Chapter 24
The Open Economy with Fixed Exchange Rates

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During the last half-century there has been a tremendous increase in cross-border economic transactions. In the first decades after the Second World War, this process of international economic integration mainly took the form of an increase in the volume of international trade. Thus, while the western countries liberalized their international trade regimes by reducing tariffs and eliminating quantitative restrictions on imports, they maintained substantial restrictions on the private export and import of capital. One motivation for this policy was that capital controls made it easier for governments to defend the fixed exchange rate parities under the so-called Bretton Woods system of fixed exchange rates established after World War II. Another motivation was that capital controls were necessary to implement the regulations of borrowing and lending which were seen by most governments as an essential part of their monetary policies.

However, during the 1970s the Bretton Woods system of fixed exchange rates broke down, and quantitative restrictions on international capital flows and on domestic credit came to be seen as increasingly ineffective and harmful to economic efficiency. In the 1980s and 1990s a large number of countries therefore abolished their capital controls. At the same time the rapid improvements in communication and information technologies significantly reduced the transactions costs associated with international investment. As a result, the last two decades of the twentieth century witnessed a truly dramatic increase in international capital mobility, as you can see from Figures 24.1 and 24.2.

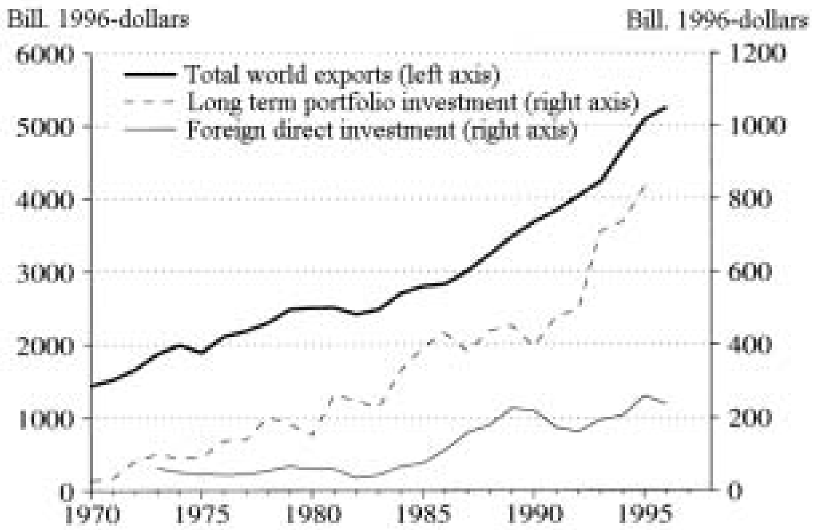

Figure 24.1: International trade and capital flows

Note: Long term portfolio investment includes international bond issues and syndicated long term international bank credits. The graph for foreign direct investment indicates the average of inbound and outbound investment in the OECD area.

Source: Danish Economic Council, The Danish Economy, Spring 1998, p. 105.

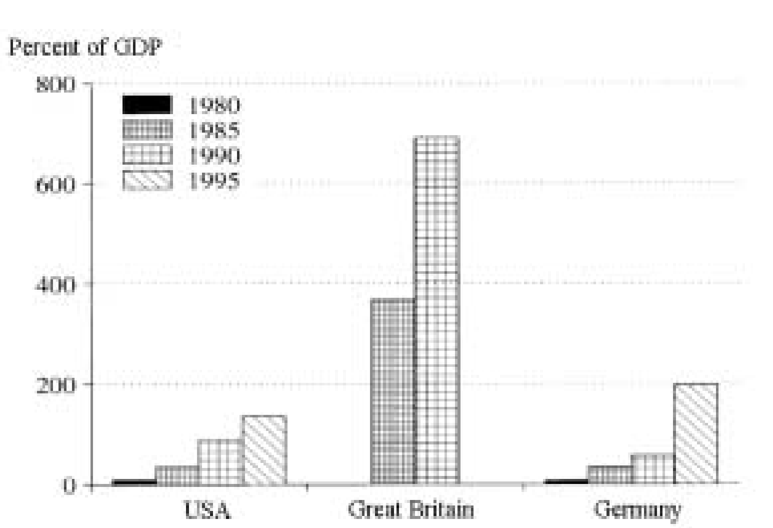

Figure 24.2: International trade in stocks and bonds

Note: Figures for the United Kingdom for 1980 and 1995 are not available.

Source: Danish Economic Council, The Danish Economy, Spring 1998, p. 107.

In this chapter we investigate the macroeconomic implications of international trade in goods and capital. We shall see that our AS-AD framework can be used to study the workings of the open economy, although the channels through which shocks are transmitted to output and inflation are somewhat different than in the closed economy.

Our analysis will be based on two key assumptions. The first one is that the domestic economy is so **small** that it cannot significantly affect macroeconomic conditions in the rest of the world. For example, if a purely domestic recession strikes our small open economy, this will not affect its export market since foreign economic activity will remain the same. The reason is that if the domestic economy is small, its imports are only a very small fraction of total foreign output, so even if imports fall due to the domestic recession, this fall in demand will hardly be felt by the rest of the world.

Our second key assumption is that the small domestic economy is **specialized** in the sense that the goods produced domestically are **imperfect substitutes** for the goods produced abroad. This means that the price of domestic goods can vary relative to the price of foreign goods. Indeed, the endogenous adjustment of the relative price of domestic goods is the basic mechanism through which the small specialized economy adjusts to a long run macroeconomic equilibrium.

For most countries except the very large ones like the United States, the assumption that the domestic economy is small relative to the world economy is a reasonable first approximation. Further, the manufactured goods which make up the bulk of exports in most industrialized countries are typically somewhat differentiated from the manufactured goods produced in other countries. Hence our assumption that countries specialize in the production of different goods also seems plausible.

