CHAPTER 4

The Open Economy

[This is a draft chapter of a new book - Carlin & Soskice (200x)[1]].

In the analysis of macroeconomics to this point in the book, we have assumed a completely closed economy. For an economy the size of the USA, that may be a useful approximation: exports constitute only about 10% of GDP. This is also the case for other large economies like Brazil, India and Japan. But when we want to analyze a European economy, for example, the picture changes dramatically. The British and German economies have export sectors of about 25% of GDP. In smaller countries, such as the Netherlands or Belgium, exports amount to more than 50% of GDP. In small economies with high levels of processing and re-export of imported goods such as Ireland or Singapore, the export share can exceed 100%. In Asia, Taiwan, Thailand and South Korea have export shares of between 40 and 50%.

Moreover, the financial markets of advanced and emerging economies are integrated into global markets. Hence we have to understand how to deal with both exports and imports and with the integration of domestic and international financial markets. Happily, understanding the closed economy takes us a large part of the way to being able to analyze economies that are plugged into the world economy. We focus in these three chapters on what is referred to as a small open economy. This is an open economy that is assumed to be too small to influence the level of world output or the world interest rate. Conditions in the rest of the world are taken as given.

Closely related to the problem of analyzing open economies is the analysis of regions within a single country. Few economists would think of analyzing a region of a country as a closed economy itself. It is too obvious in the case of a region within a country that its financial market is integrated into the national one. It is also evident that much of what is produced in a region is exported from the region, and much of what is consumed is imported from beyond the region. The open region is not identical to the open economy for two reasons. First, unlike the open economy, there may be considerable labour mobility between different regions in the same economy. In fact we make the assumption in what follows that there is no labour mobility between open economies.[2] Second, the region has no control over monetary policy, and the region usually has only limited (or no) say in fiscal policy. Both monetary and fiscal policy are the prerogative of the national not the regional government. In the case of an open economy, the national government or government and central bank (in the case of an independent central bank) can decide on monetary and fiscal policy.

There is an exception to the control by the national government (or central bank) of monetary policy. That is in the now important case of a group of economies that share a common currency, and hence a common monetary policy. This is true of the member countries of EMU, the European Economic and Monetary Union. For a member of a common currency area, in contrast to the standard open economy case, the national government has no control over monetary policy, including the exchange rate. As in the standard open economy case and in contrast to the regional case, the national government has control over fiscal policy (subject to the rules of the monetary union) and

 We are very grateful to Andrew Glyn, Georg von Graevenitz, Massimo di Matteo, William Wachtmeister and especially to Nicholas Rau for their help and advice but we are responsible for all errors.

[2]Economic migration is an important feature of the modern world as can be seen from the football pages of any newspaper. However it is unlikely to be strongly affected by relatively short-term changes in domestic economic conditions. Moreover economic analysis becomes impossible when too many variables are treated as endogenous. We therefore treat national populations as given in what follows.

there is no labour mobility. Table 4.1 provides a summary of the differences between the three main types of open economy.

Type of open economy	**Fiscal policy**	**Monetary and exchange rate policy**	**Labour market structure**
National economy not in a monetary union	No institutional constraints	Control over monetary and exchange rate policy	No mobility across national boundaries
National economy in a monetary union	Monetary union may impose (weak) institutional constraints	No control over monetary and exchange rate policy	No mobility across national boundaries
Region in an economy	National economy imposes (strong) institutional constraints	No control over monetary and exchange rate policy	Mobility across regions

Table 4.1 Types of open economy

We shall see that the fundamental concepts developed for the closed economy remain at the core of the macro analysis of the open economy. Moreover, once the analysis of the standard small open economy has been completed, it will be quite easy to extend the analysis to the case of a region and to that of an economy within a single currency union. Thus the extra effort needed for open economy analysis will have a large payback in terms of our ability to analyze real world situations.

Just as with the closed economy, we find it very useful in the open economy analysis to distinguish between, on the one hand, how output and employment are determined in the short run when prices and wages are given and, on the other hand, how they are determined in the medium term when we include feedback from changes in output to wages and prices.

The first component is based on a short-run model known as the Mundell–Fleming model after its authors Robert Mundell and Marcus Fleming, who independently developed the model in the early 1960s. We begin by addressing the following questions:

- How is output determination in the short run affected by trade and financial openness?
- What determines the trade balance and why does it matter?
- What is the real exchange rate and how does it affect output and trade?
- How do fixed and flexible exchange rate regimes work?

The chapter is organized in the following way. Section 1 deals with the consequences of opening the goods market and section 2, with the opening of the financial market. The key ground-work for the short-run open economy model is to be found in those two sections. Before putting them together, we present a short section to highlight how fixed and flexible exchange rate systems operate. Section 4 is also short and its aim is to pin down the key balance of payments concepts that are needed for open economy macro. In section 5, the Mundell–Fleming model is put together. We show how to analyze fiscal, monetary and exchange rate policy in the short-run. Along the way, we highlight the implications for the adjustment process to a new short-run equilibrium of assuming adaptive or rational expectations for exchange rates and we show how a combination of forward-looking exchange rate expectations and sluggish behaviour in the goods market will produce exchange rate overshooting. After section 5, the way is open to go on to the analysis of the medium run in Chapter 5. However, an optional section 6 is provided for those who are interested in finding out what happens when we relax three of the key assumptions made in this chapter: that there is perfect international capital mobility, that the home economy is small and that international financial assets are perfect substitutes.

In Chapter 5, the short-run Mundell–Fleming model is extended to the medium run by introducing endogenous wage and price adjustments. This is essential in order to analyze what happens to equilibrium employment and inflation in the open economy. Chapter 6 puts the model to work by analyzing different kinds of shocks and alternative policy responses.

1. Opening the goods market

The purchase of goods and services from abroad (imports) and the sale of home-produced output (exports) influences the level of output in the economy in the short run. Holding all else constant, imports of goods depress domestic output because demand for home production goes down and conversely, exports raise domestic output as foreign orders boost demand for home production. We shall begin by modifying the goods market equilibrium condition to take account of this.

The extension of the model to include imports and exports raises a second issue. At the economy's short-run equilibrium level of output, there may be a trade deficit, trade balance or a surplus. Why is it important to know the state of the trade balance? If there is a trade surplus, exports exceed imports with the result that the home economy is increasing its wealth (we ignore the receipt of net interest payments for the moment). The trade surplus can be used to buy foreign assets or to increase the official foreign exchange reserves in the home country's central bank. If there is a trade deficit, the home country is purchasing more from abroad than its receipts from the sale of exports. In order to pay for these imports in excess of exports (net imports), the home country has to borrow from abroad or to run down its reserves of foreign exchange. We shall investigate these relationships in more detail later in the chapter but already it appears that tracking the trade balance is important because of its implications for the country's wealth. An economy with a persistent trade deficit is as a consequence running down its wealth (acquiring liabilities vis a vis the rest of the world) whereas a country with a persistent trade surplus is building up its wealth (acquiring assets vis a vis the rest of the world). As we shall see, such changes in wealth may eventually affect the terms on which the country can borrow or its exchange rate or the level of aggregate demand through the effect of changes in wealth on consumption. Throughout the analysis of the open economy, we therefore monitor what happens to the trade balance.

1.1. Goods market equilibrium. We recall the goods market equilibrium condition from Chapter 2:

$$y^D = y \qquad \text{(goods market equilibrium)}$$

where y is output and y^D is aggregate demand. Aggregate demand in turn depends in the closed economy on planned expenditure on consumption and investment by the private sector and planned government spending and can be written as

$$y^D \equiv c(y, t, r, \text{wealth}) + I(r, A) + g \qquad \text{(planned expenditure, closed economy)}$$

where c is consumption, I is planned investment, g is government spending and t is taxation, all in real terms.

We now introduce the open economy. Trade in goods has two effects. First, the demand for the home economy's output is boosted by demand from abroad, in the form of exports, x. Second, it is dampened by goods imported from abroad, m, which substitute for domestic output. The concept of domestic absorption is a useful one in the open economy. Domestic absorption, Abs, is defined as total spending by home agents on consumption, investment and government purchases *irrespective* of the origin of the goods or services:

$$Abs \equiv c + I + g. \qquad \text{(domestic absorption)}$$

To calculate *domestic* spending on *home*-produced goods and services, it is necessary to subtract spending on imports, m. And to find out *total* demand for *home*-produced goods and services, y^D, foreign demand for exports, x, must be added in. If the French government plans to increase its expenditure by purchasing Italian-made metro carriages, this shows up as a rise in domestic absorption ($\uparrow\ g$) and a rise in imports ($\uparrow\ m$) of the same size. These two items cancel out and planned expenditure on home-produced goods and services does not therefore change. In general, we have

$$\begin{aligned} y^D &\equiv (c+I+g)-m+x \\ &\equiv Abs+(x-m) \\ &\equiv Abs+BT \qquad \text{(planned expenditure, open economy)} \end{aligned}$$

where the trade balance, BT, is

$$BT \equiv x-m. \qquad \text{(trade balance)}$$

The term net exports is used interchangeably with trade balance. In our French example, although planned expenditure does not change, the trade balance deteriorates due to the rise in imports.

We turn now to the determinants of exports and imports and hence of the balance of trade. To begin with, we use a very simple model. Let us assume that exports are exogenous and that imports depend only on the level of domestic output or income. Hence

$$x = \overline{x}$$

and

$$m = m_y y,$$

where m_y is a constant and is called the marginal propensity to import.

Therefore the balance of trade is

$$\begin{aligned} BT &\equiv x-m \\ &\equiv \overline{x}-m_y y \end{aligned}$$

and the level of income at which trade is balanced, i.e. $BT=0$, y_{BT}, is

$$y_{BT} = \frac{1}{m_y}\cdot\overline{x}$$

The level of output y_{BT} tells us nothing about the actual level of output, only the level of output at which the balance of trade is zero.

Next we need to see how actual output is determined. We shall see that there are four different ways of expressing the goods market equilibrium condition, each of which provides a different insight. To simplify, let consumption be a simple linear function of *disposable* income and let investment and government spending be exogenous. There is a linear tax function: $t=t_y y$ so we have $c=c_0+c_y(y-t_y y)$. The goods market equilibrium condition becomes

$$\begin{aligned} y &= Abs+BT \qquad \text{(goods market equilibrium No. 1)} \\ &= c_0+c_y(y-t_y y)+I+g+\overline{x}-m_y y \end{aligned}$$

where $I=I(r)$ and for the moment, we assume that the real interest rate is constant and equal to $\bar{r}$. Collecting the terms in y on the left hand side and rearranging gives the goods market equilibrium condition in the form: output is equal to the multiplier times the exogenous components of demand. Thus

$$y = \frac{1}{s_y+c_y t_y+m_y}\left(c_0+I+g+\overline{x}\right), \qquad \text{(goods market equilibrium No. 2)}$$

where s_y is the marginal propensity to save ($s_y=1-c_y$). As compared with the closed economy, the multiplier, $\frac{1}{s_y+c_y t_y+m_y}$ is lower because of the marginal propensity to import, m_y.

It is useful to think about the goods market equilibrium condition in a third way. If we multiply the left hand side of the goods market equilibrium condition by the denominator of the multiplier, we have:

$$\underbrace{(s_y+c_y t_y+m_y)\cdot y}_{\text{planned leakages}} = \underbrace{c_0+I+g+\overline{x}}_{\text{planned injections}} \qquad \text{(goods market equilibrium No. 3)}$$

This shows that the goods market will be in equilibrium when the planned leakages of demand from the flow of income in the economy through savings, taxation and imports are equal to the planned injections of demand in the economy in the form of autonomous consumption, investment, government expenditure and exports.

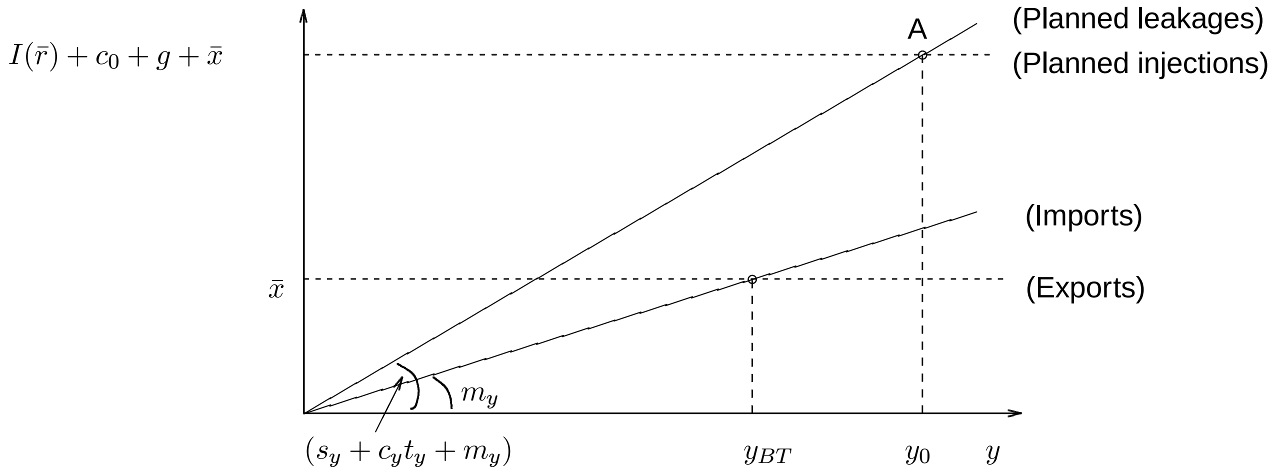

FIGURE 1. **Equilibrium output (planned injections = planned leakages); balanced trade output**

We can also rearrange the trade balance equation:

$$m_y \cdot y = \overline{x}$$

and show both the goods market equilibrium and the trade balance in the same diagram (see Fig. 4.1). Balanced trade output is shown by y_{BT} — the level of output at which exports are equal to imports. The goods market equilibrium condition is shown: planned leakages are equal to planned injections at point A — i.e. at an output level of y_0. At this level of output, it is clear from the comparison of imports with exports that there is a trade deficit.

Holding constant the marginal propensity to import and the exogenous level of exports as shown in Fig. 4.1, trade balance would require a reduction in the short-run equilibrium level of output to y_{BT}. This could be achieved either by a reduction in size of the multiplier (through a rise in the tax rate or by a drop in the marginal propensity to consume out of disposable income), which steepens the planned leakages line, or by a fall in one of the exogenous components of domestic demand (a downward shift in the planned injections line).

We can now use this model to examine the implications for output and the trade balance of, for example, an exogenous change in exports. Since a rise in exports raises the level of equilibrium output, which in turn raises imports, it is not immediately obvious what the trade balance will be in the new short-run equilibrium. However, the answer is clear from Fig. 4.2. In response to an exogenous increase in exports, balanced trade output rises by more than actual output. The consequence is that there is a trade surplus at the new equilibrium level of output. We have shown this using a simple model, but the key insight carries over to more complicated ones and will be a recurrent theme in the analysis of the open economy.

The reason that a rise in exports leads to a trade surplus is that the new equilibrium level of output will occur when additional leakages equal to the increase in exports have been generated by a rise in income. Since savings and taxation are leakages in addition to imports, the equilibrium level of output must be below the new balanced trade level.

In Fig. 4.2, the economy is initially at goods market equilibrium at point A with an output level of y_0. Since exports and imports are equal at this output level, there is trade balance: the y_{BT}-line goes through point A. Then there is a rise in the level of exports to $\bar{x}_1$. Leakages are equal to injections at point B. The new level of output is y_1. At this level of output, exports exceed imports (note the rightward shift of the y_{BT}-line) and B is therefore a position of trade surplus.

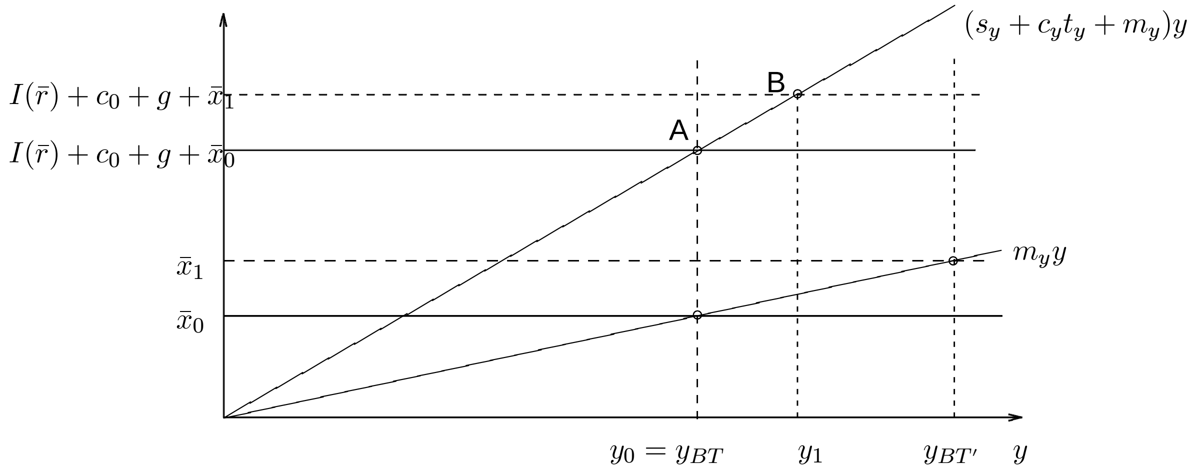

FIGURE 2. **A rise in exports improves the trade balance**

1.2. Sector financial balances. Another useful way of manipulating the goods market equilibrium condition is to write it in terms of sectoral savings and investment balances. Three sectors are of interest: the private sector financial balance (private savings net of its investment), the government sector financial balance (taxation net of government expenditure), and the trade balance (net investment abroad). To see this, we rearrange the leakages and injections equation to separate out taxation to give[3]:

$$\underbrace{(s_y y^{disp} - c_0 - I)}_{\text{private sector financial balance}} + \underbrace{(t_y y - g)}_{\text{government financial balance}} = \underbrace{\overline{x} - m_y y}_{\text{net inv abroad}}$$

(goods market equilibrium No. 4)

where the marginal propensity to save is $s_y = (1 - c_y)$ and y^{disp} is disposable income, $y^{disp} = (1 - t_y)y$.

