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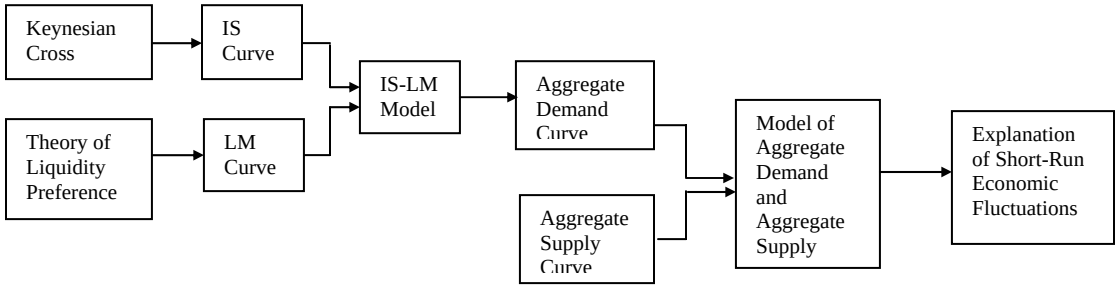
Note: **The derivation of IS, LM curve and The Effective Exchange Rate**

To go over the derivation of the IS and LM curve, I would like to start with the theory of short-run fluctuations.

The Theory of Short-Run Fluctuations



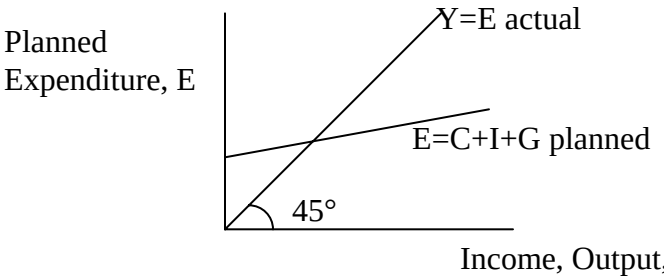
This schematic diagram shows how the different pieces of the theory fit together. The Keynesian cross explains the *IS* curve, and the theory of liquidity preference explains the *LM* curve. The *IS* and *LM* curves together yield the *IS-LM* model, which explains the aggregate demand curve. The aggregate demand curve is part of the model of aggregate supply and aggregate demand, which economists use to explain short-run fluctuations in economic activity.

The Keynesian Cross

We begin our derivative of the Keynesian cross by drawing a distinction between actual and planned expenditure. **Actual expenditure** is the amount households, firms, and government spend on goods and services, and it equals the economy's GDP. **Planned expenditure** is the amount households, firms and the government would like to spend on goods and services.

Why would actual expenditure differ from planned expenditure? The answer is that firms might engage in unplanned inventory investment because their sales do not meet their expectation. When firms sell less of their product than they planned, their stock of inventories automatically rises.

Assuming that the economy is closed (no export and import), we write planned expenditure E as $E = C + I + G$. Since C depends on disposable income $(Y - T)$, se can write $C = C(Y - T)$. We also assume that the fiscal policy, level of G and T, is fixed. The next piece of the Keynesian cross is the assumption that the economy is in equilibrium when actual expenditure equals planned expenditure. We can write this equilibrium as Actual Expenditure (Y) = Planned Expenditure (E).

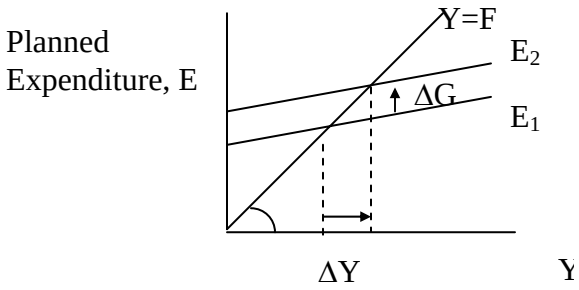


The Keynesian Cross The equilibrium in the Keynesian Cross is at point A, where income (actual expenditure) equals planned expenditure.

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.