In most of this chapter we will focus on a small specialized economy operating under a **fixed exchange rate regime**. We will start out by briefly characterizing the alternative exchange rate regimes found in the world. We will then consider the implications of international capital mobility for the formation of interest rates in the open economy. Following this, we explain how our AS-AD model can be modified to allow for international trade and capital mobility. The final part of the chapter uses the modified AS-AD model to study the effects of macroeconomic policy under fixed exchange rates.

1 Exchange rate regimes, capital mobility and monetary policy

Alternative exchange rate regimes

In Figure 24.3 we have grouped the various exchange rate regimes found in the world into three categories denoted 'hard peg', 'intermediate' regimes, and 'float'[1]. The exchange rate arrangements described as hard pegs include situations where countries have no national currency, either because they are in a currency union like the European Monetary Union, or because they have 'dollarized' by formally adopting the currency of some other country, typically the U.S. dollar. A hard peg can also take the form of a **currency board** where the central bank is obliged by law to exchange domestic currency for a specified foreign currency at a completely fixed exchange rate, and where domestic currency can only be issued against foreign currency so that the domestic monetary base is fully backed by foreign exchange reserves.

[1]Figure 22.3 is updated from Stanley Fischer: Exchange Rate Regimes - Is the Bipolar View Correct? Journal of Economic Perspectives, volume 15, Spring 2001, p. 4.

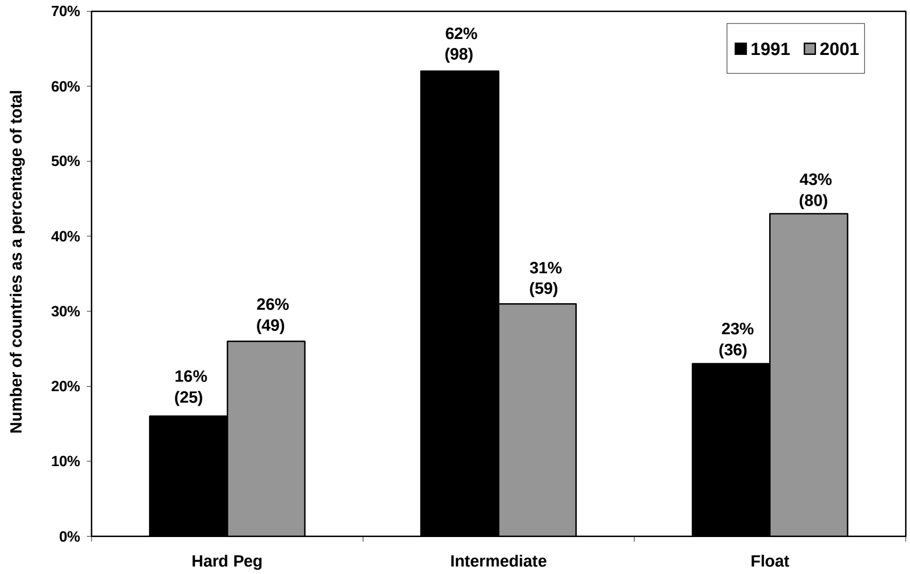

Figure 24.3: Exchange rate regimes in IMF member countries, 1991 and 2001

Note: Percent of all countries; number of countrie in brackets.

Source: IMF Annual Report 2001

The 'floating' group contains economies whose systems are described by the International Monetary Fund as either 'independently floating' or as a 'managed float'. Under independent floating the exchange rate is market determined. To the extent that the central bank intervenes in the foreign exchange market by buying or selling domestic currency against foreign currency, such interventions only aim to moderate undue fluctuations in the exchange rate, but the interventions do not seek to establish a particular level for the exchange rate. Under a managed float the central bank influences the movements of the exchange rate through active intervention in the foreign exchange market without specifying, or precommitting to, a predetertimed path for the exchange rate.

The 'intermediate' group consists of economies with a variety of exchange rate arrangements falling between the hard pegs and the floating group. For example, some countries have set a central parity for the exchange rate against a particular foreign currency or against a basket (a weighted average) of currencies, but the actual exchange rate is then allowed to fluctuate within a fixed band around the parity. Other countries operate a 'crawling band' where the band for the exchange rate is allowed to move over time, or a 'crawling peg' where the exchange rate is temporarily fixed, but where it is allowed to shift gradually over time. Table 24.1 summarizes the exchange rate regimes prevailing in the world's developed market economies at the beginning of the 21st century.

Euro Area		*Other*	
	Exchange Arrangement		*Exchange Arrangement*
Austria	No separate legal tender	Australia	Independent float
Belgium	No separate legal tender	Canada	Independent float
Finland	No separate legal tender	Denmark	Pegged rate in horizontal band
France	No separate legal tender	Hong Kong SAR	Currency board
Germany	No separate legal tender	Japan	Independent float
Ireland	No separate legal tender	New Zealand	Independent float
Italy	No separate legal tender	Norway	Managed float
Netherlands	No separate legal tender	Singapore	Managed float
Portugal	No separate legal tender	Sweden	Independent float
Spain	No separate legal tender	Switzerland	Independent float
		United Kingdom	Independent float
		United States	Independent float

Table 24.1: Exchange rate regimes in developed market economies 2001

Source: IMF Annual Report 2001

Going back to Figure 24.3, we observe a remarkable polarization of the choice of exchange rate regimes over the last decade. In 1991 almost two thirds of all countries had some form of intermediate exchange rate arrangement. A decade later a lot of countries had moved either towards a hard peg or towards floating. This is not coincidental, since almost all of the serious foreign exchange crises occurring in the 1990s involved some form of intermediate exchange rate regime. This was true of the crisis in the European Monetary System in 1992-93 and of the crises in Mexico 1994, Thailand, Indonesia and South Korea in 1997, Russia and Brazil in 1998, and Turkey in 2000[2]. The background for these crises