This expression is a very useful one because it highlights the flow equilibrium in the economy. One sector, for example, the private sector, can only run a financial deficit (investing more than it is saving) if another sector (the government or foreign trade sector) runs a surplus. Whenever the goods market is in equilibrium, private savings net of investment (the private sector's financial balance) plus the government budget surplus (the government's financial balance) is equal to the trade surplus.

Ceteris paribus, a trade surplus means that stocks of foreign assets are increasing in the home economy. This measures the increase in the foreign wealth of the home economy and is therefore referred to as net investment abroad. If trade is balanced at the goods market equilibrium, then any government deficit must be matched by an excess of private savings over investment. Similarly, if the private sector is in savings and investment balance, a budget deficit will be matched by net borrowing from abroad in the form of a trade deficit.

1.3. Real and nominal exchange rates. What affects our demand for foreign goods and services and the demand of foreign residents for our tradeable products? Tradeables are the goods and services that can potentially be bought or sold across international borders. One obvious influence

[3]A step-by-step derivation is shown below: in the first line, we multiply through by y, shift imports to the right hand side and the domestic components of demand to the left hand side. In the second line, we add and subtract $s_y t_y y$ and in the third line, we use the fact that $s_y + c_y = 1$.

$$\begin{aligned} s_y y + c_y t_y y - c_0 - I - g &= x - m_y y \\ s_y(y - t_y y) + s_y t_y y + c_y t_y y - c_0 - I - g &= x - m_y y \\ (s_y y^{disp} - c_0 - I) + (t_y y - g) &= x - m_y y \end{aligned}$$

on the demand for tradeables is 'relative prices'. If our goods are relatively expensive, then demand from foreigners will be reduced and home residents will tend to buy imported goods. In order to compare prices across countries, we need to convert them to a common currency, i.e. we want a measure of 'price competitiveness':

$$\theta \equiv \frac{\text{price of foreign goods expressed in home currency}}{\text{price of home goods}}$$

$$\equiv \frac{P^* \cdot e}{P}, \qquad \text{(price competitiveness, real exchange rate)}$$

where P^* is the foreign price level, P is the home price level and e is the nominal exchange rate measured as the number of home currency units per unit of foreign currency:

$$e \equiv \frac{\text{no. units of home currency}}{\text{one unit of foreign currency}}. \qquad \text{(nominal exchange rate)}$$

Another name for θ is the *real exchange rate* because it measures the rate at which domestic and foreign *goods* exchange for each other. Consider a mars bar, which costs 30 pence in the UK and assume that the UK's exchange rate is 0.6 ($\pounds$/€). If the price of a Mars bar is €0.50 in Germany, then the real exchange rate is equal to one (since $\theta = \frac{0.5 \times 0.6}{0.3} = 1$). If the price of a mars bar goes up to €0.55 in Germany but is still 30 pence in the UK (and there is no change in the nominal exchange rate), then the real exchange rate is now 1.1: the price of a Mars bar in the UK is low relative to that in Germany. On observing a shift in the UK's real exchange rate from 1 to 1.1, we would say that price competitiveness in the UK had risen and that the UK's real exchange rate had depreciated.

Defining the nominal exchange rate of the home country as the units of home currency per unit of foreign currency is only a convention. The opposite convention is used as well. The choice of convention differs by country and even across different economics books and articles. If the home country is a euro-zone country (say, Italy) and the foreign country is the US, then according to the above definition, Italy's nominal exchange rate is $e \equiv \frac{€}{\$}$ or euros per dollar and an increase in e means that one dollar purchases more euros, which implies that the dollar has become relatively more valuable and the euro less valuable. It is said that the euro has *depreciated* against the dollar. Similarly, a decrease in e is an appreciation of the euro.

By now, it should be clear that discussion of "a rise in the exchange rate" or the exchange rate being "high" or "low" only makes sense when it is clear which convention is being used. In order to minimize confusion, it is safest to avoid using the terms 'rise' or 'fall' or 'high' or 'low' in relation to the exchange rate. It is better to stick to the terms 'appreciation' or 'depreciation' or if discrete changes in the exchange rate are referred to, then the terms 'devaluation' or 'revaluation' are appropriate.

Home curr.	**For. curr.**	**Home's nom. exch. rate**	**Depreciation /**	**Appreciation /**
			Devaluation	**Revaluation**
€	\$	$e \equiv \frac{€}{\$}$	$\uparrow e$ i.e. $\uparrow \left(\frac{€}{\$}\right)$	$\downarrow e$ i.e. $\downarrow \left(\frac{€}{\$}\right)$

1.4. Price-setting in the open economy. The definition of the real exchange rate raises the issue of how prices are set in the open economy. Bearing in mind that companies normally operate under conditions of imperfect competition and thus face a downward sloping demand curve, they have to set a price. We assume that firms set their prices for goods to be sold at home on the basis of home costs but let us examine two alternative pricing rules for goods sold abroad (i.e. exports):

: the first — home-cost based pricing — is that firms set export prices in the same way as for goods sold at home, i.e. based on domestic costs;

: the second — world pricing — is that firms set export prices based on the prices of similar products produced abroad.

Imagine that there is an increase in costs in the home country but not abroad (and assume that the nominal exchange rate remains unchanged).

Under the first pricing hypothesis, the prices of home's exports would go up relative to the price of the output of firms abroad. This would reduce home country competitiveness and represent a real appreciation for the home country.

Under the second pricing hypothesis, home producers would not change their export prices because prices charged by firms abroad have not changed. In this case, there is no change in the price competitiveness of exports. Nevertheless relative costs have changed and we would indeed expect this to have an impact on the ability of firms to compete internationally. If the costs of home firms rise relative to their competitors but prices are unchanged, then the profit margins of home firms are squeezed. This means that home firms will be at a relative disadvantage in their access to internal finance to fund future investment, marketing, research and development or after-sales service. Although price-competitiveness is maintained, 'non-price competitiveness' will be reduced. This implies that if the second pricing hypothesis is adopted, a definition of competitiveness and the real exchange rate based on relative *costs* rather than relative *prices* is appropriate.

One commonly used definition is called relative unit labour costs or $RULC$ and is defined as follows:

$$\begin{aligned} RULC &\equiv \frac{\text{home unit labour costs}}{\text{foreign unit labour costs expressed in home currency}} \\ &\equiv \frac{ULC}{ULC^* \cdot e}. \qquad \text{(cost competitiveness; real exchange rate)} \end{aligned}$$

Since a rise in $RULC$ indicates a decline in home's competitiveness, it is an inverse measure of competitiveness. A rise in $RULC$ is a real appreciation and a fall in $RULC$ is a real depreciation.

Pricing hypothesis	**Real exch. rate**	**Measure of real exch. rate**	**Real deprec.**	**Real apprec.**
Home-cost based	Rel. price OR	$\theta \equiv \frac{P^* \cdot e}{P}$	$\uparrow$	$\downarrow$
	Rel. cost	$RULC \equiv \frac{ULC}{ULC^* \cdot e}$	$\downarrow$	$\uparrow$
World price based	Rel. cost	$RULC \equiv \frac{ULC}{ULC^* \cdot e}$	$\downarrow$	$\uparrow$

1.5. Evidence on international integration of goods markets. How do the two pricing rules discussed here relate to the so-called Law of One Price (LOP) and to the hypothesis of purchasing power parity? According to the Law of One Price, the common currency price of a traded good is identical in different countries. For any good, j, that is traded,

$$P_j = P_j^* e \qquad \text{(Law of One Price)}$$

The logic of the LOP is straightforward: international trade should have the effect of equalizing prices for the same good in different countries since profits can be made by transporting a good from a location where the price is low and selling it where the price is high. If the LOP holds for all goods *and* the same basket of goods is consumed in different countries, then this basket of goods will have the same common currency price anywhere in the world. This is referred to as Absolute Purchasing Power Parity: if for all goods j in a basket of goods that is common to consumers in both countries,

$$\begin{aligned} &P_j = P_j^* e \text{ for all goods } j \\ &P = P^* e \\ &\implies \theta = 1 \end{aligned}$$

(Absolute purchasing power parity)

The hypothesis of Absolute Purchasing Power Parity implies that the real exchange rate is equal to one always. If we add the assumption of perfect competition, then since under perfect competition, price is equal to marginal cost, marginal costs will be equalized in all countries and there will be no supernormal profits. Hence, unlike the world pricing hypothesis discussed above, where costs can differ across countries and profit margins can expand and contract, in a world of absolute PPP and perfect competition, neither price *nor* cost competitiveness can vary.

There is a great deal of empirical evidence that neither the LOP nor absolute PPP are true. Transport costs and barriers to international trade will interfere with the LOP and the presence of non-traded goods and services in the consumption bundle and differences in consumer tastes across countries will prevent the absolute purchasing power parity hypothesis from holding. However, transport costs and trade barriers are not big enough to the explain the deviations from LOP. Nor is the role of non-traded goods able to account for the failure of absolute PPP to hold. In evaluating the accumulated evidence, Obstfeld argues that "[a]pparently consumer markets for tradables are just about as segmented internationally as consumer markets for nontradables".[4]

A central part of the explanation rests on the pervasiveness of imperfect competition in international markets. Only a small proportion of traded goods fits the LOP assumption. Most tradeables — both goods and services — are differentiated products and producers pursue pricing strategies to maximize their long-run profits. This entails, for example, taking account of the impact on customers of frequent changes in price (e.g. in response to changes in the nominal exchange rate) and setting different prices in different markets to take advantage of differences in the elasticity of demand. An extensive survey of pricing strategies is provided in Goldberg and Knetter (1997)[5]. They report evidence of the widespread use of so-called pricing to market and of the incomplete pass-through of exchange rate changes into prices: what we have called 'world pricing' incorporates both these effects.

In reality, it seems that firms pursue pricing strategies that lie between the two alternatives of home-cost based and world pricing presented above. Fortunately the main results of the macro model do not depend on which of these simple pricing hypotheses is used. The way that shocks and policy responses are transmitted (e.g. via price or cost competitiveness) varies but the qualitative results are similar. Results are only very different if a model of highly integrated perfectly competitive markets without nominal rigidities or inertia is adopted (LOP plus perfect competition as the microeconomic hypothesis; purchasing power parity as the macro hypothesis).

Perhaps the simplest way to see the difference in macro implications between the 'segmented' and 'integrated' views of international goods markets is to consider the implications of a change in the nominal exchange rate under the different pricing rules. Suppose there is a depreciation of home's nominal exchange rate.

Under home-cost based pricing, the domestic currency price of exports is unchanged; the price in foreign currency falls. There is a rise in home's competitiveness and the real exchange rate depreciates in line with the nominal exchange rate.

Under world pricing, the price in foreign currency terms is kept constant (i.e. in line with the price prevailing in the export market). Hence there is no change in relative prices and price competitiveness remains unchanged. However, because of the nominal depreciation, the price of exports in terms of home currency has risen. This raises the profit margins of home firms relative to their competitors and home's cost competitiveness has improved.

Under the LOP and absolute PPP, the integrated goods market means that the depreciation will be immediately offset by a rise in the price of home's goods so as to bring common currency prices back into equality. The nominal exchange rate changes, but the real exchange rate quickly reverts to unity through arbitrage (buying cheap, selling dear) in the goods market.[6]

[4]M. Obstfeld (2001) "International macroeconomics: beyond the Mundell-Fleming model", IMF Staff Papers, 47, Special Issue, pp. 1-39.

[5]P. Goldberg and M. Knetter (1997). 'Goods prices and exchange rates: what have we learned?' Journal of Economic Literature, 35, pp. 1243-1272.

[6]There is a weaker form of purchasing parity that requires the *ratio* of the common currency prices of home and foreign goods to remain constant. This is so-called relative purchasing power parity and requires:

$$\begin{aligned} P &= \frac{P^{*}e}{k} \\ &\Rightarrow \theta = k, \end{aligned}$$

Yet one of the big facts that has emerged since the era of floating exchange rates began in 1973 is that the fluctuations in nominal exchange rates have been accompanied by fluctuations in real exchange rates. To quote Obstfeld's evaluation of the evidence: "Real exchange rate variability tends to be almost a perfect reflection of nominal rate variability, with changes in the two rates highly correlated and independent movements in price levels playing a minor, if any, role."(2001, p.12). It therefore seems sensible to work with a model that can accommodate this fact. Either the home or world pricing rule would do but we shall stick to a home-cost based pricing rule. The home-cost based rule is very convenient because it allows us to use the real exchange rate defined in terms of price competitiveness. The assumption that prices are set by home costs implies that the price level of home-produced goods sold at home and in the export market are the same and that the price in home currency of imports is set by the price in the rest of the world (i.e. by costs in those economies).[7] Hence we have:

$$P_x = P = \frac{1}{1-\mu} \cdot \text{unit cost} \qquad \text{(export price)}$$
$$P_m = P^* e, \qquad \text{(import price)}$$

where μ is the mark-up.

1.6. Exports and imports: volume and price effects. In the home market, home goods with price P compete with imports (in home currency terms) with price P^*e. The relative price is therefore our measure of competitiveness, $\theta \equiv \frac{P^*e}{P}$. In export markets, home-produced goods (exports) with price P compete with world goods priced (in home currency terms) at P^*e. Once again, the relative price is our measure of competitiveness, θ. We can now pin down export and import functions to reflect the role of competitiveness. For exports, our share of world output will depend on θ; for imports, the marginal propensity to import m_y will depend on θ. A rise in θ will raise the volume of goods exported and depress the volume of goods imported at any level of home income.

To derive the export and import functions, we begin in nominal terms. The value of exports in home currency terms, X, is equal to the price index of exports times the volume. The volume of exports can be expressed as a share of world output, where the share function σ (sigma) depends positively on competitiveness and y^* is world output:

$$\begin{aligned} X &= P_x \cdot x_{\text{volume}} && \text{(exports in nominal terms)} \\ &= P_x \cdot \underbrace{\sigma\left(\frac{P^*e}{P}\right)}_{\text{home's share}} \cdot \underbrace{y^*}_{\text{world output}} \end{aligned}$$

To get the export function in real terms, we divide each side by the domestic price level, P:

$$\begin{aligned} x &= \sigma\left(\frac{P^*e}{P}\right) \cdot y^* \\ &= \sigma(\theta) \cdot y^* && \text{(export function)} \end{aligned}$$

The value of imports M in home currency terms is the price index, $P_m = P^*e$ times the volume of imports, m_{volume}. In turn, the volume depends on the marginal propensity to import, which will be a negative function of competitiveness, and on the level of domestic output.

$$\begin{aligned} M &= P_m \cdot m_{\text{volume}} && \text{(imports in nominal terms)} \\ &= P_m \cdot \underbrace{m_y(\theta)}_{\text{marginal propensity to import}} \cdot \underbrace{y}_{\text{home output}} \end{aligned}$$

---

where k is a constant. In this case too, a change in e requires a change in P so as to keep the *ratio* of home to foreign prices (in the home currency) constant.

[7]After summarizing the evidence, Obstfeld states: "These relationships are consistent with a model in which domestic marginal cost (consisting mainly of wages) is sticky in domestic-currency terms, and export prices are set as a (perhaps somewhat variable) markup over marginal cost." Obstfeld 2001 p.22.

To derive the import function in real terms, we divide each side by P.

$$\begin{aligned} m &= \frac{P_m}{P} \cdot m_y(\theta) \cdot y \\ &= \frac{P^* e}{P} \cdot m_y(\theta) \cdot y \\ &= \theta \cdot m_y(\theta) \cdot y \qquad \text{(import function)} \end{aligned}$$

This means that the balance of trade is:

$$\begin{aligned} BT &= \sigma(\theta) \cdot y^* - \theta \cdot m_y(\theta) \cdot y \qquad \text{(balance of trade)} \\ &= x(\theta, y^*) - \theta \cdot m(\theta, y) \end{aligned}$$

We can now return to one of the questions set out at the beginning of the chapter:

- What determines the trade balance?

How is the balance of trade affected by changes in the real exchange rate, θ? First, we want to know how a change in θ affects the trade balance, holding the level of output constant.[8] We hold the level of output constant because we do not want to include the consequential effects on output and hence on imports of a change in the real exchange rate. We discuss the *full* consequences of a change in θ on the trade balance in the next sub-section.

It is not obvious simply from looking at the expression for the balance of trade, what the effect of a change in the real exchange rate on the trade balance is. The reason for the apparent ambiguity is that there are two effects of a change in the real exchange rate on the trade balance (holding the level of output unchanged) — one is the volume effect and the second is the relative price or terms of trade effect. The volume effect is the effect on the volume of exports and of imports due to a change in θ. The volume effect is unambiguous: a rise in θ — i.e. a real depreciation of the home exchange rate (which means a rise in home's price competitiveness) boosts the volume of exports ($\sigma(\theta)$ rises as home takes a larger share of world output) and reduces the volume of imports ($m_y(\theta)$ falls as home's marginal propensity to import falls). But a rise in θ will raise the real cost of a given volume of imports: this is shown by the presence of θ, which is multiplied by $m_y(\theta) \cdot y$ in the import function. The intuition is that since θ measures the relative price of foreign to home goods, any rise in it pushes up the cost to the home economy of a given volume of imported goods.

Another way of expressing the 'relative price effect' of a change in θ is to use the concept of the terms of trade. The terms of trade is defined as the price of exports divided by the price of imports:

$$\frac{P_x}{P_m} = \frac{P}{P^* e} = \frac{1}{\theta} \qquad \text{(terms of trade)}$$

where an increase in $\frac{P_x}{P_m}$ is an improvement in the terms of trade because a greater volume of imports can be bought for a given volume of exports. A deterioration in the terms of trade is when $\frac{P_x}{P_m}$ falls. An increase in θ means a rise in the price of imports relative to exports: it is a deterioration in the terms of trade.[9] For a given volume of imports, this will produce a decline in the trade balance.

