Chapter 7

Questions

1. In the Solow model, how does the saving rate affect the steady-state level of income? How does it affect the steady-state rate of growth?

   In the Solow model, a rise in the saving rate raises the steady-state level of output and capital stock as the saving rate is related to both the variables positively. However, this raise is applicable for a short-run. The rise in saving rate raises the capital stock and the steady-state growth rate to the level till the economy shifts to another steady state over a long period of time.

2. Why might an economic policymaker choose the Golden Rule level of capital?

   We know that in the Solow model, the Golden Rule of capital increases the consumption level to the maximum. It is also known that the entire growth and welfare of the economy is dependent on this very consumption level. So, any policymaker whose motive is promotion of growth and welfare of the economy will select this Golden Rule level of capital.

3. Might a policymaker choose a steady state with more capital than in the Golden Rule steady state? With less capital than in the Golden Rule steady state? Explain your answers

   The policymaker's goal to promote the interests of the economy may be limited to short period of time or may be for a long-run. On the basis of his goal, the policymaker makes his decision of choosing a steady state or the Golden Rule steady state. If the economy starts from above the Golden Rule state, then the consumption level is increased to maximum. However, if it starts from below the Golden Rule state, and then reaches to Golden level, the consumption level is reduces in the short-run so as to increase the level over a long period of time. So, if the policymaker wants to serve his short-term goals, he will choose the steady state with higher level of capital. And if his goal is to serve long-term motives, he will select the Golden Rule steady state.

4. In the Solow model, how does the rate of population growth affect the steady-state level of income? How does it affect the steady-state rate of growth?

   In the Solow model, the rate of population growth is inversely proportional to the steady-state level of income. The fall in the population growth rate leads to a fall in the steady-

state level of income as well. The steady-state level of capital per worker also decreases with the increase in the population growth rate.

How does it affect SS rate of growth?

Problems

1. Country A and country B both have the production function

$$Y = F(K, L) = K^{1/2}L^{1/2}$$

a. Does this production function have constant returns to scale? Explain.

We know,
If the capital and labor is multiplied by certain positive number, and if it results in increment of the output by same amount, in such case the production function yields constant returns to scale. In the question, the production function given is:

$$Y = F(K, L) = K^{1/2}L^{1/2}$$

Multiplying this expression with a positive number z, we get:

$$F(zK, zL) = (zK)^{1/2}(zL)^{1/2} = zK^{1/2}L^{1/2} = zY$$

Here, multiplying the capital and labor with z increases the output by z. So, the production function givens constant returns to scale.

b. What is the per-worker production function, $y = f(k)$?

In order to obtain the per-worker production function, we will divide the expression in part (a) by L, so we get:

$$\frac{Y}{L} = \frac{(K^{1/2}L^{1/2})}{L}$$

Assuming $y = \frac{Y}{L}$, we get:

$$Y = K^{1/2}L^{1/2}$$

If $k = \frac{K}{L}$, then, $y = k^{1/2}$.

Therefore, the per-worker production function is $y = k^{1/2}$.

c. Assume that neither country experiences population growth nor technological progress and that 5 percent of capital depreciates each year. Assume further that country A saves 10 percent of output each year and country B saves 20 percent of output each year. Using

your answer from part (b) and the steady-state condition that investment equals depreciation, find the steady-state level of capital per worker for each country. Then find the steady-state levels of income per worker and consumption per worker.

From the question, we have:
Depreciation rate (δ) = 5% = 0.05
Rate of saving of country A (S_A) = 10% = 0.1
Rate of saving of country B (S_B) = 20% = 0.2
Per-worker production function for country A and B: $y = k^{1/2}$
Here,
We will use the change in capital stock function and substitute the value of per-worker production function in this expression, we get:

$$\Delta k = sf(k) - \delta k.$$

Because the capital stock remains constant, we can write:

$$sf(k) = \delta k.$$

Putting the values, we can write:

$$sk^{\frac{1}{2}} = \delta k.$$

$$k^{\frac{1}{2}} = \frac{s}{\delta}$$

$$k = \left(\frac{s}{\delta}\right)^2$$

Steady state level of capital per worker is:

For country A: $(k_A^*) = \left(\frac{s_a}{\delta}\right)^2 = \left(\frac{0.1}{0.05}\right)^2 = 4.$

For country B: $(k_B^*) = \left(\frac{s_b}{\delta}\right)^2 = \left(\frac{0.2}{0.05}\right)^2 = 16.$

Similarly, steady-state level of income per worker is:

For country A: $(y_A^*) = (4)^{1/2} = 2.$

For country B: $(y_B^*) = (16)^{1/2} = 4.$

Likewise, the consumption level is:

For country A: $(c_A^*) = (1 - s)\, y_a^* = (1 - 0.1)(2) = 1.8.$

For country B: $(c_{B)}^*) = (1 - s)\, y_b^* = (1 - 0.2)(4) = 3.2.$

d. Suppose that both countries start off with a capital stock per worker of 2. What are the levels of income per worker and consumption per worker? Remembering that the change in the capital stock is investment less depreciation, use a calculator to show how the capital stock worker will evolve over time in both countries. For each year, calculate income per worker and consumption per worker. How many years will it be before the consumption in country B is higher than the consumption in country A?