[2]Argentina was also hit by a serious crisis in 2001 even though the country had a currency board. However, the Argentinian currency board had a 'soft' element since it allowed foreign exchange reserves to fall below the level of the domestic monetary base in exceptional circumstances.

was the huge increase in international capital mobility during the 1990s which greatly increased the scope for speculative attacks against 'soft' fixed exchange rate regimes. The weakness of a fixed exchange rate regime where the exchange rate can be adjusted is that speculation is virtually risk-free: if an investor moves out of a currency which is expected to be devalued, he will obviously gain from this move if devaluation actually occurs, and if the exchange rate is maintained he will lose nothing except a small transaction cost. Impressed by the numerous foreign exchange crises during the 1990s, many countries with a preference for stable exchange rates moved towards a hard peg, whereas countries with a preference for monetary policy autonomy moved towards floating. Indeed, it is now widely believed that intermediate exchange rate regimes tend to be unsustainable in the long run in the modern world of high capital mobility.

Capital mobility and interest rate parity

Reflecting the deep international integration of capital markets prevailing today, our analysis will assume that international capital mobility is perfect. Under perfect capital mobility domestic and foreign financial assets are perfect substitutes, and financial investors can instantaneously and costlessly switch between domestic and foreign assets.

For simplicity we will also assume that investors are risk-neutral, arranging their portfolios so as to maximize the expected rates of return without worrying about the variance of the rates of return.

From these assumptions it follows that foreign and domestic assets must yield the same expected rate of return. For example, if domestic bonds had a lower expected return than foreign bonds, investors would immediately sell domestic bonds in order to buy foreign bonds, thus driving down domestic bond prices and pushing up foreign bond prices until the expected rates of return are equalized. Given that this arbitrage can occur instantaneously and costlessly, the expected returns must be equal at any point in time.

Let us be more precise. Following common practice, we define the nominal exchange rate E as the number of domestic currency units needed to buy one unit of the foreign currency. If i is the domestic nominal interest rate and i^f is the foreign nominal interest rate, perfect capital mobility coupled with risk-neutral investors implies the arbitrage condition

$$1+i=\left(1+i^f\right)\left(\frac{E_{+1}^e}{E}\right) \tag{1}$$

where E is the nominal exchange rate at the start of the current period, and E_{+1}^e is the nominal exchange rate expected to prevail at the beginning of the next period. The left-hand side of (1) measures the amount of wealth accruing to an investor at the end of the current period if he invests one unit of the domestic currency in the domestic capital market at the beginning of the period. As an alternative to such a domestic investment, the investor could have bought $1/E$ units of the foreign currency at the start of the period for the purpose of investment in the foreign capital market. At the end of the period he would then have ended up with an amount of wealth $(1/E)\left(1+i^f\right)$ in foreign currency. At the start of the period when the investment is made, the investor expects that this end-of-period wealth will be worth $\left(E_{+1}^e/E\right)\left(1+i^f\right)$ units of the domestic currency. Thus equation (1) says that domestic and foreign investment must generate the same expected end-of-period wealth and hence must yield the same expected rate of return. If we take natural logarithms on both sides of (1) and use the approximation $\ln(1+x)\approx x$, we get

$$i=i^f+e_{+1}^e-e, \qquad e\equiv\ln E, \qquad e_{+1}^e\equiv\ln E_{+1}^e \tag{2}$$

The magnitude e_{+1}^e-e is the expected percentage rate of depreciation of the domestic currency against the foreign currency. This is the expected capital gain on foreign bonds relative to domestic bonds over the period considered. Thus equation (2) says that if the domestic currency is expected to devalue by x percent, the domestic nominal interest rate must exceed the foreign nominal interest rate by x percentage points to make domestic and foreign assets equally attractive.

Equation (2) (and its approximate equivalent (1)) is known as the condition for **uncovered interest rate parity**. The term 'uncovered' refers to the fact that the investor has not covered his risk: when he invests in the foreign capital market, he expects a capital gain $e^e_{+1} - e$, but this gain is uncertain, so he is exposed to risk. If he wants to cover his risk at the time of investment, he can use the **forward market** for foreign exchange. In this market he can sell an amount of foreign currency $(1/E)\left(1+i^f\right)$ for delivery one period from now at the forward exchange rate $\widetilde{E}_{+1}$ currently prevailing in the market. The one-period forward exchange rate $\widetilde{E}_{+1}$ is the domestic-currency price of one unit of foreign currency delivered one period from now. Since $\widetilde{E}_{+1}$ is known at the start of the current period when the foreign investment is made, the investor knows for sure that he will end up with $\left(\widetilde{E}_{+1}/E\right)\left(1+i^f\right)$ units of the domestic currency at the end of the period if he covers his foreign investment via the forward market. For domestic and foreign investment to be equally attractive, we thus have the arbitrage condition

$$1 + i = \left(1 + i^f\right)\left(\frac{\widetilde{E}_{+1}}{E}\right) \tag{3}$$

Taking logs on both sides of (3), we get the approximate relationship

$$i = i^f + \widetilde{e}_{+1} - e, \qquad\qquad \widetilde{e}_{+1} \equiv \ln \widetilde{E}_{+1} \tag{4}$$

Equations (3) and (4) are known as the condition for **covered interest rate parity**. Is it possible for covered and uncovered interest rate parity to hold at one and the same time? According to (2) and (4) the answer is 'yes', provided

$$\widetilde{e}_{+1} - e = e^e_{+1} - e \qquad \Leftrightarrow \qquad \widetilde{e}_{+1} = e^e_{+1} \tag{5}$$