Fiscal Policy and the Multiplier: Government Purchases

Because government purchases are one component of expenditure, higher government purchases result in higher planned expenditure for any given level of income. If government purchases rise by ΔG, then the planned expenditure schedule shifts upward by ΔG, as in figure below.



This graph shows that an increase in government purchases leads to an even greater increase in income. That is, ΔY is larger than ΔG. The ratio $\Delta Y/\Delta G$ is called the **government purchases multiplier**.

The government-purchases multiplier is most easily derived using a little calculus. Begin with the equation

$$Y = C(Y - T) + I + G \qquad \text{Holding } T \text{ and } I \text{ fixed, differentiate to obtain}$$

$$dY = C'dY + dG \qquad (C' = MPC \text{ or Slope of consumption function})$$

$$dY/dG = 1/(1 - C') = 1/(1 - MPC)$$

Fiscal Policy and the Multiplier: Taxes

A decrease in taxes of ΔT immediately raises disposable income $Y - T$ by ΔT and, therefore, increases consumption by $MPC \times \Delta T$. For a given level of income Y, planned expenditure is now higher. Just as an increase in government purchases has a multiplier effect on income, so does a decrease in taxes. Consider

$$Y = C(Y - T) + I + G \qquad \text{Holding } G \text{ and } I \text{ fixed, differentiate to obtain}$$

$$dY = C'(dY - dT) \qquad (C' = MPC \text{ or Slope of consumption function})$$

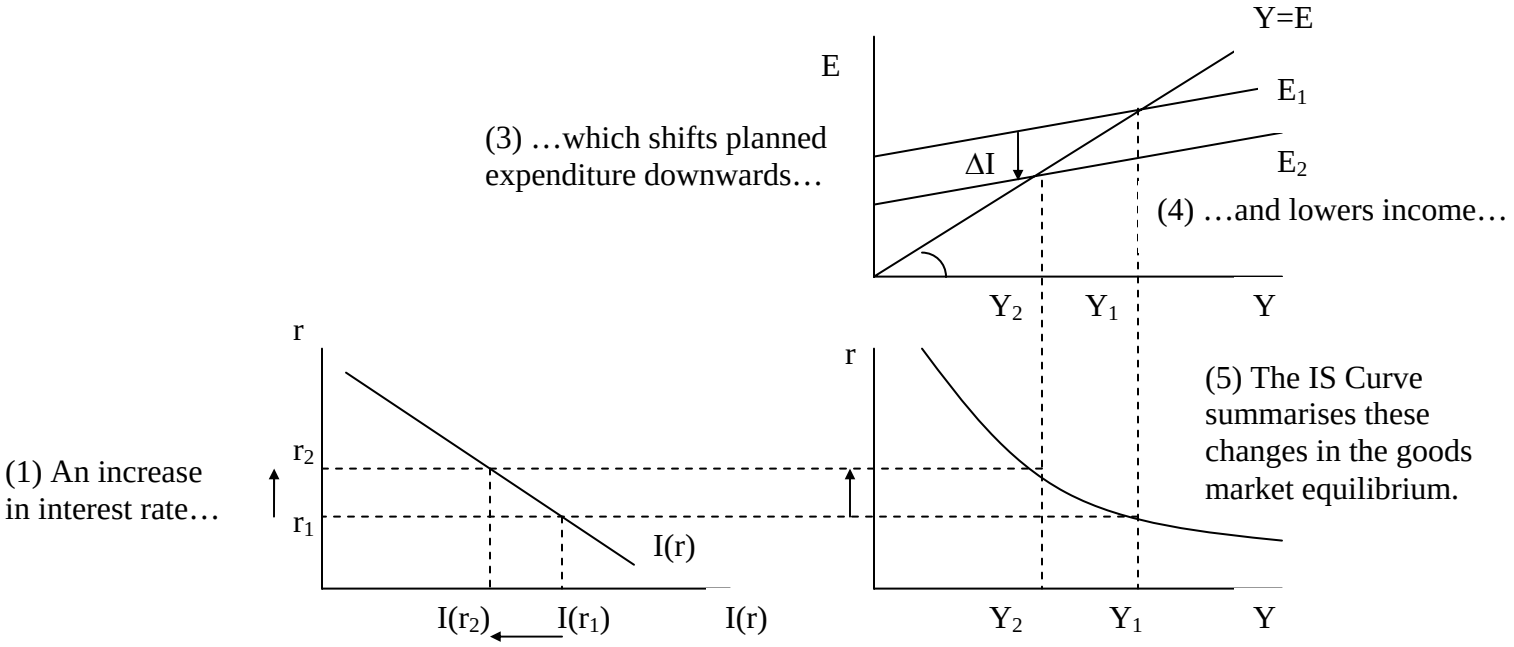
$$dY/dT = -C'/(1 - C') = -MPC/(1 - MPC)$$