From the solution above, we obtained:

Depreciation rate (δ) = 5% = 0.05
Rate of saving of country A (S_A) = 10% = 0.1
Rate of saving of country B (S_B) = 20% = 0.2

k_0 = 2 for country A and B
$y = k^{1/2}$
$c = (1 - s)y$

The required calculations are shown in the table below:

Country A

Year	k	y	c	i	δk	$\Delta k = i - \delta k$
1	2	1.414	1.273	0.141	0.100	0.041
2	2.041	1.429	1.286	0.143	0.102	0.041
3	2.082	1.443	1.299	0.144	0.104	0.040
4	2.122	1.457	1.311	0.146	0.106	0.040
5	2.102	1.470	1.323	0.147	0.108	0.039

Country B

Year	k	y	c	i	δk	$\Delta k = i - \delta k$
1	2	1.414	1.131	0.283	0.100	0.183
2	2.183	1.477	1.182	0.295	0.109	0.186
3	2.369	1.539	1.231	0.308	0.118	0.190
4	2.559	1.600	1.280	0.320	0.128	0.192
5	2.751	1.659	1.327	0.332	0.138	0.194

Hence, from the calculations in the table above, we can say that country B will have a higher level of consumption than country A within a span of 5 years.

2. In the discussion of German and Japanese post-war growth, the text describes what happens when part of the capital stock is destroyed in a war. By contrast, suppose that a war does not directly affect the capital stock, but that casualties reduce the labor force.

a. What is the immediate impact on total output and on output per person?

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In our study, we read what the effects are when the war directly affects the capital stock and the labor force as well. However, if we consider the situation we the war affects the labor force only leaving the capital stock unaffected, in such case the labor force gets reduced. As a result, the capital per person increases. From the production function, we can say that the total output decreases because the labor force gets reduced because of the war. Because the capital of each worker increases in this case, the output per person increases as a result of the war.

b. Assuming that the saving rate is unchanged and that the economy was in a steady state before the war, what happens subsequently to output per worker in the postwar economy? Is the growth rate of output per worker after the war smaller or greater than normal?

Here, we are assuming that the saving rate remains constant. As mentioned in part (a), a decrease in the labor force forces the capital stock per person to rise. The capital stock that the economy has after the war is higher than what it was before the war if the economy was in a steady state. Now, because the economy again shifts to steady state after the war, the capital stock per person again comes back to its earlier level. As a result, the output per person gets reduced. So, the growth rate of output is slow after the economy attains the steady-state. We know that in the Solow model, the output per person growth rate is determined by the technological progress. So, when the economy attains the steady-state, the technological progress becomes equal to the growth rate of output per worker as it was prior to the war.

3. Consider an economy described by the production function $Y = F(K, L) = K^{0.3}L^{0.7}$.

a. What is the per worker production function?

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Dividing the given production function by labor L, we get:

$$\frac{Y}{L} = \frac{K^{0.3}L^{0.7}}{L}$$

Or, $$\frac{Y}{L} = \left(\frac{K}{L}\right)^{0.3}$$

Here, $y = \frac{Y}{L}$ and, $k = \frac{K}{L}$, so we can write:

$y = k^{0.3}$.

Hence, the required production function is $y = k^{0.3}$.

b. Assuming no population growth or technological progress, find the steady-state capital stock per worker, output per worker, and consumption per worker as functions of the saving rate and the depreciation rate.

Change in the capital stock is given by the expression:

$$\Delta k = sf(k) - \delta k$$

$$0 = sf(k) - \delta k \text{ (Capital stock is constant in the steady-state)}$$

$$\frac{k^*}{f(k^*)} = \frac{s}{\delta}$$

Substituting values from given expression:

$$\frac{k^*}{(k)^{0.3}} = \frac{s}{\delta},$$

Or, $k^* = \left(\frac{s}{\delta}\right)^{1/0.7}$

Therefore, the steady-state capital stock per worker as function of the saving and depreciation rate is $k^* = \left(\frac{s}{\delta}\right)^{1/0.7}$.

