

Chapter 3: Aggregate Demand in the closed Economy

Aggregate demand (AD) is the relationship between the quantity of output demanded and the aggregate price level. In other words, the aggregate demand curve tells us the quantity of goods and services people want to buy at any given level of prices. It is the total amount of goods demanded in the economy. It is measured by total expenditure of the economy's demand of goods and services.

Aggregate demand is the amount of money which all sector, house hold, firm, and government are ready to spend on the purchase of goods and services in an economy during a given period of time. In general the quantity of goods demanded, depends on the level of income in the economy. It is down ward sloping that indicates output which will be demanded in the economy at various general price level.

The components of aggregate demand are Consumption (C), Investment (I), Government expenditure (G) and Net exports (NX). Thus, $AD = C + I + G + NX$. Since we are considering the case of closed economy - an economy which is not trading with other countries - the national income accounting identity for closed economy is represented as $AD = C + I + G$. Where AD is aggregate demand (planned expenditure)

3.1. Foundations of Theory of Aggregate Demand

Of all the economic fluctuations in world history, the one that stands out as particularly large, painful, and intellectually significant is the Great Depression of the 1930s. During this time, many countries experienced massive unemployment and greatly reduced incomes. This devastating episode caused many economists to question the validity of classical economic theory. Classical theory seemed incapable of explaining the Depression. According to that theory, national income depends on factor supplies and the available technology, neither of which changed substantially from 1929 to 1933 (during the Great Depression).

After the onset of the Depression, many economists believed that a new model was needed to explain such a large and sudden economic downturn and to suggest government policies that might reduce the economic hardship so many people faced. Keynesian economics is the view, and the various theories about why, in the short run (and

especially during recessions) economic output is strongly influenced by aggregate demand (total spending in the economy). In the Keynesian view, aggregate demand does not necessarily equal the productive capacity of the economy; instead, it is influenced by a host of factors and sometimes behaves erratically, affecting production, employment, and inflation. The theories forming the basis of Keynesian economics were first presented by the British economist John Maynard Keynes in his book, “The General Theory of Employment, Interest and Money”, published in 1936, during the Great Depression. Keynes contrasted his approach to the aggregate supply-focused 'classical' economics that preceded his book.

Keynes revolutionized economics with his book “The General Theory of Employment, Interest, and Money”. He proposed a new way to analyze the economy, which he presented as an alternative to classical theory. His vision of how the economy works quickly became a center of controversy. Yet, as economists debated The General Theory, a new understanding of economic fluctuations gradually developed. Keynes proposed that low aggregate demand is responsible for the low income and high unemployment that characterize economic downturns. He criticized classical theory for assuming that aggregate supply alone—capital, labor, and technology—determines national income. As to Keynes, an economy’s total income is, in the short run, determined largely by the desire to spend by households, firms, and the government. The more people want to spend, the more goods and services firms can sell. The more firms can sell, the more output they will choose to produce and the more workers they will choose to hire. Thus, the problem during recessions and depressions, according to Keynes, was inadequate spending. Keynesians, therefore, advocate an active stabilization policy to reduce the amplitude of the business cycle, which they rank among the most serious of economic problems. According to the theory, government spending can be used to increase aggregate demand, thus increasing economic activity, reducing unemployment and inflation. This is the foundations for the theory of aggregate demand. Policymakers around the world debated how best to increase aggregate demand and put their economies on the road to recovery.

Economists today reconcile these two views with the model of aggregate demand and aggregate supply. In the long run, prices are flexible, and aggregate supply determines income. But in the short

run, prices are sticky, so changes in aggregate demand influence income. Over long periods of time, prices are flexible, the aggregate supply curve is vertical, and changes in aggregate demand affect the price level but not output. Over short periods of time, prices are sticky, the aggregate supply curve is flat, and changes in aggregate demand do affect the economy's output of goods and services.

Determinants of aggregated demand in a given economy

1. Monetary and fiscal policy of the government.
2. General level of income of the people.
3. Level of economic activities in the economy itself.
4. Availability of credit.

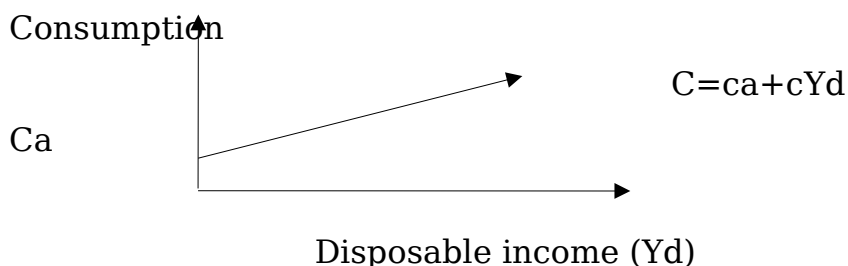
Price level being constant, any positive change in any of this factors cause a right ward shift in the aggregate demand curve, negative change shifts the aggregate demand left ward.

Consumption Function

$$C = c_a + cY_d$$

Where C is consumption, C_a is autonomous consumption, cY_d is inducing consumption, c is marginal propensity to consume, and Y_d is disposable income. Consumption cannot fall below autonomous consumption, regardless of what people are making as income.

Marginal propensity to consume tells us how much consumption increases for every birr 1 increase in income. The MPC coefficient can be between zero and one.



Graphically, the consumption function displays the relationship between consumption and disposable income. *Consumption*, the dependent variable, is on the Y-axis. *Disposable income*, the independent variable, is on the X-axis. The level of *autonomous*

consumption determines the Y-intercept. *Marginal propensity to consume* determines the slope of this curve. As *disposable income* increases from left to right it is modified by the *MPC*. For example a high *MPC* of 0.9 would lead to a steep curve. A lower *MPC* would mean a more gradual slope.

Disposable income

$$Y_d = Y - \bar{T}a \text{ where}$$

Y_d = disposable income, Y =income, and Ta =taxes

Disposable income is an aggregate measure of all the income paid to households minus income taxes. Assume that taxes do not change relative to our dependent variable, income. Again, this is shown by the horizontal bar above the two exogenous variables. Income taxes are some percentage of income which is flat rate, denoted by the lower case t . The coefficient could be any number between zero, meaning no tax, and one, meaning all income would be paid in taxes. This is then multiplied by income.

Note that our disposable income has taxes incorporated into it. I.e. $Y_d = (1-t) Y$. Therefore the consumption function can be put as follows.

$$C = \bar{c}a + c(1-t) Y$$

Consumption = *autonomous consumption* + *MPC* $\times$ (1- taxes) $\times$ income.

Aggregate Demand Equation

$$AD = \bar{A} + c(1-t)Y$$

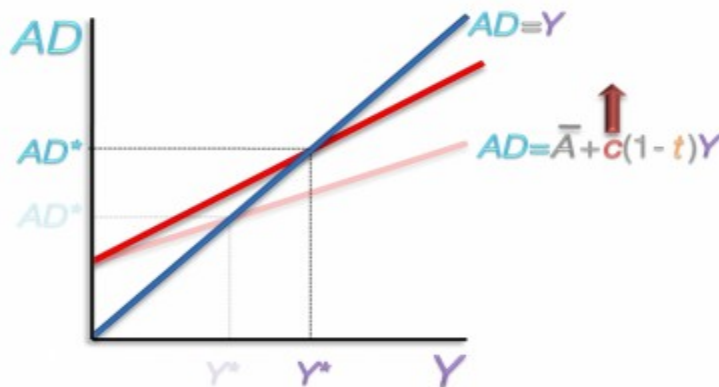
This consumption function is incorporated into the aggregate demand equation. To do so, we have to separate the **factors into exogenous and endogenous demand**. Exogenous demand is represented by $\bar{A}$. Investment and government spending are exogenous because they **aren't affected by national income in this model**, so their value won't change when income changes. These factors will be grouped at the bottom under $\bar{A}$. When we substitute the consumption function in for C we can see that there are some exogenous variables, such as

exogenous consumption and transfer payments. These can be grouped down below with the other external factors. We can bring two groups together with the simplified $\bar{A}$ to represent all of the exogenous factors and the $c(1-t)Y$ representing the determining factors

Equilibrium Output

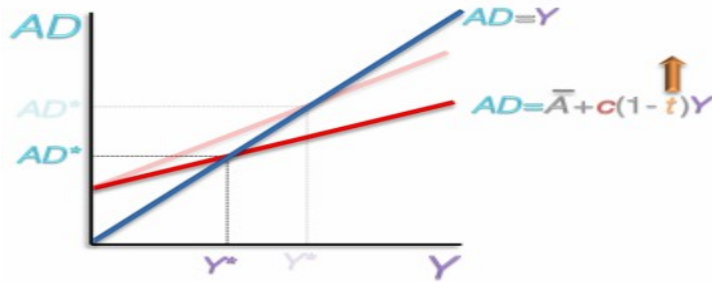
In this model, *aggregate supply* is equal to *income* at any point in time. Therefore, supply equals demand when *aggregate demand* equals *income*. When we have aggregate demand on the y axis and income on the x-axis, equilibrium is reached at any point on the 45° angle, where the values for both axis are equal. The *aggregate demand* curve starts out on Y-axis at a value equal to the exogenous demand ($\bar{A}$) and then continues upward with increasing levels of income. Equilibrium occurs when the two lines intersect; this indicates the equilibrium income and equilibrium level of aggregate demand.

