MODULE 9

Small Open Economy Equilibrium II:

Monetary Policy under Flexible Exchange Rates

This module draws on the basic concepts developed in the previous modules in the sequence, exploring the conditions of equilibrium of the small open economy under flexible exchange rates and the operation of monetary policy under a flexible exchange rate regime. It develops the traditional *IS-LM* model of open economy equilibrium under conditions where the real interest rate is fixed in the rest of the world. The analysis focuses first on the less-than-full-employment case where the domestic price level is fixed and then on the full-employment case with price level flexibility. A full-employment variant of the *IS-LM* graphing is developed with the price level on the horizontal axis and the real interest rate on the vertical one. The basic result that emerges is that domestic output is determined by the condition of domestic asset equilibrium and the world real interest rate under less-than-full-employment conditions and the domestic price level is determined by condition of asset equilibrium and the world interest rate when there is price level flexibility and full employment. In both cases the nominal and real exchange rates adjust endogenously to maintain flow or real goods market equilibrium. Monetary policy is effective in manipulating output and/or prices under flexible exchange rates.

1. Commodity Market Equilibrium

Overall equilibrium of a small open economy has two requirements: the flow of domestic output produced must equal the desired absorption of domestic goods by domestic and foreign residents for consumption and investment purposes (flow equilibrium); and the existing stocks of assets held by domestic residents must equal the quantities of those assets they desire to hold (stock equilibrium). This topic deals exclusively with goods market equilibrium, developing from a different perspective the analysis in the previous module.

We begin with equation (3) in the third topic of the previous module, which is also equation (3) in the current module.[1]

$$X = C + I_g + E - E^*, \tag{3}$$

where C, I_g, and E are total purchases of consumption, investment and export goods from both domestic and foreign sources. The star superscript refers to foreign variables so that E^* refers to domestic import expenditures. When depreciation is subtracted from both sides and the debt service balance *DSB* is added to both sides this becomes

$$Y = C + I + B_T + DSB \tag{4}$$

where I is net investment and B_T $(= E - E^*)$ is the balance of trade. These equations are interpreted as equilibrium conditions. The consumption, investment and balance of trade functions developed in the previous module determine the levels of the respective variables in (4):

$$C = \alpha + \beta Y, \tag{5}$$

$$I = \delta - \mu r^*. \tag{6}$$

$$B_T = Z_{BT} - m Y + m^* Y^* - \sigma q \tag{7}$$

where the real exchange rate, q , equals

$$q = \frac{P}{\Pi P^*}. \tag{8}$$

[1]Equations (1) and (2) in this topic, also identical to the corresponding equations in the third topic of the previous module, are omitted here.

Substitution of equations (5), (6) and (7) into (4) gives the condition of real goods market equilibrium:

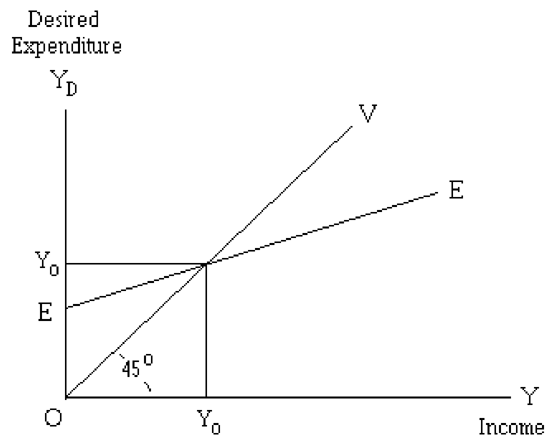
$$\begin{aligned} Y &= \frac{1}{s+m}\left(Z_{BT}+\alpha+\delta\right)+\frac{m^*}{s+m}Y^*-\frac{\mu}{s+m}r^* \\ &\qquad -\frac{\sigma}{s+m}q+\frac{1}{s+m}DSB \end{aligned} \tag{9}$$

where $s = 1-\beta$ is the marginal propensity to save. If we substitute $-Z_{S-I}$ for $(\alpha+\delta)$ this reduces to the real goods market equilibrium equation derived in the previous module.

Exogenous shocks to consumption, investment and net exports (upward shifts of α , δ and Z_{BT}) lead to an increase in the equilibrium level of domestic output. *Endogenous* changes in consumption, investment and imports then arise in the course of movement to the new equilibrium.

The equilibrating process is portrayed graphically in Figure 1.1. Income is on the horizontal axis and desired expenditure on the vertical axis. For equilibrium to occur, income generated in the economy must equal desired expenditure, given by the line *EE*. This will occur at some point along the 45 degree line from the origin.