We summarize the different ways that a change in θ can be interpreted, given the way that import and export prices have been defined. A rise in θ (the converse holds for a fall in θ) for the home economy is a

- rise in price competitiveness
- a depreciation of the real exchange rate
- deterioration in the terms of trade
- rise in the real cost of imports.

[8] We focus here on the partial derivative: $\frac{\partial BT}{\partial \theta}$.

[9] Obstfeld and Rogoff report strong evidence that a nominal depreciation is associated with a deterioration of home's terms of trade. M. Obstfeld and K. Rogoff (2000) "New directions for stochastic open economy models" Journal of International Economics 50, 117-153.

The outcome of a change in the real exchange rate for the trade balance is therefore ambiguous. As long as the volume effects are sufficiently strong so as to outweigh the countervailing terms of trade effect, then a real depreciation (a rise in θ) — i.e. an improvement in home's price competitiveness — will lead to an improvement in the trade balance.

A famous demonstration of this result is called the Marshall–Lerner condition. It states that as long as the sum of the price elasticity of demand for exports and the price elasticity of demand for imports exceeds one, a depreciation will improve the balance of trade. The simplicity of the Marshall-Lerner condition depends on the assumption that goods are in perfectly elastic supply (i.e. the price does not change as output increases)[10] and that we begin in trade balance. Nevertheless the insight that what is crucial is a comparison of the volume and the terms of trade effects is a general one.

A numerical example illustrates how the Marshall-Lerner condition works. It says that as long as the volume effects are large enough, they will outweigh the terms-of-trade effect. By 'large enough', the Marshall–Lerner condition states that the sum of the elasticities of demand for exports and imports must exceed one. For example, suppose the home economy begins in trade balance with exports equal to imports, which are equal to 100. The elasticity of demand for exports is 0.75 and for imports is 0.50. Consider the implications of a 1% rise in competitiveness arising for example from a rise of 1% in foreign relative to domestic prices:

- export volume rises by 0.75 to 100.75;
- import volume falls by 0.50 to 99.50;
- the real price of imports rises by 1%, pushing the import bill up to 100.495 (since $1.01 \times 99.5 = 100.495$).
- In this case, the balance of trade improves because $BT = 100.75 - 100.495 = 0.255$.

If, on the other hand, export demand elasticity was considerably lower at just 0.25, export volume would only rise by 0.25 to 100.25. Everything else stays the same so the balance of trade actually deteriorates ($BT = 100.25 - 100.495 = -0.245$).

The elasticities used in the example are more 'pessimistic' than the consensus estimates from empirical studies. Dornbusch (1996) reports estimates for the absolute value of the price elasticity of demand for exports of 1.06 in Germany, 1.31 in the US and 1.68 in Japan and for imports of 0.50 in Germany, 0.97 in Japan and 1.35 in the US[11]. The requirement that the sum of the price elasticities of demand is greater than one is easily met for each of these countries. More generally, Dornbusch concludes that "[a]fter 50 years of research on this topic, the finding is sturdily in support of the effectiveness of the price mechanism." From now on, we shall assume that there is a positive relationship between the real exchange rate, θ, and the trade balance, given the level of output. This implies that if the price level at home and abroad is constant, then this implies that there is a positive relationship between the nominal exchange rate, e, and the trade balance. A depreciation of home's currency is *ceteris paribus* associated with an improvement in the trade balance.

But it is often noted that empirically the trade balance actually deteriorates following a depreciation, only to improve some months later. This empirical pattern is called the J-curve since the trade balance traces out (the bottom half of) a J over time in the aftermath of a depreciation. The trade balance can worsen in the short run, for two reasons.

(1) The short-run price elasticity of demand for exports and imports is much lower (approximately one-half of) its long-run value. This means that the volume response to the devaluation is initially weak.

[10] It should be noted that the pricing assumptions that have been made imply that neither export nor import prices are affected by changes in the volume sold (within the range of variation considered). This is the traditional assumption made in the proof of the simple Marshall–Lerner condition that supply elasticities are infinite. (There are many ways to prove the Marshall–Lerner condition - one is shown in the appendix to this chapter.)

[11] R. Dornbusch "The Effectiveness of Exchange Rate Changes" Oxford Review of Economic Policy, Vol 12, No. 3, pp. 26-38, 1996

(2) To the extent that exports are invoiced in domestic currency, the dollar value of exports falls immediately, while imports invoiced in foreign currency remain unchanged in dollar terms. In home currency terms, export receipts are unchanged while the import bill rises immediately. Hence the trade balance worsens.

1.7. Output and trade balance in the short run. We can now begin to assemble a macroeconomic model of the open economy. The condition for goods market equilibrium in the open economy can be enriched by the new import and export functions in which imports and exports depend on the real exchange rate.

$$y = y^D$$

where

$$y^D = \underbrace{c(y) + I(r) + g}_{Abs} + \underbrace{x(\theta, y^*) - \theta \cdot m(\theta, y)}_{BT}$$

In summary, aggregate demand for domestic output is:

$$y^D = f(y, r, \theta, y^*)$$

where

- the marginal propensity to spend on domestic output lies between zero and one. Hence, we have: $0 < \frac{\partial y^D}{\partial y} < 1$;
- investment is negatively related to the real interest rate. Hence, $\frac{\partial y^D}{\partial r} < 0$;
- a rise in θ i.e. a depreciation of the real exchange rate or a rise in world output, y^*, boosts the trade balance. Hence, $\frac{\partial y^D}{\partial \theta} > 0$ and $\frac{\partial y^D}{\partial y^*} > 0$.

The role of government spending and taxation are basically unchanged from the closed economy and are not shown explicitly above. The only extra point to remember is that government spending on imports does not add to the aggregate demand for domestic output.

We can now define the open economy version of the IS curve: the $ISXM$ is the goods market equilibrium condition and represents the combinations of the interest rate and output at which domestic output is equal to the planned expenditure on domestically produced goods and services. The equation for the $ISXM$ curve is:

$$y = \frac{1}{1 - c_y(1 - t_y) + \theta m_y(\theta)} \left(c_0 + I(r) + g + \sigma(\theta) \cdot y^* \right). \qquad \text{(open economy ISXM)}$$

The difference between the closed economy IS curve and the open economy $ISXM$ curve is highlighted by answers to the following questions.

(1) Why is the $ISXM$ steeper than the IS curve? The reason is that the size of the multiplier is reduced in the open economy because the marginal propensity to import is positive. There is an additional source of leakage of demand away from home-produced goods: as income rises, not only do taxation and savings rise, but so does the level of imports.

(2) How does the $ISXM$ curve shift with a change in the real exchange rate? A rise in θ is a real depreciation of the home exchange rate (i.e. an improvement in home's price competitiveness). Since we assume that the Marshall–Lerner condition holds, this boosts the trade balance and aggregate demand. For any interest rate, goods market equilibrium will therefore occur at a higher level of output. A rise in θ shifts the $ISXM$ to the right and a fall in θ shifts it to the left.

(3) How does the $ISXM$ curve shift with a change in world output, y^*? A rise in world output raises the demand for exports from the home country. Therefore for any interest rate, goods market equilibrium will occur at a higher level of output: a rise in y^* shifts the $ISXM$ to the right and a fall in y^* shifts it to the left.

As we have already argued, it is important to know how a change in economic conditions in the rest of the world (e.g. a change in the world interest rate or a change in world demand) or in domestic policy (such as a change in the home interest rate) affects both the level of output and the trade balance. It is therefore useful to show the balanced trade equilibrium on the $ISXM$ diagram. The trade balance is:

$$\begin{aligned} BT &= x - m \\ &= \sigma(\theta) \cdot y^* - \theta \cdot m_y(\theta) \cdot y \end{aligned} \qquad \text{(trade balance)}$$

and we can therefore write the level of output at which trade is balanced, y_{BT} as:

$$y_{BT} = f(\theta, y^*) \qquad (y_{BT}\text{-line})$$

To the right of y_{BT} there is a trade deficit and to the left there is a trade surplus. A rise in price competitiveness increases the level of output at which trade is balanced and a higher level of world demand has the same effect: in each case the y_{BT}-line shifts to the right in the $ISXM$ diagram.

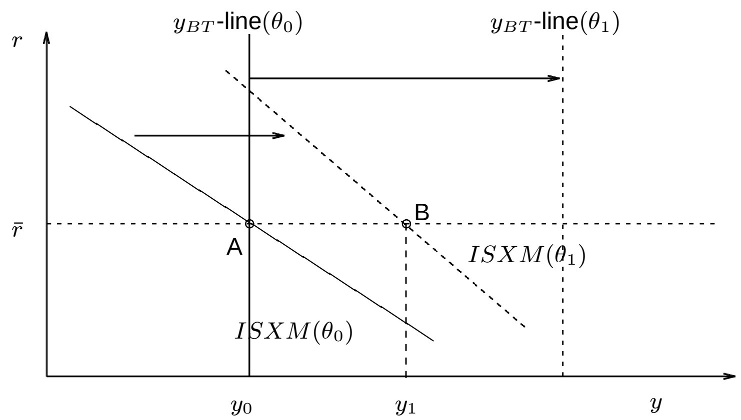

FIGURE 3. **Real depreciation (↑ θ): impact on output and the trade balance**

Earlier (in Fig. 4.2) we looked at the consequences for the level of output and for the trade balance of a change in exogenous exports. We can now look at what happens to output and the trade balance when there is an exchange rate change or a change in world output. Let us run through the case of an exchange rate depreciation. The economy begins in goods market equilibrium and with balanced trade at A in Fig. 4.3. With fixed prices, the depreciation improves price competitiveness and on the usual assumption that the Marshall–Lerner condition holds, will raise net exports. This is the 'partial' effect of a change in θ on net exports discussed earlier. Since net exports increase, the analysis exactly parallels that done in Fig. 4.2 for an exogenous rise in exports. The result will be the same: output will rise by less than the new balanced trade level of output with consequence that there will be a trade surplus at the new goods market equilibrium.

This is shown in Fig. 4.3. The $ISXM$ curve shifts to the right and so does the y_{BT}-line. We assume that the interest rate remains unchanged. The rise in net exports due to the rise in θ raises aggregate demand (y^D), which pushes up output and income until a new goods market equilibrium is established. The new goods market equilibrium is established when the higher savings, taxation and imports induced by the rise in net exports is equal to the net injection of demand ($ISXM$ shifts to $ISXM(\theta_1)$ and output rises from y_0 to y_1 in Fig. 4.3). The level of income at which trade is balanced will be at the level at which the increased imports generated by the higher incomes is equal to the change in net exports. Trade balance would therefore occur at a higher level of output than the new goods market equilibrium (the y_{BT}-line shifts to y'_{BT}). Output is to the left of the new y_{BT}-line and there is therefore a trade surplus at B.

2. Opening financial markets

By the late 1980s volumes traded in international markets for financial assets far exceeded the volume of international trade in goods and services. It is trade in international financial markets that dominates the foreign exchange market. To understand the aspects of how international financial markets work that are essential for macroeconomics, it is useful to make some simplifying assumptions.

: F1. There is *perfect international capital mobility*. This means that, for example, home residents can buy or sell foreign bonds with the fixed nominal world interest rate, i^*, in unlimited quantities at low transactions cost.

: F2. The home country is assumed to be *small* in the sense that its behaviour cannot affect the world interest rate.

: F3. Just as in the simple IS/LM model, we assume there are just *two assets* that households can hold — bonds and money. But now they can hold foreign or home bonds. We assume that they hold only home money.

: F4. There is *perfect substitutability* between foreign and home bonds. This assumption means that that there is no risk premium on bonds. If the riskiness of foreign and home bonds is identical, then the only relevant difference between home and foreign bonds is the expected return on them. Two issues lie behind this assumption. The first is whether governments differ in their default risk — i.e. in the likelihood that bonds will not be honoured. The second is whether investors care about the composition of their asset portfolio. By assuming perfect substitutability, we are ruling out differences in the riskiness of bonds and assuming that investors do not care about the balance between home and foreign bonds in their portfolio.

Once we have a working model based on these assumptions, we return to discuss their empirical plausibility and what happens in the model when they are relaxed. This is done in section 6.

2.1. Uncovered interest parity condition. Now that home residents have the opportunity to hold foreign bonds in their portfolio, we need to see what will influence their choice. We note first that in a well-functioning capital market it is impossible for there to be a different expected return on assets with the same risk. Assuming that there is no difference in risk between the bonds issued by the two governments, two factors will affect the expected return on home as compared with foreign bonds:

- any difference in interest rates and
- a view about the likely development of the exchange rate.

Let us explore the implications of the existence of foreign bonds in a well-functioning capital market. We take an example using government one-year bonds. Assume that government authorities (i.e. the government or the central bank) can set the interest rate and that the interest rate in the UK is 6.5% and in the US is 4%. This means that by holding UK rather than US bonds, the investor gets an additional interest return of 2.5%. In the context of highly integrated international capital markets, such a situation offers an opportunity for investors to make profits by switching from US to UK bonds. In order to buy UK bonds, pounds are required and there will therefore be a surge in the demand for pounds. This will lead to an immediate *appreciation* of the pound.

Evidence on how fast new information is incorporated in the market comes from a survey of foreign exchange dealers in the UK. They were asked: "How fast do you think the market can assimilate the new information when the following economic announcements from the major developed economies differ from their market expectations?"[12] For an unexpected interest rate announcement, more than two-thirds of the traders said "less than 10 seconds" with most of the rest saying less than one minute. According to this survey, speedy reaction is most common for news about interest rates and traders say that news about interest rates has a bigger impact on foreign exchange markets than announcements about inflation, unemployment, the trade deficit, the money supply or GNP.

Now let us take a different starting point and ask what expectations about a *change* in the exchange rate investors would have to have to *not* want to switch between dollars and pounds despite the interest rate difference of 2.5%. The answer is simple: investors would need to believe that the

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[12]Yin-Wong Cheung, M. Chinn and I. Marsh (2000), 'How Do UK Foreign Exchange Dealers Think Their Market Operates' NBER Working Paper 7524 p.30.

pound would *depreciate* by 2.5% over the period for which the interest differential is expected to persist. Then the 2.5% gain in terms of higher interest on pound (sterling) bonds would be wiped out by the expected loss from the depreciation of the pound. For the expected return on pound and dollar bonds to be equalized as they must in a well-functioning capital market, the expected capital loss from holding the pound bonds for one year because of a depreciation of the pound exchange rate has to be equal to the interest rate gain. This is the uncovered interest parity condition (UIP).

The condition that the interest rate differential in favour of bonds denominated in currency A must be equal to the expected exchange rate depreciation of currency A over the period for which the interest differential is expected to persist is called the uncovered interest parity condition and can be stated as follows:

$$\underbrace{i - i^*}_{\text{interest gain (loss)}} = \underbrace{\frac{e^E_{t+1} - e_t}{e_t}}_{\text{expected depreciation (appreciation)}} . \qquad \text{(Uncovered Interest Parity)}$$

where i is the home and i^* the foreign interest rate, e is the nominal exchange rate of the home country and e^E is the expected exchange rate.[13]

It is useful to take the example a step further. Assume that initially interest rates are 4% in both the US and the UK and investors expect no change in the exchange rate. Thus we start in equilibrium: the UIP condition holds because there is no difference in interest return and no expected change in the exchange rate so the exchange rate adjusted return is equal for dollar and pound bonds. The UK government then raises the interest rate to 6.5%. Now suppose investors have a fairly clear idea about two things. First, that the interest differential will last for one year and second, that whatever happens to the exchange rate in the short run — and they know it must change since the current situation is unsustainable — it will eventually come back to the current level. In other words investors think the exchange rate is at its “correct” long-run level. What will happen is that investors bid up the value of the pound as a consequence of their attempts to buy pounds in order to buy the attractive high interest pound bonds. The pound will appreciate instantaneously by 2.5%. Why? Because an appreciation of 2.5% is exactly what is required to establish equilibrium. The pound is now expected to depreciate by 2.5% (back to its unchanged long run expected value) over the course of the year during which the interest advantage of UK pounds is 2.5%.

To summarize, we can work out the amount by which the exchange rate will appreciate immediately because we know that trading in the financial market will ensure that all opportunities to make a profit are exhausted. This means that the interest rate gain from holding UK bonds must be offset by the expected loss from the depreciation of the pound exchange rate over the period for which the interest difference prevails. What happens is that when any interest rate differential is opened up, there is a jump in the exchange rate just sufficient to eliminate the interest rate gains. Then over the period for which the interest differential on the bonds is expected to remain, the exchange rate appreciation gradually unwinds and the exchange rate returns to its expected or “correct” long run

[13] To derive the UIP condition, we begin with the arbitrage equation below. If you begin with $100, then the left hand side says: this is the return after one period from converting the $100 to £ at the start of the period and buying bonds. The right hand side says: this is the return after one period from using the $100 to buy $ bonds, which are converted at the end of the period to pounds. Arbitrage will ensure that the left and right hand sides are equal.

$$e_t(1+i) = (1+i^*)e_{t+1}.$$

To turn this into the UIP condition, we note that the exchange rate at time $t+1$ is not known — we therefore replace e_{t+1} by e^E_{t+1}. In addition, we use the approximation that $\frac{1+i}{1+i^*} \approx 1 + i - i^*$ and simplify as follows:

$$\begin{aligned} 1 + i - i^* - 1 &= \frac{e^E_{t+1} - e_t}{e_t} \\ i - i^* &= \frac{e^E_{t+1} - e_t}{e_t}. \end{aligned}$$

value. An important distinguishing characteristic of financial markets (as compared with goods and labour markets) is that jumps in prices are commonly observed.