Change in MPC



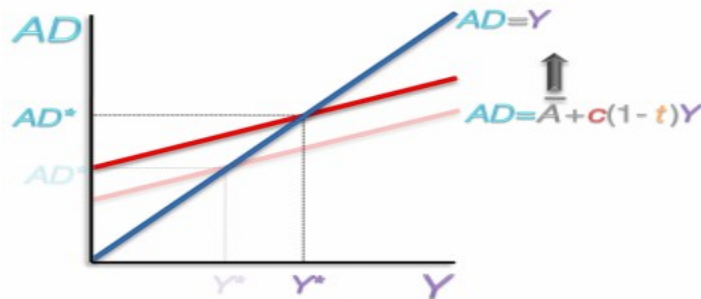
If a country becomes more inclined to spend their disposable income, their MPC is larger. An increase in the marginal propensity to consume creates a steeper aggregate demand curve. The point of origin is the same, **but steeper** line crosses the equilibrium line at a higher point. This results in larger equilibrium values for aggregate demand and national income.

Change in Tax Rate



If there is a change tax rate, say from 30% to 50%, the slope will be more gradual, resulting in lower equilibrium levels of aggregate demand and national income.

Change in Exogenous Demand



A change in Exogenous Demand would result from a change in any of the following, autonomous consumption, investment, or government spending. If there was an increase in any of these components, the entire aggregate demand curve would shift up. This leads to higher equilibrium values for aggregate demand and national income. Note that the slope remains unchanged.

3.2. The Goods Market and the IS curve

In the goods market we are going to look at the relationship between the real interest rate and the level of income using the IS curve. The IS curve plots the relationship between the interest rate and the level of income that arises in the market for goods and services. To develop this relationship, we start with a basic model called the Keynesian cross.

The Keynesian Cross

In The General Theory Keynes proposed that an economy's total income was, in the short run, determined largely by the spending

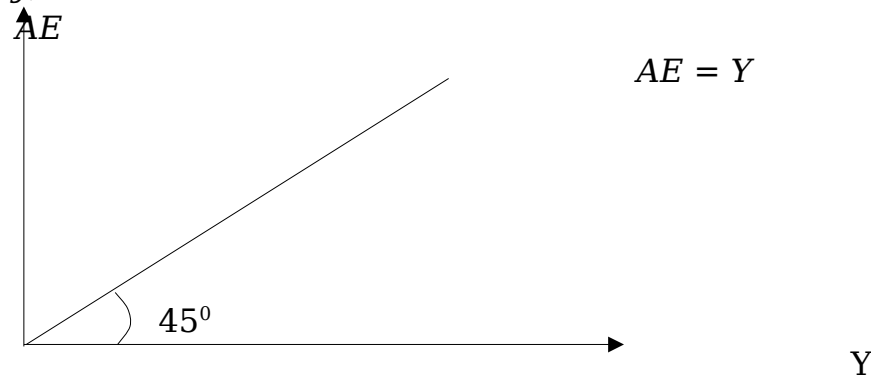
plans of households, businesses, and government. The more people want to spend, the more goods and services firms can sell. The more firms can sell, the more output they will choose to produce and the more workers they will choose to hire. Keynes believed that the problem during recessions and depressions was inadequate spending. The Keynesian cross is an attempt to model this insight. The derivation of the Keynesian cross begins by drawing a distinction between actual and planned expenditure. It relates planned expenditure to actual expenditure.

Actual expenditure is the amount households, firms and the government spend on goods and services and it equals the economy's gross domestic product (income, Y).

$$\text{Actual Expenditure (AE)} = C(Y - T) + I + \Delta \text{inv} + G;$$

Where Y is income (GDP), C is consumption, I is planned investment, Δinv is unexpected (undesired) changes in inventories, T is taxes and G is government purchase.

Graphically,



Planned expenditure is the amount households, firms, and the government would like to spend on goods and services. It excludes the unexpected (undesired) changes in inventories. Assuming that the economy is closed, so that net exports are zero, we write planned expenditure PE as the sum of consumption C , planned investment I , and government purchases G :

$$PE = C + I + G.$$

Next we will assume that aggregate consumption is a function of disposable income. Disposable income equals total income (Y) less taxes (T) and the consumption function would be written as:

$$C = C(Y - T)$$

To keep things simple, for now we take planned investment as exogenously fixed: $I = \bar{I}$

Finally, we assume that fiscal policy—the levels of government purchases and taxes—are fixed:

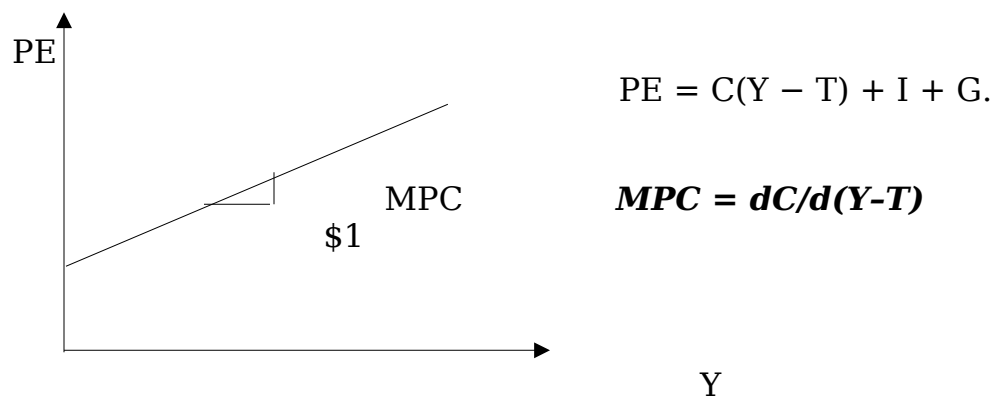
$$G = \bar{G}, T = \bar{T}.$$

Combining these equations, we obtain aggregate planned expenditure curve

$$PE = C(Y - T) + I + \bar{G}.$$

This equation shows that planned expenditure is a function of income Y , the level of planned investment I , and the fiscal policy variables G and T .

Graphically this relationship looks like,



Planned Expenditure as a Function of Income

Planned expenditure depends on income because higher income leads to higher consumption, which is part of planned expenditure. The PE line slopes upward because higher income leads to higher consumption and thus higher planned expenditure. The slope of this planned-expenditure function relating PE and Y is the marginal propensity to consume, MPC: it shows how much planned expenditure increases when income rises by 1 unit.

- This planned expenditure function is the first piece of the model called the Keynesian cross.