Figure 1.1:

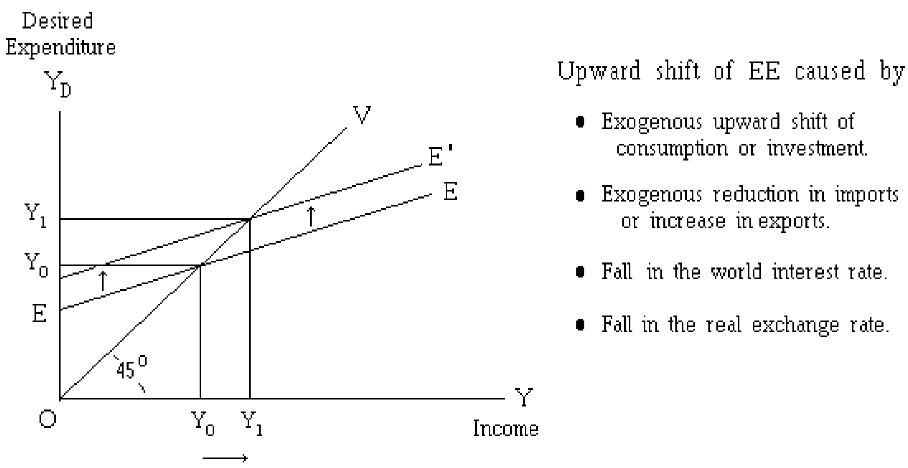


The equation of the *EE* line is obtained by substituting the consumption, investment, and net export equations (5), (6) and (7) into (4) and treating the income variable on the left side of the equality as desired expenditure, denoted as Y_D, and the domestic income variable on the right side of the equality as actual income.

$$Y_D = Z_{BT} + \alpha + \delta + m^* Y^* - \mu r^* + (\beta - m) Y - \sigma q + DSB \qquad (10)$$

Since $\beta < 1$ and $m > 0$, $(\beta - m)$ is clearly less than unity—Y_D therefore increases by less than Y as we move upward along the *EE* line. The effects of various exogenous shocks on domestic income are shown in Figure 1.2.

Figure 1.2:



Suppose now that there is full employment and the level of domestic output is thereby fixed at Y_F in Figure 1.3. For equilibrium to occur the real exchange rate must adjust to make the *EE* curve pass through the point A.

Adjustment to equilibrium thus occurs through changes in the real exchange rate when there is price level flexibility and full employment and through changes in the level of output and employment when prices and the exchange rate are fixed.

The equilibrating process described here differs only in diagrammatic presentation from the one described in the previous module. The earlier presentation is shown in Figure 1.4. The *SI* and *NL* curves give the respective responses of desired net lending abroad (savings minus investment) to the real exchange rate and the level of employment (as represented by income). The *CB* and *CA* curves give the responses of the desired current account balance to the real exchange rate and level of employment respectively.

Figure 1.3:

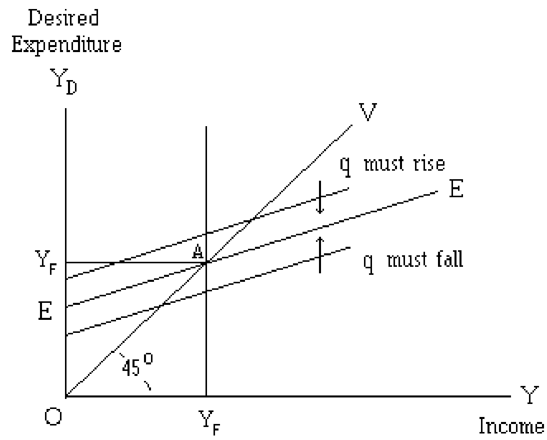
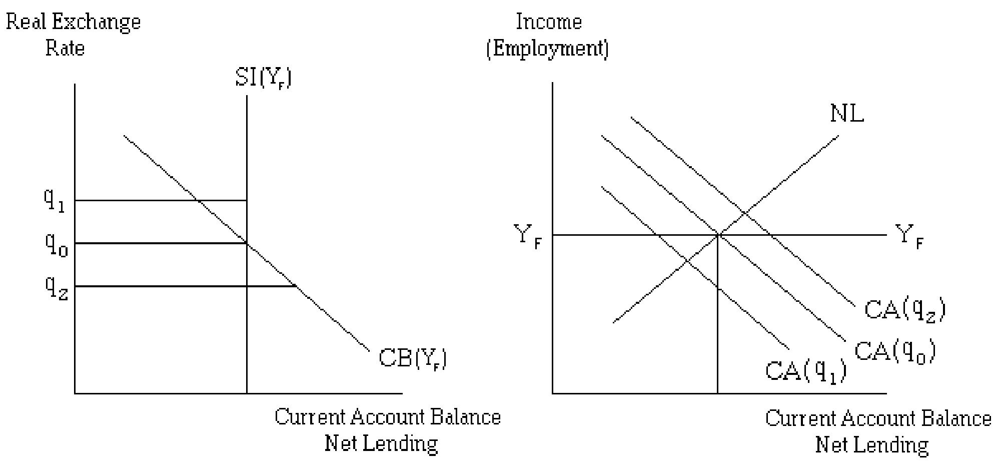


Figure 1.4:



The equilibrating adjustment of q in the full-employment case can be viewed in three alternative and equivalent ways: a) a movement down along the CB line to the point where it crosses the SI line in the left panel of Figure 1.4; b) a shift of the CA line to cross the NL line at income Y_F in the right panel of Figure 1.4; and c) a shift of the EE line in Figure 1.3 to cross OV at income Y_F.