The *IS* Curve and The Good Market

The Keynesian cross is only a steppingstone on our path to the *IS-LM* model. The IS curve plots the relationship between interest rate and level of income that arises in the market for goods and services.

We write the level of planned investment as $I = I(r)$. Because the interest rate is the cost of borrowing to finance investment projects, an increase in the interest rate reduces planned investment. As a result, the investment function slopes downward.

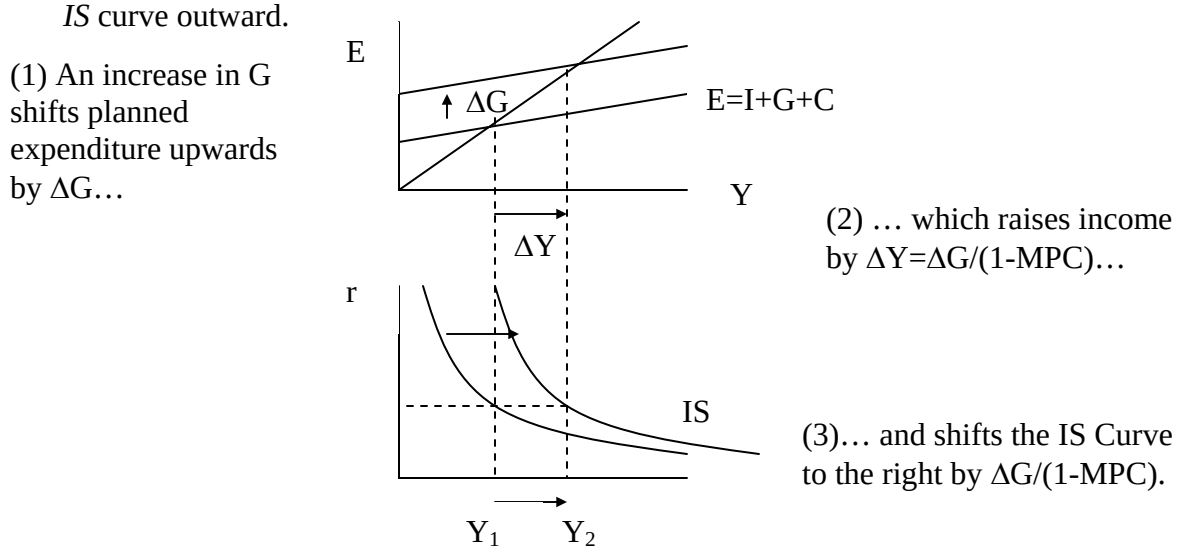
To determine how income changes when the interest rate changes, we can combine the investment function with the Keynesian cross diagram. Because investment is inversely related to the interest rate, and increase in the interest rate reduces the quantity of investment. The reduction in planned investment, in turn, shifts the planned-expenditure function downward. The shift in the planned expenditure function causes the level of income to fall. Hence, an increase in the interest rate lowers income.



How Fiscal Policy Shifts the *IS* Curve

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 figures below are drawn for a given interest rate (thus for a given level planned investment). The Keynesian cross shows that increasing in government purchasing raises planned expenditure and thereby increases equilibrium income. Therefore, an increase in government purchases shifts the *IS* curve outward.