Why would actual expenditure ever differ from planned expenditure? The answer is that firms might engage in **unplanned inventory investment** because their sales do not meet their expectations. When firms sell less of their product than they planned, their stock of inventories automatically rises; conversely, when firms sell more than planned, their stock of inventories falls. Because these unplanned

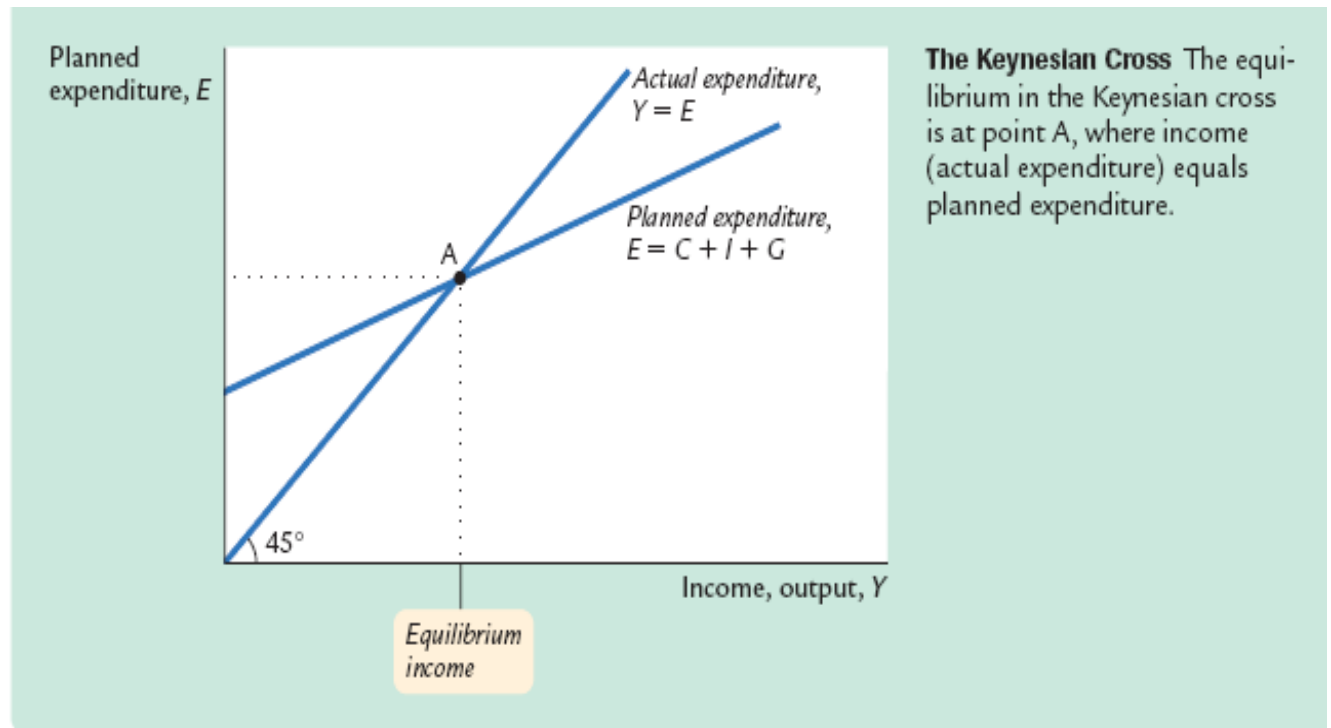
changes in inventory are counted as investment spending by firms, actual expenditure can be either above or below planned expenditure. You should note that actual expenditure equals income (Y), because any unsold goods are defined as inventory investment, but planned expenditure may not equal income. For example, firms and households may purchase more goods and services than are produced in a year, so that inventories are run down. In this case, $PE > Y$. $AE > PE$ whenever $\Delta inv > 0$; $AE < PE$ whenever $\Delta inv < 0$; and, when $\Delta inv = 0$, $AE = PE$ - the economy is in equilibrium.

The second piece of the Keynesian cross is the assumption that the economy is in equilibrium when actual expenditure equals planned expenditure. This assumption is based on the idea that when people's plans have been realized, they have no reason to change what they are doing.

Recalling that Y as GDP equals not only total income but also total actual expenditure on goods and services, we can write this equilibrium condition as

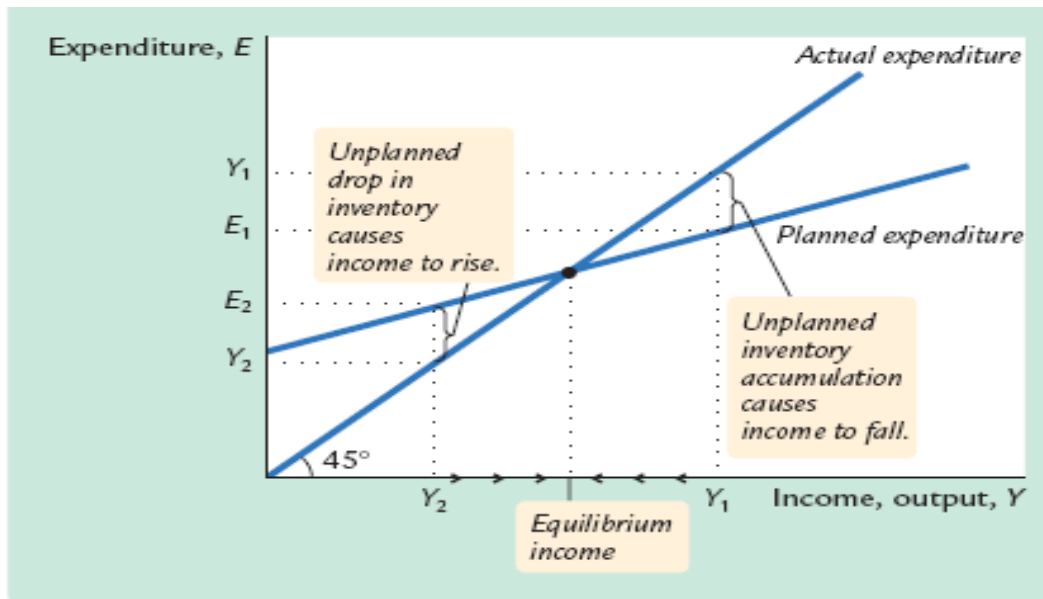
$$\text{Actual Expenditure} = \text{Planned Expenditure}$$

$$Y = PE.$$



The 45-degree line in the figure below plots the points where this condition holds. With the addition of the planned-expenditure function, this diagram becomes the Keynesian cross. The equilibrium of this economy is at point A, where the planned-expenditure function crosses the 45-degree line.

How does the economy get to the equilibrium? In this model, inventories play an important role in the adjustment process. Whenever the economy is not in equilibrium, firms experience unplanned changes in inventories, and this induces them to change production levels. Changes in production in turn influence total income and expenditure, moving the economy toward equilibrium. Equilibrium occurs along this line because there is no tendency for inventories to be built up or to be run down and the following diagram shows how this works:



The Adjustment to Equilibrium in the Keynesian Cross

For example, suppose the economy finds itself with GDP at a level greater than the equilibrium level, such as the level Y_1 in the above figure. If firms were producing at level Y_1 , then planned expenditure E_1 would fall short of production and firms would accumulate inventories (firms are selling less than they are producing). Firms add the unsold goods to their stock of inventories. This inventory accumulation (unplanned rise in inventories) would induce firms to lay off workers and reduce production; these actions in turn reduce GDP. This process of unintended inventory accumulation and falling income continues until income Y falls to the equilibrium level. Similarly, suppose GDP is at a level lower than the equilibrium level, such as the level Y_2 . If firms were producing at level Y_2 , then planned expenditure E_2 would exceed production (Y_2), and firms would run down their inventories. i.e., firms meet the high level of sales by drawing down their inventories. This fall in inventories would induce firms to hire more workers and raise production, and thus GDP rises. In both cases, the firms' decisions drive the economy toward equilibrium.

In summary, the Keynesian cross shows how income Y is determined for given levels of planned investment (I) and fiscal policy, G and T . We can use this model to show how income changes when one of these exogenous variables changes.