In the case where the real exchange rate is fixed at, say, q_o and employment adjusts (both the nominal exchange rate and the price level are fixed), equilibrium is achieved by a movement along the EE curve in Figure 1.3, by movements along the NL and $CA(q_o)$ curves in the right panel of Figure 1.4, and by shifts of both the SI and CB curves as Y changes in the left panel of Figure 1.4.

The presentation in Figure 1.4 is useful if we are interested in the forces causing changes in the equilibrium real net capital flow and current account balance. Figure 1.3 yields a simpler analysis if we are interested only in the equality of aggregate income and expenditure.

2. Aggregate Asset Market Equilibrium

Now consider the second condition of small open economy equilibrium—that domestic residents' desired holdings of assets equal their actual holdings. Non-monetary assets are the rights to receive the present and future flow of output from the human and physical capital stocks. The real stock of money represents the right to receive the transactions services yielded by that money.

Domestic residents' *stock of wealth* is the aggregate stock of assets they own—the sum total of their ownership of human capital, physical capital, and real money balances. Ownership of these primary assets can, of course, be indirect, taking the form of bonds or other claims on the individuals who directly own the money or capital goods. Individuals are in *portfolio equilibrium* when they have the desired mix of assets of various types in their portfolios. Since human capital is typically embodied in the individual who owns it, it cannot be bought and sold. Non-human assets, however, will be exchanged until portfolio equilibrium occurs.

Given overall level of wealth, willingness to hold the existing stock of money is equivalent to a willingness to hold the existing stock of non-monetary assets. Portfolio equilibrium thus requires only that the aggregate quantity of money demanded equal the quantity in circulation—an excess demand for money must have as its counterpart an excess supply of non-monetary assets and vice versa.

The demand for real money holdings can be expressed

$$\left(\frac{M}{P}\right)^{D} = \theta + \epsilon Y - \Omega\,(r^{*} + \tau^{e}) \tag{1}$$

where $(M/P)^D$ is the real quantity of money demanded, τ^e is the expected rate of inflation, and the other variables are as previously defined. An increase in the level of real income (increase in the volume of transactions) or a reduction in the nominal interest rate (fall in the cost of holding money) increases the real quantity of money demanded. A fall in the nominal interest rate can occur through a fall in the world real interest rate or a fall in the expected rate of domestic inflation. For now we assume that the supply of money is determined by the government.

Aggregate asset or portfolio equilibrium occurs when

$$\frac{M}{P} = \left(\frac{M}{P}\right)^{D} \tag{2}$$

so the condition of stock or asset equilibrium becomes

$$\frac{M}{P} = \theta + \epsilon Y - \Omega\,(r^{*} + \tau^{e}) \tag{3}$$

The condition of real goods market equilibrium, given by equation (9) in the previous topic, is reproduced here as equation (4),

$$\begin{aligned} Y \quad = \quad & \frac{1}{s+m}\,(Z_{BT} + \alpha + \delta) + \frac{m^{*}}{s+m}\,Y^{*} - \frac{\mu}{s+m}\,r^{*} \\ & - \frac{\sigma}{s+m}\,q + \frac{1}{s+m}\,\mathit{DSB} \end{aligned} \tag{4}$$

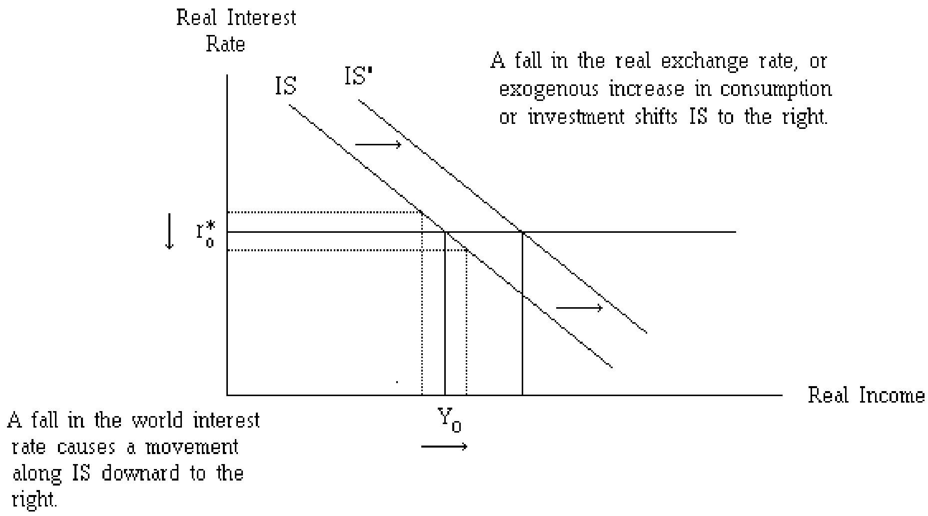
The two equations (3) and (4) solve simultaneously to produce the equilibrium levels of the endogenous variables Y and q under less-than-full-employment conditions and P and q under conditions of full employment.