Again, equating the above expression with per worker production function, we get:

$$y^* = \left(\frac{s}{\delta}\right)^{0.3/0.7}$$

Therefore, the steady-state output per worker as function of the saving and depreciation rate is $y^* = \left(\frac{s}{\delta}\right)^{0.3/0.7}$.

We know, the consumption level is equal to the amount that is not saved, so:

$$c^* = (1 - s)\, f(k^*) = (1 - s)(k^*)^{0.3} = (1 - s)\left(\frac{s}{\delta}\right)^{0.3/0.7}$$

Therefore, the steady-state consumption per worker as function of the saving and depreciation rate is $c^* = (1 - s)\left(\frac{s}{\delta}\right)^{0.3/0.7}$.

c. Assume that the depreciation rate is 10 percent per year. Make a table showing steady-state capital per worker, output per worker, and consumption per worker, for saving rates of 0 percent, 10 percent, 20 percent, and 30 percent and so on. (You will need a calculator with an exponent key for this.) What saving rate maximizes output per worker? What saving maximizes consumption per worker?

The table shows the calculations for steady-state capital per worker (k^*), output per worker (y^*) and consumption per worker (c^*) below:

Rate of saving (%)	k^*	y^*	c^*	MPK
0	0.00	0.00	0.00	---
10	1.00	1.00	0.90	0.30
20	2.69	1.35	1.08	0.15
30	4.80	1.60	1.12	0.10
40	7.25	1.81	1.09	0.08
50	9.97	1.99	1.00	0.06
60	12.93	2.16	0.86	0.05
70	16.12	2.30	0.69	0.04
80	19.50	2.44	0.49	0.04
90	23.08	2.56	0.26	0.03
100	26.83	2.68	0.00	0.03

From the table we can say that, a saving rate of 100% maximizes the output per worker as the level of consumption is nil, while a saving rate of 30% maximizes the consumption per person.

d. (Harder) Use calculus to find the marginal product of capital. Add to your table the marginal product of capital net of depreciation for each of the saving rates. What does your table show?

Here, we differentiate the given production with respect to K, we get:

$$MPK = 0.3\frac{K^{0.3}L^{0.7}}{K} = 0.3(Y/K) = 0.3(y/k).$$

The table in part (c) shows the value of MPK at different saving rates.

6. Many demographers predict that Canada will have zero population growth in the twenty-first century, in contrast to average population growth of about 1.6 percent per year in the last 75 years. Use the Solow model to forecast the effect of this slowdown in population growth on the growth of total output and the growth of output per person. Consider the effects both in the steady state and in the transition between steady states.

When the economy is in steady-state, the slow rate of population growth decreases the depreciation rate. When it attains a new steady-state, the capital per person also increases. As a result, there is a rise in the level of output per person as well. In a situation of low growth of population rate, there occurs a reduction in the growth of output. However, the output per person growth remains the same as before. So far as the transition period is concerned, the steady-state output per person increases with reduction in growth rate of population. The total output falls but the level of output per person rises.

Chapter 8

Questions

1.In the Solow model, what determines the steady state rate of growth of income per worker?

The steady-state growth rate is determined by the progress in technology in the Solow model. On the contrary, the growth in capital saving and changes in population growth rate have no effect on the steady-state rate of growth.

3. What data would you need to determine whether an economy has more or less capital than in the Golden Rule steady state?

The difference between marginal product of capital and depreciation is compared with the growth rate of output to determine whether an economy has more or less capital than in the Golden Rule steady state. The data regarding growth rate of output can be easily collected. However, to calculate MPK, i.e. marginal product of capital, data related to capital stock and depreciation relative to GDP and the share of capital in GDP is required.

Problems

1. An economy described by the Solow growth model has the following production function:

$$y = \sqrt{k}$$

a. Solve for the steady-state value of y as a function of s, n, g and δ.

We have the equation for the growth in capital stock:

$$\Delta k = sf(k) - (\delta + n + g)k = 0$$

We will square the given production function and substitute its value in the above given expression, we get:

$$sy - (\delta + n + g)y^2 = 0$$

Solving this, we get:

$$y^* = s/(\delta + n + g).$$

So, the steady-state value of y is $y^* = s/(\delta + n + g)$.

b. A developed country has a saving rate of 28 percent and a population growth of 1 percent per year. A less-developed country has a saving rate of 10 percent and a population growth rate of 4 percent per year. In both countries, g = 0.02 and δ = 0.04. Find the steady state value of y for each country.

From the question, we have the following information:

For a developed country:

Saving rate (s) = 28% = 0.28; Population growth rate (n) = 1% = 0.01

For less-developed country:

Saving rate (s) = 10% = 0.10; Population growth rate (n) = 4% = 0.04

For both countries, value of g and δ is same, i.e. g = 0.02 and δ = 0.04.