The term on the left-hand side of the first equation in (5) is the **forward foreign-exchange premium**, defined as the percentage difference between the price of forward exchange (the price of foreign exchange for delivery one period from now) and the current **spot** exchange rate E (the price of foreign exchange for immediate delivery). Equation (5) says that if the spot exchange rate is expected to increase by $e^e_{+1} - e$ percentage points over the next period, then the forward foreign-exchange premium should also equal $e^e_{+1} - e$ percentage points. When investors are risk neutral, this condition must hold. To see this, suppose that $\widetilde{e}_{+1} < e^e_{+1}$. In that case it would be possible to score an expected profit by buying foreign exchange in the forward market today and then selling the foreign currency in the spot market when it is delivered one period from now. Similarly, if $\widetilde{e}_{+1} > e^e_{+1}$ investors will want to sell foreign exchange in the forward market today and buy foreign exchange in the spot market one period ahead when the foreign currency is to be delivered, thus scoring an expected profit of $\widetilde{e}_{+1} - e^e_{+1}$ at the time of delivery. To rule out such arbitrage opportunities for pure profit making, equation (5) will have to be satisfied, so covered and uncovered interest rate parity will hold simultaneously when investors are risk neutral.

Equations (2) and (4) suggest that when exchange rates can vary a lot, the interest rates of different countries can also deviate substantially from each other. However, when countries move towards a 'hard peg', the expected exchange rate changes should tend towards zero, forcing national interest rates into equality. Figure 24.4 confirms this hypothesis. Around the mid-1990s the exchange rates within the European Monetary System could in principle vary within an exchange rate band of +/-15 percent around the central parity, and countries like Italy and Spain with a history of devaluations against the German mark had relatively high nominal interest rates, reflecting the perceived probability of devaluation of the Italian and Spanish currencies. At the same time countries like Germany, Netherlands and France whose currencies were perceived to be strong had nominal interest rates below the average EU level. However, when financial markets became convinced that political leaders in Europe were determined to establish a monetary union with completely fixed exchange rates (and ultimately a common currency), the nominal interest rates of the different EU countries quickly converged, as fears of substantial exchange rate movements vanished.

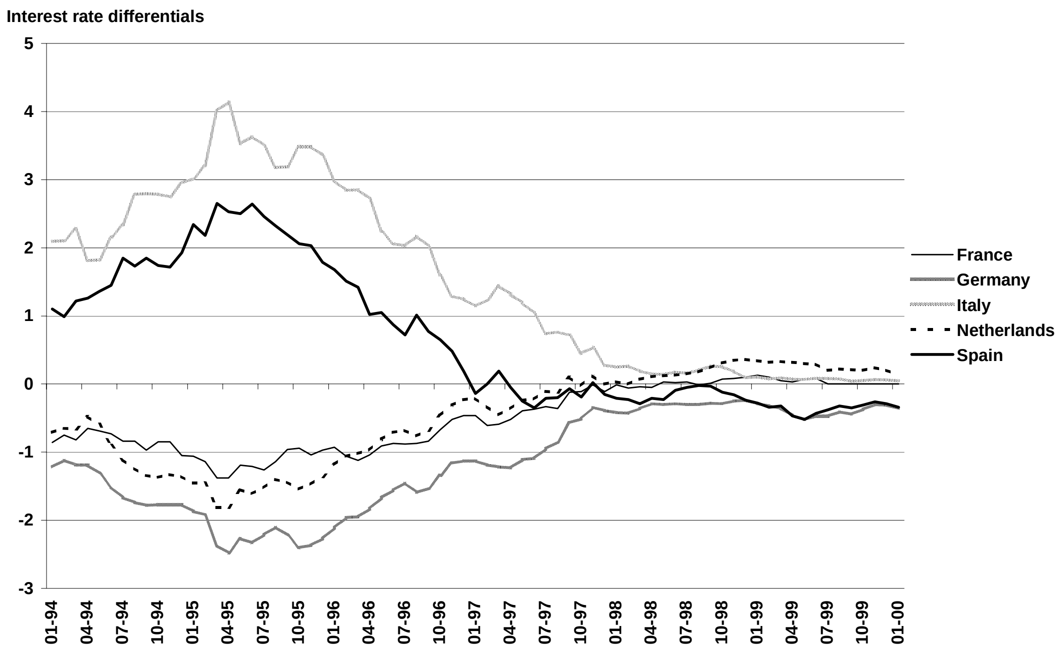

Figure 24.4: Nominal interest rate differentials in Europe, 1994 to 2001

Note: 10-year government bond yield

Source: IMF International Financial Statistics

Figure 24.5 tells a similar story about Denmark. From the early 1970s to the early 1980s, the Danish krone was devalued against the German mark on numerous occasions, and expectations of future devaluation kept the Danish nominal interest rate far above the German interest rate. But as the policy of systematic Danish devaluations was abandoned after 1982 and the krone became a much more stable currency, the Danish interest rate gradually converged towards the German level.

