opposite way. The marginal product of labor falls, GDP per capita falls and the population decreases. This will again lead to an increase in the marginal product of labor and GDP per capita return to the "survival rate".

The main point of the model is that population growth will always eliminate the positive effects of technological development and GDP per capita will always return to the survival level. This very "dismal" growth theory was prominent in the early 1800s, and economics to this day is sometimes called the "dismal science".

Today we know that the predictions of the model where incorrect. During the rest of the 1800s Europe experienced a growth in GDP per capita. Although the population growth was high, it was not nearly sufficient to eliminate the positive effects of technological development.

4.2 The neo-classical growth model:

The main purpose of another important growth model, the neo-classical growth model, is to explain how it is possible to have a permanent growth in GDP per capita. The model was developed by Robert Solow in the 1960s and it is sometimes called the Solow growth model or the exogenous growth model.

The neo-classical growth model should not be confused with the neoclassical synthesis, which we will study in chapter 10. "Neo" means "new" - the neo-classical growth theory is a "new version" of the classical growth model.

The crucial difference between the classical and neo-classical growth model is that population is endogenous in the former and exogenous in the latter. In the classical model, population will increase or decrease depending on whether GDP per capita is higher than or lower than the survival level. In the neo-classical model population growth is not affected by GDP per capita (however, the population growth will affect the growth in GDP per capita).

In the neo-classical model, it is the technological progress only that affects the GDP per capita in the long run. We will have a permanent increase in GDP per capita when there is a technological development that increases productivity of labour. Permanent growth in GDP then requires continuous technological progress.

It is not possible for the government, except temporarily, to affect the growth rate in the neo-classical growth model. The government might be able to affect GDP per capita (and thus is the growth rate) but the growth rate always returns to the level determined by the technological progress. The same is true for savings. An increase in savings may have a temporary effect on GDP but it will have no effect in the long run.

4.3 Endogenous growth theory:

Endogenous growth theory or new growth theory was developed in the 1980s by Paul Romer and others. In the neo-classical model, technological progress is an exogenous variable. The neo-classical growth model makes no attempt to explain how, when and why technological progress takes place.

The main objective of the endogenous growth theory is to make the technological progress an endogenous variable to be explained within the model, hence the name endogenous growth theory.

There are many different explanations for technological progress. Most of them, however, have a lot of common characteristics:

• They are based on constant return to scale for capital. Thus, MPK is not a decreasing function of K in these models.

• They consider technological development as a public good.

• They focus more on human capital.

• It is possible for the government to affect the growth rate. Higher savings also leads to higher growth, not just higher GDP per capita.

• They predict convergence of GDP per capita between countries in the long run. This is a consequence of the public good property of the technological developments.

Separation of growth and fluctuation

It is often useful to separate the evolution of a variable that grows over time into a trend and fluctuations around the trend. The graphs below show such a separation for real GDP.

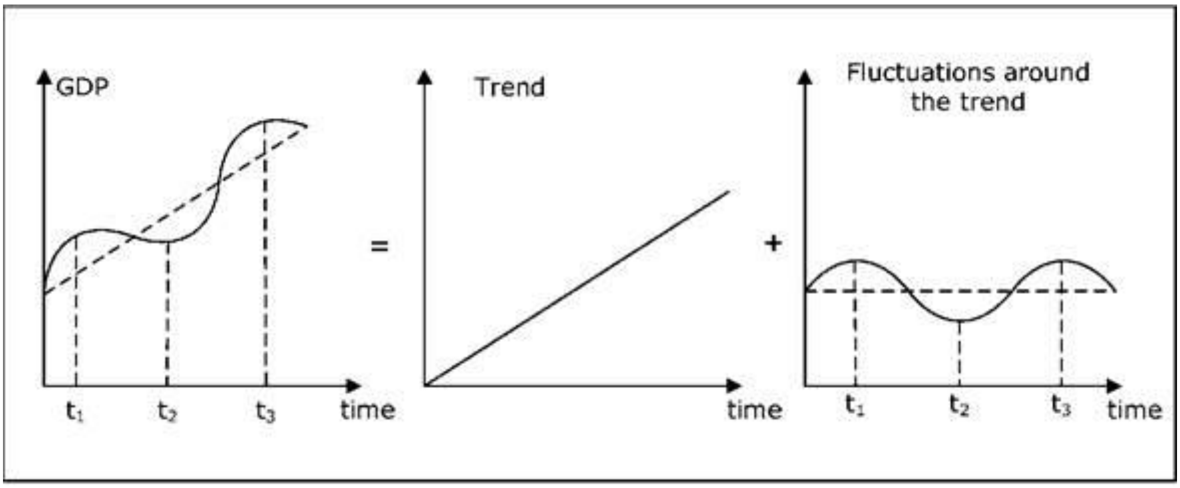


Fig: Growth and the fluctuation around the trend.