Because a decrease in taxes also expands expenditure and income, it too shift the *IS* curve outward.

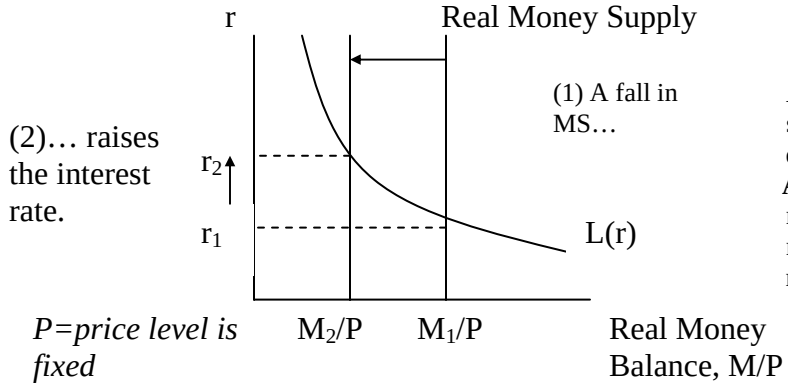


The Theory of Liquidity Preference

Just as Keynesian cross is a building block for the *IS* curve, the theory of liquidity preference is a building block for the *LM* curve. 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 assumes there is a fixed supply of real money balances. That is $(M/P)^S = \bar{M}/\bar{P}$. The money supply M is an exogenous policy variable chosen by a central bank. The price level is also an exogenous variable in this model. These assumption implies that the supply of real money balance is fixed and , in particular, does not depend on the interest rate.

Next, consider the demand for real money balances. The theory posits that the interest rate is one determinant of how much money people choose to hold. 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 $(M/P)^D = L(r)$. Thus, the demand curve slopes downward because higher interest rate reduce the quantity of real money balances demanded.



According to the theory of liquidity preference, the supply and demand for real money balances determine what interest rate prevails in the economy. **A reduction in the money supply** in this theory raises the interest rate and the higher interest rate makes people satisfied to hold the smaller quantity of real money balances.

The *LM* Curve and the Money Market

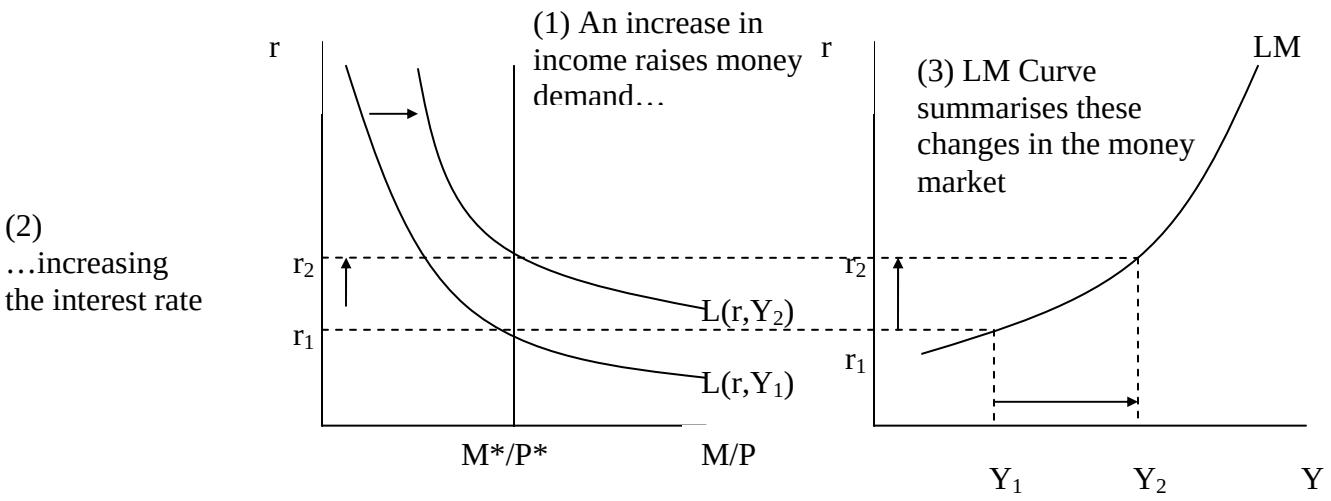
We now can use the theory of liquidity preference to derive the *LM* curve. When income is high, expenditure is high, so people engage in more transactions that require the use of money. Thus, greater income implies greater money demand. It follows that