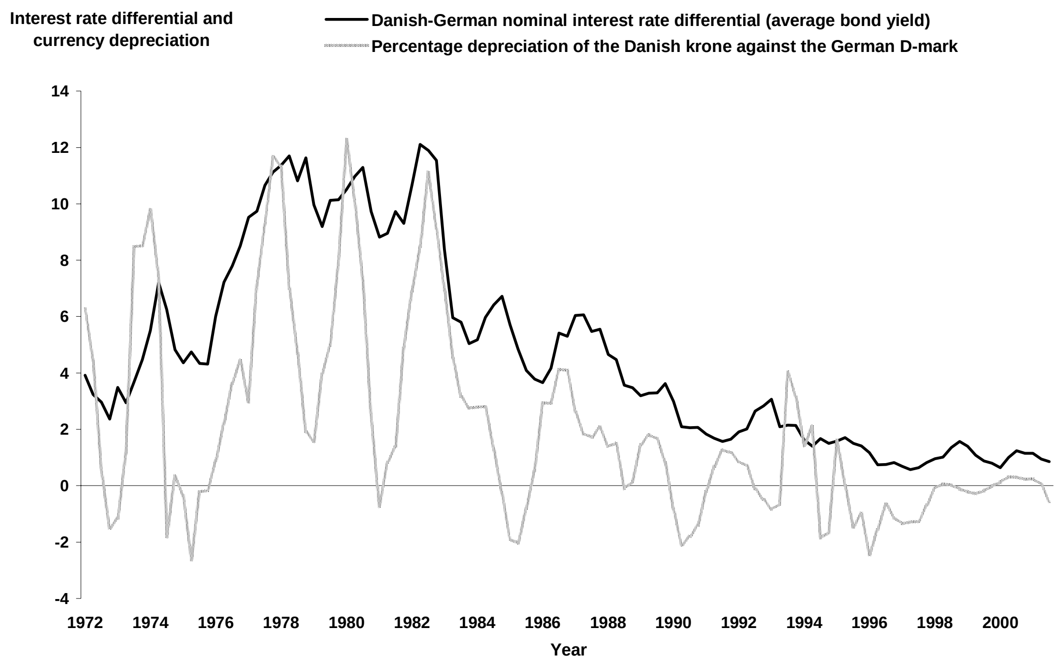

Figure 24.5: Interest rates and currency devaluation in Denmark, 1972 to 2000

Source: MONA database, Danmarks Nationalbank

The impotence of monetary policy under fixed exchange rates

Under a 'hard peg' where the exchange rate is credibly fixed, the expected exchange rate change will be zero, that is, $e^e_{+1} - e = 0$. It then follows from (2) that

$$i = i^f \tag{6}$$

In other words, under fixed exchange rates and perfect capital mobility the domestic nominal interest rate is tied to the foreign nominal interest rate.

As far as the market-determined interest rates are concerned, the equality in (6) is enforced by the arbitrage between domestic and foreign assets described in the previous section.

When it comes to the short-term domestic interest rate set by the central bank, equation (6) is enforced by the need to protect the country's foreign exchange reserves. If the central bank tries to keep the domestic short-term interest rate below the foreign short-term interest rate, capital will flow out of the domestic economy. As investors sell domestic currency and buy foreign currency to invest in foreign assets, the central bank will have to sell foreign currency and buy domestic currency to maintain the fixed exchange rate. In this way the country's foreign exchange reserves may quickly be exhausted, if the central bank insists on keeping the domestic short-term interest rate below the foreign level. Indeed, the market will most likely interpret such an interest rate policy as a signal that the central bank is not committed to defending the exchange rate. In that case expectations of a future devaluation will arise, and a speculative attack on the domestic currency will occur, leading to an even faster depletion of foreign exchange reserves. Once the reserves are gone, the central bank can no longer intervene in the foreign exchange market to keep the exchange rate fixed, and the domestic currency will have to fall.

On the other hand, if for some reason the central bank keeps the domestic short-term interest rate above the foreign short-term interest rate, a massive inflow of capital from abroad will occur. This will swell the foreign exchange reserves and create a constant upward pressure on the exchange rate. The huge capital inflow will also lead to a large expansion of domestic bank credit and a sharp rise in domestic asset prices which will generate strong inflationary pressures.

The upshot is that if the central bank wishes to maintain a fixed exchange rate, it cannot set a short-term interest rate which deviates from the short-term interest rate abroad. The situation in Denmark illustrates this point very well. The Danish krone is pegged to the euro, and whenever the European Central Bank decides to change its leading interest rate, the Danish central bank interest rate is almost always changed by exactly the same amount within one or two hours.

Monetary policy thus becomes **impotent** under fixed exchange rates and perfect capital mobility. When the exchange rate is fixed, the central bank cannot pursue an independent interest rate policy aimed at managing aggregate demand. Instead, monetary policy is fully bound by the commitment to defend the exchange rate. By contrast, if a country is willing to accept exchange rate variability, it can set its interest rate independently of the foreign interest rate, as indicated in equations (2) and (4).

The case for fixed exchange rates

If the price of maintaining fixed exchange rates is the loss of monetary policy autonomy, why would a country nevertheless choose a fixed exchange rate regime? Advocates of fixed exchange rates usually point to the disadvantages of exchange rate uncertainty and to the benefits of using a fixed exchange rate as a nominal anchor in the fight against inflation. Let us briefly summarize these arguments.

The first argument is that the large exchange rate movements often observed under floating exchange rates may hamper international trade and investment by creating exchange rate uncertainty. The impediment to trade may not be large, since short term and medium term foreign exchange risk can be covered via the forward exchange market at a modest transaction cost. But the opportunities for covering long term foreign exchange risks are much more limited, and this might discourage long term investments if the exchange rate is highly unstable.

The second argument starts from the observation that exchange rates often seem to 'overshoot' their long run equilibrium values under floating. The concern is that such excessive exchange rate movements may cause an unintended redistribution of real income across different sectors in the economy. For example, a sharp appreciation of the domestic currency will erode the international competitiveness of the domestic export industry and of domestic industries which are competing against imports. As a consequence, profits and employment in those sectors will be squeezed, whereas sectors relying on imported inputs and selling their output in the domestic market without any competition from abroad will benefit from the appreciation. If the resulting redistribution of incomes is significant, it may cause social tensions.

