**Economics of Banking and Finance Markets**
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**Lecture - 54**
**Policy Effects in IS-LM Framework - II**

Hi everyone. Welcome to this session. In this session we are going to discuss how to derive IS schedule and IS curve.

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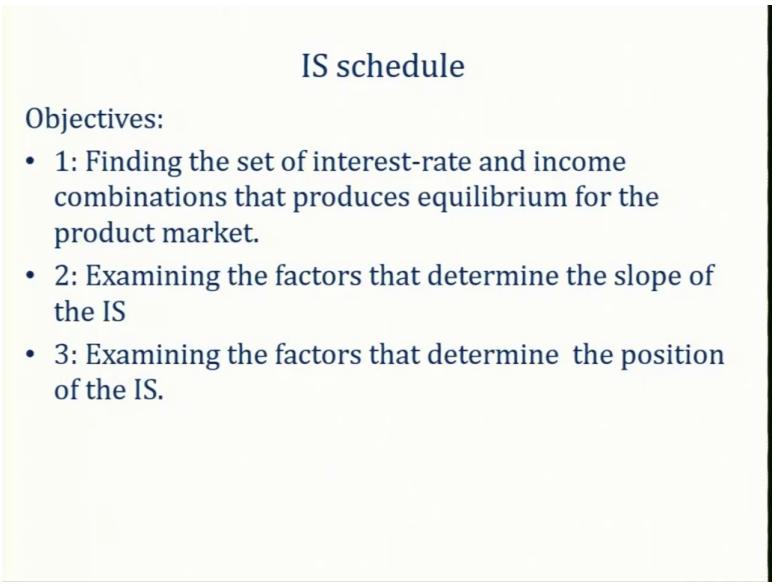


We will be examining what are the factors that determine the slope of the IS curve. And we will also discuss the factors that determine the position of the IS curve.

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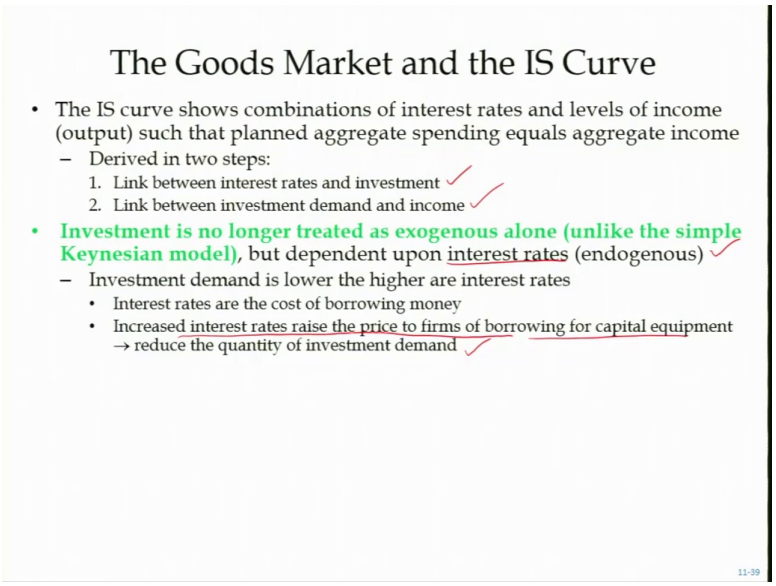


The IS curve is also called as the Goods Market. The IS curve shows the combination of interest rates and the level of income. Level of income we mean output here such that planned aggregates spending, that is, aggregate demand equals aggregate income.

So, here we derived the IS schedule or IS curve in a two-step procedure. First by examining the link between interest rates and investment, and subsequently in the 2nd stage the link between investment and income; investment demand and income. Unlike in the simple Keynesian model, in the IS model we assume investment is no longer treated as autonomous variable.

In contrast to simple Keynesian model, in the IS model we introduce money market as well. And then subsequently we consider investment also depends upon interest rate as well. This is determined within the system, within the model.

So, especially the about the investment demand, you know the relationship between investment demand and rate of interest. You know that there is an inverse relationship. That means, higher the rate of interest lower will be the investment demand, because the cost of production. Because interest is one of the cost components of production, that means, the cost of borrowing money.

Since increased interest rate raise the price to firms of borrowing for capital equipment, there will be a reduction in the quantity of investment demand. So, in short, there is an inverse relationship between rate of interest and investment demand.

