

IS relation \rightarrow equality between supply of goods (goods market) and demand for goods. Y is determined by this equality.

It tells us how the interest rate (i) affects output (Y).

Condition for IS Relation:

$$Y = C(Y-T) + I(Y, i) + G \Rightarrow Y = Z$$

Supply of goods
= production

Demand for goods
= sales

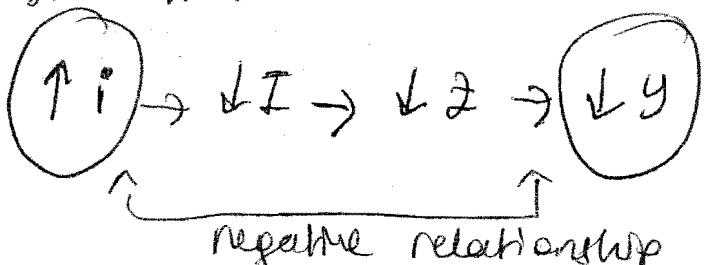
Look at the equation above to understand how a change in the interest rate changes output (Y).

$$Y = C(Y-T) + I(Y, i) + G \Rightarrow Y = Z$$

Interest rate enters this equation here!

If i goes up, I goes down because of the negative relationship between the cost of borrowing, the interest rate (i), and investment (I), increase in capital stock (new machines, equipments). The decrease in I leads to one-for-one decrease in demand, which is the right hand side of the equation. Thereafter the decrease in demand leads to a decrease in output (Y), which further decreases investment and consumption through the multiplier effect.

Let us use a convenient short-hand to understand this mechanism. Note that the equation is $Y = C(Y-T) + I$



So, an increase in i leads to a decrease in Y .

Let us derive the IS curve now. 2
Suppose the economy is in equilibrium and the
interest rate is 3% and output level is \$100 billion.
Let us say this equilibrium point is $A(Y, i) = A(100, 3\%)$.

Suddenly i goes up to 6%. What happens to Y ?

We already know that there is a negative relationship
between i and Y . Therefore, Y will decrease.
Let us suppose that Y decreases from \$100 billion
to \$80 billion. Now the economy is again in
equilibrium, but with a different i and Y . Let us
call this new equilibrium point as point B.

$$B(Y, i) = B(80, 6\%)$$

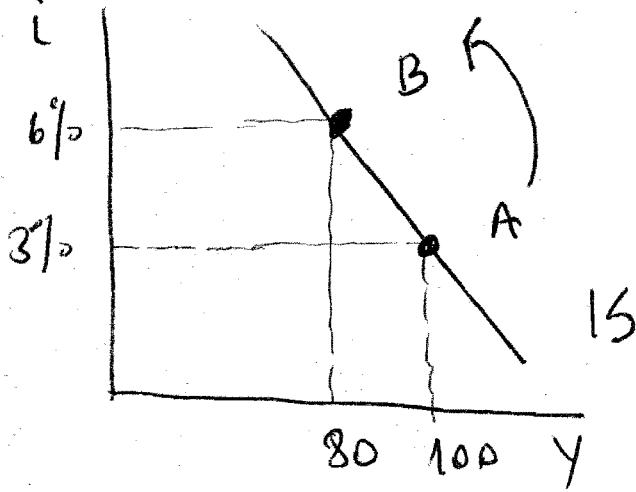
We have two equilibrium points now, A and B.
Suppose that the relationship between i and Y
is linear, which means that we can have the
relationship between i and Y through a line.

Hence two points is sufficient to draw a line.

Two points are $A(100, 3\%)$ and $B(80, 6\%)$

Remember that we want to establish a relationship
between i and Y . In other words, we want to see the
effect of i on Y , when other things that can
affect Y are constant (*ceteris paribus*).

So let us plot i (measured on the vertical
axis) against Y (measured on the horizontal
axis).



$$A = (100, 3\%)$$

$$B = (80, 6\%)$$

Mark these points and joint these two points and your IS curve is ready. Note that along a line, the slope is constant. Take any two points and calculate the slope, you will come up with the same slope!