A third argument is that a fixed exchange rate can provide a nominal anchor which may help to bring down inflation. In the longer term a country can only maintain a fixed exchange rate against a foreign trading partner if the domestic inflation rate does not systematically exceed inflation in the foreign country. Policy makers may therefore signal a commitment to keep the domestic inflation rate low by announcing that they will peg the domestic currency to the currency of a foreign country with a history of low inflation. If this commitment is credible, it will keep domestic inflation expectations in check, and this in turn will make it easier to keep the actual inflation rate low. Thus, by pegging to a stable foreign currency, domestic policy makers may 'import' some of the credibility and discipline of foreign policy makers who have been successful in fighting inflation. Such a strategy is most likely to succeed if the political costs of giving up the peg to the foreign currency are perceived to be considerable. Otherwise the public may not consider the fixed exchange regime to be credible.

The belief that pegging to a stable foreign currency can help to bring down domestic inflation motivated many previous high-inflation countries in Europe to tie their currencies closer to the German D-mark after the mid-1980s. After a set-back caused by the speculative attacks on the European Monetary System in 1992-93, this policy of pegging to the D-mark gradually led to lower exchange rate variability which did in fact drive national inflation rates in the EU closer to the low German level, as shown in Figures 24.6.a and 24.6.b.

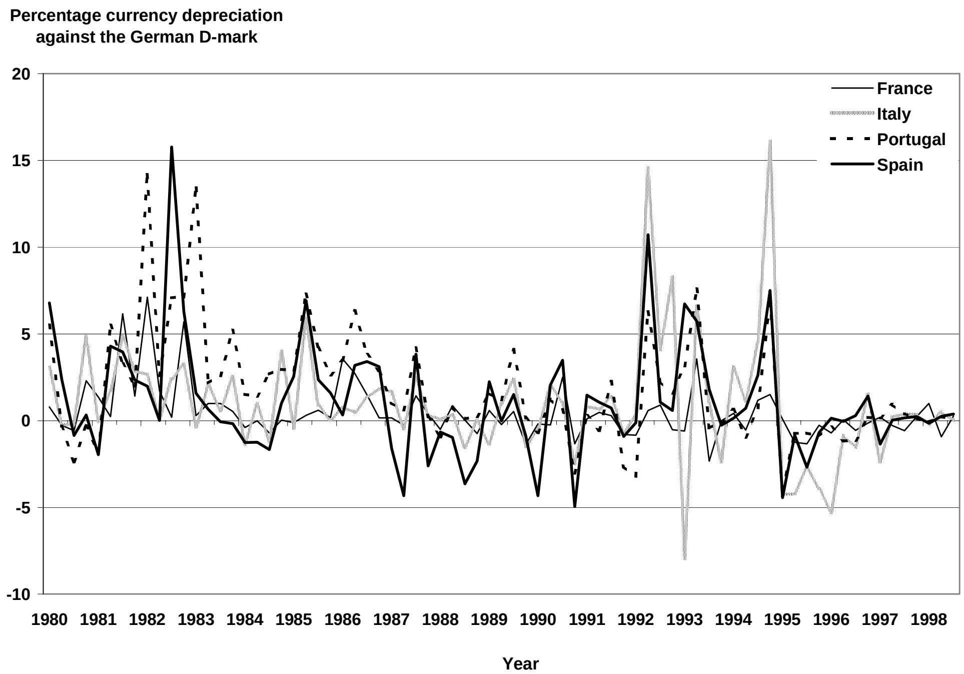

Figure 24.6a: Exchange rate variability in Europe, 1980 to 2000

Note: Percentage rate of currency depreciation against the German D-mark

Source: IMF Financial Statistics

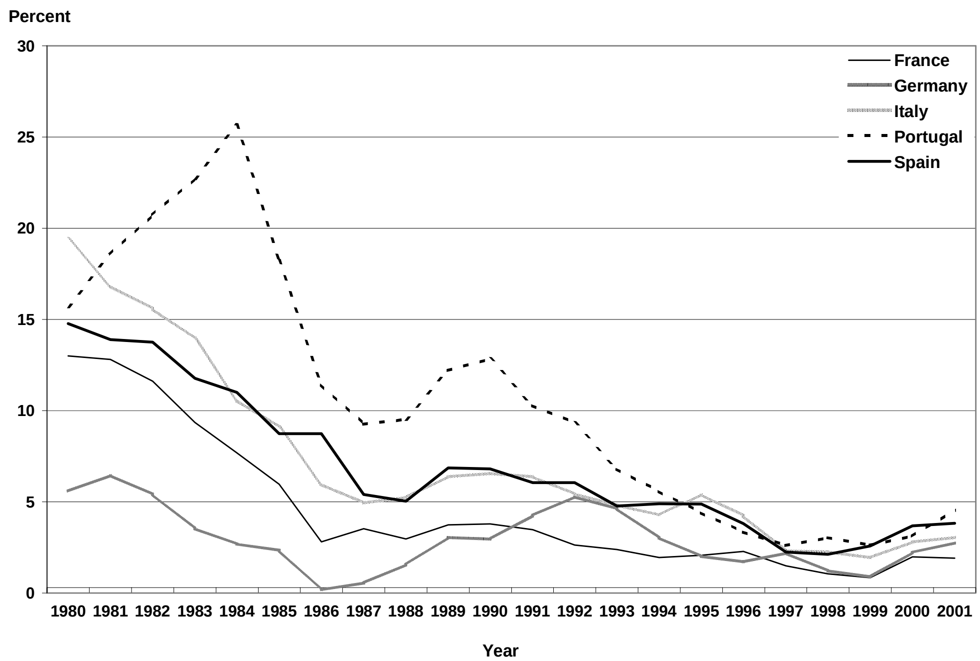

Figure 24.6b: Inflation rates in Europe, 1980 to 2000

Source: OECD Main Economic Indicators

Economists have a long-standing debate on the costs and benefits of fixed versus flexible exchange rates. In this section we have briefly restated the main arguments in favour of fixed exchange rates. In the next chapter we shall consider the case for flexible exchange rates. At this stage we can already see one basic trade-off in the choice of exchange rate regime: by fixing the exchange rate, a country may eliminate nominal exchange rate uncertainty and provide a nominal anchor for domestic prices, but these benefits can only be reaped by giving up monetary policy autonomy. In contrast, flexible exchange rates offer monetary policy autonomy, but only if policy makers are willing to accept the possibility of large fluctuations in exchange rates. Given this difficult trade-off, it is hardly surprising that different countries with different economic histories and different economic structures have chosen different exchange rate regimes.