Working through a numerical example helps to clarify this important relationship. Consider one-year government bonds. Initially, interest rates in the two countries are identical and the nominal exchange rate is 0.650 pounds per dollar. Then suppose that the interest rate in the UK is raised to 6.5% and is expected to stay above the US interest rate for one year. This means that there is a 2.5% $(6.5-4=2.5\%)$ gain from holding pound rather than dollar bonds. As stated above, for the expected return on pound and dollar bonds to be equalized, it must be the case that the expected capital loss from holding the pound bonds for one year because of a depreciation of the pound exchange rate is equal to the interest rate gain. Thus to work out the exchange rate, e_t, that will deliver an expected exchange rate loss of 2.5%, we need to have a view about the exchange rate that will prevail in one year's time. On our assumption that the exchange rate was originally at and will return to its "correct" long run value, this is simply the exchange rate at time t_0 when interest rates were equal at 4%. Then the expected depreciation of the exchange rate between time 1 and time 2 must equal the interest rate differential:

$$\begin{aligned} \frac{e_2^E - e_1}{e_1} &= \frac{0.650 - e_1}{e_1} = 2.5\% \\ \text{Therefore } e_1 &\approx 0.635. \end{aligned}$$

This means that on the announcement of the rise in the UK interest rate, the pound exchange rate immediately *appreciates* from a rate of 0.650 to 0.635. Over the course of the year from t_1 to t_2 the pound *depreciates* back to the original level of 0.650. The box below shows the data for each period.

	time=t_0	time=t_1	time=t_2
i^{UK}	4	6,5	4
i^{US}	4	4	4
e	0.650	0.635	0.650

The paths of the nominal exchange rate and the interest rate are shown in Fig. 4.4.

2.2. Using the UIP condition. The UIP condition is a very useful tool in open economy macroeconomics because it provides a direct link from a change in monetary policy (which changes the nominal interest rate) to a change in the exchange rate. We can show the UIP condition in a diagram with the interest rate on the vertical axis and the nominal exchange rate on the horizontal axis.

In equilibrium, the expected and the actual exchange rate must be equal — i.e. expectations must be fulfilled. Hence the home and world interest rates are equal. This allows us to define the financial integration line or $i = i^*$-line, which is shown in Fig. 4.5. We begin from an initial equilibrium with the home interest rate equal to the world interest rate $(i = i^*)$ and exchange rate expectations fulfilled $(e_0 = e_0^E)$. This is point A on the diagram. This is the first point on the UIP curve defined for the world interest rate i^* and the expected exchange rate of e_0^E. To fix another point on this UIP curve, consider a rise in the home interest rate to i_1 that is expected to prevail for one year. Assuming that the expected exchange rate remains fixed at e_0^E, then since the interest rate is now above the world interest rate, there must be a change in the exchange rate. According to the UIP condition, the exchange rate will appreciate immediately (jump) to e_1 so that its expected depreciation over the year is equal to the interest rate differential. This requirement fixes point B and defines the UIP curve (see Fig. 4.5)[14]

The key features of the UIP diagram are

[14]Note that if you draw the UIP curve accurately, it will be steeper than shown in Fig. 4.5. We magnify the scale on the horizontal axis to allow for easier viewing of exchange rate changes.

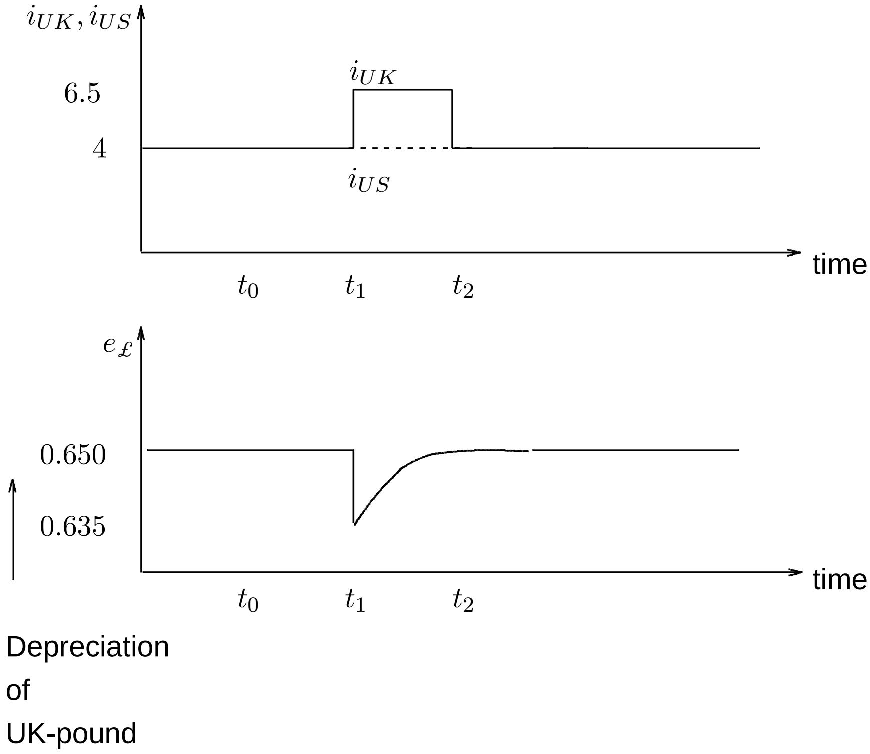


FIGURE 4. **Paths of UK interest rate and UK-pound exchange rate: the interest rate on UK bonds exceeds that on US bonds for 1 period**

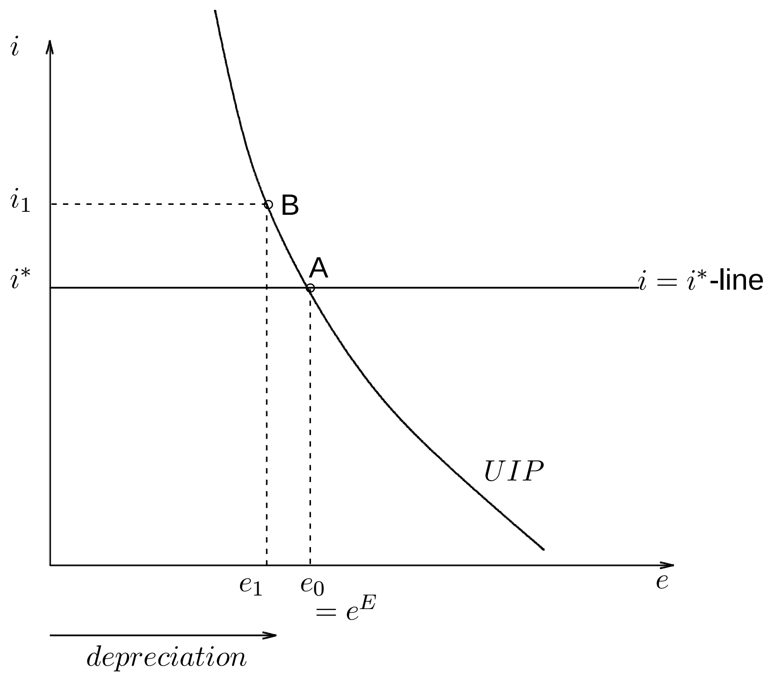


FIGURE 5. **The uncovered interest parity condition**

- each UIP curve must go through the point (e^E, i^*)
- for a given world interest rate, any change in the expected exchange rate shifts the UIP curve
- for a given expected exchange rate, any change in the world interest rate shifts the UIP curve.

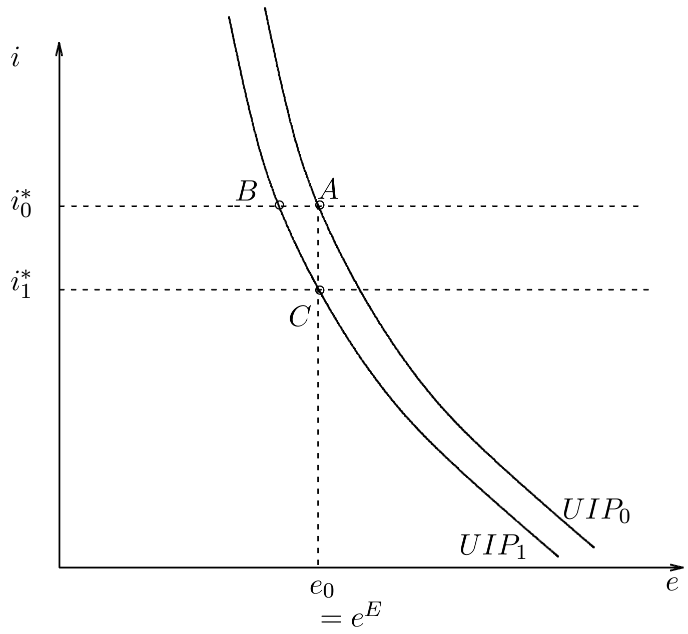


FIGURE 6. **The uncovered interest parity condition: fall in the world interest rate.**

To illustrate how the UIP curve works, suppose there is a fall in world interest rates. What is the implication for the home country's exchange rate assuming that there is no change in the home interest rate? To answer this question, we must make an assumption about what we expect the exchange rate to be in the long run. We assume no change in the expected exchange rate. The shift in the UIP curve from UIP_0 to UIP_1 due to the fall in the world interest rate is shown in Fig. 4.6.

The economy is initially at point A on UIP_0. With the expected exchange rate equal to e_0^E and with the home interest rate now above the world interest rate of i_1^*, arbitrage in the financial market will lead to an immediate appreciation of the exchange rate as shown by point B on the new UIP curve, UIP_1. We can conclude that a fall in the world interest rate will lead to an immediate appreciation of the home currency. The diagram also helps to illustrate that there will be no exchange rate change if the central bank in the home country shifts the interest rate down so that it is equal to the new lower world interest rate: the economy then shifts from A to C in Fig. 4.6.

A final exercise is to consider the implications of a change in sentiment in the foreign exchange market as to the expected exchange rate in the future. If traders suddenly change their view about the likely exchange rate in a year's time, then the UIP curve will shift. In the case where a depreciated exchange rate is expected, then the UIP curve will shift to the right. With the home and world interest rates equal, such a change in sentiment will have the effect of leading to an immediate depreciation so that the exchange rate is at its new expected value. This illustrates how expectations about future developments are incorporated into today's exchange rate. If the government is to prevent an immediate depreciation, it must raise the interest rate as shown by the new UIP condition to compensate holders of home bonds for the expected depreciation. The sooner traders expect an exchange rate change to occur, the higher will the home interest rate have to go to keep the current exchange rate unchanged. This is especially relevant in the case in which a country has a fixed exchange rate and where doubts emerge about the 'credibility' of the exchange rate peg. .

3. Fixed and flexible exchange rate regimes

In an open economy, it is useful to think about two polar exchange rate regimes. At one extreme is the case of a freely floating, fully flexible exchange rate where neither the government nor central bank intervenes in the foreign exchange market to influence the price at which one currency trades with another. The exchange rate is then determined by supply and demand for the currency relative to other currencies.

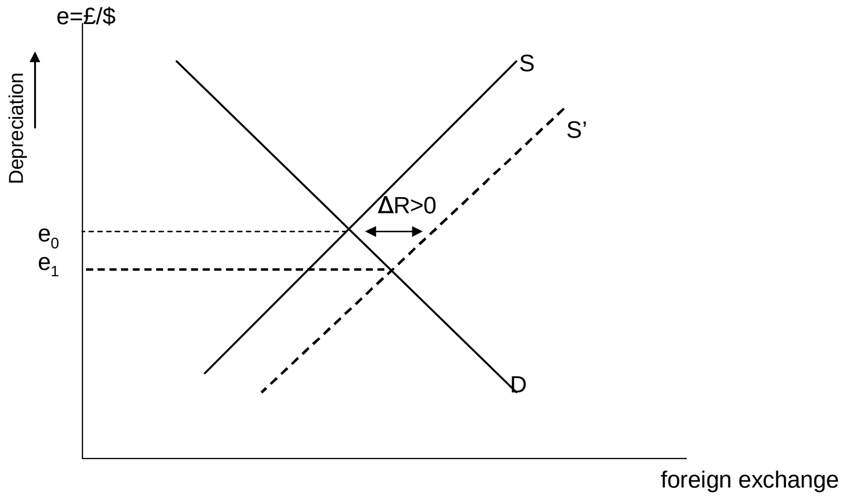


FIGURE 7. The foreign exchange market

At the other extreme is the case of fixed exchange rates where the government sets a rate (a so-called peg) at which it will buy or sell foreign exchange as necessary in order to keep the 'price' fixed. These sales or purchases of foreign exchange by the central bank are called official intervention and we denote them by ΔR. The purchase by the home central bank of foreign exchange is $\Delta R > 0$ and the sale of foreign exchange is $\Delta R < 0$. In a flexible exchange rate regime, there is no official intervention and hence $\Delta R = 0$.

Fig. 4.7 shows the foreign exchange market: the home exchange rate is on the vertical axis and the quantity of foreign exchange is on the horizontal axis. The supply and demand curves for foreign exchange are shown. As e depreciates ($\uparrow e$), the foreign currency becomes more valuable and the supply of foreign exchange rises. Similarly, the demand for foreign exchange is downward sloping. Initially the market is in equilibrium with an exchange rate of e_0. Suppose there is a rightward shift in the supply of foreign exchange (e.g. as a consequence of a rise in the domestic interest rate relative to the world interest rate). Since home bonds are now more attractive than foreign ones at the given exchange rate, there is an excess supply of foreign exchange. Under a flexible exchange rate regime, the exchange rate would appreciate to e_1 and there would be no official intervention, i.e. $\Delta R = 0$. Under a fixed exchange rate with a peg set at e_0, the central bank will have to intervene in the market to absorb the excess supply of foreign exchange in order to keep the exchange rate fixed. Hence home's official foreign exchange reserves will rise by ΔR (see Fig. 4.7).

Of course, even in the case of fixed exchange rates, the exchange rate peg can be changed. We shall examine the use of a change in the peg as a policy instrument later in the chapter. It is only in the case in which two (or more) countries form a currency union that the exchange rate between them is irrevocably fixed.

Under flexible exchange rates, the uncovered interest parity condition shows how arbitrage in the international financial market will lead to changes in the exchange rate in response

- to a change in home's interest rate assuming that exchange rate expectations and the world interest rate remain unchanged,
- to a change in the world interest rate assuming that exchange rate expectations and the home interest rate remain unchanged and
- to a change in exchange rate expectations if interest rates at home and abroad remain unchanged.

In a fixed exchange rate regime, the government requires that the central bank actively intervenes in the foreign exchange market in order to keep the exchange rate constant. As the interest parity condition makes clear if the expected depreciation or appreciation of the exchange rate is zero (as in a fixed exchange rate regime), then the home interest rate must always be equal to the world interest rate. With the home interest rate set equal to i^*, and given the home demand for money function, the central bank must adjust the money supply to ensure money market equilibrium at $i = i^*$. We shall see that the intervention in the foreign exchange market to buy and sell foreign assets in exchange for home currency *at the fixed exchange rate* is another way of describing how the central bank has to change the money supply in order to keep the interest rate unchanged.

Suppose there is a fall in the demand for money in the home country due to an innovation in the banking sector, for example. The home interest rate falls. If the UK is the home country, pound bonds are now a bad deal. Demand for foreign exchange by holders of pounds rises in the foreign exchange market: there is excess demand for foreign exchange. In order to keep up the demand for pounds and hence prevent the exchange rate from depreciating, the central bank intervenes immediately to buy pounds. To do so, it must sell some of its foreign exchange reserves. As a consequence the home money supply falls in line with the fall in the home demand for money, which keeps the interest rate unchanged. The intervention by the central bank through buying and selling foreign reserves in exchange for pounds is what keeps the exchange rate unchanged at its expected value (the so-called peg) and the interest rate equal to the world interest rate. As the economy is affected by domestic or foreign shocks, the domestic money supply moves around in order to keep $e = e^E =$ *exchange rate peg* and $i = i^*$.

Fig. 4.8 shows the comparison between the flexible exchange rate regime and the fixed exchange rate regime when there is an exogenous fall in the demand for money. In the upper panel (flexible exchange rates), the fall in the demand for money lowers the home interest rate (A to B). The UIP condition in the left hand panel shows that this leads to an immediate depreciation of the home exchange rate (A' to B'). By contrast in the fixed exchange rate case (lower panel), by contrast, the fall in the demand for money puts downward pressure on the interest rate and the incipient collapse in the demand for pounds requires the central bank to intervene in the foreign exchange market to buy pounds. It uses foreign exchange reserves to do this ($\Delta R < 0$) and the result is a decline in the money supply to match the new lower demand for money (from A to B). The interest rate and exchange rate remain unchanged (at A').

It is important to remember that the home money demand function is the same as in the closed economy. The difference that opening the economy makes is that it creates a connection between the home interest rate, the world interest rate (and hence money demand and supply in the rest of the world) and the exchange rate. The money supply is under the control of the domestic authorities in the flexible exchange rate economy but not in the fixed exchange rate economy because official intervention to stabilize the exchange rate (ΔR) automatically affects the money supply.

It is useful to reinforce the link between the change in official reserves and the money supply by summarizing the ways in which the money supply can increase. We introduced the simplest case in the closed economy (Chapter 2). This is where the central bank engages in an open market operation in which it uses newly printed money to purchase bonds from the public. This has the effect of increasing the stock of high-powered money and reducing the stock of bonds in the hands of the public. The central bank's assets rise by the increase in bonds and its liabilities rise exactly in line by the increase in high-powered money (LM shift only).