By looking at this line you can see the relationship between i and Y . You can tell what happens to Y when i changes. For instance, when i goes up from 3% to 6%, Y goes down from \$100 to \$80. A change in the interest rate leads to a movement along the IS line (curve). In this case, the economy moves from point A(3%, 100) to B(6%, 80). Look at where the arrow points above. But please remember that we assumed all other things that affect Y are held constant. For example, what happens if the government reduces taxes? This relationship between i and Y will be broken because tax is one of the determinants of Y .

Let us go back to the condition that gives the 4 equilibrium conditions in the goods market:

$$Y = C(Y-T) + I(Y, i) + G \rightarrow \text{given } T \text{ fixed}$$

We established a relationship between i and Y when T and G are fixed. What happens if one of these factors changes? We need to establish a new relationship. Suppose that taxes are reduced. This will lead to an increase in disposable income ($Y-T$), leading to an increase in consumption, leading in turn to an increase in the demand for goods and to an increase in equilibrium output. Remember that there is no change in the interest rate. Changes in factors (G and T) that increase the demand for goods given the interest rate shift the IS curve to the right.

\Rightarrow given the interest rate means that the interest rate is unchanged.

Use a shorthand to understand the mechanism.

Cause: $\downarrow T \rightarrow \uparrow (Y-T)$ - decrease in taxes (T)

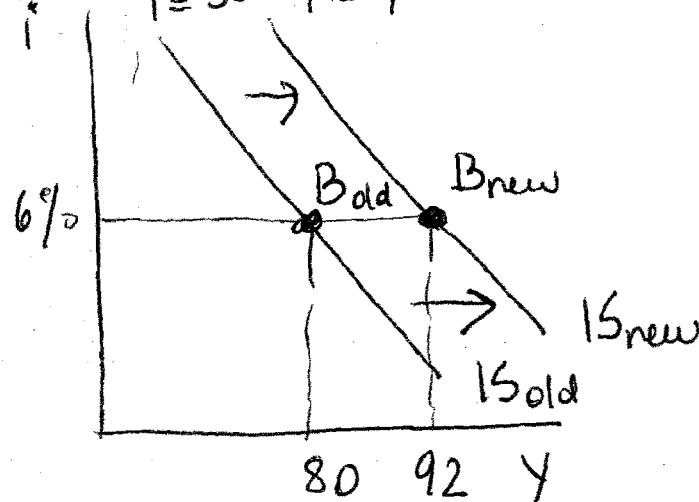
We would like to see the effect of this cause on Y when there is no change in i .

$$\downarrow T \rightarrow \uparrow (Y-T) \rightarrow \uparrow C \rightarrow \uparrow I \rightarrow \uparrow Y$$

for given interest rate.

Now let us see the effect of a tax decrease

on the IS curve.



Please note that I use imaginary numbers.

IS Old

Take point B $(6\%, 80)$

and $T = 50$

there is equilibrium.

Then T goes down to 40.

Equilibrium is broken because

T is lower now at the

same interest rate. So, consumption will ^{increase}, leading to an increase in i and Y . New Y is \$92. Interest rate is unchanged. Therefore, we have a new point, $B_{New} = (6\%, 92)$.

More generally, any factor $(TG, \downarrow T)$ that, for a given interest rate, increases the equilibrium level of income (output) causes the IS curve to shift to the right.

Symmetrically, any factor $(\downarrow G, \uparrow T)$ that, for a given interest rate, increases the equilibrium level of output causes the IS curve to shift to the left.

LM Relation (Money market)

→ equality between supply of b and demand for money. i is determined by this equality.

It represents the relation between i and Y , or the effect of Y on i . It tells us how Y affects i .

Condition for LM relation

$$\frac{M}{P} = YL(i) \quad (*)$$

real money
Real money demand
Real money supply = money
in terms of goods
not dollars or euros.

$$\begin{matrix} \text{Real money supply} & = & \text{Real money demand} \end{matrix}$$

Remember that Y is real income not nominal income.
 Y is measured in goods not in dollars or euros.
Look at the right-hand side (RHS) of equation. Real money demand depends on two things: real income (+) and the interest rate (-).