The left diagram shows a stylized graph of real GDP over time. It demonstrates the two important characteristics in real GDP. GDP fluctuates over time and GDP grows over time - at least over a longer period of time. The left graph is the sum of the middle graph and the right graph.

The middle graph shows the trend in GDP. The trend represents the second characteristic of GDP - the fact that GDP grows over time. The right graph shows the fluctuations around the trend (cycles) of GDP. These fluctuations around the trend represent the first property of GDP.

In macroeconomics it is common to study trends and cycles separately. The purpose of growth theory is to investigate the trend while most of macroeconomics apart from growth theory is about the cycles. The trend is about the very long run perspective of the economy while cycles are about the short and medium run. The rest of this is all about cycles and not at all about trends. Therefore, when you think of GDP in the remaining chapters, you should think of GDP as in the right-hand graph: GDP has cycles but no trend. Basically, we will study GDP where the trend has been removed.

4.4 The classical model:

The Classical Model was popular before the Great Depression. It says that the economy is very free-flowing, and prices and wages freely adjust to the ups and downs of demand over time. In other words, when times are good, wages and prices quickly go up, and when times are bad, wages and prices freely adjust downward.

The major assumption of this model is that the economy is always at full employment, meaning that everyone who wants to work is working, and all resources are being fully used to their capacity. The thinking goes something like this: if competition is allowed to work, the economy will automatically gravitate toward full employment, or what economists call potential output - just like the expressway at an average speed of 55 miles per hour. Remember what happened when traffic slowed down because there were too many cars? After a few minutes, everything went back to normal. Classical economists believe that the economy is self-correcting, which means that when a recession occurs, it needs no help from anyone. So that's the Classical Model.

4.5 Keynesian cross model:

The Keynesian model has as its origin the writings of John Maynard Keynes in the 1930s, particularly the book “The general theory of Employment, Interest, and Money”.

The similarities between the Keynesian model and the classical model are definitely greater than the differences. Let’s point out the three most important differences directly:

Say's Law does not apply in the Keynesian model.

The quantity theory of money does not apply in the Keynesian model.

The nominal wage level W is an exogenous variable in the Keynesian model.

Remember that W being exogenous means that it is pre-determined outside the model. It does not necessarily mean that it is constant over time – even though this is a common assumption. However, the nominal wage must be known at any point in time in this model. To simplify our description of the Keynesian model, we will begin by assuming that W is constant.

The Keynesian model is slightly more complicated than the classic model, and it is developed in four stages by analyzing four separate models. Each model has, however, a value in itself. The models we will consider and the major characteristics of each are:

Cross model: W, P and R are constant (and exogenous).

IS-LM model: W, P is constant, and R is endogenous.

AS-AD model: W is constant, P and R are endogenous.

The full Keynesian model: W is exogenous (but not constant), P and R are endogenous.

Once we have developed the full Keynesian model, we will combine it with the classic model which will lead to the neoclassical synthesis. The final section covers the Mundell-Fleming model – an extension of the neoclassical synthesis to an open economy where we also analyse the exchange rate.

4.6 IS-LM-model:

The IS-LM model, which stands for "investment-savings, liquidity-money," is a Keynesian macroeconomic model that shows how the market for economic goods (IS) interacts with the loanable funds market (LM) or money market. It is represented as a graph in which the IS and LM curve intersect to show the short-run equilibrium between interest rates and output.

BREAKING DOWN 'IS-LM Model':

British economist John Hicks first introduced the IS-LM model in 1937, just one year after fellow British economist John Maynard Keynes published "The General Theory of Employment, Interest, and Money." Hicks's model served as a formalized graphical representation of Keynes's theories, though it is used mainly as a heuristic device today.

The three critical exogenous variables in the IS-LM model are liquidity, investment and consumption. According to the theory, liquidity is determined by the size and velocity of the money supply. The levels of investing and consumption are determined by the marginal decisions of individual actors.

The IS-LM graph examines the relationship between real output, or GDP, and nominal interest rates. The entire economy is boiled down to just two markets, output and money, and their respective supply and demand characteristics push the economy towards an equilibrium point. This is sometimes referred to as "the Keynesian Cross."