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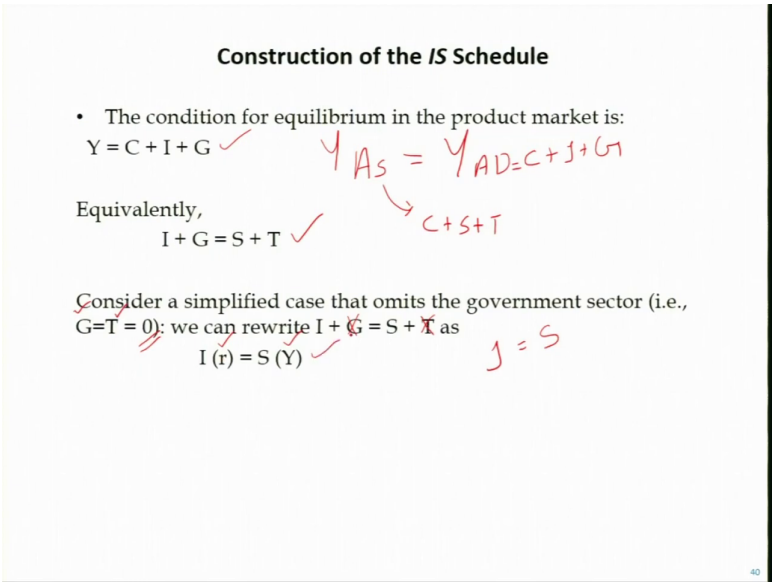


Let us start the construction of the IS schedule. The condition for equilibrium in the product market is that aggregate demand is equal to C plus I plus G, and equivalently have we already seen that that Y aggregate supply is equal to Y aggregate demand where we have already written that aggregate demand is equal to C plus I plus G. And aggregate supply is equal to C plus S plus T.

This one we have written C plus C plus T. This one we already defined; this one is C plus I plus G. So, that means, C is constant. So, then we can see that I plus G is equal to S plus T and considering a simplified case that omits government sector. That assuming that government expenditure is equal to 0, tax is equal to 0. That means, omitting the government sector we can rewrite this equation as 'I' is equal to S, as we assume G and T as 0.

So, in the case of 'I 'you know that 'I' investment is a function of rate of interest. You know that there is an inverse relationship, higher the rate of interest lower will be the investment demand. And the household savings is a function of the income.

So, obviously, the saving is a function of income. Higher the income higher will be the saving. And there is a positive relationship between saving and income. So, finally, we can say that I (r) is equal to S (Y).

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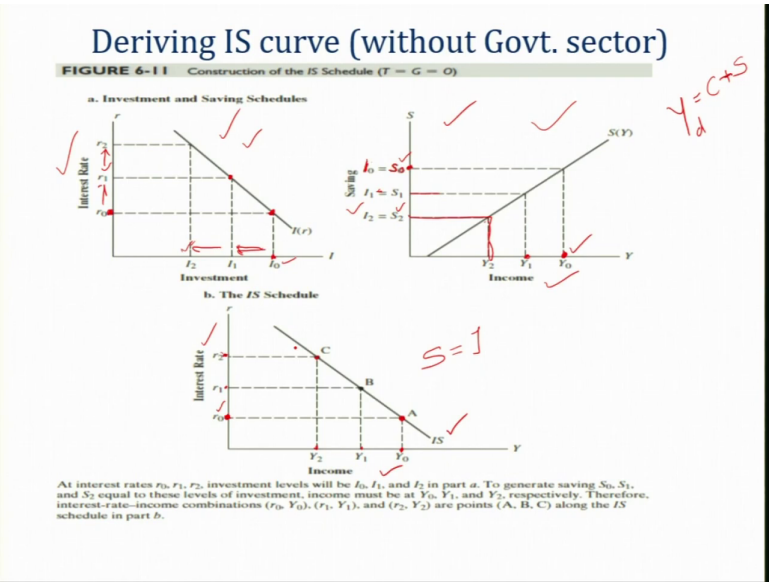


Starting with the inverse relationship between investment and rate of interest, you can consider an interest rate $r_0$ and the corresponding level of investment demand is $I_0$. Because the lower rate of interest, you can see that there is large demand for investment.

The amount of investment is $I_0$ are shown in this schedule. So, to generate this, again look at this when the rate of interest increases to $r_1$, investment decline to when the rate of interest increase you can see that investment is going to be $I_1$. And further if the rate of interest further increases to $r_2$, the investment decrease to $I_2$.