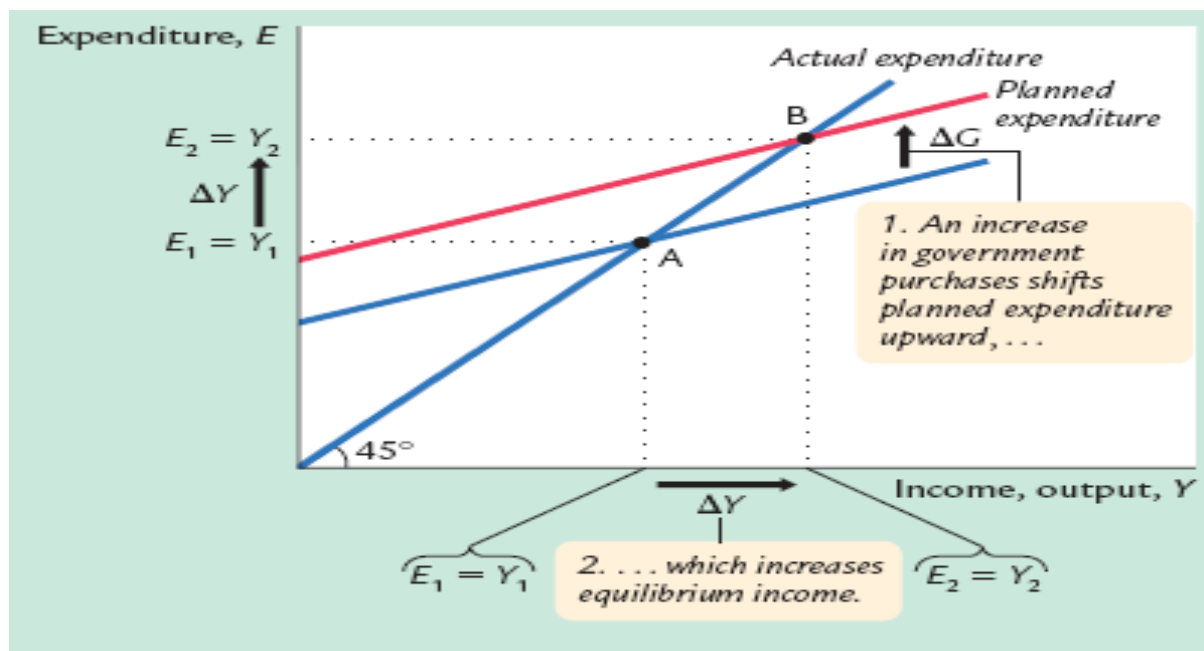
The multiplier

A multiplier is the ratio expressing the relationship between the increase in national income and the increase in investment, government expenditure and tax which induces the rise in income. Now we will examine what happens when an exogenous change occurs.

Fiscal Policy and the Multiplier: Government Purchases

Consider how changes in government purchases affect the economy. Suppose that government purchase of goods and services increased (expansionary fiscal policy).

The following graph shows what happens:



An Increase in Government Purchases in the Keynesian Cross

Because government purchases are one component of expenditure, an increase in government purchases of ΔG raises planned expenditure by that amount for any given level of income. If government purchases rise by ΔG , then the planned-expenditure schedule shifts upward by ΔG , as in above figure. The equilibrium of the economy moves from point A to point B and income rises from Y_1 to Y_2 . Note that the increase in income ΔY exceeds the increase in government purchases ΔG . i.e., ΔY is larger than ΔG . The initial increase in government expenditure causes an even greater increase in actual (and planned)

expenditure, or income, than is first implied by just looking at the increase in government expenditure alone. The final effect of the change in an exogenous variable is a multiple of the initial change. This particular multiple is called the **government purchases multiplier**, i.e., the ratio of $\Delta Y / \Delta G$; it tells us how much income rises in response to a \$1 increase in government purchases. An implication of the Keynesian cross is that the government-purchases multiplier is larger than 1. Thus, fiscal policy has a multiplier effect on income.

If we consider a change in G of size ΔG , then the following sequence of events occurs:

STEP 1: Initially E changes by the change in G

STEP 2: Next, the change in Y causes a change in C — i.e. by $MPC \times \Delta G$.

STEP 3: The change in C causes E and Y to change again by $MPC \times \Delta G$.

STEP 4: The extra change in Y causes a further change in C — i.e. C changes by a further

$$MPC \times (MPC \times \Delta G).$$

STEP 5: And so on, with the changes in C and Y getting smaller with each step.

This process continues but the decreases in consumption and thus expenditure and income become smaller with each round. The overall impact can be calculated by adding up all the terms, that is,

$$\Delta Y = (1 + MPC + MPC^2 + MPC^3 + \dots) \Delta G.$$

The way to work this out is to realize that this sum is a simple infinite geometric series and so we can use the appropriate mathematical formula. Doing this gives us:

$$\Delta Y = \frac{1}{(1 - MPC)} \Delta G$$

Since we have a simple infinite geometric series to add, and can use

the relevant mathematical formula. The term, $\frac{1}{(1 - mpc)}$ is called the government expenditure multiplier and it is greater than one because $0 < MPC < 1$.

For example, if the marginal propensity to consume is 0.6, the multiplier is

$$\Delta Y / \Delta G = 1 + 0.6 + 0.6^2 + 0.6^3 + \dots = 1 / (1 - 0.6) = 2.5.$$

In this case, a Br 1.00 increase in government purchases raises equilibrium income by Br 2.50.

Examples: - 1. If there is investment of 10 million in an economy, what would be the amount of increase in the level of income, taking the marginal propensity to consume 0.9?

$$1/1-mpc = 1/1-0.9 = 10$$

Then $\Delta Y = K \cdot \Delta I = 10 \times 10 \text{ million} = 100 \text{ million}$.

1. Let the government expenditure increase and tax reduction be 10 million with marginal propensity to consume being 0.8 (hint find multiplier and multiply by changes in g and T)

A) What is the amount of multiplier for ΔG and ΔTR ?

B) Calculate the change in the level of income

C) Interpret the result in A. (change in g exerts greater expansionary effect than change in T).

D) $t = 1/5$ determine the change in the level of income when $\Delta G = 10$ answer (25)

DERIVING THE IS CURVE

The income-expenditure relationship is the first step in building our macro model. It shows what determines an economy's income, given a level of planned investment. It is very unrealistic, however, to assume that planned investment is exogenous as it will depend on economic variables, the values of which are determined by the actions of people. The next step is to relax the assumption of fixed planned investment and include it in the income-expenditure model.

Endogenous Planned Investment

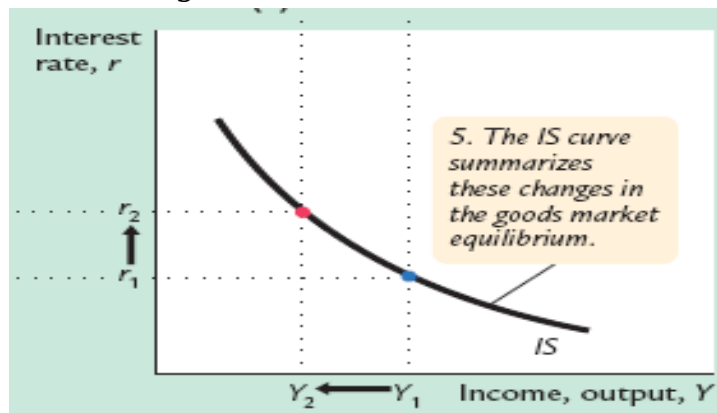
We know that an important factor determining the level of investment is the (real) interest rate (r). If the interest rate increases then the amount of business fixed investment undertaken decreases as the increase in r causes the cost of owning capital to increase. Firms reduce the amount of K they have, by lowering the level of I undertaken, to increase the Marginal Product of capital (MPK), that is the benefit of owning capital. Inventory and residential investment were also shown to be negatively affected by changes in r . So now assume that the level of planned investment is a negative function of the real interest rate, or in symbols that,

$$I = c - dr$$

Where $c \geq 0$ is the amount of autonomous investment and $d \geq 0$ determines how sensitive investment is to the interest rate, r , which implies that,

$$\frac{dI(r)}{dr} \leq 0$$

When this additional feature is added to the income-expenditure model we get the IS curve, which we can show graphically as:



The IS curve summarizes the relationship between r , the level of Y that results from the investment function and the income-expenditure relationship. The IS curve displays the values of r and Y such that aggregate planned expenditure is consistent with actual income, where income is assumed to be derived from output produced (which is taken as un-modeled so far).

The focus of attention of the IS curve is the market for goods: consumption, investment, and government purchases. It is also worth noting that the IS curve depends on the *fiscal position* of the government, where fiscal relates to government spending and taxation. Finally, if C was affected by r then it would just add and therefore reinforce the impact of r on I with the basic results of the model not changing.

Fiscal policy and the IS curve

The IS curve shows us, for any given interest rate, the level of income that brings the goods market into equilibrium. As we learned from the Keynesian cross, the level of income also depends on fiscal policy. The IS curve is drawn for a given fiscal policy; that is, when we construct the IS curve, we hold G and T fixed. When fiscal policy changes, the IS curve shifts. The Keynesian cross shows that expansionary fiscal policy raises planned expenditure and there by increases equilibrium income from .Therefore, an increase in government purchases shifts the IS curve outward.