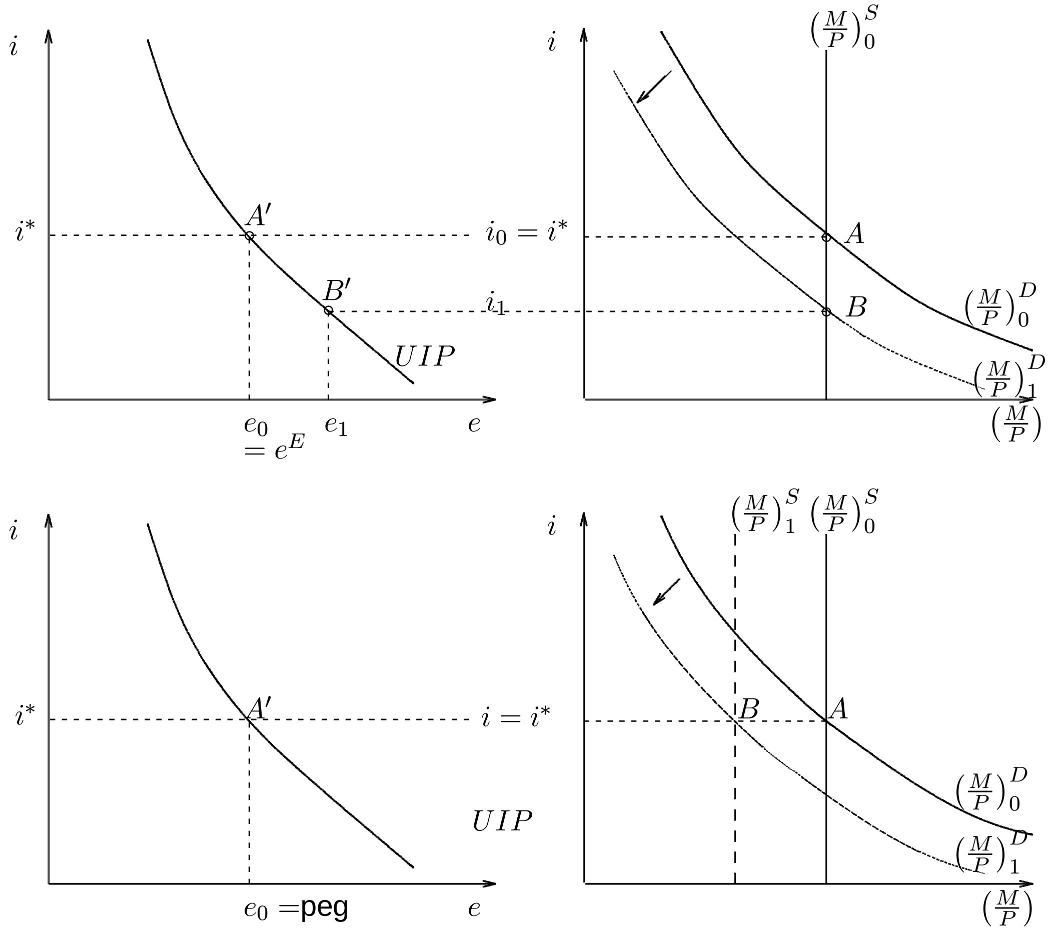


FIGURE 8. **Fall in the demand for money: consequences under flexible and fixed exchange rates.**
Top panel: Flexible exchange rates
Bottom panel: Fixed exchange rates

The second case is where the government has a budget deficit that it has to finance. It could sell more bonds to the public to finance its deficit (IS shift only) with no implications for the money supply but it could also choose to sell the bonds to the central bank in exchange for newly printed money (IS and LM shift). The central bank ends up with more bonds (assets) and a matching rise in liabilities.

The third way in which the money supply can rise is if the central bank intervenes in the foreign exchange market and buys foreign exchange with newly printed money. The central bank's assets rise (by the increase in foreign exchange reserves) as do its liabilities (LM shift only).

This highlights the fact that any change in the central bank's assets (its holdings of bonds or of foreign exchange reserves) will have a counterpart in a change in its liabilities, i.e. the money supply in the hands of the public.

Balance sheet of the Central Bank in open economy	
Assets	Liabilities
government bonds + foreign exchange reserves	high-powered money in hands of public
$B + R$	H

4. Trade balance and balance of payments

This chapter is building up to the stage where we put together goods and financial market openness under fixed and flexible exchange rate regimes and build a model of how output and the balance of trade are determined in the short run. Before doing that it is necessary to clarify the open economy accounting concepts.

The transactions between the home country and the rest of the world are recorded in the balance of payments. The balance of payments account is divided into the current account and the capital account.[15]

The **current account**

- consists of the trade balance plus net interest and profit receipts. Net interest and profit receipts arise from earnings from foreign assets (e.g. bonds, equities) owned by residents of the home country less payments of interest and profit to foreigners who own home country assets.

The **capital account**

- records changes in the stock of various types of foreign assets owned by home residents and home assets owned by overseas residents. It also records changes in official foreign exchange reserves of the central bank.

To understand the balance of payments accounts, it is useful to separate the private and official parts of the capital account.

$$\begin{aligned} BP &\equiv \underbrace{\left(\underbrace{(X-M)}_{\text{trade balance}} + \text{ net interest receipts}\right)}_{\text{current account}} + \underbrace{(\text{capital inflows-capital outflows})}_{\text{capital account}} \\ &\equiv (BT + INT) + (F - \Delta R) \equiv 0, \end{aligned}$$

where BT is the balance of trade and INT is net receipts of factor income from abroad. F records net private capital inflows and $-\Delta R$ records the net decline in official foreign exchange reserves.

If we rearrange the balance of payments equilibrium by putting the increase in foreign exchange reserves on the left hand side, we have:

$$\Delta R = (BT + INT) + F$$

If there is a current account surplus, there will be no change in official reserves if the net private capital outflow is equal to the current account surplus. The net capital outflow (i.e. $F < 0$) reflects the *acquisition* by the home country of foreign assets. In the opposite situation of a current account deficit (i.e. a situation in which domestic savings is less than domestic investment) for there to be no change in official reserves, there must be a net capital inflow (i.e. $F > 0$). Home is borrowing from abroad and thereby acquiring a foreign liability. At first sight it may seem paradoxical that a negative F in the balance of payments represent the acquisition by home of foreign assets. But as we have seen, this is explained by the fact that the balance of payments records the sources and uses of foreign exchange: the purchase of foreign assets is a use of foreign exchange and therefore has a negative value in the balance of payments accounts.

[15] With the publication of the IMF's Balance of Payments Manual Fifth Edition in 1993, official the terminology has changed. The main change was to reclassify part of the current account and call it the capital account, which then became part of the new 'capital and financial' account. The traditional conceptual distinction between the current and capital account is replaced in the new terminology by that between the current and 'capital and financial' account. The rationale for the change is to bring reporting closer to the underlying economic concepts. We shall continue to use the more familiar standard terminology since we are only concerned with the most basic decomposition of the balance of payments account. The IMF's Balance of Payments Manual Fifth Edition (1993) is available from
http://www.imf.org/external/np/sta/bop/BOPman.pdf.

It should now be clear that official foreign exchange reserves will rise ($\Delta R > 0$) when a current account surplus exceeds the net private capital outflow. Similarly, official reserves will fall when a current account deficit is not fully financed by a private capital inflow. Under flexible exchange rates, it is assumed that the nominal exchange rate moves to secure balance of payments equilibrium so that there is no official intervention.

There are two questions about the balance of payments that we need to answer:

(1) Why is the balance of payments equal to zero?
(2) Does it matter if the current account or trade balance is in surplus or deficit? This raises the related question — if the balance of payments is always zero, how can there be a balance of payments crisis?

4.1. Why is the balance of payments equal to zero? We begin by considering the export of mobile phones from Sweden to New Zealand and ask how this transaction will show up in the Swedish balance of payments statistics. Sweden is the home country in this example. The balance of payments identity requires that

$$BP \equiv (BT + INT) + (F - \Delta R) \equiv 0.$$

The export of mobile phones will be registered as a positive item in the current account (i.e. $BT > 0$). For the identity to hold and assuming for simplicity that net interest payments are zero, there are three different ways in which the Swedish balance of payments could record this transaction:

- (i) an exactly equal value of imports from New Zealand to Sweden takes place. In this case, the current account balances and the capital account (private and official) is zero.
- (ii) an exactly equal capital outflow from Sweden to New Zealand takes place. The Krona are used to purchase New Zealand assets. In this case, the current account is in surplus, the private capital account is in deficit and there is no change in official reserves.
- (iii) an official intervention in the foreign exchange market — e.g. the Swedish Central Bank sells Krona and buys New Zealand dollars. In this case, there is a current account surplus and a capital account deficit that takes the form of a rise in foreign exchange reserves.

One of these three alternatives (or some suitable mixture) must take place. Why? The answer is that the Swedish exports have to be paid for in Krona so through some means or other, the Krona have to be found. After all, the world is a closed system. The balance of payments is the method by which records of international transactions are kept. In practice, the records are incomplete, with the result that an entry for errors and omissions has to be added to make the balance of payments sum to zero.

To tie up the loose ends, let us take one further example. What happens if the current account is in balance, there is no official intervention and there is a private capital outflow from Sweden. For example, suppose a Swedish firm is setting up a mobile phone subsidiary in New Zealand. This is a long-term flow of capital from Sweden to New Zealand as the Swedes buy assets (e.g. land and a factory) (i.e. $F > 0$). In order to buy the New Zealand assets, the Swedish firm needs NZ dollars. Since the current account is in balance and there is no official intervention, the Swedish firm would have to borrow New Zealand dollars in order to engage in the investment in New Zealand. Borrowing NZ dollars means that there is capital inflow on Sweden's capital account (the NZ dollars) (i.e. $F < 0$). This matches the capital outflow and the balance of payments is equal to zero.

4.2. Do current account imbalances matter? Turning to the second question, does it matter from an economic perspective if there is a current account or trade deficit or surplus in the economy? To answer this question, it is necessary to understand that any non-zero current account reflects a change in the country's wealth. If the home country has a current account surplus then this means that it is lending abroad — if it has a current account deficit, then it is borrowing from abroad. Recall that the trade balance reflects any difference between domestic savings and investment (refer back to Section 4.1). If there is a trade deficit, then the domestic private and public sector savings are inadequate to finance private and government investment. The home country must therefore borrow from abroad. Since this borrowing will have to be repaid (with interest) in the future, the trade deficit represents a decline in the home country's wealth. A trade deficit will imply a current account deficit unless the home country receives a sufficient net inflow of interest and profit receipts on the foreign assets that it owns.

A decline in wealth sounds like a bad thing — but this is not always the case. When a student goes into debt to finance their university studies, their financial wealth falls. The wisdom of this move depends on the extent to which the university education increases the student's human capital and improves their earning capacity. Similarly, if the home country's trade deficit reflects a high level of investment in profitable projects in the home economy, then the possibility of borrowing from abroad is a method of increasing the wealth of the home country in the future. Provided the investments in the home economy bear fruit, its exports rise and it is able to repay its international debts. A good example of this is the Norwegian economy in the 1970s: it had persistent current account deficits as it borrowed abroad to develop its oil reserves.

Equally, for a country that does not have very profitable investment opportunities at home, it makes sense that domestic savings are used for net investment abroad. The purchase of foreign assets that the current account surplus represents may provide a higher return than would higher investment at home. High saving economies in Asia such as Singapore provide examples here.

If all economic agents act rationally weighing up the relative returns from different investment opportunities, then a current account imbalance simply reflects the differences in preferences and in investment opportunities across countries. However, a persistent current account deficit is not necessarily benign. A current account deficit may not reflect higher investment at home in response to especially attractive investment opportunities — rather, it may reflect low savings because of high private or government consumption or it may reflect investment in wasteful projects. High current consumption or wasteful investment offers no prospect of a new stream of returns in the future. It may not be clear how the foreign debt that is accumulating each year during which there is a current account deficit will be paid off. A persistent or excessive current account deficit may become increasingly difficult to finance. In practice this means that under flexible exchange rates, there may be a depreciation of the exchange rate. Under fixed exchange rates, if private counterparties cannot be found to finance the deficit, the central bank will be obliged to sell foreign exchange reserves in order to maintain the exchange rate. It may clamp down on the access of home residents to foreign exchange, thereby keeping them from engaging in the purchase of foreign bonds. If so, the assumed perfect international capital mobility breaks down — i.e. it becomes impossible for home residents to borrow at the world interest rate. In circumstances such as these, the government and central bank will be obliged to change domestic policy so as to reduce the current account deficit.

Since a current account deficit implies a running down of the home country's wealth (an increase in its foreign liabilities) whereas a surplus represents an accumulation of wealth, there is an essential asymmetry between the two. Foreigners may stop lending to the home economy: they cannot stop the home economy from lending abroad. In the following chapters, the consequences for domestic policy makers of current account imbalances are investigated in more depth.

4.3. What is a balance of payments crisis? If the balance of payments must sum to zero, what is a balance of payments crisis? Similarly, why is there reference to a balance of payments 'deficit' or 'surplus' if the balance of payments is always in balance? The explanation lies in an unfortunately sloppy use of terms. Balance of payments surplus, deficit or crisis refer to the state of the current account plus the capital account *excluding official intervention* — i.e. to $(BT + INT) + F$ in our terminology. Thus a balance of payments surplus arises when the sum of the current account and net capital inflows is positive. This means that official reserves are rising: since $BT \equiv 0$ and $(BT+INT)+(F) > 0$, this implies that $\Delta R > 0$. Conversely a deficit means that the private capital inflows are inadequate to finance the current account deficit with the result that official reserves are falling. The possibility of a crisis should now be clear. If a balance of payments deficit persists, the central bank may eventually run out of reserves. A potential crisis of this kind will lead to a change in government policy (e.g. the introduction of contractionary policies to stem imports; a devaluation of the exchange rate to boost net exports) and possibly ultimately to intervention by the IMF. This issue is taken further in Chapter (Crises).

5. Mundell–Fleming model for the short run

The elements are now ready to be combined to provide a model for use in macro analysis. In setting up the Mundell–Fleming model, the aim is to show the impact of policy and of domestic and foreign shocks on output and the balance of trade in the short run. We make the following assumptions:

: MF1. Prices and wages are fixed.

: MF2. The home economy is small. This means the home economy cannot affect the world interest rate or world output.

: MF3. Perfect capital mobility and perfect asset substitutability. Residents of the home economy can buy and sell bonds of the foreign country (with the interest rate i^*) in unlimited amounts at low transactions costs. There is no difference in risk between the bonds. This implies that uncovered interest parity holds.

The Mundell–Fleming model consists of four elements:

(1) the open economy version of the goods market equilibrium condition for the home economy summarized in the $ISXM$ curve
(2) the money market equilibrium condition for the home economy summarized in the LM curve
(3) the financial market arbitrage or uncovered interest parity condition summarized in the UIP curve and
(4) the condition for financial integration when expectations are fulfilled in the foreign exchange market, summarized in $i = i^*$-line.

The first task is to set out how the model works. We begin by asking how to find the new short-run equilibrium following a change in fiscal or monetary policy. But how is the short-run equilibrium defined? The short-run equilibrium is where the goods market is in equilibrium and where the exchange rate is not expected to change. This means that in the short-run equilibrium, the economy must lie on the $i = i^*$-line where the home and world interest rates are equal. As the UIP condition makes clear, only when home and world interest rates are equal is the expected exchange rate equal to the actual exchange rate. When discussing monetary policy, we show the equivalent policy instrument to the use of monetary policy in a fixed exchange rate regime: a discrete change in the exchange rate peg.

Once the operation of the model is clear, it can be applied not only to policy choices by the home government but also to examine the implications of a change in economic conditions emanating from the rest of the world — e.g. a change in the world interest rate or a change in world aggregate demand — or from the domestic economy — e.g. a consumption boom or a slump in investment. We draw together the results for different disturbances under different exchange rate regimes, leaving the task of working through the details of each case as an exercise for the reader.

5.1. The Mundell–Fleming model and monetary policy.

5.1.1. *Fixed exchange rates.* As we have seen above, when the exchange rate peg has to be maintained, the home economy loses control of its money supply. This means that any attempt by the home economy to use monetary policy is bound to be ineffective. Let us take the example of an expansionary monetary policy. The central bank engages in an open market operation that consists of the purchase of home bonds in exchange for newly printed money. The LM curve shifts to the right (Fig. 4.9). Note that in the Mundell–Fleming model, prices and wages are fixed. Hence inflation and expected inflation are zero and the real and nominal interest rates are equal. We therefore work with an IS/LM diagram with the nominal interest rate on the vertical axis.

What is the new short-run equilibrium? Since the exchange rate is fixed, equilibrium in the international financial market summarized in the UIP condition dictates that the interest rate must

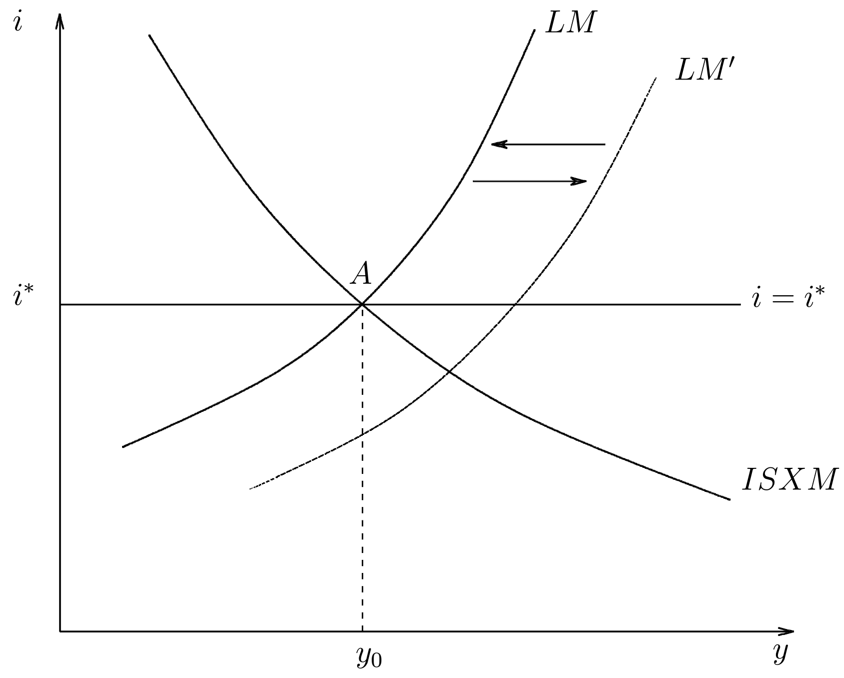


FIGURE 9. **Expansionary monetary policy: fixed exchange rates**

be equal to the world interest rate. Hence the new equilibrium must be at A: monetary policy has no effect.

How does this result come about? The purchase of home bonds by the central bank bids up their price and pushes the interest rate downwards, making pound bonds unattractive. But the central bank is committed to maintaining the exchange rate so it must use foreign exchange reserves to purchase pounds and prevent the exchange rate from depreciating. This decline in the monetary base exactly offsets the initial injection of new high-powered money. The LM curve shifts left again back to its initial position.