Now, let us consider the first case, initial position of $r_0$. When the rate of interest is $r_0$ you can see that investment is $I_0$. To finance this much investment, what is the source of the fund? Investment is generated through saving; saving is the source of this investment. So that means, if the rate of interest is $r_0$, $I_0$ is the desired investment.

So, to generate this much investment, saving must increase. Corresponding to $I_0$ you can see that saving must increase this much. That means, to generate $I_0$ we need an equivalent $S_0$ of saving. So, look at schedule, the diagram second diagram, this one. On the y axis we are

putting saving and on the x axis, we are putting Y. Since we are already familiar now that saving is a function of income, there is a positive relationship.

So, in the first case here, we have seen that when the rate of interest is $r_0$, you can see that $I_0$ is the investment. So, to generate this much $I_0$ investment we need saving $S_0$ saving. So, this $S_0$ saving is require this much income, because total income is equal to C plus S.

To generate this much saving, to finance $I_0$ investment $Y_0$ level of income is required. So that means, the second diagram shows that $S_0$ saving is possible through $Y_0$ level of income. What if rate of interest increases to $r_1$, in this first diagram?

Then you know that investment will be declining to $I_1$, then in this case $I_1$ require only $S_1$ amount of saving; that means, this $S_1$ is less than $S_0$. So, correspondingly only $Y_0$ level of income is required further. When the rate of interest increased to $r_2$ then you know that corresponding investment is $I_2$; that means, $I_2$ require $S_2$ level of saving. So, $S_2$ level of saving will come from $Y_2$ level of income.

So, what we have shown in the second diagram is the positive relationship between saving and income.

Transforming this one into another diagram, making relationship between interest rate and this income that is interest rate on the Y axis and income on the X axis you know that $r_0$ level of rate of interest requires $Y_0$ level of income, and similarly $r_1$ rate of interest requires $Y_1$ level of income and $r_2$ rate of interest requires $Y_2$ level of income.

Linking this one, making a relationship, you can see that there is an inverse relationship between rate of interest and income. We can derive an IS curve from this first diagram and the second diagram, and then we can see an inverse relationship between rate of interest and the level of income. So, this is the IS curve.

So, summarizing here, we can see that the IS curve is derived from the first two diagrams, and then we plot the IS curve as a relationship between rate of interest and income, and then we can see that there is an inverse relationship between both. So that means, when the $Y_0$ level of income we need $r_0$ rate of interest, and when the $Y_2$ level of income we need $r_2$ rate of interest.

In this market we can see that saving is equal to investment. So, and each point along this curve denotes product market equilibrium. Product we mean saving and investment here.

For example, when the rate of interest is low, we are seeing that at a lower rate of interest $r_0$, the income is very high. What does it mean? So, the economic intuition behind here is at a lower rate of interest investment demand increases. Investment demand increases. So, that equivalently, saving level, a large amount of saving is required when the investment increases to finance that. That much saving can come from income $Y_0$.

So, that means, when the rate of interest is low, investment demand increases and the corresponding level of saving must be generated, which is possible from the corresponding level of income. So that means, at low level of rate of interest, the investment demand increases, then saving must increase and for that the income must also increase.

To make the saving is equal to investment, that is the product market in equilibrium, when the rate of interest decrease, the investment increases, to generate enough saving the income must also increase. So, that means when the rate of interest decreases, the income must increase. So, that product market will be in equilibrium. So, that is why we are getting an inverse relation: the negative slope for the IS schedule.

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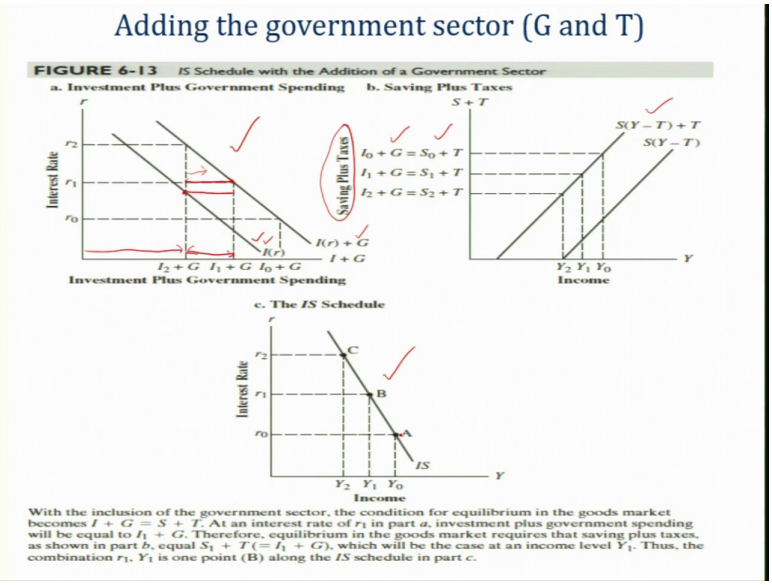

Now, including government sector as well, because the first diagram what we have shown that only investment is a function of rate of interest. Now, what we can add government expenditure as well. Then, that means, the aggregate demand curve shift rightwards.