Characteristics of the IS-LM Graph

In the IS-LM graph, the IS curve slopes downward and to the right. This assumes the level of investment and consumption is negatively correlated with the interest rate but positively correlated with gross output. By contrast, the LM curve slopes upward, suggesting the quantity of money demanded is positively correlated with the interest rate and with increases in total spending, or income.

Gross domestic product (GDP), or (Y), is placed on the horizontal axis, increasing as it stretches to the right. The nominal interest rate, or (i or R), makes up the vertical axis. Multiple scenarios or points in time may be represented by adding additional IS and LM curves. In some versions of the graph, curves display limited convexity or concavity.

Limitations of the IS-LM Model

Many economists, including many Keynesians, object to the IS-LM model for its simplistic and unrealistic assumptions about the macroeconomy. In fact, Hicks later admitted model's flaws were fatal, and it was probably best used as "a classroom gadget, to be superseded, later on, by something better." Subsequent revisions have taken place for so-called "new" or "optimized" IS-LM frameworks.

The model is a limited policy tool, as it cannot explain how tax or spending policies should be formulated with any specificity. This significantly limits its functional appeal. It has very little to say about inflation, rational expectations or international markets, although later models do attempt to incorporate these ideas. The model also ignores the formation of capital and labor productivity.

4.7 The AS-AD-model:

Aggregate Supply is the total amount of goods and services in the economy available at all possible price levels. Aggregate Demand is the amount of goods and services in the economy that will be purchased at all possible price levels. In an economy, as the prices of most goods and services change, the price level changes and individuals and businesses change how much they buy. The aggregate supply curve on a graph illustrates the relationship between prices and output supplied whereas the aggregate demand curve shows relationship between price and real GDP demanded.

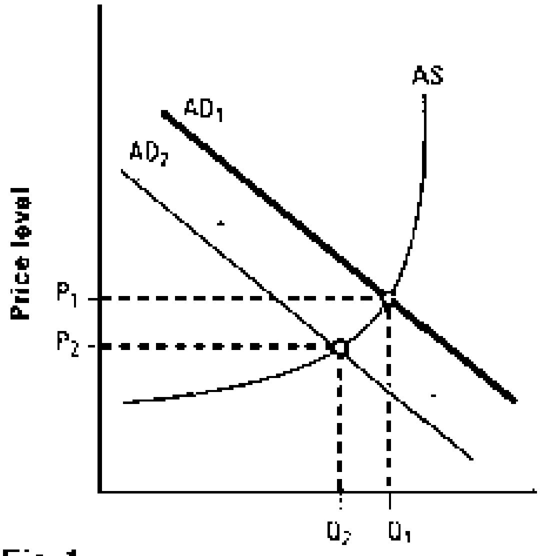


Fig 1[1]

When aggregate supply (AS) curve and aggregate demand (AD) curves are put together, it shows the AS/AD equilibrium in the economy. The intersection of the AS and AD1curves indicated an equilibrium price level of P1 and an equilibrium real GDP of Q1. Any shift in aggregate supply or aggregate demand has an impact on the real GDP and the price level. [1]

Short-run macroeconomic equilibrium occurs when the quantity of GDP demanded equals the quantity supplied, which is where the AD and short-term AS (SAS) curves intersect. The price level adjusts to achieve equilibrium. Short-run equilibrium does not necessarily take place at full employment. Long-run macroeconomic equilibrium occurs when real GDP equals potential GDP so that the economy is on the long term AS curve (LAS) as shown in Fig 2.

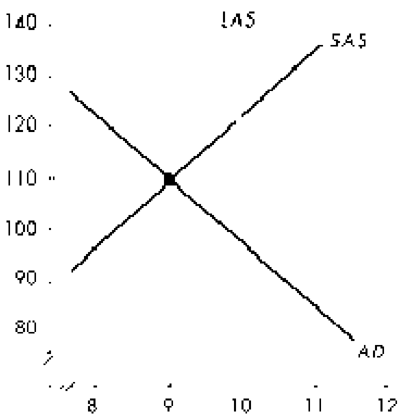


Fig 2[2]

The AS/AD framework illustrates the reaction of an economy to an increase in aggregate demand:

In the short run, the AD curve shifts to the right and the equilibrium moves along the initial SAS curve. Real GDP increases and the price level rises.