We can use the Keynesian cross to see how other changes in fiscal policy shift the IS curve. Because a decrease in taxes also expands expenditure and income, it too shifts the IS curve outward. A decrease in government purchases or an increase in taxes reduces income; therefore, such a change in fiscal policy shifts the IS curve inward. Generally, changes in fiscal policy that raise the demand for goods and services (expansionary) shift the IS curve to the right. Changes in fiscal policy that reduce the demand for goods and services (contractionary) shift the IS curve to the left.

ALGEBRA OF THE IS CURVE: We assume saving and investment are equal and that the IS curve is just pairs of r and Y such that income (Y) equals planned expenditure (E),

$$Y = C + I + G.$$

Substituting in for C and I we get,

$$Y = a + b(Y - T) + c - dr + G.$$

Grouping the Y s together and rearranging and solving for Y we get:

$$Y = \left(\frac{1}{1-b} \right) (a+c) + \left(\frac{1}{1-b} \right) \bar{G} - \left(\frac{1}{1-b} \right) \bar{T} - \left(\frac{d}{1-b} \right) r$$
 Which is the IS curve in

algebraic form.

Example1. Given $C=100+0.80Y_d$, $I=50-25i$ and $G=T=50$ Then estimate the IS equation?

$$Y=C+I+G$$

$$Y=100+0.8Y_d+50-25i+50$$

$$Y=100+0.80(Y-T)-25i+50 \text{ then, } Y=100+0.80(Y-50)-25i+50$$

$$Y=200+0.80Y-25i \text{ this implies } Y-0.80Y=200-25i$$

$$0.20Y=200-25i. \quad \text{There for the general IS curve equation will be}$$

$$Y=800-125i$$

2. Given consumption(C) = $200+0.5(Y-T)$; investment (I) = $200 - 1000r$;

Government expenditure (G) = 250 and tax (T) = 200. Derive the IS relation

Points to Note about the IS Curve:

1) The IS curve is downward sloping because the coefficient on r is negative (i.e. increases in r imply that a lower value of Y is associated with being on the IS curve).

2) The slope of the IS curve is determined by the coefficient on r . If d is large (I is sensitive to r) or b is large (the MPC is large) then the IS curve is flat. A large d means that an increase in r will lead to a large

decrease in I and hence a large decrease in Y . Similarly, if b is large then an increase in expenditure will induce a large increase in C consumption, and hence a large increase in Y .

3) Changes in autonomous expenditure from G , T , a , or c will shift the IS curve in or out. The sizes of these shifts are determined by b through their impact on induced consumption. The larger b (the MPC) then the larger the multipliers, and the larger the shift in the IS curve.

4) The government expenditure multiplier is bigger than the taxation multiplier.

That is, $\left(\frac{1}{1-b}\right) > \left(\frac{b}{1-b}\right)$

This is because if G increases it directly increases planned expenditure and then causes subsequent increases in C , whereas if T decreases it only indirectly increases planned expenditure by causing C to increase.

3.3. The Money market and the LM curve

The LM curve plots the relationship between the interest rate and the level of income that arises in the market for money balances. To understand this relationship, we begin by looking at a theory of the interest rate, called the theory of liquidity preference.

The Theory of Liquidity Preference

In his classic work *The General Theory*, Keynes offered his view of how the interest rate is determined in the short run. That explanation is called the theory of liquidity preference, because it posits that the interest rate adjusts to balance the supply and demand for the economy's most liquid asset-money. The theory of liquidity preference suggests that a higher interest rate, r , lowers the quantity of real balances demanded, because r is the opportunity cost of holding money. Just as the Keynesian cross is a building block for the IS curve, the theory of liquidity preference is a building block for the LM curve. The supply and demand for real money balances determine the interest rate. At the **equilibrium interest rate**, the quantity of money balances demanded equals the quantity supplied.

To develop this theory, we begin with the supply of real money balances. If M stands for the supply of money and P stands for the price level, then M/P is the supply of real money balances. The theory of liquidity preference assumes there is a fixed supply of real money balances. That is,

$$(M/P)^s = \frac{\bar{M}}{\bar{P}}$$

The money supply M is an exogenous policy variable chosen by a central bank. The price level P is also an exogenous variable in this model. (We take the price level as given because the IS-LM model explains the short run when the price level is fixed.) These assumptions imply that the supply of real money balances is fixed and, in particular, does not depend on the interest rate. Thus, when we plot the supply of real money balances against the interest rate we obtain a vertical supply curve.

Next, consider the demand for real money balances. The theory of liquidity preference posits that the interest rate (actually a nominal interest rate, R) is one determinant of how much money people choose to hold. The reason is that the interest rate is the opportunity cost of holding money: it is what you forgo by holding some of your assets as money, which does not bear interest, instead of as interest-bearing bank deposits or bonds. When the interest rate rises, people want to hold less of their wealth in the form of money. We can write the demand for real money balances as:

$$(M/P)^d = L(R),$$

Where the function $L(R)$ shows that the quantity of money demanded depends on the interest rate. Thus, the demand curve slopes downward because higher interest rates reduce the quantity of real money balances demanded. Thus according to the theory of liquidity preference, the supply and demand for real money balances determine what interest rate should prevail in the economy

However the demand for real money balances is not only a function of interest rate, it is also a function of income. The level of income affects the demand for money. When income is high, expenditure is high, so people engage in more transactions that require the use of money. Thus, greater income implies greater money demand. We can then express the money demand function as:

$$(M/P)^d = L(R, Y)$$

$$L[R, Y] = eY - fR,$$

Where $e \geq 0$ measures the strength of the transactions demand for real money balances and $f \geq 0$ measures the interest sensitivity of the demand for real money balances. Given the above equation we would expect that the partial derivatives of the demand for real money balances with respect to R and Y take the following signs:

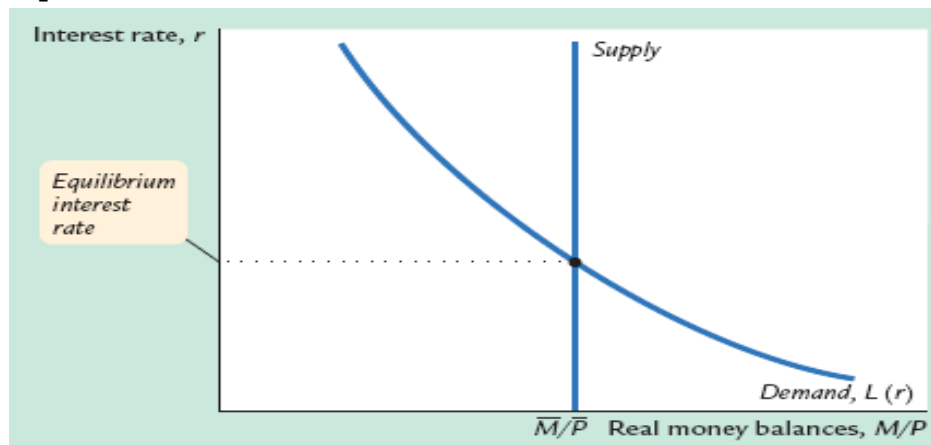
$$L_R = -f < 0 \text{ and } L_Y = e > 0.$$

EQUILIBRIUM IN THE MONEY MARKET

Equilibrium in the money market occurs when the quantity of real money balances demanded equals their supply of them, or,

$$\frac{\bar{M}}{\bar{P}} = L[R, Y].$$

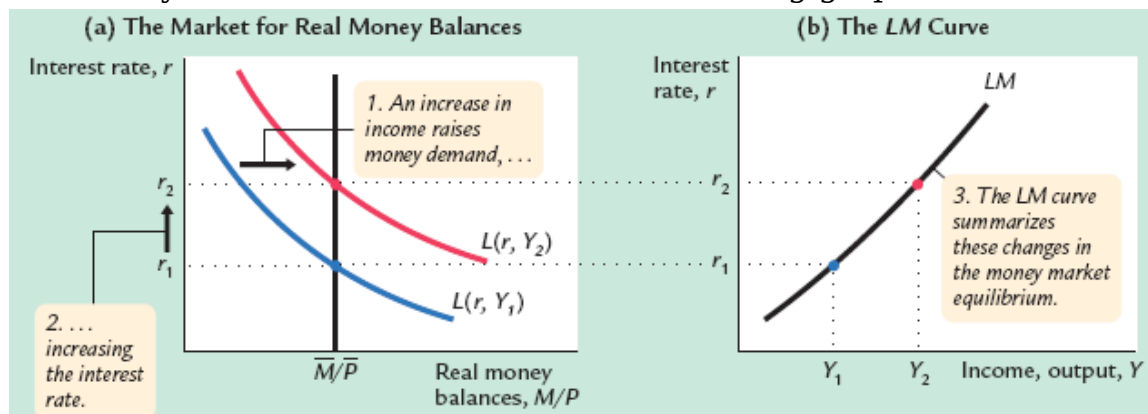
This situation is shown in the following graph with the equilibrium interest rate:



The supply and demand for real money balances determine the interest rate. The supply curve for real money balances is vertical because the supply does not depend on the interest rate. The demand curve is downward sloping because a higher interest rate raises the cost of holding money and thus lowers the quantity demanded. At the equilibrium interest rate, the quantity of real money balances demanded equals the quantity supplied.