Hence, steady-state value of y for developed country is given by:

$y^* = 0.28/(0.04 + 0.01 + 0.02) = 4$

Likewise, the value for less-developed country is:

$y^* = 0.10/(0.04 + 0.04 + 0.02) = 1$

c. What policies might the less-developed country pursue to raise its level of income?

We know that the level of income depends upon the saving rate and the population growth rate. So, if the less-developed country wants to raise its level of income, it will have to adopt policies that reduce the population growth rate and increase the rate of saving. To control the population growth rate, the country could adopt various birth control measures and also increase awareness among people. On the other hand, the country could reduce the budget deficit so as to increase the public saving which would result in a rise in the rate of saving.

5. The amount of education the typical person receives varies substantially among countries. Suppose you were to compare a country with a highly educated labor force and a country with a less educated labor force. Assume that education affects only the level of the efficiency of labor. Also assume that the countries are otherwise the same: they have the same saving rate, the same depreciation rate, the same population growth rate, and the same rate of technological progress. Both countries are described by the Solow model and are in their steady states. What would you predict for the following variables?

a. The rate of growth of total incomes,

It is true that in countries where the quality of education varies, the efficiency of labor also varies. Here, let us suppose the efficiency of highly educated labor force as E1, and the

efficiency of less educated labor force E2. It is obvious that E1 is greater than E2. We know that the changes in the efficiency of labor leaves the rate of growth unaffected. Because the other variables of both the countries are same, so difference in efficiency of labor leaves the rate of growth of total incomes unaffected.

b. The level of income per worker,

Since the saving rate, rate of population growth and technological progress of both the countries are same; the countries will also have same steady-state capital per efficiency unit of labor (k^*). The output per efficiency unit of labor in the steady state is given by the production function $y^* = f(k^*)$ is equal for both the countries. But $y^* = Y/(L * E)$, or, $Y/L = y^*E$. We know, E1>E2. So, $y^*E1 > y^*E2$. So, we can say that the income per worker will be higher in the country with highly educated labor force.

c. The real rental price of capital,

Here, both the countries have the same capital stock per efficiency of labor because of the same saving rate, population growth rate and technological progress. Because the marginal product of capital depends upon the capital stock per efficiency of labor, the marginal product of capital will also be same for both countries. As we know the real rental price of capital is equal to the marginal product of capital. Hence, both the countries will have the same real rental price of capital in spite of difference in efficiency of labor.

d. The real wage.

The wage per efficiency is given by the expression:

$w = f(k) - MPK*k$.

Because both countries have same steady-state capital stock and marginal product of capital MPK, the wage per efficiency of both countries will also be same. But it is the wage per labor that the workers are concerned with and not the wage per efficiency. The wage per labor is given by:

Wage per labor = wE.

Because the wage per labor depends upon the efficiency of labor, the country with highly educated labor force will have higher wage per labor.

Chapter 10

Questions

1. Use the Keynesian cross to explain why fiscal policy has a multiplied effect on national income.

$\Delta G \Rightarrow \Delta Y$ by $1/(1-mpc)$

The reason why the fiscal policy has a multiplied effect on national income is that with a rise in the income, the level of consumption also tends to rise. If the government makes a change in the fiscal policy by increasing the government purchase by certain amount, then it causes the expenditure, and thereby the income to rise. However, this increase in consumption level forces the expenditure and income again. This process continues for an indefinite period. Therefore, if the government purchase is increased by certain amount, then it causes the national income to rise by an amount which is greater than the amount by which the government purchase was increased.

2. Use the theory of liquidity preference to explain why an increase in the money supply lowers the interest rate. What does this explanation assume about the price level?

The theory of liquidity preference describes how a rise in the money supply decreases the interest rate. An assumption is made that the supply of money is constant as decided by the central bank of the country. It is also assumed that the level of price remains unchanged that would keep the supply of real money balances constant. We know that the rate of interest adjusts itself so as to make the supply equal to demand in the market. In a case when the interest rate is high, the cash that the people hold is comparatively less than what they would hold when the interest rate is low. Now, when the money supply increases, the existing supply of real money balances exceeds the demand. To equilibrate the demand and supply, the interest rate adjusts itself and lowers down.

3. Why does the IS curve slope downward?

We know that the rate of interest is inversely proportional to investment, i.e. when rate of interest increases, the level of investment gets reduced and vice-versa. As we know that a decrease in the level of planned investment tends to decrease the expenditure and thereby the national income. It means that an increase in interest rate reduces the income level. As the IS curve traces the interest rate in relation to the level of income, it slopes downward.