The money wage rate rises to reflect the higher prices, and the SAS curve shifts leftward, decreasing real GDP and further raising the price level.

In the long run, the SAS curve shifts leftward enough so that real GDP returns to potential GDP. Further adjustments cease. Real GDP is at potential GDP, and the price level is permanently higher than before the increase in aggregate demand.

The AD/AS model also explains how the economy responds to a decrease in aggregate supply:

The SAS curve shifts leftward, real GDP decreases and the price level rises. A period of time with combined recession and inflation is known as stagflation. [2]

Factors that Affect AS and AD

There are multiple activities that can cause shifts in the AS and AD curves. The following are factors that can shake the aggregate supply:

The increase in nominal wages shifts AS to the left because costs of production increases, which lowers profits.

The increase in prices of other inputs into manufacturing of products also shifts AS to the left because production costs increase. For example, the rise in the price of oil or electricity would increase costs for producers and lower their profits (so they produce less).

The usage of technology can shift the AS to the right because it increases the productivity; as a result, firms can produce more output with the same amount of resources (increases in efficiency). An example is computers. [3]

Similarly, there are factors that can cause changes in the AD curve as well such as:

When there is an increase in the country's exchange rates, the net exports decrease, and aggregate expenditure also takes a dip resulting in shifting the AD curve to the left.

An increase in the income of the citizens will encourage them to spend more; eventually causing a rightward shift.

Foreign income also has a significant impact on the aggregate demand. When foreign income increases, exports will increase causing the curve to shift to the right as a result of increased aggregate demand. [4]

The AD-AS framework divides the economy into two parts – the 'demand side' and the 'supply side' – and examines their interaction using accounting identities, equilibrium conditions and behavioral and institutional equations. The 'demand side' typically examines factors relating to the demand for goods and the demand and supply of assets. The 'supply side' typically examines factors relating to output and pricing decisions of producers, and factor markets. The framework ensures that neither demand nor supply side factors are overlooked in the analysis and that macroeconomic outcomes depend on the interaction between the different markets. [5]

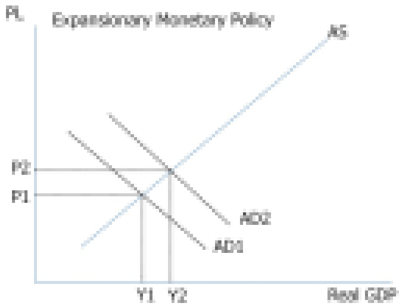
This model scores highly in terms of simplicity. In terms of flexibility, it is comparable to IS-LM. It can straightforwardly be extended to deal with stochastic shocks and open-economy issues. However, where this model does fail badly is in terms of accuracy. Again the basic assumption concerning monetary policy is that the authorities fix the value of the money stock. This leads to the unattractive feature that the 'equilibrium' is one in which the price level has converged on a constant value.

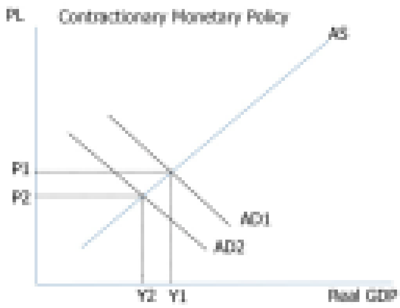
There are other problems as well with the AD-AS model than the assumption of a fixed money stock. Colander (1995) pointed out that the model contains two contradictory accounts of aggregate supply. In deriving the aggregate demand curve a fixed price multiplier theory is assumed while in deriving the aggregate supply curve the underlying assumption is one in which supply expands to the point at which marginal cost equals marginal revenue. [6]

Effect of Monetary Policy

In the case of contractionary monetary policy, the money supply in the economy is decreased which further leads to a decrease in the nominal output, also known as the Gross Domestic Product (GDP). Additionally, the declined money supply in the market also leads to reduced spending by the consumers which thus shifts the aggregate demand curve to the right.