The natural way to understand this equilibrium is to put the two equations on a diagram as separate curves and find the point where they cross. We do this next.

3. The *IS* and *LM* Curves

The combinations of r^* and Y for which equation (4) above holds holds can be presented as a negative relationship between income and the real interest rate, called the *IS* curve in Figure 3.1.

Figure 3.1:



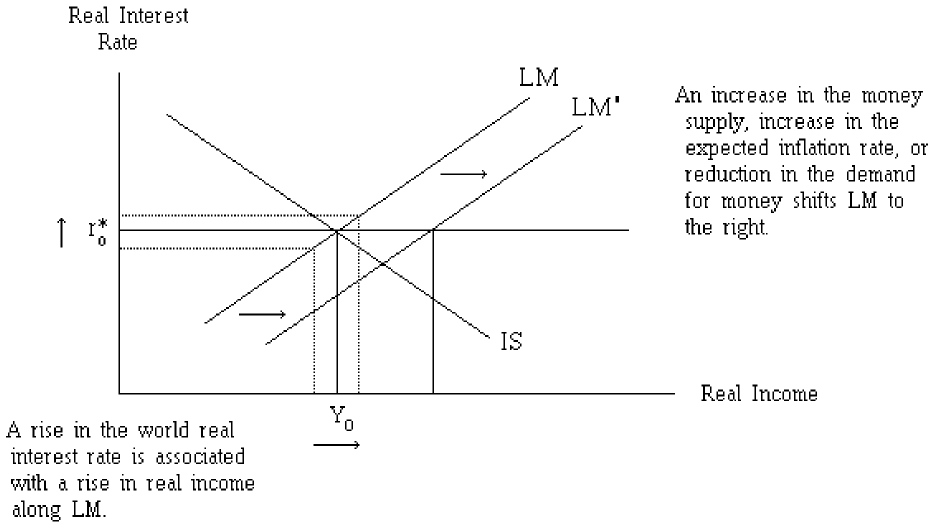
A fall in the interest rate leads to an expansion of investment, causing equilibrium income to increase as we move down along the *IS* line. A fall in the real exchange rate shifts world demand onto domestic goods, increasing income at each level of the real interest rate and shifting *IS* to the right. An increase in rest-of-world income, or exogenous increase in consumption or investment at any given level of the real interest rate also causes the *IS* line to shift to the right and the equilibrium level of income to increase.

To portray asset equilibrium in terms of the relationship it implies between the world real interest rate and the level of income, it is useful to rearrange equation (3) of the previous topic to put r^* on the left side:

$$r^* = \frac{1}{\Omega}\theta - \frac{1}{\Omega}\frac{M}{P} + \frac{\epsilon}{\Omega}Y - \tau^e \tag{1}$$

This equation defines a positive relationship between the real interest rate and level of income, holding everything else constant, as portrayed by the upward sloping line *LM* in Figure 3.2, which gives the combinations of income and the interest rate for which the demand for money (or desired liquidity) equals the money supply and hence for which domestic residents are in asset equilibrium.

Figure 3.2:



The intuition behind the positive slope of *LM* is as follows: An increase in the interest rate reduces the demand for money and an increase in income increases it. To keep the demand for money equal to a constant money supply as the interest rate rises and we move along the *LM* line, the level of income must increase. An increase in the money supply or in the expected inflation rate leads to a rightward shift of *LM*.

Overall equilibrium of the small open economy will occur where the two lines cross. But there is a complication. The real interest rate is determined in the world market at the level r^* and cannot vary with changes in the domestic variables. So the two curves must cross at a real interest rate equal to r^*.

4. Monetary Policy Under Flexible Exchange Rates: Less Than Full Employment

Assume for now that the exchange rate is flexible, the price level is fixed and there is less than full employment in the economy. The equations of asset and goods market equilibrium that have been developed in previous topics are reproduced as (1) and (2) below:

$$r^* = \frac{1}{\Omega}\theta - \frac{1}{\Omega}\frac{M}{P} + \frac{\epsilon}{\Omega}Y - \tau^e \tag{1}$$

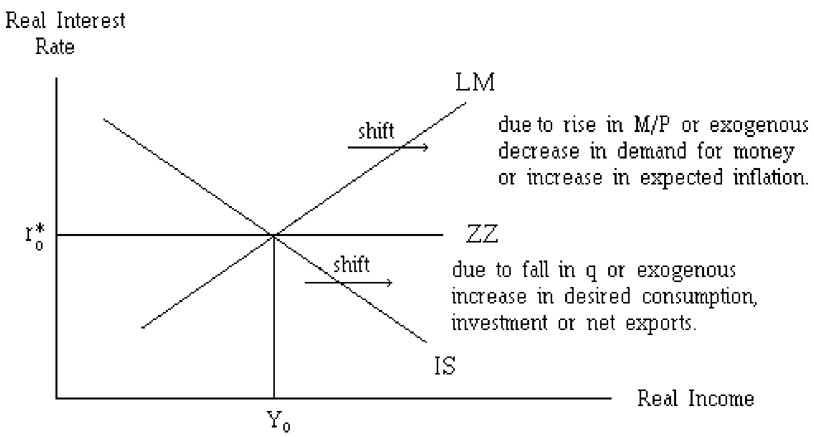
$$\begin{aligned} Y \;\; = \;\; & \frac{1}{s+m}(Z_{BT} + \alpha + \delta) + \frac{m^*}{s+m}Y^* - \frac{\mu}{s+m}r^* \\ & - \frac{\sigma}{s+m}q + \frac{1}{s+m}\mathit{DSB} \end{aligned} \tag{2}$$