5.1.2. *Flexible exchange rates.* With flexible exchange rates, the exchange rate can adjust to any discrepancy between the domestic and the world interest rate generated by a change in home monetary policy. An expansionary monetary policy will push down the home interest rate. This will make pound bonds unattractive and lead to a depreciation of the exchange rate. The depreciation will boost net exports of the home economy and push up the level of output. As output rises the demand for money will rise and the home interest rate will return to the world level. Monetary policy can therefore affect output and the trade balance. To fill in the details, we look first at the new equilibrium and then at the adjustment path.

What is the new short-run equilibrium? It must lie on the $i = i^*$-line with the exchange rate equal to the expected exchange rate and the interest rate equal to the world interest rate. Given the new LM curve, this means that the new equilibrium will be at point Z in Fig. 4.10. Hence the $ISXM$ curve must shift to the right and intersect both the LM' and $i = i^*$-line at Z. The rightward shift in the $ISXM$ curve will be brought about by the depreciation of the exchange rate. We also know that the exchange rate depreciation shifts the y_{BT}-line to the right. There will be a trade surplus at the new short-run equilibrium because the depreciation will have increased output by more than the increase in domestic absorption (refer back to Section 4.1 above).

But how does the economy adjust from the initial equilibrium of A to the new equilibrium of Z and what role is played by the UIP-condition? By using both diagrams together, as in Fig. 4.11, we can see what is going on. We draw the initial UIP-condition in the left panel. Remember that this is drawn for a given expected exchange rate, e^E and shows what will happen to the nominal exchange rate if the interest rate deviates from the world rate. The process of adjustment to the new equilibrium depends on how exchange rate expectations are formed. In the step-by-step description

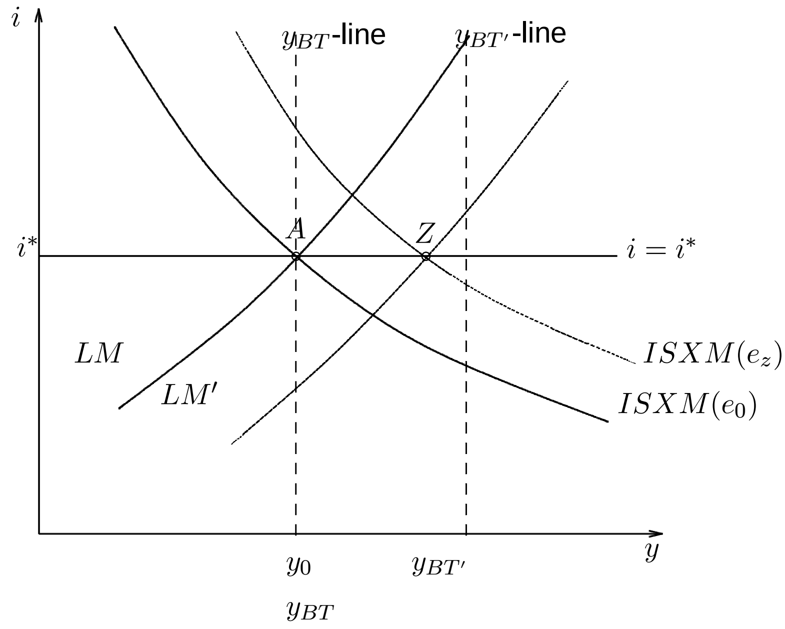
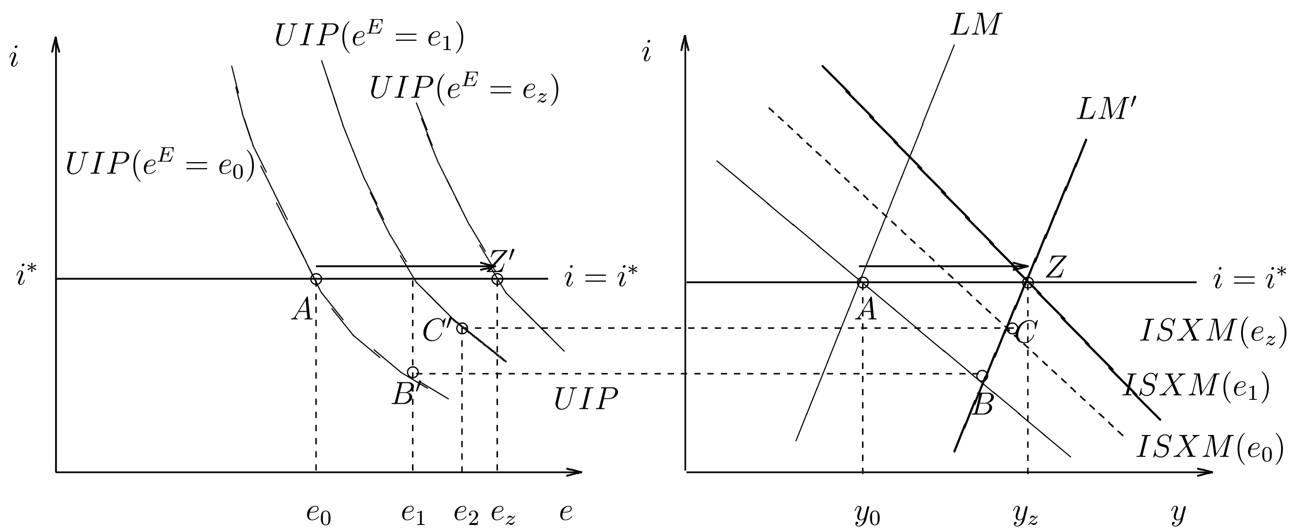


FIGURE 10. **Expansionary monetary policy: flexible exchange rates**



(a) Slow adjustment of exchange rate expectations (adaptive expectations) and slow adjustment of output and employment: A to B to C ... to Z.

(b) Immediate adjustment of exchange rate expectations to new short-run equilibrium (rational expectations) and rapid adjustment of output: A to Z.

FIGURE 11. **Expansionary monetary policy: adjustment under flexible exchange rates**

below, we shall assume that agents update their exchange rate expectations using a form of adaptive expectations. If the exchange rate appreciates from e_0 to e_1, then we shall assume that the new expected exchange rate is equal to to e_1. After looking at the adjustment process, we shall return to consider how satisfactory backward looking exchange rate expectations is as an assumption and compare it to rational expectations.

- **:** Step 1. The rightward shift of the LM curve leads to a fall in the domestic interest rate and output rises $(A \to B)$ in the $ISXM/LM$ diagram.
- **:** Step 2. The fall in the interest rate implies via the UIP condition that there is an immediate depreciation of the exchange rate to B' in order that the expected appreciation back to A' would offset the expected interest loss from holding pound rather than dollar bonds. The depreciation occurs because home residents sell pounds so as to buy dollars with which to purchase the higher interest dollar bonds.
- **:** Step 3. The depreciation of the exchange rate leads to a rightward shift of the $ISXM$ curve to $ISXM(e_1)$ which raises output further ($B \to C$) in the $ISXM$ diagram. This leaves the home interest rate below the world interest rate.
- **:** Step 4. Because of the depreciation of the exchange rate, the expected exchange rate changes according to the adaptive expectations rule. The new UIP curve crosses the $i = i^*$-line where the expected exchange rate equals e_1(see Fig. 4.11). Given that the expected exchange rate is now e_1 the actual exchange rate will depreciate further to e_2 and the economy will move to C' in the UIP diagram.
- **:** Step 5. This is simply a repetition of step 3: the depreciation to e_2 shifts the $ISXM$ further to the right.

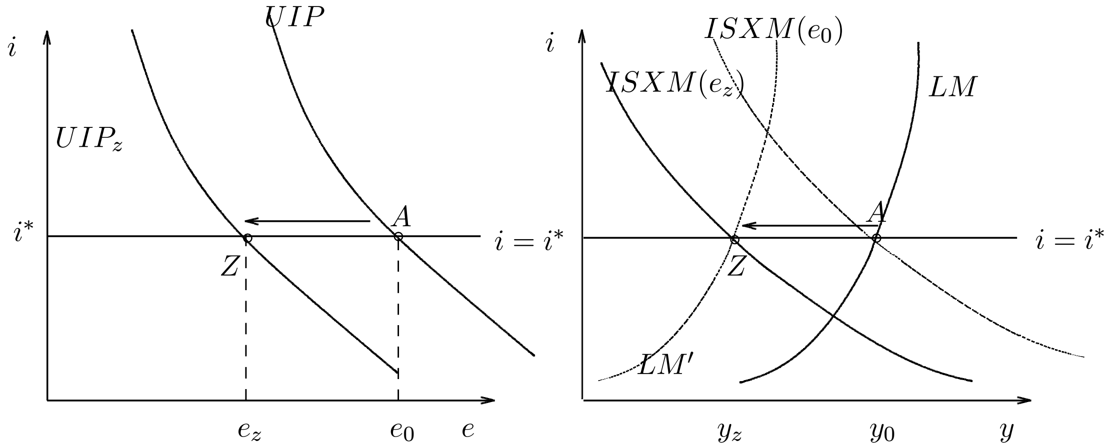
Once the home interest rate is equal to the world interest rate again, there will be no further adjustment: the economy is at the new short-run equilibrium at Z.

But let us return to the question of exchange rate expectations. Since *we* know that the new short-run equilibrium is at point Z with a nominal exchange rate of e_z, why do the economic agents maintain the belief during the adjustment process that the exchange rate is expected to remain at its value in the recent *past*? We could take a radically different assumption about expectations. Suppose that all agents understand the model of the economy and can figure out the exchange rate that is consistent with the new short-run equilibrium at Z. This means that they expect the nominal exchange rate to be $e^E = e_z$ as soon as the new monetary policy is announced. This implies that the UIP-curve jumps from UIP_0 to UIP_z immediately (see Fig. 4.11). *If* the goods market adjusts equally rapidly, then the $ISXM$ curve also jumps immediately to $ISXM(e_z)$ and the economy moves straight to the new short-run equilibrium at Z. With so-called rational exchange rate expectations and rapid adjustment in the goods market, we observe the shift from A to Z. With adaptive expectations and slow adjustment in the goods market, we observe the home interest rate falling below the world rate and output adjusting slowly to the new equilibrium.

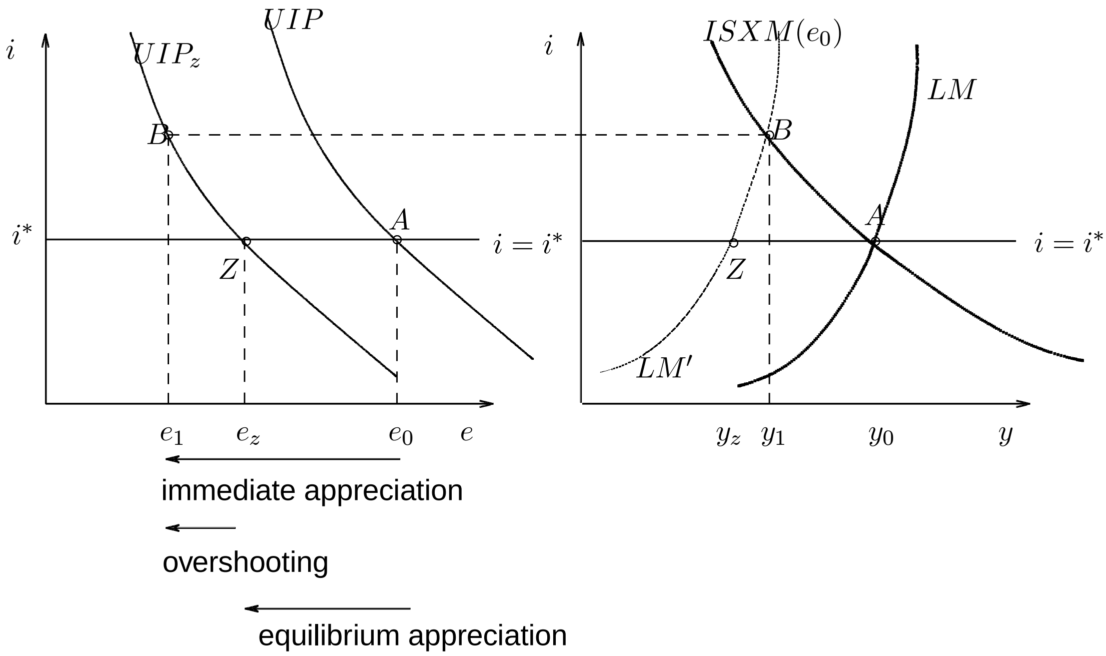
5.1.3. *Introduction to exchange rate overshooting.* In the analysis of how the economy adjusts to a change in monetary policy under flexible exchange rates, we have considered two different ways in which expectations about the exchange rate are formed. We looked at adaptive expectations, where people's view about the exchange rate is determined by the value of the exchange rate that they have observed in the recent past. The alternative model was the rational expectations assumption, where people expect the exchange rate to be at the new short-run equilibrium level. We have already pointed out the obvious problem with the adaptive view — people are constantly making a mistake about what they expect to happen to the exchange rate but they continue to use the same old rule to form their expectations.[16]

There is a different problem with the rational expectations hypothesis. As we have seen, at least conceptually it is straightforward to calculate the new short-run equilibrium exchange rate. But for it to be rational for agents to adjust their expectations immediately to this new exchange rate, it must also be the case that the goods market adjusts swiftly to the new short-run equilibrium output level. The aim of this sub-section is to point out what can happen if this is not the case.

[16]Whilst this appears to be a powerful reason for avoiding the use of a backward-looking rule, it is less clear that foreign exchange dealers use rational expectations in forming their expectations about the exchange rate. Evidence suggests that the best guess as to what the exchange rate will be next period may indeed be what it was last period. This is called random walk behaviour. For a recent study, see Yin-Wong Cheung, Menzie D. Chinn, Antonio Garcia Pascual (2002) 'Empirical Exchange Rate Models of the Nineties: Are Any Fit to Survive?'NBER Working Paper 9393.



(a) Rational expectations and rapid adjustment in the goods market



(b) Forward looking expectations and sluggish adjustment in the goods market

FIGURE 12. **An example of exchange rate overshooting: unanticipated monetary contraction**

To highlight the possible consequences when exchange rate expectations are formed in a forward-looking way, let us assume there is an unanticipated monetary contraction. In the top panel of Fig. 4.12, we can see the leftward shift of the LM curve and the new short-run equilibrium at point Z, with a new nominal exchange rate of e_z. If people know that the economy will react immediately to the monetary contraction, then they will rationally expect that the exchange rate will jump to e_z and that output will jump to y_z. The economy jumps from point A to point Z.

But what happens if output in the economy adjusts only sluggishly? There is plenty of evidence that changes in the real exchange rate take a long time to feed through[17]: the $ISXM$ curve will therefore shift only slowly to the right in response to the real depreciation. Let us suppose that

[17] For example, Carlin, Glyn and Van Reenen (2001) report that the full effect on export market share of a change in the real exchange rate (measured by cost competitiveness) takes five to six years to feed through. 'Export market performance of OECD countries: an empirical examination of the role of cost competitiveness' W. Carlin, A.Glyn & J. Van Reenen (2001) Economic Journal. Vol. 111, No. 468, 128-162.

expectations in the foreign exchange market react in a forward-looking way to the monetary contraction and that the expected exchange rate therefore jumps to the new equilibrium rate, e_z. The new UIP curve is UIP_z in the lower panel of Fig. 4.12. If output only adjusts sluggishly to the monetary contraction, then the economy moves up the $ISXM(e_0)$ to point B. Now we need to consider the implications for the exchange rate. Since the expected exchange rate has appreciated to e_z, the relevant UIP curve is UIP_z. With the home interest rate above the world interest rate, the nominal exchange rate must appreciate *further* than e_z. As shown in the lower panel of Fig. 4.12, the exchange rate jumps to e_1. The extra appreciation beyond that associated with the new short-run equilibrium is referred to as 'exchange rate overshooting'.[18] The overshooting of the exchange rate may complicate the process of adjustment to the new short-run equilibrium since the tradeables sector is harder hit than is consistent with the new equilibrium at Z. Since sluggish adjustment in the goods market is well documented, exchange rate overshooting is believed to be a factor lying behind the volatility of the exchange rate.

5.1.4. *Discrete changes in the peg: the fixed exchange rate equivalent of monetary policy.* The use of monetary policy — either by changing the money supply or by directly changing the interest rate — cannot affect the level of output in the fixed exchange rate economy. However, the government or central bank has the option of making a discrete change in the exchange rate peg. With a contractionary monetary policy under flexible exchange rates, output shrinks because of the appreciation of the exchange rate induced by the higher interest rate. In order to mimic this outcome, the authorities need to announce a new peg for the exchange rate: they must revalue the exchange rate and intervene at a lower value of $e \equiv \frac{\text{home curr.}}{\text{foreign curr.}}$. With a revaluation of the exchange rate, the $ISXM$ curve shifts to the left. This in turn pulls the interest rate below the world rate and induces an incipient capital outflow. To maintain the new peg, the central bank sells foreign exchange ($\Delta R < 0$). As the monetary base shrinks, the LM curve shifts to the left. The process continues until the new short-run equilibrium at lower output (with $i = i^*$) is reached. (Recall that the ineffectiveness of using a contractionary monetary policy under fixed exchange rates arises because a tighter monetary policy *raises* the interest rate and induces a capital inflow.)

It is important to note that if a government changes the exchange rate peg repeatedly, this is likely to give rise to speculation about future moves, with the consequence that the government will have to change the interest rate in order to hold the announced peg. A fixed exchange rate system cannot survive with the existing peg intact if an atmosphere of exchange rate speculation develops. Thus there are limits to the extent to which changes in the exchange rate can be made and a fixed rate system maintained.

5.2. The Mundell–Fleming model and fiscal policy.

5.2.1. *Fixed exchange rates.* The impact of an expansionary fiscal policy is to push up domestic interest rates as the extra spending raises the demand for money. Whereas the expansionary monetary policy was completely ineffective under fixed exchange rates, a fiscal expansion in an open economy with fixed exchange rates, is very effective in raising output. The reason is that the increase in the demand for money that follows from the fiscal expansion leads to an increase in the money supply in order to keep the interest rate equal to the world interest rate.