4. Why does the LM curve slope upward?

We already know that the rate of interest adjusts itself to equilibrate the demand and supply of real money balances. The liquidity preference theory assumes that the supply of money and the price level remains constant in the short run. So, in the case there is an increase in the level of income, it causes demand to rise. At the existing interest rate, the demand exceeds the supply. To equilibrate this condition, the interest rate goes down. It means that when the level of income is increased, it decreases the rate of interest and

vice-versa. Since the LM curve traces the level of income against the rate of interest, it slopes upward.

Problems graphs Required

1. Use the Keynesian cross to predict the impact on equilibrium GDP of
   a. An increase in government purchases.

The Keynesian cross gives the planned expenditure function as: $E = C(Y - T) + I + G$. We know that in equilibrium, actual expenditure (Y) is equal to the planned expenditure (E). When the government increases the government purchases, it tends to raise the planned expenditure as well. It shifts the economy to new state of equilibrium. It changes the actual expenditure by an amount equal to $\Delta Y = [1/(1 - MPC)]\Delta G$, MPC being the marginal propensity to consume. Here, the MPC is less than one. So, the amount ΔY is greater than the amount by which the government purchase is increased. So, an increase in government purchase by certain percentage increases Y by a greater percentage comparatively.

b. An increase in taxes.

Let ΔT be the increase in tax. A rise in tax ΔT reduces the disposable income $(Y - T)$ by the same amount, i.e. ΔT. It lowers the level of consumption by MPC * ΔT. It also forces the planned expenditure to lower down by the same amount. Hence, a rise in tax by ΔT causes the Y to fall by an amount: $\Delta Y = [- MPC/(1 - MPC)]\ \Delta T$.

c. An equal increase in both government purchases and taxes.

An equal increase in both government purchases and taxes increases Y by an amount obtained by multiplying the amount from part (a) and part (b).

i.e. $\Delta Y = [1/(1 - MPC)]\Delta G - [MPC/(1 - MPC)]\ \Delta T$.

Since, the question assumes $\Delta G = \Delta T$, we can write:

$$\Delta Y = [(1/(1 - MPC) - (MPC/(1 - MPC))]\Delta G$$
$$= \Delta G.$$

It means any equal increase in both government purchases and taxes increases Y by the same amount.

3. Although our development of the Keynesian cross in this chapter assumes that taxes are a fixed amount, in many countries taxes depend on income. Let's represent the tax system by writing tax revenue as

$$T = \bar{T} + tY,$$

Where $\bar{T}$ and t are parameters of the tax code. The parameter t is the marginal tax rate: if income rises by \$1, taxes rise by t × \$1.

a. How does this tax system change the way consumption responds to changes in GDP?

Suppose the income increases by \$1 in the system where tax is dependent on income. This increase will raise the disposable income by an amount equal to \$(1 – t) where t refers to tax. The consumption level rises by an amount that is \$(1 – t)MPC, MPC being the marginal propensity to consume. Here, the increase in disposable income is lower than the increase in income. So, we can say that under this system, the consumption level is affected by a smaller amount.

b. In the Keynesian cross, how does this tax system alter the government purchases multiplier?

Suppose the government purchase increases by an amount ΔG in the system where tax is dependent on income. It raises income by the same amount while the disposable increases by amount (1 – t) ΔG which is less than the amount by which income increases. Likewise, the consumption level rises by amount (1 – t) ΔG * MPC. This forces the income level and expenditure to increase by the same amount. This, in turn, increases the consumption level and this process increases for an indefinite period. The change in the level of output is given by:

$\Delta Y = \Delta G[1/(1 - (1 - t)MPC)]$.

Thus, the multiplier gets decreased under this system.

c. In the IS-LM model, how does this tax system alter the slope of the IS curve?

To see the changes in the IS curve under this tax system, we will solve the national income identity which is given by:

$Y = C + I + G$.

We will put the values of I and C from the investment function and consumption function respectively, we get:

$Y = [a + b(Y - \bar{T} - tY)] + c - dr + G$

Here,

$[I = c - dr; C = a + b(Y - \bar{T} - tY)]$

$$\text{Or, } Y = \frac{a+c}{1-b(1-t)} + \frac{1}{1-b(1-t)}G + \frac{-b}{1-b(1-t)}\bar{T} + \frac{-d}{1-b(1-t)}r.$$

The IS curve becomes steeper under this system because each term in the above equation is divided by $1 - b(1 - t)$ in place of $(1 - b)$ and value of Y will be greater.