Look at the equation (*) to understand how an increase in Y affects i .

Initially, money market is in equilibrium.

Cause: Y goes up.

We would like to see the effect of this change on the equilibrium interest rate.

When Y goes up, real money demand also goes up since we tend to buy more and tend to hold more money. Therefore, the equilibrium is broken.

The two sides of the equation (*) are not equal anymore. Real money supply is less than real money demand. As a result, equilibrium interest rate will rise to maintain equilibrium in the market. Please remember that interest

rate is opportunity cost of holding money or price of money?

If demand for money increases, price of money will increase.

Let us use a short-hand to understand the mechanism.

$$\uparrow Y \rightarrow \frac{\uparrow M_d = Y L(i)}{\text{Real money demand}} \rightarrow \uparrow i$$

positive relationship

So, an increase in Y leads to an increase in i.

Cause

effect

Let us derive the LM curve now.

Suppose the money market is in equilibrium and i is 2% and Y is \$200, corresponding to an equilibrium at point $A = (200, 2\%)$. What will happen to

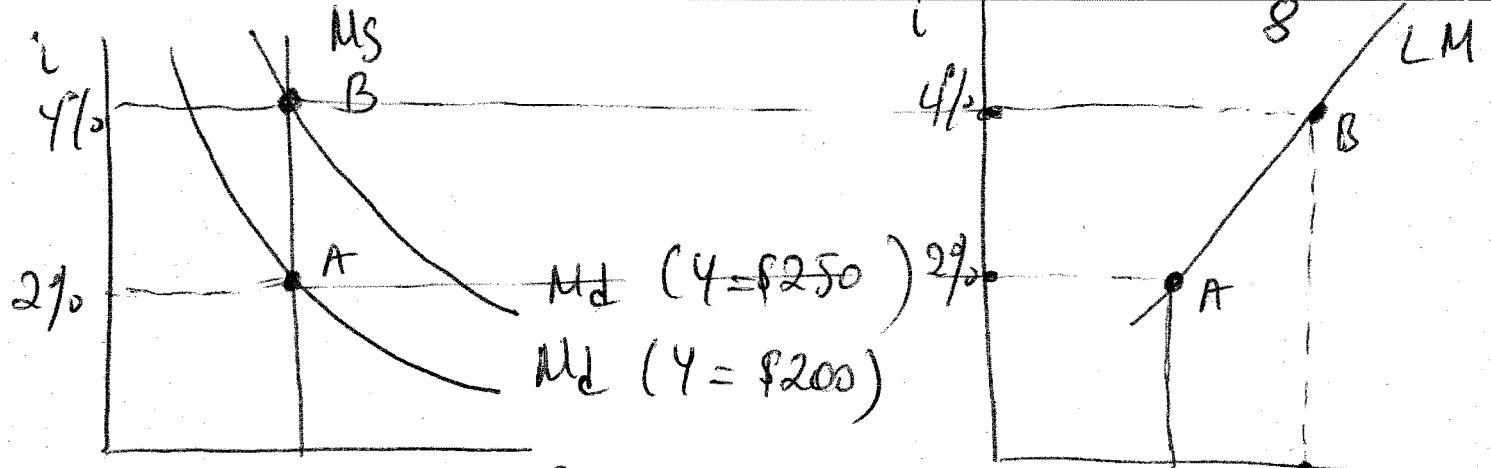
the equilibrium interest rate of 2%, if Y increases to 250?

We already know that there is a positive relationship between Y and i in the money market. (Look at the mechanism given by the short-hand) Thus, equilibrium interest rate will also increase, say to 4%.

So, the new equilibrium is at point $B = (250, 4\%)$.

We have two equilibrium points now, A and B. Assuming a linear relationship between Y and i , we can derive our LM line very easily.