In the case of expansionary monetary policy, the central bank increases the money supply in the market by purchasing government bonds, and this pumps money into the market, and also decreases the interest rate as banks have more cash to loan to firms. Thus, firms begin to invest in order to increase output i.e. increased GDP. This leads to increase in employment. Additionally, as there is more money in the market, the consumer spending increases as well. All this activity shifts the aggregate demand curve to the left. [7]

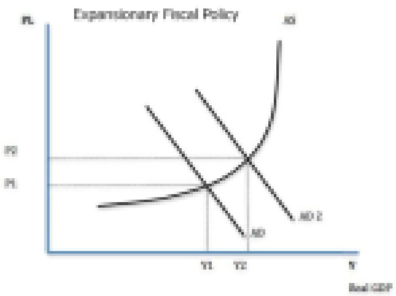


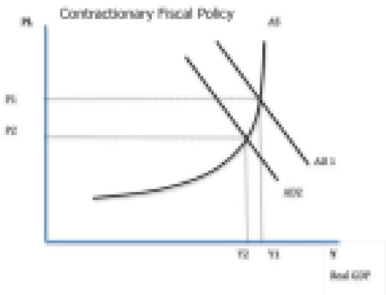


Effect of Fiscal Policy

In pursuing expansionary fiscal policy, the government either increases spending, or reduces taxes or does a combination of both. As mentioned above, increase in the government spending shifts the AD curve to the right. Reduced taxes mean the consumer has more dispensable income at hand, and so can purchase more. This as well shifts the AD curve to the right. Plus, a combination of both increased government spending and reduced taxes also works in shifting the AD curve to the right. The extent of the shift in the AD curve due to government spending depends on the size of the spending multiplier, while the shift in the AD curve in response to tax cuts depends on the size of the tax multiplier.

The government uses a contractionary fiscal policy when there is a demand-pull inflation. It also facilitates in paying off unwanted debt. In the case of contractionary fiscal policy, the government either decreases spending, or raises taxes, or does a combination of the two. Less money rotation in the market leads to decline in the output which means reduced GDP. The consumer spending also takes a dip as there is lesser money available for expenses. Contractionary fiscal policy shifts the AD curve to the left. If the tax revenues exceed government spending, then this type of policy leads to a budget surplus. [8]





The complete Keynesian model:

Wage inflation:

In this section, we will continue to develop the Keynesian model removing the assumption of fixed nominal wages. We define **wage inflation nw** as the percentage average increase in wages. Wages and wage inflation are still **exogenous,** i.e. they are not determined within the model. One justification for this assumption is that wages often are determined by agreements which often last for several years.

We do not need a new model to deal with inflation. Non-constant wages can be handled within all three Keynesian models as long as they are exogenous. The reason we chose to let wages be constant in the previous Keynesian models were entirely pedagogical - these models are easier to understand when wages are constant.

Price Inflation

The main reason for allowing for non-constant wages in the model is that we then can allow for persistent inflation/deflation. With constant wages, we cannot have persistent inflation as real wages would go to zero.

Neutral inflation is defined as a situation where wage inflation is equal to inflation (in prices). With neutral inflation, the real wages are constant. The Keynesian model does not require neutral inflation and real wages may vary over time. However, we cannot have an inflation which is always greater than or always smaller than wage inflation as real wages again would go to zero or infinity (again, remember that growth has been removed so we expect no upward trend in real wages). However, a few adjustments must be made in the models when we have inflation.

Adjustments to the Keynesian models when wages are no longer constant

Real interest rates, nominal interest rate and expected inflation

When we have inflation, we cannot, of course, assume that expected inflation is zero. Therefore, real interest rate will no longer be equal to the nominal interest rate and we must use **R** = **r + ne.** In this chapter, expected inflation ne is **exogenous** (although not necessarily constant. In more advanced Keynesian models you will find various assumptions on how expectations are formed.

Aggregate demand with inflation

In previous versions of the Keynesian model, none of the components of aggregate demand depended on P. In the IS-LM and in the AS-AD models, investments depended on the nominal interest rate R. We argued that investment **actually** depends on the real interest rate r, but since **R** = **r** when **if** = 0, we could make it a function of R.

When **if** no longer is zero and the real interest rate **r** = **R - if,** we should write **I(r)** or **I(R - if).** We should also write **YD(Y, r)** or **YD(Y, R - if).** Since inflation expectations are exogenous (given), it is still the case that **YD** depends negatively on R. Note that if there is an equal increase in expected inflation and in nominal interest rate, real interest rate is unaffected and so is investments and aggregate demand.

The IS curve with inflation

We can draw the IS curve for a given value of **if.** As previously explained, the IS curve is not affected by changes in P. However, it will shift upwards when **7f** increases.