5. Suppose that the money demand function is

$$(\frac{M}{D})^d = 1{,}000 - 100r,$$

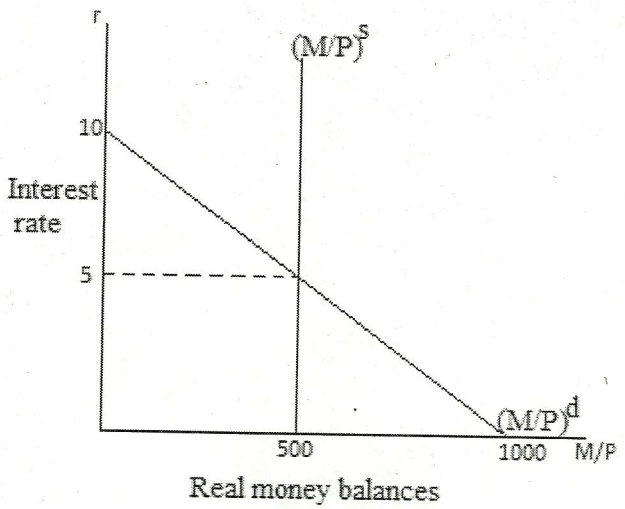
where r is the interest rate in percent. The money supply M is 1,000 and the price level P is 2.

a. Graph the supply and demand for real money balances.

Here, the supply of real balances is given by:

$$(\frac{M}{D})^s = 1{,}000/2$$
$$= 500$$

Below is the graph of demand for and supply of real balances:



Real money balances

b. What is the equilibrium interest rate?

To find the equilibrium rate of interest, we equate the demand for and supply of real money balances, we get:

$500 = 1{,}000 - 100r$

$r = 5.$

Thus, the required equilibrium interest rate is 5%.

c. Assume that the price level is fixed. What happens to the equilibrium interest rate if the supply of money is raised from 1,000 to 1,200?

Here, because the money supply is raised to 1,200, the new supply of real money supply is given by:

$(\frac{M}{D})^s = 1{,}200/2$

$= 600$

Equating the demand and supply, we get:

$600 = 1{,}000 - 100r$

$r = 4.$

The new equilibrium rate of interest gets reduced to 4%.

d. If the central bank wishes to raise the interest rate to 7 percent, what money supply should it set?

Here, interest rate (r) = 7%.

Equating the demand and supply, we have:

$M/P = 1{,}000 - 100r$

Or, $M/2 = 1{,}000 - 100 * 7$

Or, $M = 600$

So, the money supply should be lowered to 600 to raise the interest rate to 7%.

Chapter 11

Questions

1. Explain why the aggregate demand curve slopes downward?

We know that there is an inverse relation between the level of price and the level of national income. As the level of price increases, the level of national income decreases. This relation is traced by the aggregate demand. Assuming a constant supply of money, any rise in the price level causes a reduction in the real balances. Because of this, the level of income also gets reduced. Since the relation between price level and income level is inverse, the aggregate demand curve slopes downward.

2. What is the impact of an increase in taxes on the interest rate, income, consumption and investment?

From the Keynesian-cross model, we know that an increase in the tax reduces the income by an amount $\Delta T * [- MPC/(1 - MPC)]$, where ΔT is the increase in tax. This shifts the economy to a new state of equilibrium. Tax increment causes the interest rate to fall, and

thereby the level of income. The consumption level also falls along with the income. We know that the interest rate and investment are inversely related. So, when the rate of interest falls, it causes the level of investment to increase.

3. What is the impact of a decrease in the money supply on the interest rate, income, consumption and investment?

   Assuming that the level of price is constant, any reduction in the money supply tends to lower supply of real money balances. This decrease causes the rate of interest to rise. The economy shifts to a new state of equilibrium. The reduction in the supply of money reduces the income level, and thus the disposable income as well. With the reduction in the disposable income, the level of consumption also lowers down. On the other hand, because of rise in the rate of interest, the level of investment falls.

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4. Describe the possible effects of falling prices on equilibrium income.

   Reduction in the price level can cause the equilibrium income to rise. It happens because the rise in real money balances shifts LM curve downward and leads to an increase in income level. Another reason is because of the Pigou effect which causes people to consume more as a result of increase in the real money balances. It results in shifting of the IS curve to the right and thereby, increasing the equilibrium income.
   However, the reduction in the price level can also lead to a reduction in the level of income. It is possible when there is a sudden fall in the price level which causes the redistribution of wealth from debtors to creditors. A higher propensity to consume of the debtors decreases their expenditure by more than that of creditors. As a result, the consumption level falls, thereby the income.

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Problems

1. According to the IS-LM model, what happens in the short run to the interest rate, income, consumption and investment under the following circumstances?
   a. The central bank increases the money supply.

   LMC ?

   We know that when the money supply is increased, the level of income gets raised while the rate of interest falls. As the level of income increases, so does the disposable income. As a result, the consumption level also increases. On the other hand, the fall in the rate of interest causes the level of investment to rise.

   8/16

   b. The government increases government purchases.

use the model to explain...

how ISC?