where

$$q = \frac{P}{\Pi P^*} \tag{3}$$

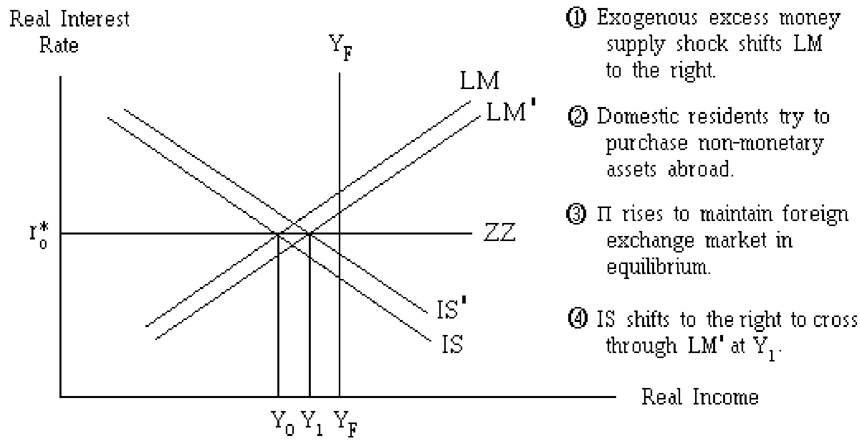
Equations (1) and (2) appear as the *LM* and *IS* curves respectively in Figure 4.1. The exogenously determined (in the rest of the world) real interest rate is given by the horizontal line *ZZ*.

Figure 4.1:



Consider the asset equilibrium equation (1). M is fixed by the government, P is fixed by short-term price rigidity, r^* is fixed in the world market, and τ^e is determined by people's expectations based on past history. The only variable that can change to produce equilibrium is Y. And given this level of Y, and the values of Y^* and r^* determined in the rest of the world and the level of *DSB* determined by past history, the only variable that can adjust to maintain real goods market equilibrium in equation (2) is q. And since P is fixed all adjustments of q must take place through changes in the nominal exchange rate Π . This means that the level of income will be determined (by equation (1)) at the point where *LM* crosses *ZZ*, and that the nominal exchange rate must continually adjust in equation (2) to ensure that the IS curve crosses through this same point.

Figure 4.2:

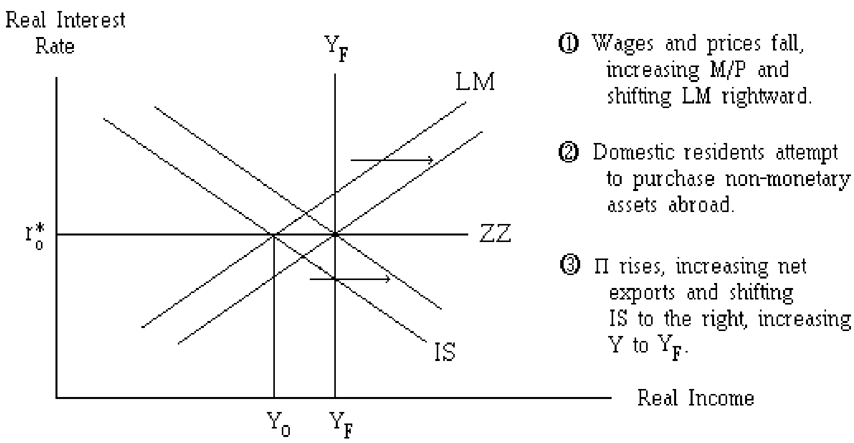


To visualize this adjustment process, imagine a government policy induced increase in the money supply or an exogenous decrease in domestic residents' demand for money. The *LM* line shifts to the right to *LM'* in Figure 4.2. Domestic residents try unload their excess money balances and reestablish portfolio equilibrium by purchasing assets from foreign residents, creating an excess supply of the domestic currency on the foreign exchange market. This causes the domestic currency to depreciate, switching world demand onto domestic goods and shifting the *IS* curve to the right. The resulting increase in output, employment and income as commodity market equilibrium is maintained raises domestic residents' desired money holdings. This adjustment process will continue until *IS* crosses *LM'* on the *ZZ* line at income level Y_1.

It is extremely important to notice the essential feature of the process of adjustment to monetary shocks. Employment and income respond to real exchange rate changes induced by domestic residents' attempts to reestablish portfolio equilibrium through purchases and sales of non-monetary assets on the international market. Exchange rate changes provide the mechanism of adjustment. Real interest rates are determined in the international capital market and play no role in the adjustment process.