Suppose at this rate, this much is the investment demand and at this point this is the investment demand, so, then accordingly we draw this diagram. What if we include this much government expenditure?

So, as a result you can see that the curve will be shifting to this much; that means, this much distance it shifts. So, that means, the IS curve I investment curve plus government spending is denoted in this first plane, first diagram. Then accordingly, you can also see that government expenditure is normally financed through taxes.

So, equivalently tax also increases. So, that $I_0$ t plus G is equal to $S_0$ plus T. So, accordingly, this is our new diagram showing the level of income with a saving and tax, both are denoted on the Y axis. Saving plus taxes are given on the Y axis here. So, then again, we know that when the rate of interest decreases investment increases, level of saving must increase so that to finance that income also must increase.

We can find out the IS schedule, you know IS schedule again. It is downward sloping.

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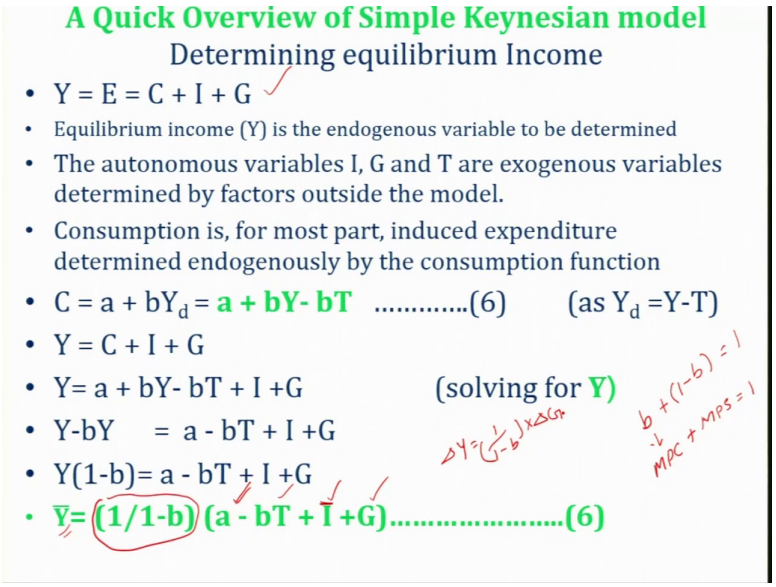

Let us now derive the IS equation. Prior to that, let us have a quick overview of the simple Keynesian model, which we had discussed in the previous session. So, I am just displaying here in the slide; we have elaborated that the aggregate demand is equal to C plus I plus G.

Then elaborating this and solving for Y, and finally, the equilibrium income can be denoted with this equation; that means, Y bar is equal to 1 by 1 minus b. Where we have mentioned that b is marginal propensity to consume that we have discussed in the previous class. That is b, b is marginal propensity to consume and remaining is the marginal propensity to save, that is called 1 minus b; both is equal to 1. The b is shortly MPC, Marginal Propensity to Consume

And 1 minus b is marginal propensity to save. Summing both, we will be getting 1. So, this is the simple Keynesian multiplier. On the right-hand side, these are all the autonomous variables. That 'a' is the intercept, even when the income is 0 there will be some level of consumption, that is denoted by 'a'. T is tax, 'I' is autonomous investment, but in the simple Keynesian model C is autonomous consumption, G is government expenditure.

So, to see any change, for example, government expenditure, we can see due to change in government expenditure the income will increase 1 by 1 minus b, it is a multiplier times government expenditure. For example, you can see that del Y is equal to 1 by 1 minus b. That is a multiplier times del G. So, this is the simple Keynesian model. Let us see how this can be expanded into an IS model.