When the government increases government purchases, it causes both income level and interest rate to rise. Because of the increase in level of income, the disposable income also rises, and thereby the level of consumption level. However, the rise in rate of interest causes the level of investment to fall.

c. The government increases taxes.

ISC?

When there is a tax increase, it leads to a reduction in the income level and the rate of interest as well. The fall in the income level reduces the disposable income and thereby the level of consumption. However, the fall in the interest rate raises the level of investment.

d. The government increases government purchases and taxes by equal amounts. explain

The increase in the government purchases and taxes by equal amounts causes the output to increase. However, the level of disposable income falls, so does the consumption. The rate of interest rises which decreases the level of investment.

(Y-t)

ISC?

ΔY?

3. Consider the economy of Hicksonia.
   a. The consumption function is given by
   $C = 200 + 0.75(Y - T)$.

   The investment function is
   $I = 200 - 25r$.

   Government purchases and taxes are both 100. For this economy, graph the IS curve for r ranging from 0 to 8.

   We know, the IS curve is given by the expression:
   $Y = C(Y - T) + I(r) + G$.
   From the question, the consumption and investment functions are:

   $C = 200 + 0.75(Y - T)$.

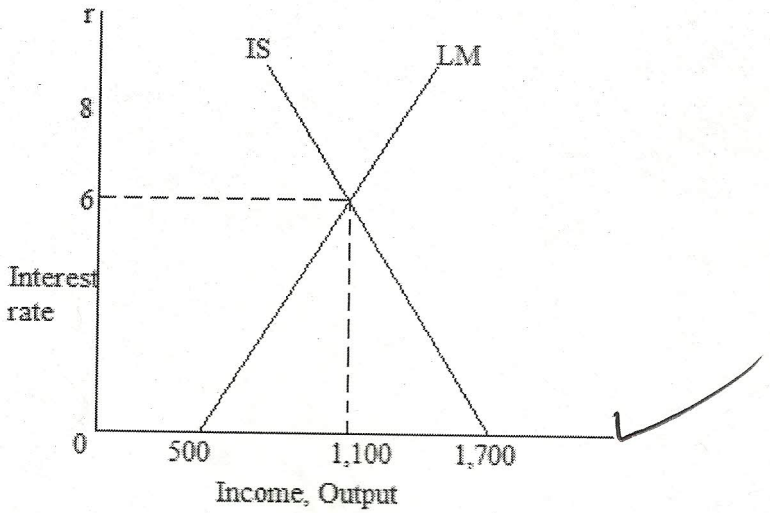
   $I = 200 - 25r$.

   Equating these three equations, we get:

   $Y = 200 + 0.75(Y - 100) + 200 - 25r + 100$
   $Y - 0.75Y = 425 - 25r$
   $(1 - 0.75)Y = 425 - 25r$
   $Y = 1,700 - 100r$

20
20

The graph below traces the IS curve:



b. The money demand function in Hicksonia is

$(\frac{M}{P})^d = Y - 100r.$

The money supply M is 1,000 and the price level P is 2. For this economy, graph the LM curve for ranging from 0 to 8.

Here,

The supply of real money balances is given by: 1,000/2 = 500. Here, we equate the demand for and supply of real money balances, we get:

500 = Y – 100r. Y =
500 + 100r.

The graph in part (a) traces the LM curve.

c. Find the equilibrium interest rate r and the equilibrium level of income Y.

Solving part (a) and (b), we get:

1,700 – 100r = 500 + 100r.

1,200 = 200r

r = 6.

Putting this value of r in the above equation, we get:

Y = 1,700 – 100*6 = 1,100.

d. Suppose the government purchases are raised from 100 to 150. How much does the IS curve shift? What are the new equilibrium interest rate and level of income?

The IS curve function after this increment is,

$Y = 200 + 0.75(Y - 100) + 200 - 25r + 150.$

$Y = 1{,}900 - 100r.$

It shows that IS curve shifts to the right by 200 units.

Equating this equation with previous LM curve function, we get:

$1{,}900 - 100r = 500 + 100r$

$r = 7.$

Putting this value of r in the above equation, we get:

$Y = 1{,}200.$

e. Suppose instead that the money supply is raised from 1,000 to 1,200. How much does the LM curve shift? What are the new equilibrium interest rate and level of income?

The LM curve equation after this increment is:

$(1{,}200/2) = Y - 100r$

i.e. $Y = 600 + 100r.$

It shows that the LM curve shifts by 100 units.

Equating it with the previous IS function, we get:

$1{,}700 - 100r = 600 + 100r$

$r = 5.5.$

Putting this value of r in the above equation, we get:

$Y = 1{,}150.$

f. With the initial values for monetary and fiscal policy, suppose that the price rises from 2 to 4. What happens? What are the new equilibrium interest rate and level of income?