(Panel A) $\frac{M}{P}$
(real money)

\$200 \$250
(Panel B) Y

(I didn't show the derivation of IS curve in detail as I do here for the LM curve. Look at the story and do it on your own.)

Note that ~~in~~ the figure in panel B plots the equilibrium interest (i) on the vertical axis against equilibrium level of output (income) Y on the horizontal axis.

Equilibrium in the money market implies that a higher level of output ($B = \$250$) is associated with a higher equilibrium interest rate ($A = 2\%$, $B = 4\%$).

This relation between output and the interest rate is represented by the upward sloping LM curve.

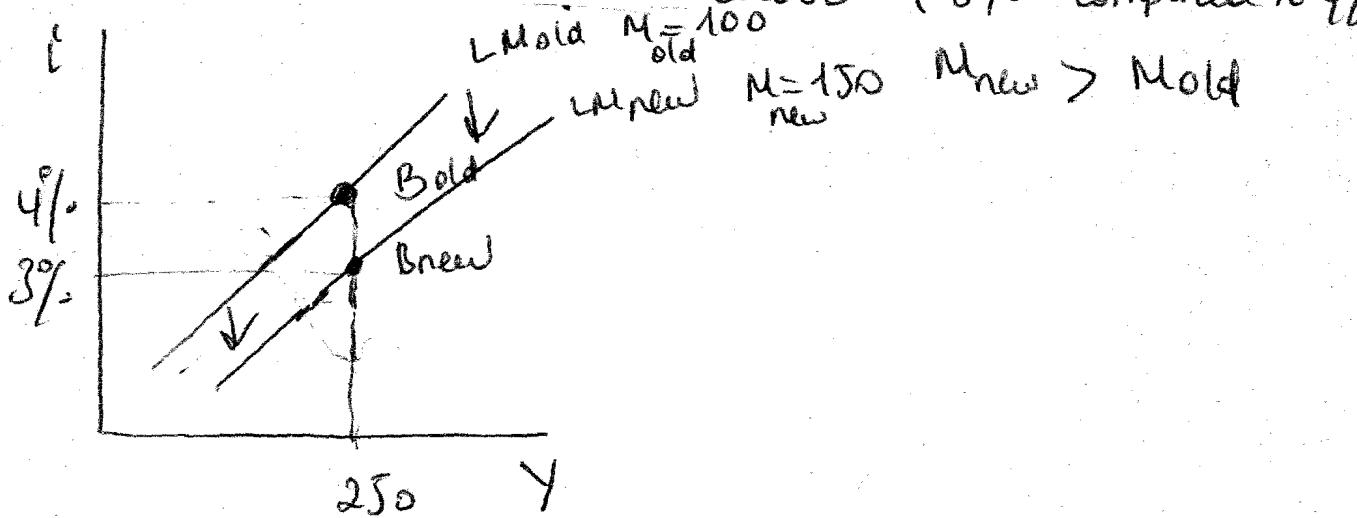
A change in Y leads to a movement along the LM curve. (from A to B)

We established a relationship between Y and i when the other variables that enter the equilibrium condition equation (*) are constant.

$$(*) \quad \frac{M}{P} = YL(i)$$

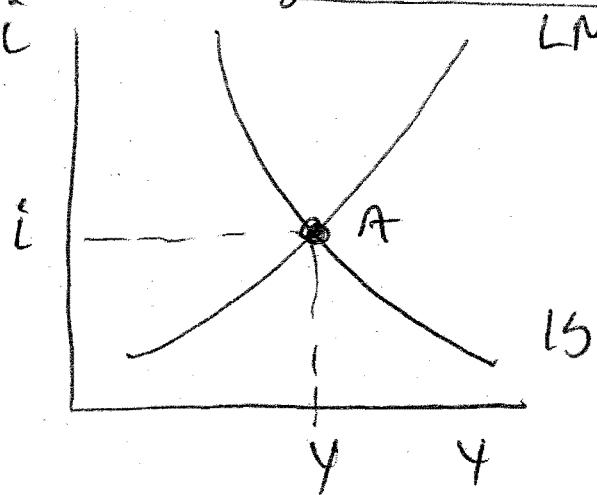
What happens if RHS of the equation changes?