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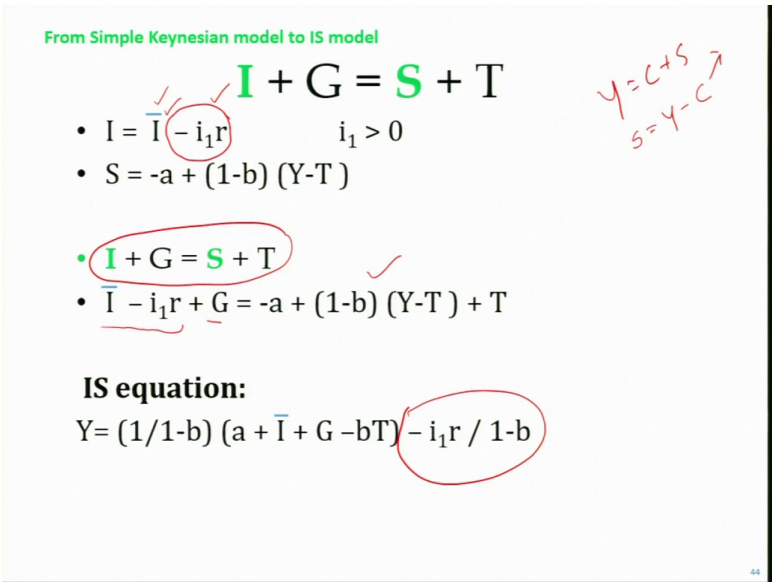

In the simple Keynesian model, we assume that there is only autonomous component of investment, but in the IS model we also bring money market into the picture. Then here total investment has autonomous component, and the other component is a function of rate of interest, that is, an inverse relationship between rate of interest and investment, it is called interest rate-induced investment.

The rate of investment is negatively related to rate of interest; that means this component. So, here i1 is greater than 0. That means, induced component is greater than 0. In the IS model we decompose the total investment into autonomous and that is this is autonomous, and another one is interest rate induced component.

In the simple Keynesian model, we assume that autonomous component, no interest induced component. So, Y is equal to C plus S. So, then S is equal to Y minus C.

So, finally, for the equilibrium, we say that I plus G should be equal to S plus T. Then rewriting 'I' as this autonomous and interest rate induced component plus G, we can rewrite it in this way. Then finally, IS equation: IS equation the necessary condition is the condition is I plus G should be equal to S plus T.

We can rewrite the IS equation in this way. Where you can write Y is equal to 1 by 1 minus b times a plus I bar plus G minus bT minus i1r divided by 1 minus b. So, this is the IS equation that we derived. We are just adding this component to this. That means, we are bringing money market also in the picture. That means, not only the autonomous component of investment, but also the interest rate-induced component as well.

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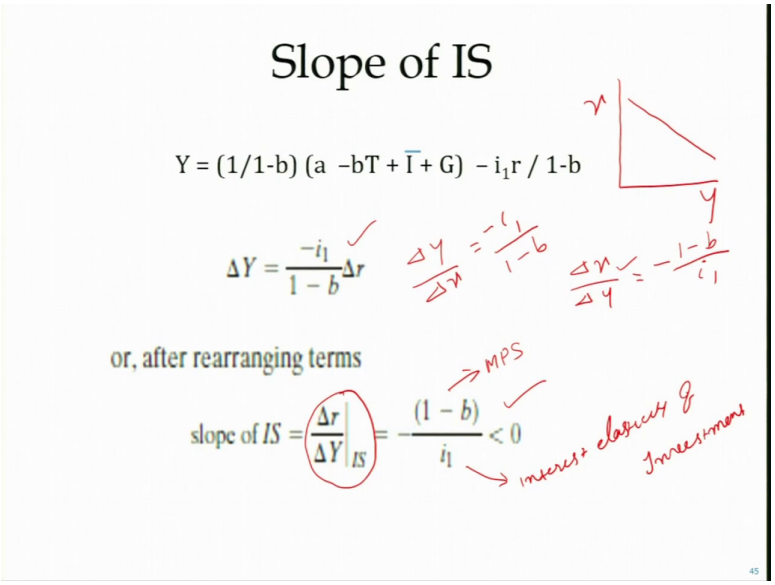


Let us see the slope of the IS curve, because in the IS schedule we write like this here rate of interest, here level of income. We know that the sign is inverse, the inverse relationship. So, the slope of the curve that means, del r divided by del Y.

So, what we need is instead of del r, del r del Y for here del Y divided by del r we are getting minus 1 divided by 1 minus b, but the slope is this one that is del r divided by del r divided by del Y. So, that then we will be getting the slope as inverse that is 1 minus b divided by i 1. So, the slope of the IS, that del r divided by del Y we are getting this one.