The new price level is 4.

The supply of real money balances in this case is: $1{,}000/4 = 250.$

So, the LM equation becomes:

$Y = 250 + 100r.$

We will equate it with the IS equation, we get:

$1,700 - 100r = 250 + 100r$

$r = 7.25.$

Putting this value of r in the above equation, we get:

$Y = 975.$

g. Derive and graph an equation for the aggregate demand curve if fiscal or monetary policy changes, as in parts (d) and (e)?

IS: $Y = 1,700 - 100r$

$100r = 1,700 - Y.$

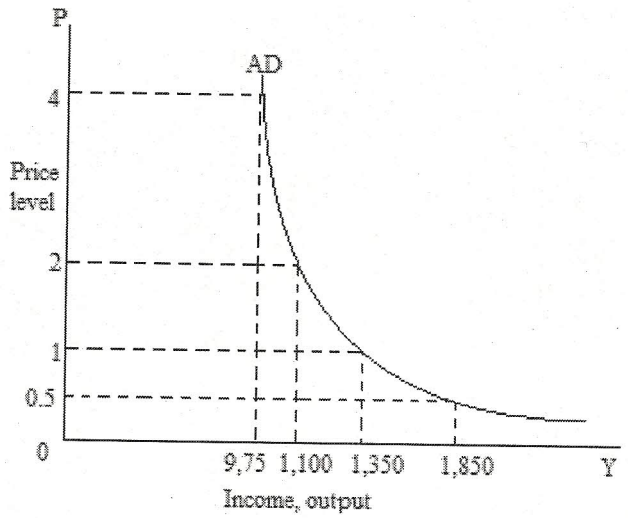
LM: $(M/P) = Y - 100r$

$100r = Y - (M/P).$

Equating these two, we get:

$1,700 - Y = Y - (M/P)$
$2Y = 1,700 + M/P$
$Y = 850 + M/2P$
$Y = 850 + 500/P.$

The graph below traces the aggregate demand curve:



When fiscal or monetary changes as in part (d) are made, then,

The IS curve is:

$Y = 1,900 - 100r$

$100r = 1,900 - Y.$

Likewise the LM curve is:

$(1,000/P) = Y - 100r$

$100r = Y - (1,000/P)$

Solving these two, we get:

$1,900 - Y = Y - (1,000/P)$

$Y = 950 + 500/P.$

Therefore, the changes make the aggregate demand curve to shift to the right by 100 units.

Likewise, when fiscal or monetary changes as in part (e) are made, then,

$Y = 850 + 600/P.$

Thus, the aggregate demand curve shifts to the right.

6. Use the IS-LM diagram to describe the short-run and long-run effects of the following changes on national income, interest rate, the price level, consumption, investment, and real money balances.

a. An increase in the money supply.

As a short-run effect, the increase in the supply of money causes the interest rate of fall and thereby increasing the level of investment. As there is a growth in the level of investment, the output increases. Because of this, the prices tend to fall, which lead to a fall in real money balance. This, in turn, raises the rate of interest. So, we can see that in the long-run the rate of interest raises. The prices continue to rise till the economy reaches the previous state of equilibrium. Thus, the increase in the money supply does not have any effect on these variables.

b. An increase in government purchases.

As a short-run effect, the increase in the government purchases raises the output and the interest rate as well. It causes a reduction in the level of investment. In the short-run, the LM curve remains unaffected. After the output increase, the prices also tend to rise. So, the LM curve shifts to the left. The rate of interest continues to rise in the long-run till the long-run level of output is attained. The prices also remain increased. The effect of fiscal policy is not enough to change the long-run level of output.

c. An increase in taxes.

We know that the increase in the tax causes a reduction in the disposable income leading to a reduction in the output and rate of interest as well. However, in the long-run, the prices tend to fall because the output is low which shifts the LM curve to the right. The real balances increase which lead to a further fall in the interest rate. It substantially increases the investment level and thereby the income.

8. Suppose that the demand for real money balances depends on disposable income. That is the money demand function is

$M/P = L(r, Y - T)$.

Using the IS-LM model, discuss whether this change in the money demand function alters the following:

a. The analysis of changes in government purchases.

The real money balances being dependent on disposable income brings no change in the analysis of changes in government purchases. It is because it tends to only affect the IS curve by shifting it to the right but the LM curve remains unaffected.

b. The analysis of changes in taxes.

The analysis of changes in taxes is substantially affected by making the real money balances dependent on disposable income. It is because an increase in the tax reduces the disposable income of consumers, thereby reducing their consumption level. So, it causes the IS curve to shift to the left. The tax increase also decreases the total money demand. As the result, the LM curve shifts downward as well.