Suppose that $\frac{M}{P}$ or real money supply due to the increase in nominal money stock, M . The relation between Y and i that we learned for the LM curve will be broken. We have to establish a new relation and draw a new LM curve. Let us remember the story. The money market is in equilibrium, say at point $B = (\$250, 4\%)$. Suddenly, Central Bank increases ^{the} money supply by conducting an expansionary monetary policy through purchasing bonds. Now, money in circulation or money supply is greater than money demand. In other words, people want to hold less money than it is in circulation. Hence, price of money, the interest rate will decrease to 3% . Please note that there is no change in Y . It is still \$250 billion. At the same income level, now the interest rate is lower (3%) compared to 4% .



At a given level of income (Y) (say \$250), an increase (decrease) in money supply leads to a decrease (increase) in the interest rate, causing the LM curve to shift down (up).

Putting the IS and LM curves together 10



Equilibrium in the goods market implies that an increase in i leads to a decrease in Y . This relation is represented by the IS curve.

Equilibrium in the money market implies that an increase in Y leads to an increase in i . This relation is represented by the LM curve.

- Only at point A, which is on both curves, are both goods and money markets in equilibrium.

The Effects of Fiscal Policy

Suppose the government follows an expansionary fiscal policy through either an increase in G or a decrease in T . What is the effect of this policy on IS and LM curves and in turn on the equilibrium income and the equilibrium interest rate?

Cause: Increase in G ($\uparrow G$)

Effect? on Y and i

First step: What is the impact on IS and LM curves of $\uparrow G$?

Answer: Go through IS and LM relations, i.e. the equilibrium conditions for the goods market and the money market. Identify in which equation G enters.



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

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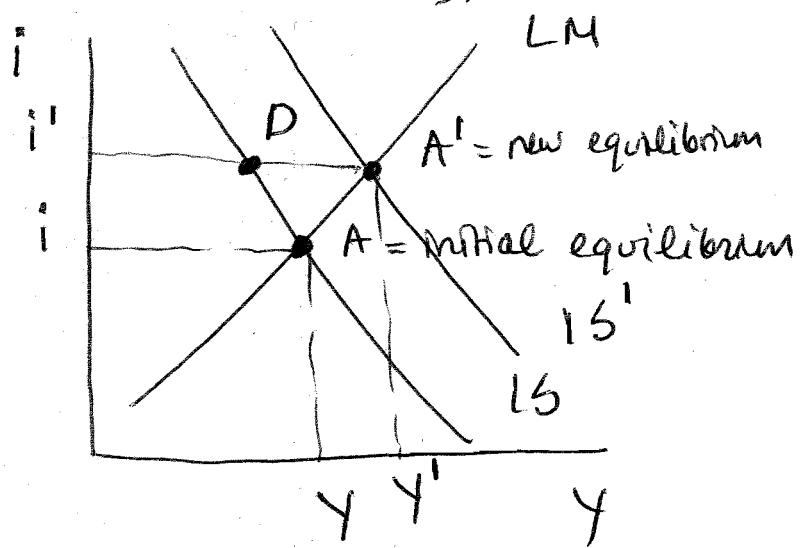
$$LM \text{ relation: } \frac{M}{P} = YL(i)$$

Notice that G enters ^{only} into the IS relation equation.
 So, LM curve will not be affected by fiscal policy.
 But the goods market and accordingly IS curve
 will be affected. Remember the mechanism by looking
 at the IS relation equation:

$$\uparrow G \rightarrow \uparrow Z \rightarrow \uparrow Y$$

Remember also that a change in a factor that
 leads to an increase in the equilibrium level of
 income (Y) will shift the IS curve to the right.

Let us depict this situation on a graph combining
 IS and LM curves.