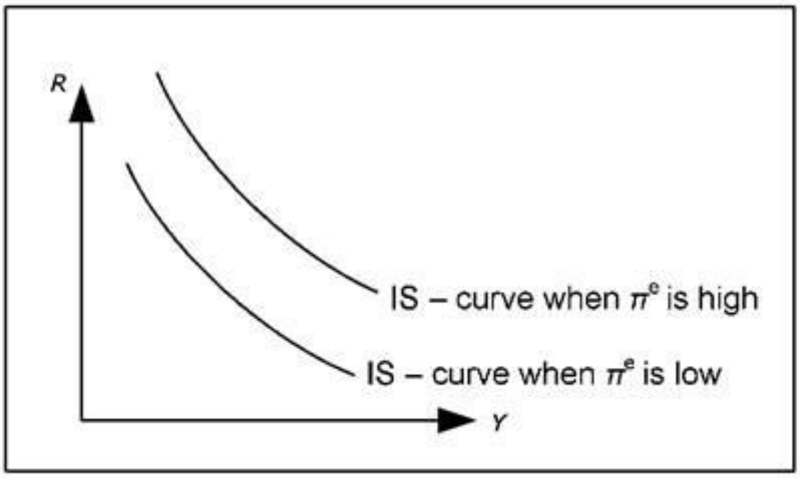


Fig: The IS curve and expected inflation.

If **if** increases, **R** must increase by the same amount to keep **r** and **YD** unaltered.

The money market with inflation

Let us begin with the money market diagram in 12.3.6 and introduce inflation. Since the **MD** depends positively on P, the **MD** curve to "glide" out towards the right when inflation is positive and toward the left when we have deflation.

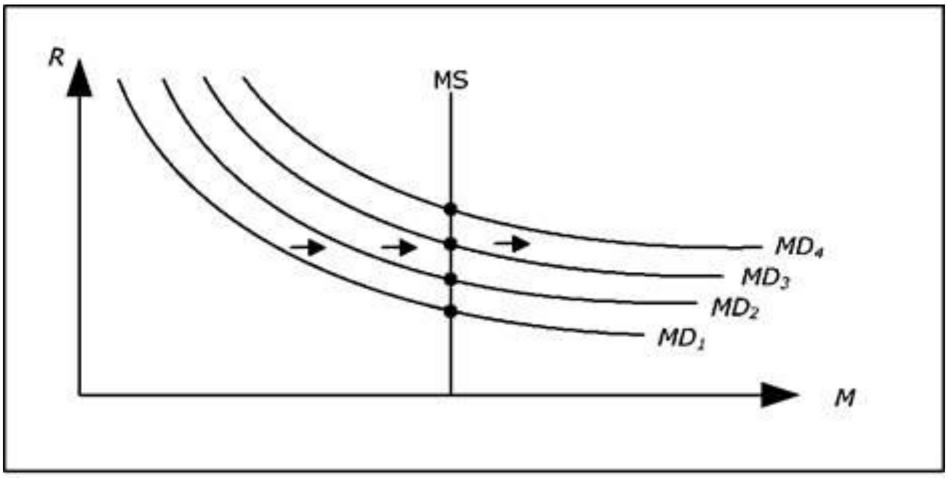


Fig: The money market with inflation and constant money supply.

If money supply is constant, nominal interest rate will continuously increase when we have inflation and continuously decrease when we have deflation.

An interesting special case is when **money supply increases by the same rate as P.** In this case, the money supply curve will also glide outwards or inwards (depending on whether we have inflation or deflation) at exactly the same rate as the money demand. **The nominal interest rate will then be constant.**

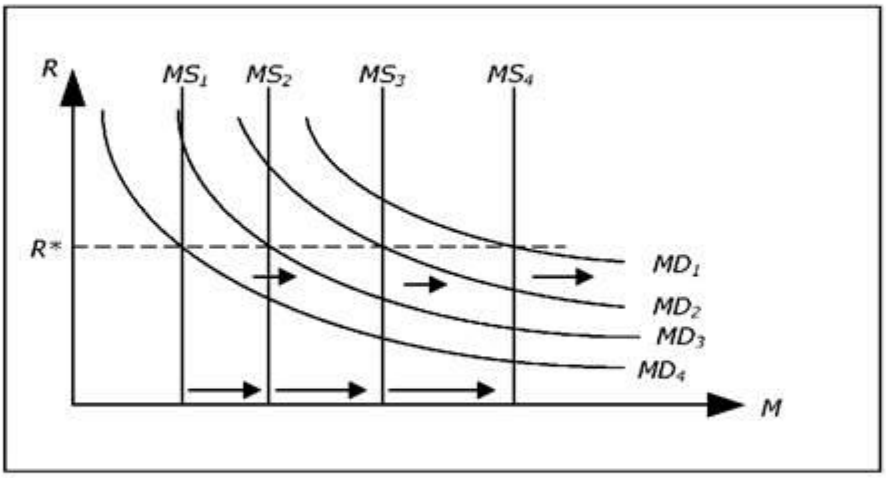


Fig: The money market with inflation and rising money supply.