$$(M/P)^D = L(r, Y)$$

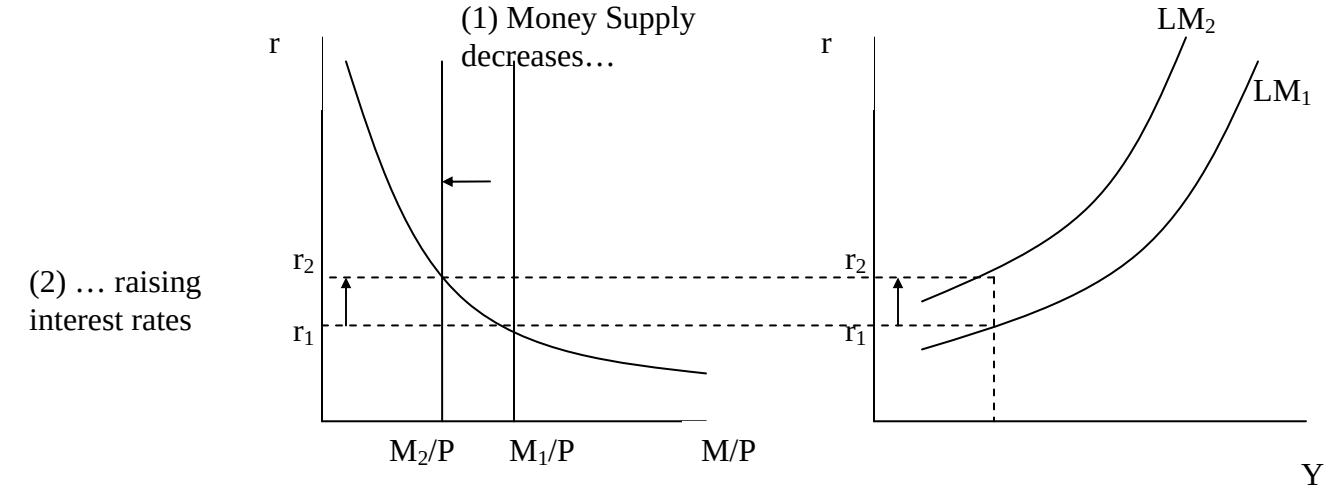
The quantity of real money balances demanded is negatively related to the interest rate and positively related to income.

Using the theory of liquidity preference, we can figure out what happens to the equilibrium interest rate when the level of income changes. An increase in income shifts the money demand curve to the right. With the supply of real money balances unchanged, the interest rate must rise from to equilibrate the money market. Therefore, according to the theory of liquidity preference, higher income leads to a higher interest rate.

The *LM* curve plots this relationship between the level of income and the interest rate. The higher the level of income, the higher the demand for real money balances, and the higher the equilibrium interest rate. For this reason, the *LM* curve slopes upward.



We can also use the theory of liquidity preference to understand how monetary policy shifts the *LM* curve. Holding constant the amount of income and thus the demand curve for real money balances, we see that the reduction in the supply of real money balances raises the interest rate that equilibrates the money market. Hence, a decrease in the money supply shifts the *LM* curve upward.