So, this is the slope of the IS schedule. Slope of the IS is 1 minus b is nothing but marginal propensity to save MPS. And i1, i is the interest elasticity of investment. This is interest elasticity of investment. So, these are the slopes of the two variable that determining the slope of IS schedule.

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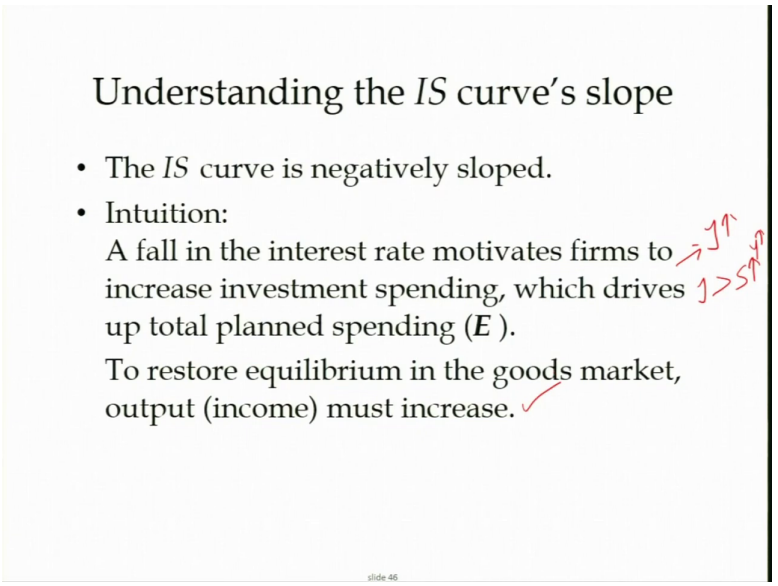


So, summary, the understanding the IS curve slope. IS curve has negatively slope. A fall in the interest rate motivates firms to increase investments spending, which drives up a total planned spending. Spending means here total investment.

So, to restore this equilibrium in the goods market, saving must also increase; for that income also must increase. So, you need to restore equilibrium in the goods market, output must increase. This is the economic intuition about why IS curve is negatively sloped.

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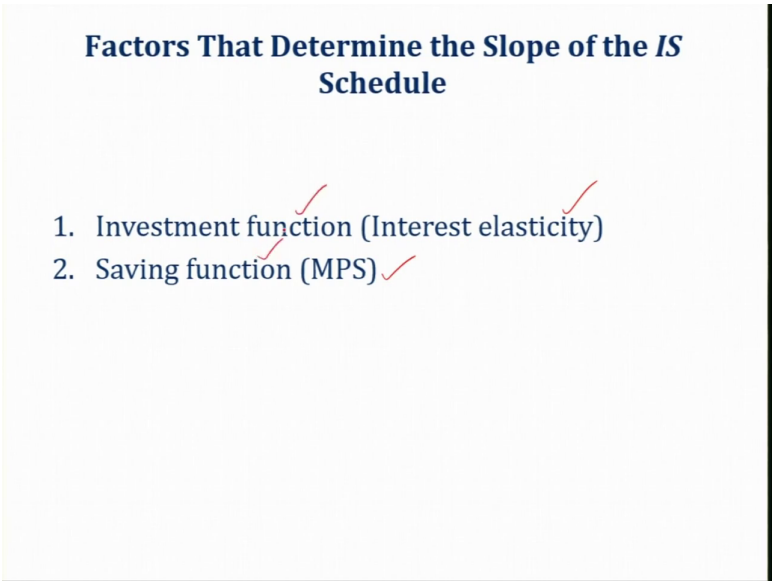

So, coming to the factors that determine in the slope of the IS schedule. There are two factor, one we have just shown there. One is saving function that is marginal propensity to save. And the other one, we have seen the interest elasticity. So, let us call both in this term. That means, interest elasticity of investment, let us call it as investment function and the other one marginal propensity to save, let us call it as saving function.