If we let **%**M denote the growth rate in money supply, we can conclude the following. For a given **Y, R** will increase if **n** > **nM** (prices increase faster than the money supply) and **R** will fall if **nM** > **n. R** is unchanged if **n** = **nM.**

For example, when **n** > nM, the MD curve glides out to the right faster than **MS** curve which is why **R** increases.

The LM curve with inflation

Earlier, we found that the LM curve will shift upwards when **P** increases (assuming **MS** is constant). This is still true, but we can also add that the LM curve **glides** upwards if **n** > **nM** (as **R** increases) and the LM curve glides downwards if **nM** > **n.**

The previous result is a special case of this result. If **P** increases, then **n** > 0 and if **MS** is constant then **nM** = 0 and the LM curve glides upwards. Earlier, we only considered cases when **P** jumped (from say 100 to 120). This translates into having inflation for a short period, an LM curve that glides upwards and when **P** reaches 120, inflation cease and the LM curve will stop moving.

The neo-classical synthesis:

The neoclassical synthesis was a post-World War II academic movement in economics that worked towards absorbing the macroeconomic thought of John Maynard Keynes into neoclassical economics. The resultant macroeconomic theories and models are termed Neo-Keynesian economics. Mainstream economics is largely dominated by the synthesis, being largely Keynesian in macroeconomics and neoclassical in microeconomics.

The term 'neoclassical synthesis' appears to have been coined by Paul Samuelson to denote the consensus view of macroeconomics which emerged in the mid-1950s in the United States. This synthesis remained the dominant paradigm for another 20 years, in which most of the important contributions, by Hicks, Modigliani, Solow, Tobin and others, fit quite naturally. The synthesis had, however, suffered from the start from schizophrenia in its relation to microeconomics, which eventually led to a serious crisis from which it is only now re-emerging. I describe the initial synthesis, the mature synthesis, the crisis and the new emerging synthesis. The term ‘neoclassical synthesis’ appears to have been coined by Paul Samuelson to denote the consensus view of macroeconomics which emerged in the mid-1950s in the United States. In the third edition of Economics (1955, p. 212), he wrote: In recent years 90 per cent of American Economists have stopped being ‘Keynesian economists’ or ‘anti-Keynesian economists’. Instead they have worked toward a synthesis of whatever is valuable in older economics and in modern theories of income determination. The result might be called neo-classical economics

Exchange rate determination:

Exchange rate systems

For an open economy, the particular exchange rate system in use becomes important. In **Exchange rate** we discussed some possible systems. In simple models, only two systems are considered: a floating or a fixed exchange rate.

With a **floating exchange rate**, the exchange rate is determined as any price, that is, by supply and demand. The central bank never intervenes in the market.

With a **fixed exchange rate**, the exchange is completely fixed. In reality, most countries with a fixed rate allow the exchange rate to vary within certain limits. These variations are disregarded and the central bank will always intervene to keep the exchange rate at its fixed value.

Also remember the following notation:

	Fexible exchange rate	Fixed exchange rate
Our currency stronger	Appreciation	Revaluation
Our currency weaker	Depreciation	Devaluation

Fig: Changes in exchange rates.

The classical model of exchange rate determination:

The classical model of exchange rate determination is the one we have used so far. This section will consider the foundations of this model

The law of one price:

The classical model for exchange rate determination is based on **the law of one price**. This law claims that there can be only one price for a given product at any given time. Gold, for example, must cost more or less the same wherever you buy it.

If gold was traded for USD 30,000 per kilo in New York and for USD 40,000 per kilo in Chicago, you would be able to make a lot of money by buying gold in New York and selling it in Chicago. There would be opportunities for **arbitrage** – opportunities to make money with no risk. Gold would be transported from New York to Chicago until the price difference was eliminated.

The law of one price need not apply exactly due to the following reasons:

Transportation costs: If the price difference is less than the cost of transport, the difference may remain.

Ease of access.: A soda in a convenience store is often more expensive than in a super market. You pay slightly more for the convenience of the ease of access.

Government intervention: The government may, for example, by subsidizing electricity for firms, create a market with two different prices for the same good.