Conclusion: The Short-Run Equilibrium

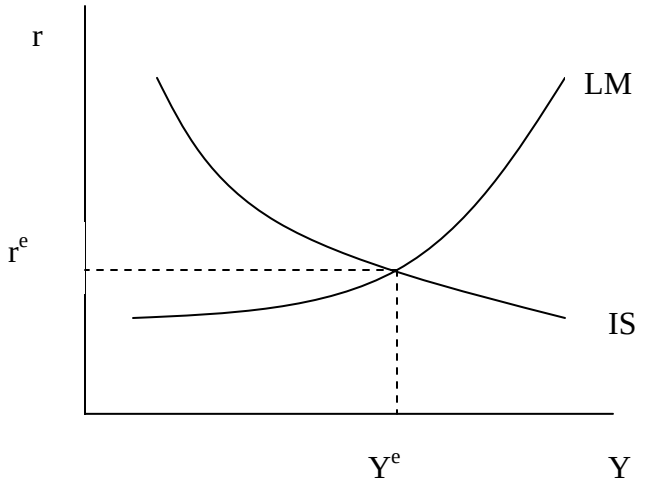
We now have all pieces of the *IS-LM* model. The two equations of this model are

$$Y = C(Y - T) + I(r) + G \qquad IS\,,$$

$$M/P = L(r, Y) \qquad LM\,,$$

The model takes fiscal policy, G and T, monetary policy M, and the price level P as exogenous. Given these exogenous variables, the IS curve provides the combinations of r and Y that satisfy the equation representing the goods market, and the LM curve provides the combinations of r and Y that satisfy the equation representing the money market. .

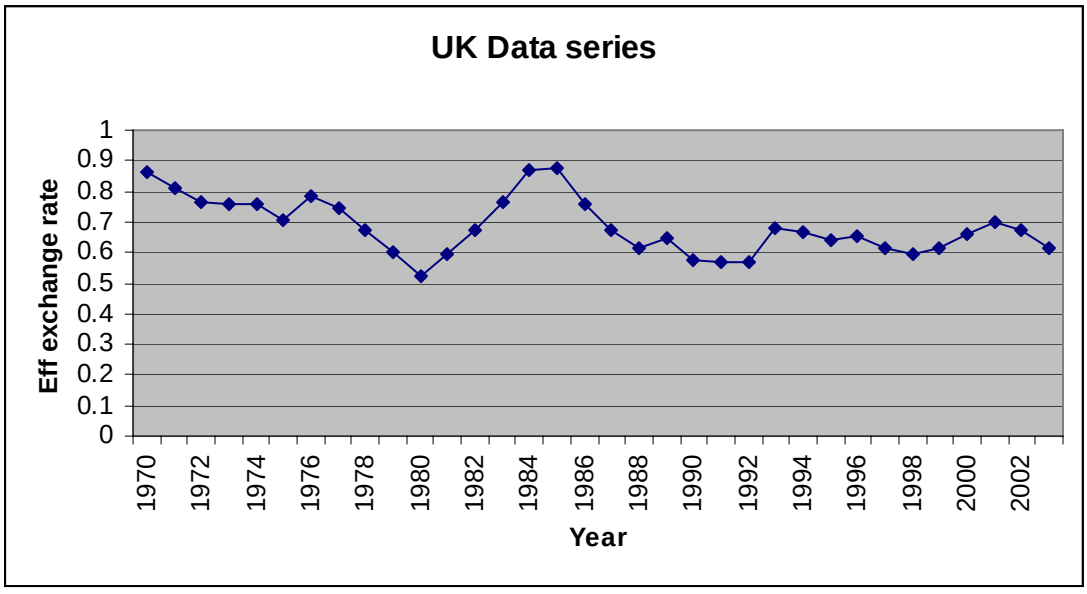
The equilibrium of the economy is the point at which the IS curve and the LM curve cross. This point gives the interest rate r and the level of income Y that satisfy conditions for equilibrium in both the goods market and the money market. In other words, at this intersection, actual expenditure equals planned expenditure, and demand for real money balances equals the supply.



The Effective Exchange Rate

The effective exchange rate is define as

$$EER = e_{\$/} \left(\frac{UK.CPI}{US.CPI} \right)$$



Exchange rate against $ x UKCPI divided by US CPI (consumer price index)

It has shown volatility in short periods but over a long period of time does suggest purchasing power parity may have some validity in the long run.