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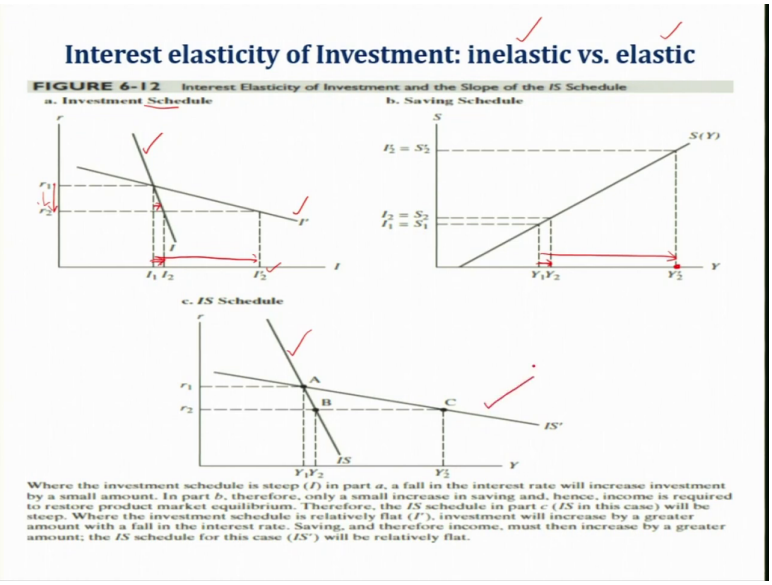


About the first part: Interest elasticity of investment. What if assume two scenarios. One is interest elasticity of investment is very inelastic. Another case is it is highly elastic. So, in this diagram the part 1 investment schedule this diagram; that means, this investment curve it is very steep; that means, this is the inelastic, relatively inelastic, this one is inelastic. And this $I^1$ curve this is more elastic.

So, what does it mean inelastic means? Inelastic you can look at from here. Even when the rate of interest decreases from r1 to r2; in the case of inelastic investment curve, you can see that here only a small increase in investment. When the rate of interest declines from r1 to r2, investment increase only from I1 to I2. That means the investment interest elasticity of investment is inelastic.

In contrast what if the interest elasticity of investment is very elastic? Then you can see that a small a decline in rate of interest from r1 to r2 leads to huge increase in investment from I1 to I2, here to this much increase in investment.

So, you can see here that corresponding to this one, in the first case, you know that since when the interest elasticity of investment is inelastic there was only a small increase in investment. So, that only a small increase in saving is required.

So, correspondingly a small increase in income is required, but if the interest elasticity of investment is very high elastic, then you know that for a small decrease in rate of interest there is large increase in investment so that the corresponding increase in saving also must be high which can be generated only a large increase in income, as denoted by this much. This much increase in income required.

So, in both cases: if we assume interest elasticity of investment is inelastic then our IS curve is going to be very steep. In contrast to this if interest elasticity of investment is elastic then the IS curve is going to be very flat.

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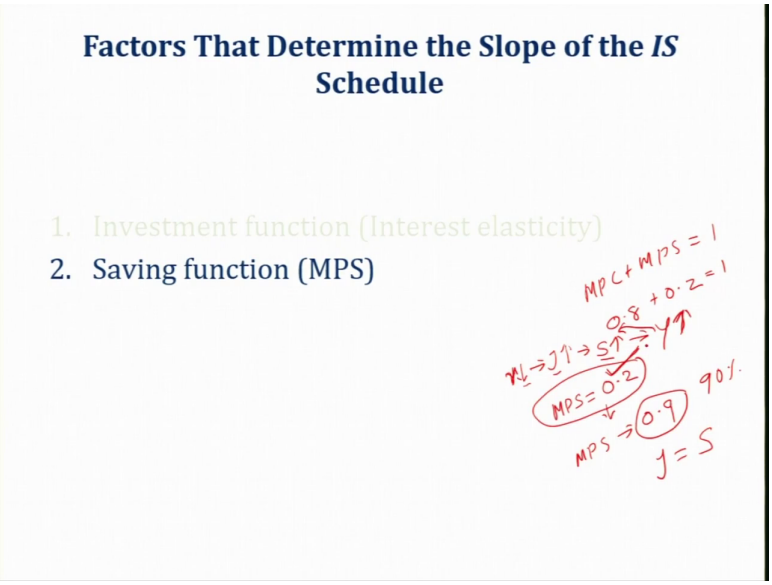


So, second factor is a saving function. In the case of saving function size of the marginal propensity to save. For suppose we already seen that MPC plus MPS is equal to 1. Assume that 0.8 is MPC and 0.2 is MPS.

Initially, you take two scenarios, in one case MPS that the Marginal Propensity Save is 0.2. In another case is MPS is going to be for example, 0.9.