DERIVING THE LM CURVE

The equilibrium interest rate that clears the money market depends on the level of income through the demand for real money balances. This implies that there is a systematic relationship between Y and r in the money market. This is shown in the following graph:

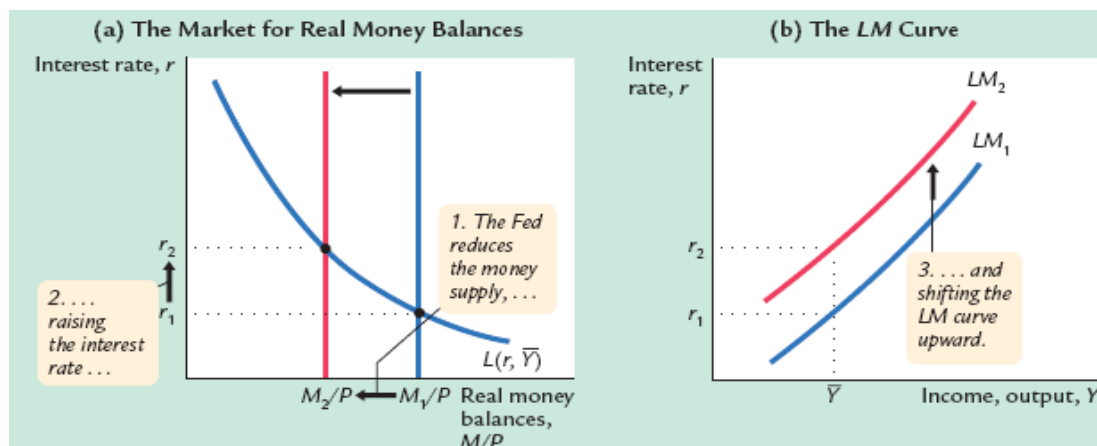


Deriving the LM Curve Panel (a) shows the market for real money balances: an increase in income from Y_1 to Y_2 raises the demand for money and thus raises the interest rate from r_1 to r_2 . Panel (b) shows the LM curve summarizing this relationship between the interest rate and income: the higher the level of income, the higher the interest rate.

Higher levels of Y increase the demand for real money balances and given a fixed supply of real money balances, nominal interest rate (R) must increase. That is why the LM curve is upward sloping. The higher R causes the opportunity cost of holding money to increase, reducing the quantity of real money balances demanded, and restoring equilibrium in the money market. This relationship between R and Y that gives equilibrium in the money market is known as the LM curve.

SHIFTS IN THE LM CURVE

Changes in R and Y will be movements along the LM curve, but any change in an exogenous variable will shift the position of the LM curve. For example, consider a once-off increase in the currency drain because people are worried about the solvency of the banking system. This will cause the money multiplier to fall, for a given level of the monetary base, which will cause a fall in the quantity of money supplied. With a fixed P , the supply of real money balances will fall. The following graph shows the situation:



A Reduction in the Money Supply Shifts the LM Curve Upward Panel (a) shows that for any given level of income Y , a reduction in the money supply raises the interest rate that equilibrates the money market. Therefore, the LM curve in panel (b) shifts upward.

ALGEBRA OF THE LM CURVE

As with the IS curve we will now derive the LM curve algebraically as doing so increases our understanding of the goods market relationship and also is needed to understand some aspects of the model which cannot be easily seen on the graph. We also know that money market equilibrium requires that,

$$\left(\frac{\bar{M}}{\bar{P}}\right) = eY - fR$$

and rearranging this expression we get,

$$R = \frac{e}{f}Y - \frac{1}{f}\left(\frac{\bar{M}}{\bar{P}}\right),$$

is the LM curve in algebraic form.

Points to Note about the LM Curve:

1. The LM curve is the schedule of combinations of interest rates and levels of income such that the money market is in equilibrium.
2. The LM curve is positively sloped given the fixed money supply, because an increase in the level of income, which increases the quantity of money demanded, has to be accompanied by an increase in interest rate. This reduces the quantity of money demanded and thereby maintains money market equilibrium.
3. At points to the right of the LM curve, there is an excess demand for money and at points to its left; there is an excess supply of money.
4. The LM curve is upward sloping because the coefficient on Y is positive (i.e. if R increases then a higher value of Y is associated with the money market being in equilibrium).
5. The slope of the LM curve is determined by the coefficient on Y . If e is large (changes in Y cause large changes in the transactions demand for real money balances) then the LM curve is relatively steep (i.e. a given increase in R will cause the demand for real money balances to fall, if e is large then only a small increase in Y is required to produce an offsetting increase in the demand for real money balances). If f is large (changes in R cause large changes in the quantity of real money balances demanded) the LM curve is

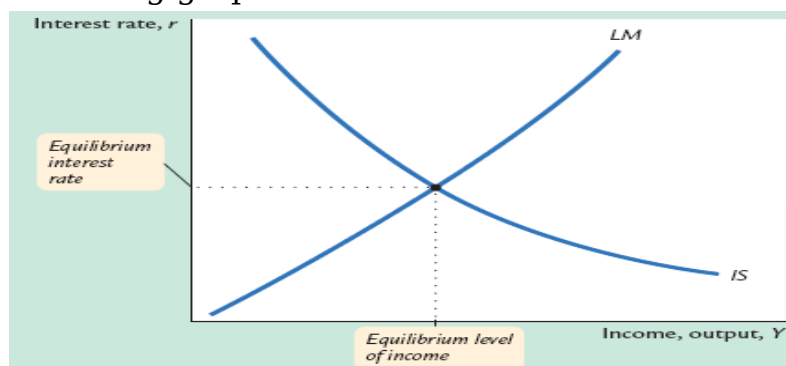
relatively flat (i.e. a given increase in Y will cause the demand for real money balances to increase, if f is large then a small increase in R is required to produce an offsetting decrease in the demand for real money balances.

6. Changes in $\bar{M}$ or $\bar{P}$ will shift the LM curve in or out. The sizes of these shifts depend upon the value of f . If f is large then an increase in $\bar{M}$ or decrease in $\bar{P}$ will cause a small downward shift in the LM curve (i.e. for a given Y and a given increase in $\bar{M}$ or decrease in $\bar{P}$, then a large f implies a small fall in R).

3.4. The Short Run Equilibrium

The IS and LM curves give us two equilibrium relationships between income and the interest rate. One problem though is that the goods market is affected by the real interest rate whereas the money market is affected by the nominal interest rate. There is a relationship between the two interest rates of the following form:

$R = r + \pi^e$ Where π^e is people's expectations of future inflation. What we will assume is that expected future inflation is zero, so that the two interest rates are the same. With this assumption, equilibrium occurs in the IS-LM model when the values of $r(R)$ and Y imply equilibrium in both the goods market and the money market (and thus in all other asset markets). What this equilibrium looks like is shown in the following graph:



Equilibrium in the IS-LM Model The intersection of the IS and LM curves represents simultaneous equilibrium in the market for goods and services and in the market for real money balances for given values of government spending, taxes, the money supply, and the price level.

One final and important point to notice is that changes in a , c , G , and T will have smaller impact on Y than in the income-expenditure relationship in isolation. *Example:* Assume that G increases which causes an increase in planned expenditure and falling inventories initially. As firms increase production, factor incomes increase, which induces an increase in C etc. We can show this by a shift out of the IS curve and it looks as though Y increases by the full impact of the increase in G . This is incorrect as simultaneously, though, the increase in Y causes the demand for money to increase which leads to a rise in r to restore equilibrium in the money market. The increase in r causes planned I to fall, reducing factor incomes, induced C , etc. In the end, Y is higher than we started off with but is not as high as suggested by the income-expenditure relationship in isolation because the increase in G has caused the “crowding out” of some planned I .