To make the working of the model clear, we again look first at the new equilibrium and then at the adjustment path. The initial policy change is shown in Fig. 4.13 by the rightward shift of the $ISXM$ from $ISXM(g_0)$ to $ISXM(g_1)$. Since the new short-run equilibrium must lie on the $i = i^*$-line, it must be at the higher output level of B. This means that the LM curve must shift from LM to LM' as a consequence of the increase in the domestic money supply induced by the incipient rise in the interest rate. The y_{BT}-line does not move because the real exchange rate remains unchanged — so at the new short-run equilibrium there is a trade deficit (imports have increased).

[18]You may have noticed that the term forward-looking rather than rational expectations is used here. The reason is that if expectations are formed fully rationally, then the actual and the expected exchange rate will coincide. As we can see in the lower panel of Fig. 4.12, the actual exchange rate appreciates further than expected in the first period.

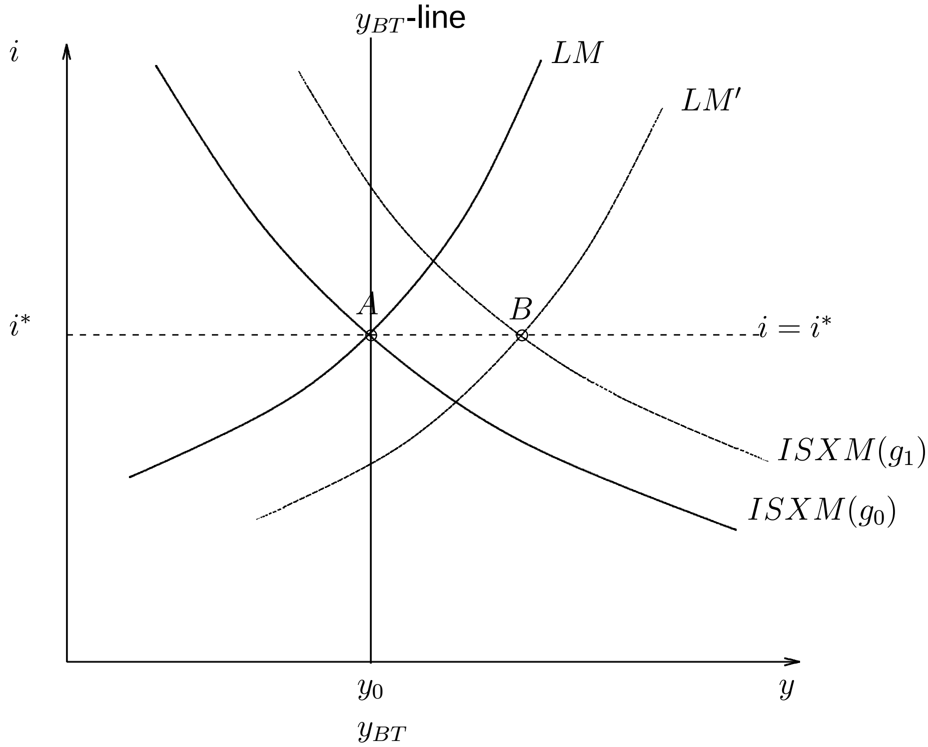


FIGURE 13. **Expansionary fiscal policy: fixed exchange rate**

The adjustment process centres on the impact of the upward pressure on the home interest rate due to the fiscal expansion. This upward pressure on the interest rate creates excess demand for pounds in the foreign exchange market. In order to keep the exchange rate fixed, the central bank will have to use newly printed money to purchase foreign currency. The foreign exchange reserves rise ($\Delta R > 0$) with the result that the domestic money supply expands. This shifts the LM curve to LM'. The intervention by the central bank reequilibrates the foreign exchange market. Simultaneously the rise in money supply in the home economy (via the increase in the monetary base as reserves rise in line with the increase in demand), maintains the interest rate at the world rate.

5.2.2. *Flexible exchange rates.* The intuition here is that under flexible exchange rates an expansionary fiscal policy will lead to a counteracting depressive effect because the increase in the domestic interest rate will lead to an appreciation of the home currency, which will weaken net exports.

To find the new short-run equilibrium, we know that the $ISXM$ shifts initially to the right to $ISXM(g_{1,}e_0)$ and that in the new equilibrium the economy must be on the $i = i^*$-line. It is therefore clear that the appreciation of the exchange rate must be sufficient to shift the $ISXM$ to the left to $ISXM(g_{1,}e_z)$, which intersects the $i = i^*$-line at A (see Fig. 4.14). The level of output at the new short-run equilibrium (Z) is exactly the same as it was originally. But its composition has changed: there is a higher level of government expenditure and a lower level of net exports: the increased government spending has 'crowded out' some net exports. This is confirmed by the fact that the y_{BT}-line shifts to the left to a new equilibrium: a less competitive exchange rate implies that trade balance will occur at a lower output level. There is therefore a trade deficit at the new short-run equilibrium.

The process of adjustment to the new equilibrium can be analyzed using the same steps as were introduced in the analysis of the expansionary monetary policy and is left as an exercise for the reader. Adjustment will look somewhat different in each of the expectations scenarios: backward looking, rational with rapid adjustment of output, and forward looking with slow adjustment of output (i.e. overshooting).

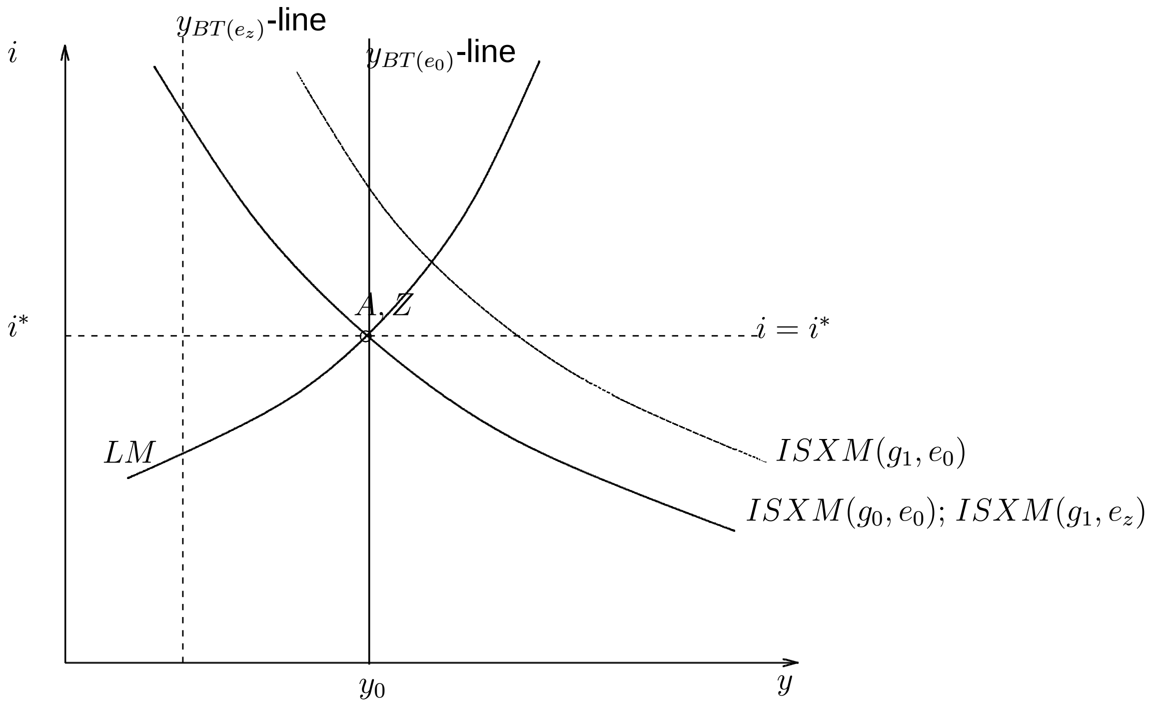


FIGURE 14. **Expansionary fiscal policy: flexible exchange rate**

6. Extensions (optional)

In the model of the small open economy we have set out in this chapter, the focus has been on providing clarity in the analysis by using bench-mark cases. Specifically we have developed a model of

- a small open economy
- in a world of perfect capital markets and
- perfect asset substitutability.

The assumptions about financial integration (perfect capital mobility and perfect asset substitutability) establish hard corners on the so-called inconsistency triangle or open economy trilemma. Only two of the following three can be maintained simultaneously:

(1) open capital market
(2) fixed exchange rate
(3) monetary policy oriented to domestic goals.

With perfect international capital mobility, either (a) exchange rates have to be fixed — with the implication that monetary policy cannot pursue domestic objectives or (b) monetary policy is used to pursue domestic objectives — with the implication that the exchange rate as a target has to be given up. Because the extent of internationalization of capital markets has been increasing in recent decades, it has been suggested that countries are increasingly forced into the two corners — either by adopting a hard exchange rate peg or by adopting a free float. This is the so-called "bipolar" view of exchange rate regimes.[19] This debate is taken up in Chapter (Crises). In this section we shall explain the additional ingredients that are needed for an understanding of the interaction between capital mobility, exchange rate and monetary goals that will allow us to step away from the bench-mark cases. How might a country with a fixed exchange rate gain some monetary policy autonomy and how might a country with a flexible exchange rate be able to influence the interest rate separately

[19] For a good introduction, see S. Fischer (2001). 'Exchange rate regimes: is the bipolar view correct?', Journal of Economic Perspectives 15 (Spring 2001), 3–24.

from the exchange rate? We explore what happens to the short-run behaviour of the economy when the three assumptions of perfect capital mobility, smallness and perfect asset substitutability are relaxed. We begin by noting the evidence in relation to international financial integration.

6.1. Evidence on financial integration. When perfect international capital mobility is assumed, changes in the nominal exchange rate are caused by developments affecting the capital account. In principle, any current account imbalance can be financed through the capital account at the world interest rate. This is summarized in the UIP condition. This feature of the small open economy model raises two questions: what do current account imbalances look like and how good is the UIP condition in practice in accounting for exchange rate changes? The answers to both questions suggest that the assumptions made to date in this chapter are open to challenge. Research in this field is in an intense phase and new findings are likely to emerge over the coming years.

A feature that continues to distinguish countries from regions is that the current account imbalances that are observed for countries are much smaller than they are for regions within countries. In other words, there is a tight connection between domestic savings and investment at the national level but very little connection when we look at the sub-national level. Limited spatial correlation is exactly what would be expected if the capital market was doing its job of allocating savings to the most productive investment projects — irrespective of where the savings were generated.

The high correlation between national savings and investment rates was first documented in 1980 by Feldstein and Horioka[20]. Feldstein and Horioka (1980) found a correlation between the share of investment in GDP to savings in GDP of 0.89 for the period 1960-74; a more recent study has found a correlation of 0.6 for OECD countries between 1990-97 (which rises to 0.76 if Korea is included) (Obstfeld and Rogoff (2000)).[21] Thus even in the 1990s, national borders appear to matter for access to capital.

The UIP condition predicts that if the home interest rate is above the world interest rate, the exchange rate is expected to depreciate. However, a large number of empirical studies have shown that the interest rate differential between two currencies is not a good predictor of changes in the exchange rate. For periods of up to one year, the predicted change in the exchange rate often has the wrong sign. Studies using longer periods, have found results more in line with the predictions of UIP but interest differentials are still able only to predict a small proportion of exchange rate variation.[22]

6.2. Imperfect capital mobility. We have developed a model of the small open economy under the assumption that capital mobility is perfect. We shall now explain why capital mobility may be imperfect and suggest how this can alter the predictions of the model. If there is perfect international capital mobility then residents of country A can buy or sell bonds denominated in the currency of country B with the international interest rate $i^*$with low transactions costs and in unlimited quanitities. There are two main reasons why this assumption may be unwarranted. First, a country may implement a policy that aims to limit capital mobility. Such a policy is referred to as one of capital controls. Second, information problems and the development of financial institutions in the economy may prevent domestic residents from having free access to international capital markets.

Capital controls have been used by countries both to restrict inflows of foreign capital and to restrict outflows. As we shall see in Chapter (Crises), large flows of foreign exchange are implicated in currency crises. A country may seek to reduce its vulnerability to a future currency crisis by restricting capital inflows: the foreign exchange can then not suddenly be withdrawn and so precipitate a crisis. A policy of preventing capital outflows is frequently a futile attempt to contain a currency crisis that is already in motion.

[20]M. Feldstein & Horioka, C., (1980). 'Domestic saving and international capital flows.' Economic Journal 90, 314-329.

[21]M. Obstfeld and K. Rogoff (2000) Global Economic Integration Opportunities and Challenges Federal Reserve Bank of Kansas City Annual Monetary Policy Symposium, p. 175.

[22]A recent study that includes a survey of previous results is M. Chinn and G. Meredith (2002) 'Testing uncovered interest parity at short and long horizons in the post Bretton Woods era'. University of California Santa Cruz Working Paper.

We shall look at two examples of how constraints on capital mobility affect the operation of macroeconomic policy.

: Example 1. Monetary policy under fixed exchange rates.

The attraction of capital controls for a country operating with a fixed exchange rate is that it means that monetary policy can have an effect on output. As we have seen, under fixed exchange rates and perfect capital mobility, an expansionary monetary policy does not get off the ground. This is because when the central bank engages in an open market purchase of bonds with the intention of increasing the domestic money supply (of easing monetary conditions through a lower interest rate), the domestic interest rate falls below the world interest rate. This sparks immediate pressure on the exchange rate as agents try to sell domestic currency. To maintain the parity, the central bank has to purchase domestic currency with official foreign exchange reserves and its attempt to raise the domestic money supply is thwarted. Financial integration under perfect capital mobility and fixed exchange rates requires the home and world interest rates to be equal.

If the government is able to control the access of agents holding domestic currency (pounds) to the foreign exchange market, then the arbitrage mechanism in the UIP condition cannot function smoothly. To the extent that those holding pounds cannot purchase dollars so as to shift into the now more attractive dollar bonds, the central bank is able to keep the domestic interest rate below the world interest rate. Monetary policy is therefore effective in raising output under fixed exchange rates. Since the private incentives for evading the capital controls are very strong, the government is unlikely to be able to completely prevent a leakage of reserves. This loss of reserves will ultimately place a limit on the use of this policy.

Note that in the opposite case, where the government uses capital controls in conjunction with a tightening of monetary policy it is seeking to prevent an inflow of foreign exchange reserves that would offset its objective of raising the interest rate. Whilst private incentives to evade these controls are the same as in the previous case, the government has more freedom of manouevre because the accretion of foreign exchange reserves is not as immediately problematic as the running down of reserves. We have noted this asymmetry earlier.

Indeed if the central bank is able to insulate the economy from the effects of an increase in foreign exchange reserves, the ability to use monetary policy under fixed exchange rates increases. In the analysis so far, we have assumed that a change in foreign exchange reserves has a direct impact on the domestic money supply since foreign exchange reserves form part of the monetary base. This direct connection can be broken if 'sterilization' is possible. We discuss the meaning of and scope for sterilization below.

: Example 2. Monetary policy under flexible exchange rates.

In our model of the small open economy with perfect capital mobility, monetary policy is highly effective in changing the level of output. It works entirely through its effect on the exchange rate: a monetary expansion pushes the interest rate below the world interest rate and via arbitrage in international capital markets (the UIP condition) the exchange rate depreciates. In the new short-run equilibrium the interest rate is at the world rate and the higher output is due to the real depreciation (i.e. the induced shift in the ISXM curve). Since the interest rate is at its original level, interest-sensitive spending is the same in the new equilibrium as it was originally (refer back to Fig. 4.10). The full flexibility of the exchange rate has the effect of preventing the government from choosing the domestic interest rate in the new short run equilibrium: although there is full monetary policy autonomy its effects on the economy are entirely through the exchange rate channel.

If capital mobility is less than perfect then financial integration will not require that the economy be on the $i = i^*$-line. Being on the $i = i^*$-line means that a trade deficit or surplus of whatever size is offset by a capital inflow or outflow financed at the constant world interest rate. If capital mobility is imperfect, then there is no automatic financing of a current account deficit or automatic lending of a current account surplus at the world interest rate. Instead, the size of the required capital inflow or outflow will affect the interest rate. For example, a larger trade deficit implies not only a larger accumulation of debt but also a less favourable rate of interest. We begin with the balance of payments identity:

$$BP \equiv (BT + INT) + (F - \Delta R) \equiv 0.$$

We are looking at the flexible exchange rate economy so there is no official intervention and therefore $\Delta R = 0$ and for simplicity, we ignore net interest receipts (i.e. we assume that $INT = 0$). For balance of payments equilibrium, we require:

$$BP \equiv BT(\theta, y) + F(i) = 0,$$

where $F(i)$ is private net capital inflow and is a positive function of i. The BP-line replaces the horizontal $i - i^*$-line under perfect capital mobility — where there is a perfectly elastic supply of capital at the world interest rate. We can show the BP line in the interest rate-output diagram (see Fig. 4.15). The BP line is upward-sloping in the interest rate-output diagram and is drawn for a given level of the real exchange rate. At a low level of output such as y_L, BT is high (since imports are depressed). Thus for balance of payments equilibrium, the net capital inflow must be low, and only a low interest rate will be required to finance it, hence i is low (i_L). Conversely at a high level of output, a weak trade balance has to be offset with a net capital inflow, which requires a high interest rate, i_H. Note that since we are interested in rather small deviations from perfect capital mobility, we shall assume that the BP-line is flatter than the LM. How does the BP line shift with a change in the real exchange rate? If at y_L, the real exchange is θ_1 (i.e. competitiveness is higher) instead of θ_0, then BT will be higher and balance of payments equilibrium will require a smaller net capital inflow and hence a lower interest rate than i_L. Hence the BP-line for θ_1 lies below that for θ_0.

We turn now to examine how an expansionary monetary policy would work under imperfect capital mobility. With an expansionary monetary policy, the LM moves to LM'. This leads to a lower interest rate and an expansion of output. The current account deteriorates and the exchange rate depreciates.