For **non-transportable** goods and services, the price difference may be much larger. Even if the price of a haircut is much higher in Chicago than in Boise, Idaho, there are no strong arbitrage possibilities that will remove the price difference.

Purchasing Power Parity (PPP)

If we apply the law of one price to goods in different countries, we can derive the purchasing power parity (PPP). If gold is trade in the U.S. at USD 30,000 per kilo and 1euro costs USD 1.40, you can be pretty sure that gold will trade for around $30{,}000/1.4 \approx 21{,}400$ euro per kilo. If that was not the case, there would again be arbitrage opportunities (unless there are restrictions on transporting gold across borders). If **PF** is the price of a good in the foreign country, **P** is the price of the same good in our country and **E** is the exchange rate (domestic / foreign) then PPP claims that **P** = **PF*E**

The Big Mac Index

Based on PPP, the Economist regularly publishes the "Big Mac Index". **PF** is then the price of a Big Mac in the U.S. In February of 2009, **PF** was on average 3.54 USD and E = 1.28 USD / euro. According to PPP, a Big Mac should cost 2.77 euro in the euro area. In reality, it costs on average 3.42 euro. We would need an exchange rate of 3.54 / 3.42 = 1.04 USD / euro for the PPP to be entirely correct for the Big Mac.

According to Big Mac index, the euro is over-valued by about 24% in relation to the USD. The most expensive Big Mac, however, is found in Norway. Here a Big Mac costs USD 5.79 at the current exchange rate making the Norwegian krona overvalued by 63%.

Exchange rate determination

In PPP, **PF** and **P** denote the domestic and foreign price of a particular good. If we instead let **PF** and **P** denote **price levels**, we can derive the classical model of exchange rate determination simply by dividing both sides in PPP by **E**: **E** = **P**/**PF**

If the UK is our home country and a basket of goods costs 12.0 million UK pounds

(GBP) while the exact same basket costs 14.1 million euro in France, the exchange rate, according to the classical model, ought to be 0.851 GBP/EUR or 1.175 EUR/GBP.

The exchange rate that we just calculated is often called the **purchasing power adjusted exchange rate**. If this was the actual exchange rate, the price levels (in the same currency) in the two countries would be the same. When we compared **GDP** per capita for various countries in section 3.6, it was the purchasing power adjusted exchange rate that we used to transform GDP into the same currency.

For countries where the GDP per capita is very different, the actual exchange rate is often very far from the purchasing power adjusted exchange rate. The price level in countries with a high GDP per capita is generally higher than the price level in countries with a low GDP per capita (in the same currency). It is often for services and non-transportable goods where prices deviate the most.

Inflation

If the price level in the home country and the foreign price level do not change, then, according to the classical model of exchange rate determination, **E** will be constant. The same is true if **P** and **PF** increase at the same rate, that is, if the home country has the same inflation as the rest of the world: π = π**F**, where π**F** is the rate of inflation abroad.

If, however, π > π**F** (**P** increases faster than **PF**), then **E** will increase (our currency will depreciate). For example, if π = 8% while π**F** = 5%, **P** increases by 8% while the **PF** increases by 5% over the same period. **P**/**PF** will then be 1.08 / 1.05 ≈ 1.03 times larger than the old value, that is, **E** will increase by about 3%. Our currency will have depreciated by 3% during this period.

If π**E** is the rate of increase in the exchange rate (rate that our exchange rate depreciates), the classical model predicts: π**E** ≈ π − π **F**

The rate of depreciation is (approximately) equal to the differences in inflation between the countries.

4.8 The Mundell-Fleming model:

The Mundell–Fleming model, also known as the IS-LM-BoP (Balance of Payments) model (or IS-LM-BP model), is an economic model first set forth (independently) by Robert Mundell and Marcus Fleming. The model is an extension of the IS-LM model. Whereas the traditional IS-LM model deals with economy under autarky (or a closed economy), the Mundell–Fleming model describes a small open economy.

The Mundell–Fleming model portrays the short-run relationship between an economy's nominal exchange rate, interest rate, and output (in contrast to the closed-economy IS-LM model, which focuses only on the relationship between the interest rate and output). The Mundell–Fleming model has been used to argue that an economy cannot simultaneously maintain a fixed exchange rate, free capital movement, and an independent monetary policy. This principle is frequently called the "impossible trinity," "unholy trinity," "irreconcilable trinity," "inconsistent trinity" or the "Mundell–Fleming trilemma."

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