An increase in Government expenditure and the Crowding out effect

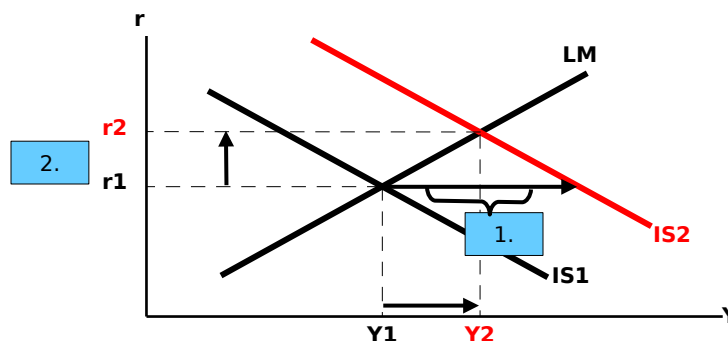
1. IS curve shifts right by

by $\frac{1}{1-MPC} \Delta G$, causing output & income to rise.

2. This raises money demand, causing the interest rate to rise...

3. ...which reduces investment, so the final increase in Y is less than

$\frac{1}{1-MPC} \Delta G$



INTERACTION BETWEEN MONETARY AND FISCAL POLICY

When analyzing any change in monetary or fiscal policy, it is important to keep in mind that the policymakers who control these policy tools are aware of what the other policymakers are doing. A change in one policy, therefore, may influence the other, and this interdependence may alter the impact of a policy change.

Monetary and Fiscal policy variables (M, G & T) are exogenous variables. Real world, monetary policymakers may adjust M in response to changes in fiscal policy, or vice versa. Such interaction may alter the impact of original policy change.

Suppose the Parliament increase G. Possible responses of the monetary authority (Central Bank) are:

- Hold M constant
- Hold r constant
- Hold Y constant

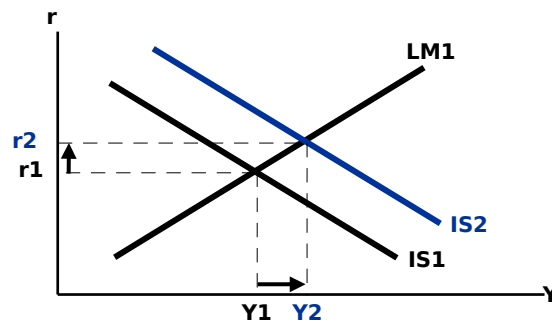
Response a: Hold M constant

When G increases, the IS curve shifts to the right. If the central bank holds M constant, the LM curve doesn't shift.

Results:

$$\Delta Y = Y_2 - Y_1$$

$$\Delta r = r_2 - r_1$$



Response b: Hold r constant

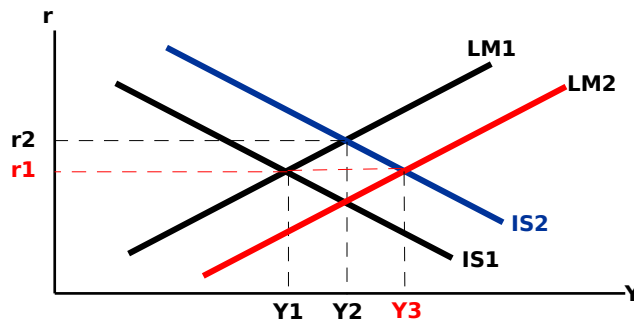
When G increases, the IS curve shifts to the right.

To keep r constant, Central Bank increases M to shift LM curve right.

Results:

$$\Delta Y = Y_3 - Y_1$$

$$\Delta r = 0$$



Response c: Hold Y constant

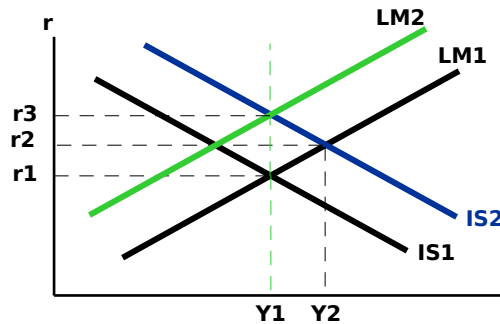
When G increases, the IS curve shifts to the right.

To keep Y constant, Central Bank reduces M to shift LM curve left.

Results:

$$\Delta Y = 0$$

$$\Delta r = r_3 - r_1$$



Example: the following equation describes an economy, where C, I, G etc are being measured in billions and r as percentage (a 5 percent interest rate implies $r=5$) and given

$$C = 0.8(1-t)y, \quad T = 0.25, \quad I = 900 - 50r, \quad G = 800, \quad M_d = 0.25Y - 62.5r \text{ and } M/P = 500$$

A). what is the equation that describes IS and LM curves.

B). what are the equilibrium levels of r and y

Solution

a. $Y = C + I + G = AD \rightarrow$ IS equation

$$Y = 0.8(1-t)Y + 900 - 50r + 800$$

$$Y = 0.8(1-t)Y - 50r + 1700$$

LM Equation $M_d = M_s$

$$0.25Y - \frac{62.5r}{62.5} = \frac{0.25y + 500}{62.5}$$

$$0.25Y - 62.5r = 0.25y + 500$$

$$R = (0.25y + 500)/62.5$$

b. substitute r in the above equation

$y = 0.8(1-t)y - 50((0.25y - 500)/62.5) + 1700$, $t = 0.25$. Then solve for Y and substitute for r

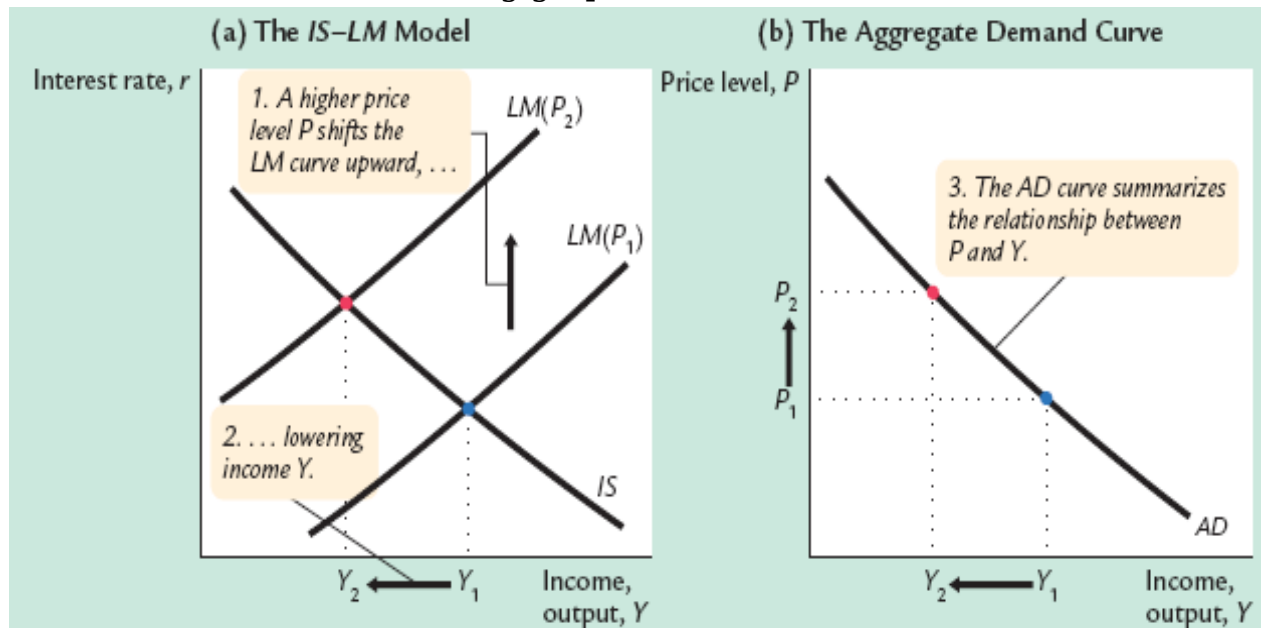
3.5. From the IS-LM to Aggregate demand

Having derived the IS and LM curves and establishing the condition for simultaneous equilibrium in these markets we are now in a position to go one step further and use this model to derive the aggregate demand curve which we will do next.

DERIVING THE AD CURVE

The final step in constructing the AD curve is to relax the price level which has so far been kept fixed in value in deriving the LM curve.