- IS curve shifts right,
- LM curve is unchanged

If the money market did not exist, the economy would end up at point D instead of A'. However, as IS curve shifts, the economy moves along the LM curve, from A to A'.

Second step: What is the impact on i and Y of $\uparrow G$?

The economy moves from point A to point A'. As a result, both i and Y go up.

Tell the mechanism with short-hand and then in words.

$$\frac{\uparrow G}{\text{Goods market}} \rightarrow \frac{\uparrow Z}{\text{Goods market}} \rightarrow \frac{\uparrow Y}{\text{Money market}} \rightarrow \frac{\uparrow M_d}{\text{Money market}} \rightarrow \frac{\uparrow i}{\text{Money market}} \rightarrow \frac{\downarrow I}{\text{Goods market}} \rightarrow \frac{\downarrow Y}{\text{Goods market}}$$

In words: The increase in G leads to an increase in demand for goods (Z), leading to an increase in output and income. At the same time, the increase in income increases demand for money, causing the interest rate to rise. The increase in the interest rate leads to lower investment, demand, and output. But the increase in the interest rate reduces but does not completely offset the effect of higher government spending on equilibrium level of income.

The Effect of Monetary Policy

Suppose the CB follows an expansionary monetary policy through buying bonds. What is the effect of this policy on IS and LM curves and in turn on the equilibrium level of income and the equilibrium interest rate?

Cause: Increase in M ($\uparrow M$)

Effects: on Y and i .

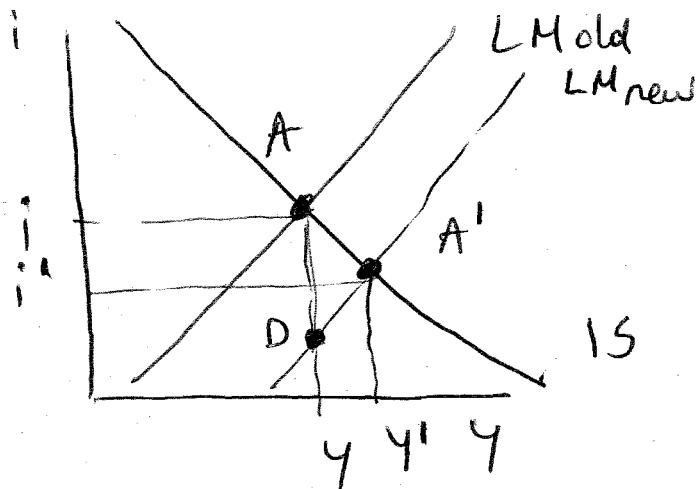
First step: What is the impact of $\uparrow M$ on IS and LM curve?

Answer: Look at IS relation and LM relation equations and identify in which equation M appears.

IS : $Y = C(Y-T) + I(Y, i) + G \rightarrow M \text{ does not appear here!}$

$$LM: \frac{M}{P} = L(i)$$

So, IS curve will not shift. Only LM curve will shift.



Initial eq: $A(Y, i)$
New eq: $A'(Y', i')$

If the goods market did not exist or were not taken into account, the economy would end up at point D instead of A'. However, as LM curve shifts, the economy moves along the IS curve from A to A'.

Second step: What is the impact on Y and i of ΔM ?

The economy moves from point A to point A'. As a result,
 i goes up and Y goes down.

Tell the mechanism with short-hand and in words.

$\Delta M \rightarrow \downarrow i \rightarrow \uparrow I \rightarrow \uparrow Y$ Then $\Delta M \rightarrow \downarrow i$

The increase in money supply leads to a lower interest rate. The lower interest rate leads to an increase in investment and, in turn, to an increase in demand and output. Consumption and investment unambiguously goes up after monetary expansion.

While identifying the effects of fiscal and monetary policy, do not forget to characterize the shift(s) in IS and LM curves, then show the effect on equilibrium point, and, accordingly on the equilibrium interest rate and equilibrium output. Use short-hand to tell the mechanism. Then tell the story in words. Use this method to explain the effects of a policy mix.