The natural process of adjustment to full employment is shown in Figure 4.3. The initial less-than-full-employment income level is Y_0. Excess supply in the labour market eventually leads to declines in wages and firms competitively pass these cost reductions on in lower prices with the result that M/P increases, shifting *LM* to the right. The resulting portfolio adjustment pressure on the exchange rate causes Π to rise, lowering q and shifting world demand onto domestic output. This shifts *IS* to the right along with *LM*, until the two curves intersect along the *ZZ* line at Y_F.

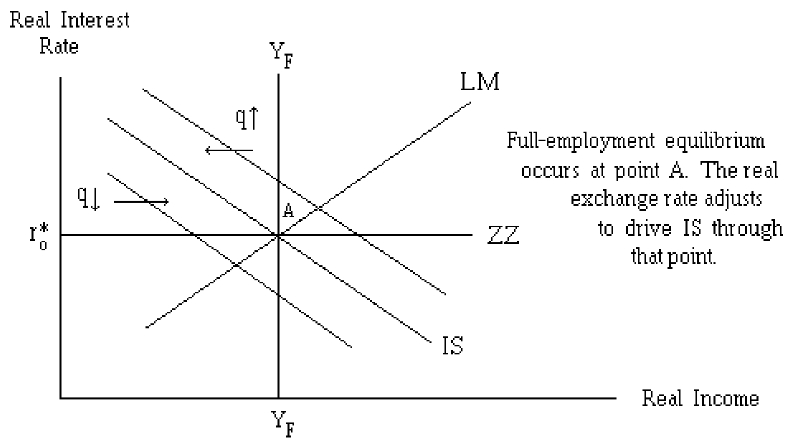
Figure 4.3:



5. Monetary Policy Under Flexible Exchange Rates: Full Employment

Full-employment equilibrium requires that the *IS*, *LM* and Y_F cross at the world interest rate, given by the line *ZZ* in Figure 5.2.[2] The real exchange rate must adjust to drive the *IS* curve through the point where Y_F and *ZZ* cross. If *IS* crosses *ZZ* at an output level above full employment there will be excess demand for domestic output. The relative price of domestic output q must rise, shifting the *IS* curve to the left until it passes through the point A. If *IS* and *ZZ* cross at an output level below full employment there will be excess supply of domestic output and q will fall.

Figure 5.2:



Suppose that q has adjusted so that *IS* crosses *ZZ* at the point A but that, as shown in Figure 5.3, the *LM* curve crosses the *ZZ* line at a level of income Y_1 above full employment. Domestic residents are out of portfolio equilibrium and will buy non-monetary assets from foreign residents with their excess money holdings, creating an excess supply of domestic currency on the world market. The resulting rise in Π at the initial domestic price level will reduce the relative international price of domestic goods, q , shifting world demand onto domestic output. This will result in rightward pressure

[2]Figure 5.1 is not shown here because the corresponding figure in the module merely presents the *IS* and *LM* curves for purposes of review.

on the IS curve and a bidding up of P until q and IS have returned to their original levels. As P rises domestic residents' real money holdings will decline, shifting the LM line to the left. This adjustment process will continue until LM crosses ZZ at the point A.

Figure 5.3:

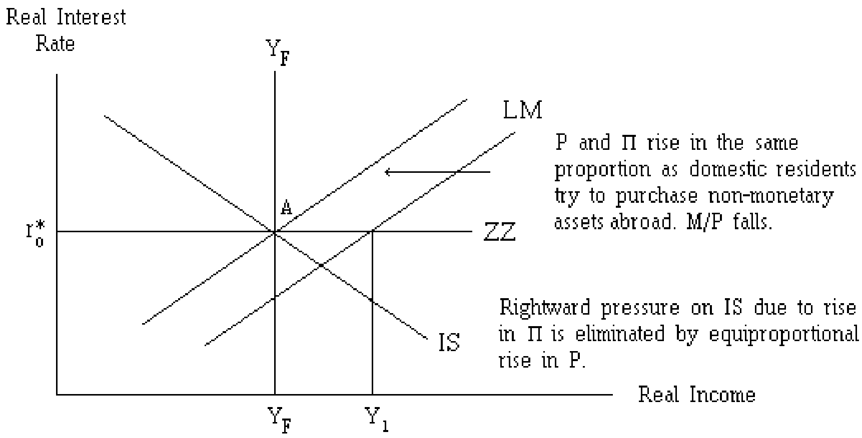
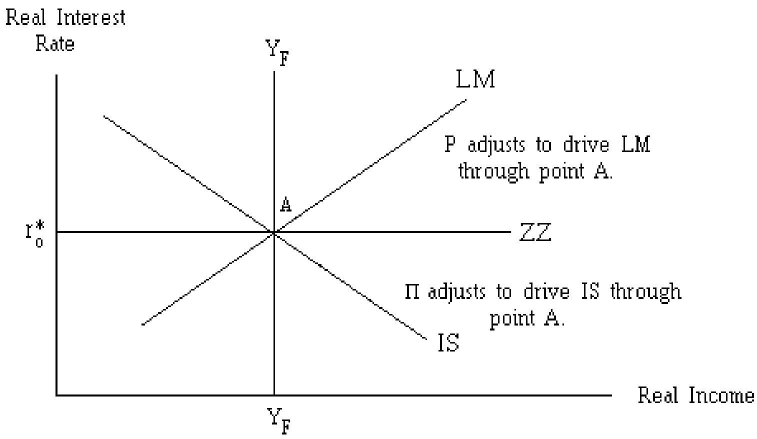
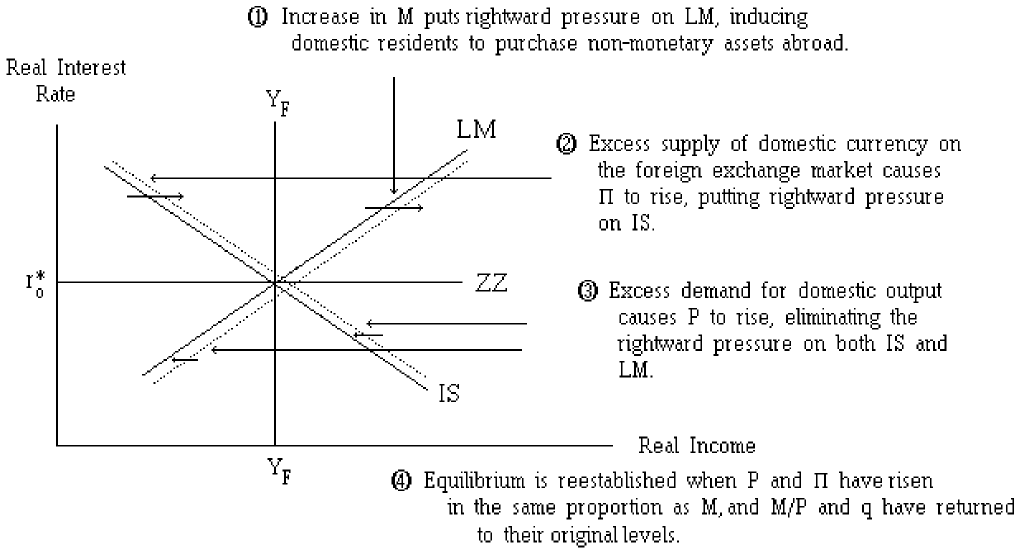


Figure 5.4:



Thus, starting from any position of disequilibrium, the price level will adjust until domestic residents are in portfolio equilibrium, shifting the *LM* curve until it crosses through the equilibrium point A. As this happens, the nominal exchange rate will also adjust to ensure a level of q sufficient to make the *IS* curve cross through point A. This is illustrated in Figure 5.4.

Figure 5.5:



Suppose that, starting from a position of full-employment equilibrium, the government increases the domestic nominal money supply. This will create excess money balances in the hands of domestic residents, putting rightward pressure on the *LM* curve in Figure 5.5 and leading domestic residents to attempt to purchase assets abroad. The resulting excess supply of domestic currency on the international market will cause it to depreciate which will create excess aggregate demand for domestic output and lead to an increase in the price level. Ultimately, the domestic price level will rise in proportion to the increase in the nominal money supply so that M/P will return to its original level. And Π will rise in proportion to the increases in P (and M) to maintain q at its original level. The *LM* and *IS* curves will return to their initial positions without any actual net purchases of assets by domestic residents from abroad taking place—the change in the price level will return real money holdings to their old level, at which no increase in holdings of non-monetary assets will be required. Similarly, no actual switch of world expenditure onto domestic goods will take place since the real exchange rate (relative price of domestic goods) will also return to its old level. Nominal money is *neutral* under full-employment conditions in the sense that it has no effect on real magnitudes.

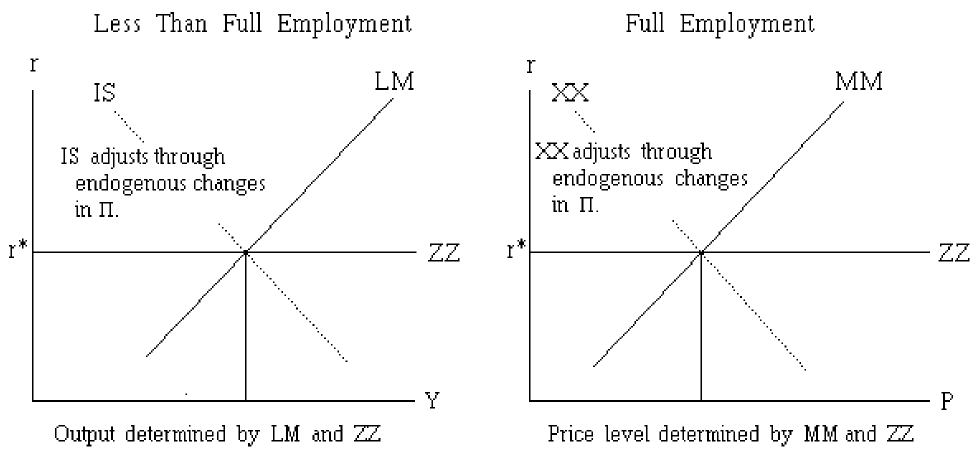
6. An Alternative Full-Employment Perspective