In the rest of this chapter we will focus on the workings of an economy with fixed exchange rates, postponing further discussion of flexible exchange rates until the next chapter.

2 The AS-AD model for the open economy with fixed exchange rates

To prepare the ground for an analysis of macroeconomic policy in the open economy, the following sections will explain how our AS-AD framework can be extended to allow for economic transactions with the rest of the world. We start by deriving the aggregate demand curve for the open economy, and then we discuss how the openness of the economy affects the aggregate supply curve.

The trade balance and the real exchange rate

In the open economy, the condition for equilibrium in the goods market is

$$Y = D + G + NX \tag{7}$$

where we recall that Y is real GDP, D is total private demand for goods and services, G is public demand for goods and services, and NX is the trade balance, defined as exports minus imports (net exports). Thus net exports add to the total demand for domestically produced goods. One important determinant of net exports is the real exchange rate E^r, defined as

$$E^r \equiv \frac{EP^f}{P} \tag{8}$$

where P^f is the price of foreign goods denominated in foreign currency, and EP^f is the price of foreign goods measured in domestic currency. We see that the real exchange rate is simply the relative price of foreign goods, indicating the number of units of the domestic good which must be given up to acquire one unit of the foreign good. The inverse of the real exchange rate ($1/E^r$) is referred to as the international **terms of trade**, since an increase in the real exchange rate implies a deterioration in the terms on which domestic goods can be traded for foreign goods. Notice also that the real exchange rate is a measure of the **international competitiveness** of domestic producers: the higher the real exchange rate, the cheaper are domestic goods relative to goods produced abroad.

All of the components of demand on the right-hand side of (7) - including the trade balance - are measured in units of the domestic good. In other words, we are using the domestic good as our **numeraire** good. If the **quantity** of imported foreign goods is M, the nominal value of imports measured in domestic currency units will be $EP^f M$. Given that one unit of the domestic good sells at the price P, the volume of imports measured in units of the domestic good will then be $EP^f M/P \equiv E^r M$. If the quantity of domestic goods which is exported abroad is denoted by X, we thus have

$$NX \equiv X - E^r M \tag{9}$$

It is reasonable to assume that the volume of exports X depends positively on the international competitiveness of domestic producers, measured by the real exchange rate E^r, and positively on total output Y^f in the rest of the world, since higher economic activity abroad leads to a larger export market for domestic producers. Hence we may write $X = X\left(E^r, Y^f\right)$.

In Chapter 19 we saw that total private goods demand in the closed economy depends on domestic output Y, the total tax bill T, the real interest rate r, and the state of confidence (the expected future growth rate) ε. In the open economy all of these variables are also likely to affect imports, since part of the goods demanded by the private sector are imported from abroad. In addition, the quantity of imported foreign goods will depend negatively on the real exchange rate, since a higher relative price of foreign goods will reduce domestic consumer demand for foreign goods, partly because a rise in the price of imported goods reduces the purchasing power of domestic nominal incomes (the income effect), and partly because a higher price of foreign goods induces consumers to substitute towards domestic goods (the substitution effect). We may therefore specify the import function as $M = M(E^r, Y, T, r, \varepsilon)$.

With these specifications of exports and imports, it follows from (9) that net exports are given by

$$NX = X\left(\overset{+}{E^r}, \overset{+}{Y^f}\right) - E^r M\left(\overset{-}{E^r}, \overset{+}{Y}, \overset{-}{T}, \overset{-}{r}, \overset{+}{\varepsilon}\right) \tag{10}$$

where the signs above the variables indicate the signs of the partial derivatives. We see that a rise in Y or ε will raise the level of imports, because an increase in these variables will stimulate total private demand for goods and services. On the other hand a rise in T or r will reduce imports by dampening total goods demand.

A crucial question is how a change in the real exchange rate will affect the trade balance. To investigate this, we calculate the partial derivative of the nex export function (10) with respect to E^r:

$$\frac{\partial NX}{\partial E^r} = \frac{\partial X}{\partial E^r} - E^r \cdot \frac{\partial M}{\partial E^r} - M \tag{11}$$

Without loss of generality, we may choose our units of measurement such that the initial value of the real exchange rate is unity, $E_o^r = 1$. Furthermore, as a benchmark case we will assume that the trade balance is initially in equilibrium so that $X_o = E_o^r M_o$. Using these relationships, we may rewrite equation (11) as

$$\frac{\partial NX}{\partial E^r} = M_o\left(\frac{\partial X}{\partial E^r}\frac{E_o^r}{X_o} - \frac{\partial M}{\partial E^r}\frac{E_o^r}{M_o} - 1\right) \qquad \Longleftrightarrow$$

$$\frac{\partial NX}{\partial E^r} = M_o \left(\eta_X + \eta_M - 1 \right), \qquad \eta_X \equiv \frac{\partial X}{\partial E^r} \frac{E^r}{X} > 0, \qquad \eta_M \equiv -\frac{\partial M}{\partial E^r} \frac{E^r}{M} > 0 \tag{12}$$

where η_X is the elasticity of exports with respect to the real exchange rate, and η_M is the numerical elasticity of imports with respect to the real exchange rate. Equation (12) shows that a real depreciation of the domestic currency - that is, a rise in the real exchange rate E^r - will improve the trade balance provided the sum of the relative price elasticities of export and import demand is greater than one ($\eta_X + \eta_M > 1$). This important result is called the Marshall-Lerner condition, named after its discoverers. Numerous empirical studies for a large number of countries suggest that the Marshall-Lerner condition is almost always satisfied, at least when the time horizon is one year or longer. In the following, we will assume that this condition is in fact met.