Under **perfect capital mobility**, the new short run equilibrium is at point C with a trade surplus (the surplus is lent at the international interest rate i^*).

Under **imperfect capital mobility**, the trade surplus entails a capital account outflow (net investment abroad) that will attract a lower interest rate than i^*. This is shown by point D.

With perfect capital mobility, the exchange rate changes because of disequilibrium in the asset (bond) market; under imperfect capital mobility, it is the flow disequilibrium arising from the trade imbalance that leads to exchange rate changes.

At point D, since the domestic interest rate is below i^*, output is increased above its initial level (y_0) through two channels:

- **:** (i) the interest rate channel, which leads to a movement along the $ISXM$ and
- **:** (ii) the exchange rate channel (due to the depreciation), which shifts the $ISXM$. The economy must be on the LM' curve: hence the new $BP(\theta)$ curve will go through point D.

We have the result that the new short run equilibrium will lie between that of the closed economy (B) and the small open economy with perfect capital mobility (C).

To summarize, the use of monetary policy is affected by the presence of capital immobility. Under fixed exchange rates, some role for monetary policy in influencing the level of output in the short run is reinstated. Under flexible exchange rates, an additional channel for monetary policy to influence the level of output is introduced: instead of having its effect entirely through the exchange rate, monetary policy also affects domestic demand directly because the home interest rate can diverge from the world interest rate in the short run equilibrium.

6.3. The large open economy. All the analysis in this chapter has assumed that the home economy is unable to influence the world interest rate. Together with the perfect capital mobility and perfect asset substitutability assumptions, this allowed us to specify the response of the economy to domestic policy changes and external shocks using the Mundell–Fleming model. The simplest way of modelling a large open economy is to have a world comprising just two economies. Whenever

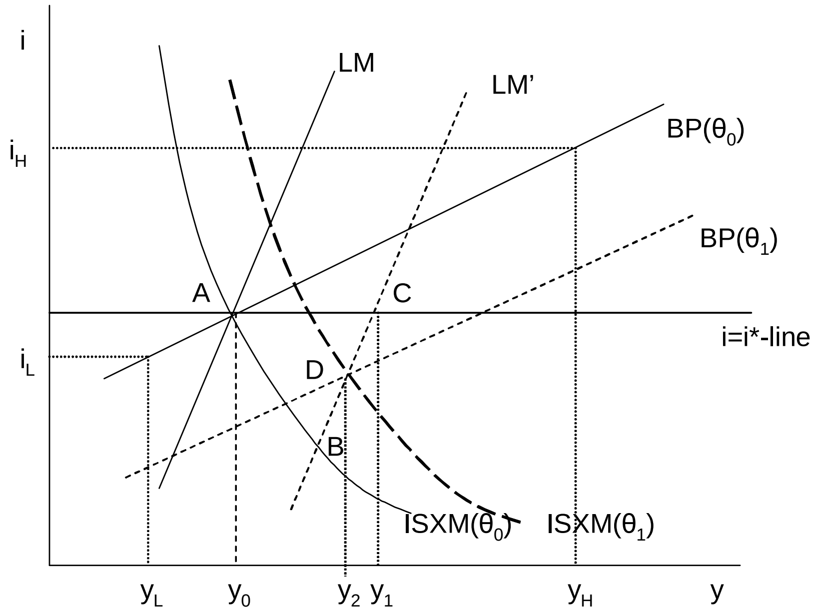


FIGURE 15. Imperfect capital mobility and flexible exchange rates: a monetary expansion

one of these economies changes fiscal or monetary policy, it will have an effect on the other — and hence, on outcomes for 'the world'. In Chapter (Interdependent Economies) we develop a simple two-country extension of the small open economy model. Here we provide an intuitive explanation of how monetary and fiscal policy affect the outcome for a large open economy in a world of perfect capital mobility.

As our large country, e.g. the euro-zone, loosens monetary policy, this will lower its interest rate relative to the other country, say, the US. As a consequence of perfect capital mobility, the exchange rate of the euro-zone will depreciate. By virtue of its size, the fall in the euro-zone's interest rate will pull down the world interest rate, i^*. The new short-run equilibrium for the euro-zone will be at a point such as D in the left hand panel of Fig. 4.16: on the new LM' curve, with the world interest rate at $i^{*\prime}$ and with the $ISXM$ shifted to $ISXM(\theta_1)$ by the depreciation.

The impact on output of a monetary expansion under flexible exchange rates in a large open economy differs in two respects from that of the small open economy. First, there are now two channels through which output is raised: the exchange rate channel and the interest rate channel. The second difference is that the rise in output will be somewhat less than in the small open economy case. The large open economy ends up at point D between that of the closed economy (B) and the small open economy (C).

In the small open economy with flexible exchange rates, fiscal policy is completely ineffective in changing the level of output and employment because the exchange rate moves to completely offset the impact of fiscal policy on aggregate demand. However, in a large open economy, this

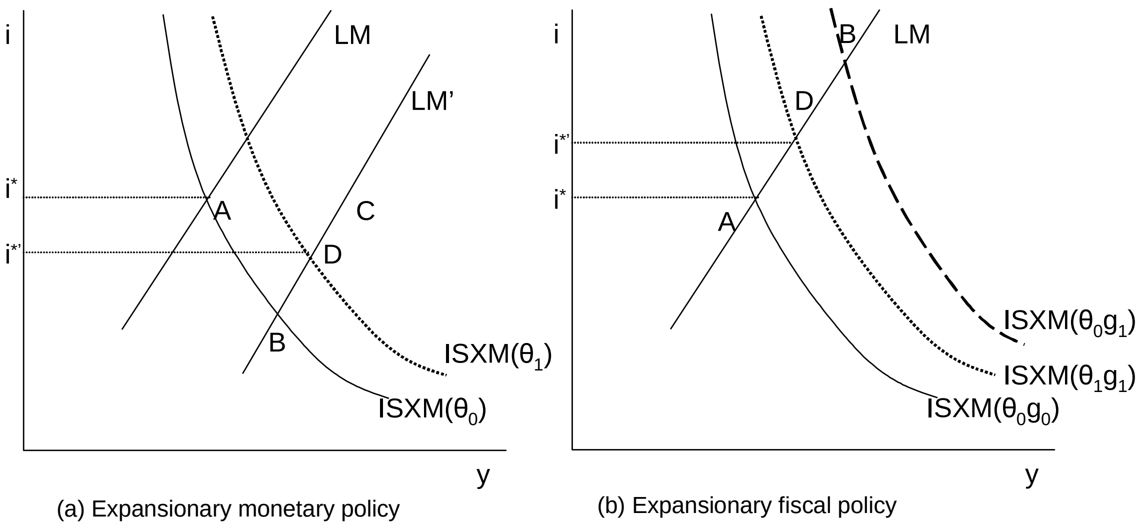


FIGURE 16. Flexible exchange rate large open economy

will not be the case. Instead, the economy will end up on the original LM curve at a point such as D in the right hand panel of Fig. 4.16: the world interest rate rises and the exchange rate of the euro-zone appreciates. Both the interest rate and exchange rate channels are working to reduce the expansionary impact of the higher government spending but their combined effect does not fully offset the expansionary impulse.

Just as in the case of a monetary expansion, the behaviour of the large open economy lies between that of the closed economy (B) and of the small open economy (A). This is an intuitively appealing result.

6.4. Perfect asset substitutability and the risk premium. Another key assumption that we made about financial openness was that home and foreign bonds were perfect substitutes. This means that only the expected return on bonds influences the choice between them. Another way of putting this is that if the assets are perfect substitutes, agents are indifferent as to the composition of their portfolio. Since the expected return is identical on foreign and home bonds and there is no difference in riskiness, even risk-averse investors are quite happy to put all their eggs in the one basket. Once the possibility of different riskiness of the bonds arises, then risk-averse investors will prefer a more balanced portfolio. It is necessary to amend the uncovered interest parity condition so that it is the 'risk-adjusted expected return' that is equalized through arbitrage:

$$i_t = i_t^* + \frac{e_{t+1}^E - e_t}{e_t} + \rho_t, \qquad \text{(Risk-adjusted UIP condition)}$$

where ρ (rho) is the risk premium. Specifically if the home currency is the euro, then the interest rate on euro bonds will be equal to the interest rate on dollar bonds plus the expected depreciation of the euro plus any additional risk premium that is required to compensate the investor in euros.

There are two ways to think about where the risk premium may come from. First, there may be a difference in the default risk on the two bonds — for example, it is plausible that investors would require a positive risk premium to hold Russian bonds as compared with euro bonds because of the greater likelihood that the Russian government would default on its obligations to honour the bonds. But even if the default risk is the same, risk premia can arise. For example if investors are concerned about unexpected fluctuations in the exchange rate, a balanced portfolio would be preferred.

We look at two examples of why the existence of risk premia can matter for macroeconomic outcomes:

- an unplanned increase in risk such as can occur when there is a change of government and
- the attempt by the central bank to use changes in portfolio composition as a tool of monetary policy.

6.5. Unplanned increase in risk. If a new government is elected and is considered riskier, in the sense that it is more likely to default on the government's debt, then this will raise the risk premium. In a fixed exchange rate regime, if the government is to hold the exchange rate peg, it will have to raise the interest rate to ensure that the expected return on home bonds *including the risk premium* is equal to the world interest rate. In terms of our earlier diagram, the UIP curve shifts upwards. The adjustment mechanism is that as the risk premium emerges, people will want to switch out of the home currency. In order to maintain the peg, the central bank must intervene to buy home currency. This loss of reserves, leads to a leftward shift in the LM and the interest rate rises. The outcome is therefore a recession for the home economy.

Under a flexible exchange rate regime, the exchange rate will depreciate when the risk premium emerges. Since the new short-run equilibrium requires that the home interest exceed the world interest rate by the risk premium, the exchange rate will depreciate sufficiently to ensure this (the $ISXM$ shifts to the right as the economy moves up the LM). This produces the perhaps surprising result that a rise in the risk premium boosts output in the home economy. However, this result should be treated with scepticism: growing concern about the credit-worthiness of the government may lead to an increase in the demand for money and hence a leftward shift in the LM, which would reverse the depreciation and induce a recession. Alternatively, speculation may mount about likely future depreciation of the exchange rate, which could spark a currency crisis: if the expected exchange rate depreciates sharply, the UIP curve shifts to the right and the government would have to raise the interest rate further to prevent the exchange rate from collapsing. These possibilities are taken up in Chapter (Crises).

6.6. Sterilized intervention by the central bank. Although there is considerable scepticism amongst economists as to whether central banks are able to engage successfully in sterilized intervention in the foreign exchange market for any length of time, it is important to understand the principle. Without using the term, we have only considered 'non-sterilized' foreign exchange market interventions to this point. To explain what this means, we take the case of a contractionary monetary policy in a fixed exchange rate regime. In the analysis so far, we have seen that this is fruitless when capital markets are perfect since the reduction in the monetary base due to the initial open market sale of bonds is exactly offset by the rise in monetary base due to the rise in official foreign exchange reserves as the central bank intervenes to hold the exchange rate constant when investors seek to switch to the home-currency denominated bonds. But now suppose that the inflow of foreign exchange is accompanied by an additional policy move by the central bank. How could it neutralize the impact of the rise in foreign exchange reserves on the money supply? It must match its acquisition of foreign assets ($\uparrow R$) with a sale of domestic assets, i.e. by a sale of bonds ($\downarrow B$). We reproduce the balance sheet of the central bank below. Sterilization means that the rise in R is offset by a fall in B. Since H does not change, there is no change in the money supply.

Balance sheet of the Central Bank	
Assets	Liabilities
government bonds + foreign exchange reserves	high-powered money in hands of public
$B + R$	H

The problem with engaging successfully in sterilization is that by selling more bonds, the price will tend to fall and the interest rate to rise: this is just what the central bank does not want because it will elicit a further capital inflow. In theory there is a way around this if the sales of bonds have a sufficient effect in raising the risk premium and therefore in influencing the public's desired portfolio. If the central bank sells more bonds, the public has to hold a higher proportion of the total stock of bonds outstanding: the central bank will hold fewer and the public will hold more. If the public care about the composition of their portfolio, then they will require additional compensation in the form of a risk premium. Hence the central bank is able to raise the risk premium and therefore hold the exchange rate unchanged. This is consistent with the risk-adjusted UIP condition because the domestic interest rate is above the world interest rate by exactly the amount of the risk premium. Hence the expected depreciation of the exchange rate is zero. The aim of the sterilization is to drain liquidity in a way that does not make home bonds more attractive. Manipulating the risk premium is in principle a way of doing this. This is a highly stylized description in order to highlight the logic. To the extent that sterilized intervention of this kind is possible, the central bank is able to use the interest rate and exchange rate as independent instruments.

Under flexible exchange rates, as we have seen in this chapter, there is no official intervention. Hence the issue of 'sterilized intervention' does not arise. However let us open up the possibility that the central bank chooses to intervene in the foreign exchange market in an ostensibly flexible exchange rate regime. There is substantial empirical evidence that central banks in countries that declare that they have a freely floating exchange rate engage in considerable intervention activities.[23] By an ostensibly flexible exchange rate regime we mean that there is no announced exchange rate target or peg that the government is standing ready to defend (as in the fixed exchange rate case). We are therefore investigating how the government could try to influence the exchange rate through intervention. We take the case where the government is trying to dampen activity in the economy but it does not want an appreciation of the exchange rate (as would occur under a flexible rate regime if monetary policy was tightened). In other words, the aim is to raise the home interest rate but prevent an immediate appreciation of the currency (as dictated by UIP). Why might the government want to do this? One possible explanation is that the government is concerned not only about the *level* of output but also about the structure of the economy. It may then seek to dampen interest-sensitive expenditure rather than to have the fall in output concentrated on net exports.

The central bank would have to intervene in the foreign exchange market in exactly the manner described for the fixed exchange rate case — selling home bonds to mop up the liquidity from the excess supply of foreign currency. This will only work if portfolio composition matters to investors and the risk premium on home bonds rises.

These examples provide an illustration of the mechanics of an exchange rate regime somewhere between fixed and flexible. If policy can be used to manipulate the risk premium, then the interest rate can diverge from the world interest rate even when the exchange rate is at its expected value. Once again, it should be noted that in the case in which the government is seeking to run a looser monetary policy but prevent a depreciation, the use of the sterilization policy will be limited by the available foreign exchange reserves. However it is important to emphasize that the kinds of deviation from the uncovered interest parity condition that are observed empirically can only be accounted for by risk premia if these vary dramatically over time and in the way that has been assumed. In particular, attempts to explain such premia empirically via portfolio-balance effects have been unsuccessful. The notion that sterilization can be used systematically through changing the risk premia as described in this section should be treated with scepticism.

[23]G. Calvo and C. Reinhart (2002) 'Fear of floating' Quarterly Journal of Economics 117, 2, pp. 379-408.

7. Conclusion

In this chapter, many of the tools required for open economy analysis have been introduced.

- The concepts of the nominal and real exchange rate and the terms of trade have been explained.
- The IS/LM model has been extended to include exports and imports and international financial markets.
- The international financial arbitrage condition — uncovered interest parity (UIP) — provides a vital link from the interest rate to the exchange rate.
- The Mundell–Fleming model puts the $ISXM/LM$ model together with the UIP condition to enable us to conduct macro economic analysis of policy changes and changes in private spending emanating from home or abroad.

In the short run with prices and wages given, what happens in response to a policy change or a change in private spending behaviour depends on

- what happens to the home interest rate relative to the foreign interest rate.

In turn, the implications of that discrepancy depend on

- the exchange rate regime.
  - if exchange rates are fixed, then the domestic money supply will automatically change to offset any excess demand or supply for money;
  - if exchange rates are flexible, then the exchange rate will appreciate or depreciate in response to the interest rate differential and this will affect net exports and aggregate demand; and on
- how exchange rate expectations are formed.

We have set out the implications of relaxing the Mundell-Fleming assumptions of smallness, perfect capital mobility and perfect asset substitutability.

We are now ready to move on to analyze inflation and unemployment in the open economy. In Chapter 5, we complement the Mundell–Fleming model of the short run with explicit consideration of what happens in the medium run once we allow prices and wages to respond in the wake of output and exchange rate changes.

1. Appendix: The Marshall–Lerner condition: a proof

Assume that trade is initially balanced and that the prices of exports and imports do not change in response to the volume sold. Since $BT = \sigma(\theta)y^* - \theta m_y(\theta)y$, the change in the trade balance in response to a change in competitiveness is

$$\begin{aligned} \frac{dBT}{d\theta} &= \sigma'(\theta)y^* - \theta m_y'(\theta)y - m_y y \\ &= \sigma y^* \frac{\sigma'(\theta)}{\sigma} - \theta m_y'(\theta)y - m_y y. \end{aligned}$$

But by assumption, $BT = 0$, i.e. $\sigma(\theta)y^* - \theta m_y(\theta)y$, and therefore

$$\frac{dBT}{d\theta} = \theta m_y y \frac{\sigma'(\theta)}{\sigma} - \theta m_y'(\theta)y - m_y y.$$

Dividing through by $m_y y$,

$$\frac{1}{m_y y} \cdot \frac{dBT}{d\theta} = \frac{\theta\sigma'(\theta)}{\sigma} - \frac{\theta m_y'(\theta)}{m_y} - 1.$$

Since $m_y y > 0$, $\frac{dBT}{d\theta} > 0$ if and only if

$$\frac{\theta\sigma'(\theta)}{\sigma} - \frac{\theta m_y'(\theta)}{m_y} > 1.$$

Now, $\frac{\theta\sigma'(\theta)}{\sigma}$ is *minus* the elasticity of demand for exports, since θ is the inverse of the real price of exports. Similarly, $\frac{\theta m_y'(\theta)}{m_y}$ is the elasticity of demand for imports. The Marshall–Lerner condition for an improvement in the balance of trade to follow from a rise in competitiveness is that the sum of the absolute values of the demand elasticities is greater than one; i.e.,

$$\left|\frac{\theta\sigma'(\theta)}{\sigma}\right| + \left|\frac{\theta m_y'(\theta)}{m_y}\right| > 1.$$