So, in case 1 when the marginal propensity to save is small, in this case due to change in rate of interest a large increase in income is required to finance the savings, because we know that

when the rate of interest decrease, we know that investment will be increasing. Then what we need? Saving must increase. So, in this case when the MPS is 0.2. It means only 20 percentage of the income will be used for saving purpose.

So, that means, here say a large increase in income is required. A large increase in income is required when the MPS is small. In contrast to this what if MPS is very high, 0.9? So, in this case we can see the same storyline, rate of interest increase. Investment increase, saving increase, but since the marginal propensity to save is 0.9, that is, 90 percentage of the income will be saved, only a small increase in income is required.

A small increase in r is required to generate the necessary amount of level of savings. So, that means, saving function influence in this way; that means, when the MPS is very high a small increase in income is required so that product market is in equilibrium; That means, 'I' is equal to S right.

In contrast to that if the MPS is very small for a decrease in rate of interest in order to generate a necessary amount of saving, a large increase in income is required so that necessary amount of saving can be generated.

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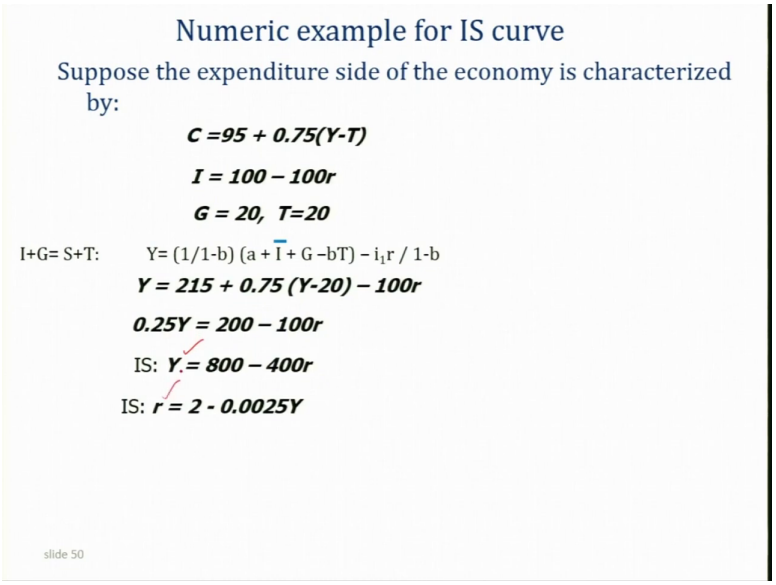


This is a numerical example of estimating the IS curve. I have given here the values of C, I and G. And you can plug this value in this equation and then accordingly you can find out the

values. So, here you will be finding the IS equation. Either you can solve it for the level of income, or you can solve it for the rate of interest.

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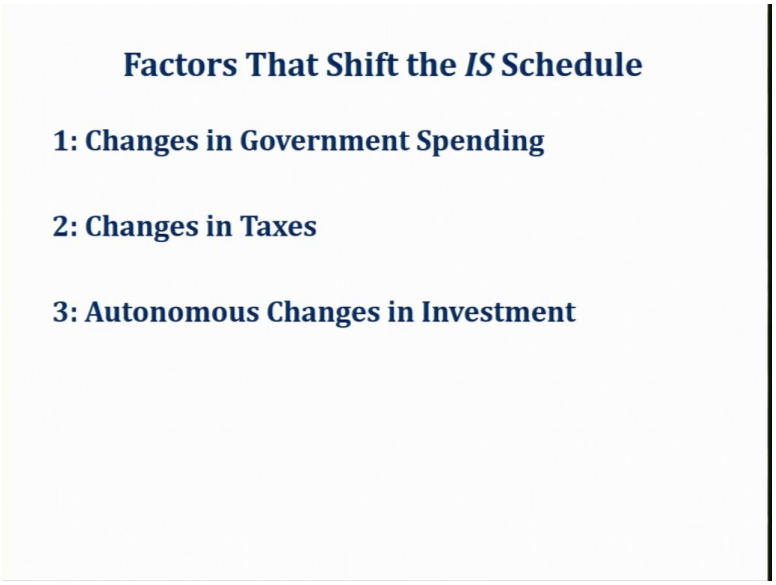


So, in the next session we are going to discuss what are the factors that shift the IS schedule.

Thank you for watching this video and see you in the next session.

Thank you.

**Keywords:** IS schedule, simple Keynesian model, rate of interest, income, slope, shift in IS, saving function, investment function