When we unfix the price level then the IS-LM model can be used to derive the quantity of aggregate output demanded in an economy. As an example, consider a decrease in the price level from P_1 to P_2 which is shown in the following graph:



Deriving the Aggregate Demand Curve with the IS-LM Model

Panel (a) shows the IS-LM model: an increase in the price level from P_1 to P_2 lowers real money balances and thus shifts the LM curve upward. The shift in the LM curve lowers income from Y_1 to Y_2 . Panel (b) shows the aggregate demand curve summarizing this relationship between the price level and income: the higher the price level, the lower the level of income.

The fall in P causes the supply of real money balances to increase. To obtain equilibrium in the money market, r must fall. The fall in r lowers the opportunity cost of holding money, thus inducing people to increase the quantity of real money balances that they demand. This is shown by the LM curve shifting to the right. The fall in r increases the demand for I . Through the multiplier effect, this leads to an increase in Y , which is represented by a movement along the IS curve. The new equilibrium point results in a higher value of Y and a lower value of r . Notice that the fall in r is not by as much as you would think right at the beginning. This is because the increase in Y partially offsets it. What this tells us is that lower (higher) values of P are associated with higher (lower) values of Y , that the AD curve is downward sloping in P . In this case the value of Y represents

aggregate income, or the aggregate quantity of goods and services demanded (Y^d).

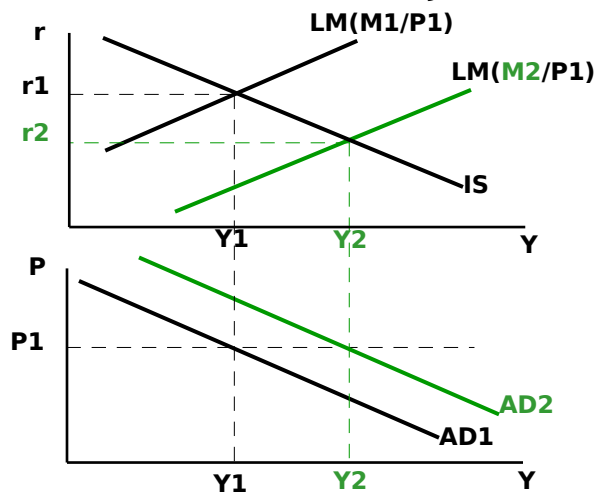
A SHIFT OF THE AGGREGATE DEMAND CURVE

A. Monetary Policy and Aggregate Demand

The Central Bank can increase aggregate demand:

$M \Rightarrow LM$ shifts right

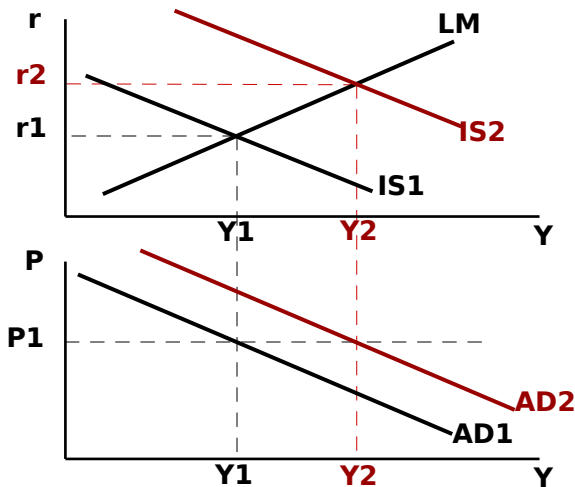
$\Rightarrow \downarrow r \Rightarrow \uparrow I \Rightarrow \uparrow Y$ at each value of P .



B. Fiscal Policy and the Aggregate Demand

Expansionary fiscal policy (G and/or $\downarrow T$) increases agg. Demand:

$\downarrow T \Rightarrow C \Rightarrow IS$ shifts to right $\Rightarrow Y$ at each value of P



ALGEBRA OF THE AGGREGATE DEMAND CURVE

The IS-LM model is a tool which can be used to analyze economic fluctuations, although to use this tool properly we need to understand two important characteristics of the IS and LM curves:

- 1. The slope of the curves;
- 2. The factors affecting the size of the shifts of the curve; and the clearest way of doing this is to derive it algebraically which we will now do. In equilibrium r and Y have to be the same regarding the money market and the goods market. This means that we can substitute for r from the LM curve,

$$R = \frac{e}{ff} Y - \frac{1}{\left(\frac{\bar{M}}{\bar{P}}\right)}$$

Into the IS curve,

$$Y = \left(\frac{1}{1-b}\right)(a+c) + \left(\frac{1}{1-b}\right)\bar{G} - \left(\frac{b}{1-b}\right)\bar{T} - \left(\frac{d}{1-b}\right)r$$

Given that $R=r$ since we are assuming $\pi^e=0$, which gives us the AD curve where Y is a function of P , or

$$Y = \frac{a+c}{1-b} + \frac{1}{1-b}\bar{G} - \frac{b}{1-b}\bar{T} - \frac{de}{f(1-b)}Y + \frac{d}{f(1-b)}\left(\frac{\bar{M}}{\bar{P}}\right)$$

This also means that P is no longer taken as given but is determined by the economic behavior of people in the model. We show this by removing the line over it. Now group together all the Y s and solving for Y we get,

$$Y = \frac{f(a+c+\bar{G}-b\bar{T})}{f(1-b)+de} + \frac{d\bar{M}}{f(1-b)+de} \left(\frac{1}{p} \right)$$

This is AD curve in algebraic form

Points to Note about the AD Curve:

Observe the algebraic form of the AD curve that we derived above:

$$Y = \frac{f(a+c+\bar{G}-b\bar{T})}{f(1-b)+de} + \frac{d\bar{M}}{f(1-b)+de} \left(\frac{1}{p} \right)$$

1. The AD slopes downward because the coefficient on (M/P) is positive and P is on the denominator (i.e. higher values of P are associated with lower values of Y). An increase in P causes the supply of real money balances to fall. This causes an increase in r to lower the demand for real money balances to get back to money market equilibrium. The increase in r causes the amount of planned I to fall. As a result, planned expenditure is now lower than actual expenditure, so that inventories build up. Production is cut back to reduce inventories (note that we are still have not formally introduced aggregate supply so this story is very informal) which will lower incomes paid to factors. Lower Y through the multiplier process causes lower C and further falls in Y . The net result is a fall in Y (because of a fall in the quantity of aggregate output demanded).
2. The slope of the AD curve depends on the slopes of the IS and LM curves. The bigger the coefficient on (M/P) then the steeper is the AD curve. The AD curve is steeper when:
 1. b (the MPC) is small.
 2. d (the interest sensitivity of planned I) is small.
 3. e (the income sensitivity of the demand for real money balances) is large.
 4. f (the interest sensitivity of the demand for real money balances) is large; as 1 and 2 imply a steep IS curve which means that a change in r has a small impact on Y , and 3&4 imply smaller shifts in the LM from a change in P and thus smaller changes in r and Y .

Example: Assume that b is small and $P \downarrow$. Then the LM curve shifts to the right, r falls, I increases, and Y increases. We know that the effect on the level of induced C depends on the value of b . If b is small (large) then amount of induced C is small (large), and so the ultimate increase in Y is relatively small (large). That is, a given decrease in P causes a small (large) increase in Y , which equates to the slope of the AD curve being steep (flat) if b is small (large).

– 3) Changes in $a, c, \bar{G}, \bar{T}, \text{ or } \bar{M}$ will shift the AD curve in or out. The sizes of these shifts depend on the values of the parameters (as shown in the table below).

1. The LM curve:

$$R = \frac{e}{ff} Y - \frac{1}{f} \left(\frac{\bar{M}}{\bar{P}} \right) \quad (1)$$

2. The IS curve:

$$Y = \left(\frac{1}{1-b} \right) (a+c) + \left(\frac{1}{1-b} \right) \bar{G} - \left(\frac{b}{1-b} \right) \bar{T} - \left(\frac{d}{1-b} \right) r \quad (2)$$

3. The AD curve:

Given that $R=r$ since we are assuming $\pi^e = 0$, substitute (1) into (2) and rearrange to get Y on the LHS by itself to get the AD curve, where Y is a function of P , or,

$$Y = \frac{f(a+c+\bar{G}-b\bar{T})}{f(1-b)+de} + \frac{d\bar{M}}{f(1-b)+de} \left(\frac{1}{p} \right)$$