A convenient modification of the above *IS-LM* framework is to put the price level on the horizontal axis instead of income, which is constant anyway, and redefine the *IS* and *LM* curves appropriately. First, we can modify the goods market equilibrium equation by setting $Y = Y_F$ and moving q to the left-hand side:

$$q = \frac{1}{\sigma}(Z_{BT} + \alpha + \delta) + \frac{m^*}{\sigma} Y^* - \frac{\mu}{\sigma} r^* - \frac{(s+m)}{\sigma} Y_F + \frac{1}{\sigma} DSB \qquad (1)$$

This implies a negative relationship between r^* and q. At every level of the nominal exchange rate, an increase in q requires an increase in P. Thus a fall in the real interest rate, at given Y_F and Π, must be associated with a rise in P as shown in the right panel of Figure 6.1. The curve XX thus gives the combinations of r and P for which flow equilibrium holds in exactly the same way that the *IS* curve in the left panel of Figure 6.1 gives the combinations of r and Y consistent with flow equilibrium.

Figure 6.1:



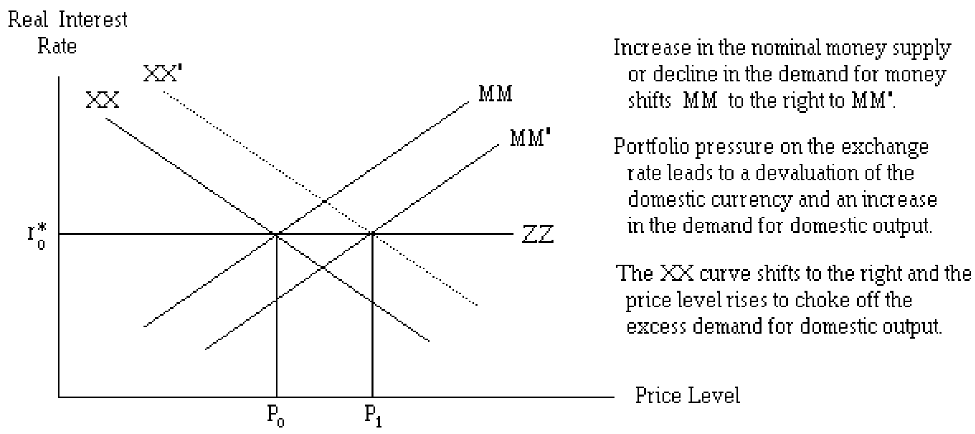
The asset equilibrium equation, presented in demand for money form with $Y = Y_F$ and nominal money supply equal to M_0,

$$\frac{M_0}{P} = \theta + \epsilon Y_F - \Omega(r^* + \tau^e), \tag{2}$$

reveals an obvious positive relationship between r^* and P. These combinations of r^* and P trace out the upward sloping *MM* curve in the right panel of Figure 6.1. It is equivalent to the *LM* curve in the left panel except that P is on the horizontal axis instead of Y.

The two panels in Figure 6.1 have essentially the same interpretation. Under flexible exchange rates and less-than-full employment (left panel), the level of income is determined by the intersection of the *LM* and *ZZ* curves with the nominal exchange rate adjusting to ensure that *IS* passes through that *LM*-*ZZ* intersection. Under full-employment conditions the price level is correspondingly determined by the intersection of *MM* and *ZZ* with the nominal exchange rate adjusting continuously to ensure that *XX* passes through that *MM*-*ZZ* intersection.

Figure 6.2:



An exogenous increase in the supply of money (or decline in the demand for money) shifts *MM* to the right. This causes domestic residents to purchase assets abroad to rebalance their portfolios. Resulting pressure on the exchange rate leads to a devaluation of domestic currency which shifts world demand onto domestic goods and raises the equilibrium price level until the equilibrium real money stock has been reestablished. This is shown in Figure 6.2.

Study Question

One frequently reads in the business pages of major newspapers that "the Bank of Canada is attempting to expand employment by reducing the domestic interest rate". Does this view make any sense in terms of the analysis presented here? What is the mechanism by which the Bank of Canada's monetary policy initiatives can increase domestic output and employment?

References

Richard E. Lipsey, Douglas D. Purvis, and Paul N. Courant, *Economics*, Eighth Canadian Edition, 1994, 564-577, 588-595, 686-689.

N. Gregory Mankiw, *Macroeconomics*, Worth Press, 1997, Chapters 7 and 11. Alternatively, students can read the same chapters in any edition of Mankiw's book. The same material can also be found in the Canadian edition of this book, written jointly with William Scarth, also available from Worth Press.

Michael Parkin and Robin Bade, *Economics*, Addison Wesley, 1991, 654-668, 674-677, 758-761, 826-835, and 847-860.