The aggregate demand curve in the open economy

We are now ready to derive the aggregate demand curve for the open economy. Recalling the factors influencing the trade balance and private goods demand, and assuming that total tax payments correspond to total public spending ($T = G$), we may restate the goods market equilibrium condition (7) as

$$\begin{aligned} Y &= D\left(Y, G, r, \varepsilon, E^r\right) + NX\left(E^r, Y^f, Y, G, r, \varepsilon\right) + G \\ &= \widetilde{D}\left(Y, G, r, \varepsilon, E^r, Y^f\right) + G, \qquad\qquad \widetilde{D} \equiv D + NX \end{aligned} \tag{13}$$

The magnitude $\widetilde{D} \equiv D + NX$ measures the total private demand for domestic goods emanating from the domestic as well as the foreign private sector. Notice from (13) that the real exchange rate E^r influences D due to the income effect mentioned earlier: when the price of imports increases relative to domestic prices, the purchasing power of domestic money incomes is eroded, and this will ceteris paribus reduce total private demand for goods because domestic residents become poorer.

While an increase in domestic economic activity Y will stimulate total private goods demand D, it will also increase imports and hence reduce the trade balance NX. Thus it would seem that the sign of the partial derivative $\widetilde{D}_Y \equiv \partial\widetilde{D}/\partial Y$ is ambiguous. However, since only a fraction of total goods demand will be directed towards imports, the rise in imports will be less than the rise in total goods demand. Hence we have $\widetilde{D}_Y \equiv \partial D/\partial Y + \partial NX/\partial Y = \partial D/\partial Y - E^r(\partial M/\partial Y) > 0$. Maintaining our assumption from Chapter 19 that $\partial D/\partial Y < 1$, it then follows that

$$0 < \widetilde{D}_Y \equiv \frac{\partial D}{\partial Y} + \frac{\partial NX}{\partial Y} < 1 \tag{14}$$

The fact that only a fraction of total demand is directed towards imports also implies that

$$\widetilde{D}_r \equiv \frac{\partial D}{\partial r} + \frac{\partial NX}{\partial r} < 0 \tag{15}$$

$$\widetilde{D}_\varepsilon \equiv \frac{\partial D}{\partial \varepsilon} + \frac{\partial NX}{\partial \varepsilon} > 0 \tag{16}$$

Given our assumption of a balanced government budget, a rise in government spending G will lead to a similar rise in taxation. Consumers react to this fall in disposable income by reducing consumption, but the fall in consumption is not as great as the rise in taxation, since private saving will also fall when the tax bill goes up. Hence we have $-1 < \partial D/\partial G$. Furthermore, only a part of the fall in consumption will manifest itself as a fall in imports; the remaining part will show up as a fall in the demand for domestic goods. From this it follows that

$$-1 < \widetilde{D}_G \equiv \frac{\partial D}{\partial G} + \frac{\partial NX}{\partial G} < 0 \tag{17}$$

Finally, we assume that

$$\widetilde{D}_E \equiv \frac{\partial D}{\partial E^r} + \frac{\partial NX}{\partial E^r} > 0 \tag{18}$$

Recall that $\partial NX/\partial E^r > 0$ when the Marshall-Lerner condition is met. However, because of the negative income effect of a higher real exchange rate, we have $\partial D/\partial E^r < 0$. The assumption in (18) that $\widetilde{D}_E > 0$ thus requires that the Marshall-Lerner condition is satisfied with a certain margin so that $\eta_X + \eta_M$ is sufficiently greater than one. Empirically this has turned out to be a reasonable assumption (except for the very short run where the price elasticities in export and import demand are small, due to inertia in consumer reactions to relative price changes).

It will be convenient to measure the real exchange rate in natural logarithms. We therefore define

$$e^r \equiv \ln E^r = e + p^f - p, \qquad p^f \equiv \ln P^f, \qquad p \equiv \ln P \tag{19}$$

Using the above definitions and assumptions on partial derivatives, the appendix to this chapter derives the following log-linear approximation to the goods market equilibrium condition (13):

$$y - \overline{y} = \beta_1(e^r - \overline{e}^r) - \beta_2(r - \overline{r}) + \beta_3(g - \overline{g}) + \beta_4\left(y^f - \overline{y}^f\right) + \beta_5(\ln\varepsilon - \ln\overline{\varepsilon}) \tag{20}$$

The notation $\overline{x}$ indicates the initial long-run equilibrium value of variable x. The variables y, y^f and g are measured in natural logarithms, and all the β-coefficients are positive. We will now show that (20) implies a negative relationship domestic output and the domestic inflation rate, just as we found in the closed economy.

Our first step is to note from (19) that

$$e^r_{-1} = e_{-1} + p^f_{-1} - p_{-1} \tag{21}$$

which may be subtracted from (19) to give

$$e^r = e^r_{-1} + \Delta e + \pi^f - \pi, \tag{22}$$

$$\Delta e \equiv e - e_{-1}, \qquad \pi^f \equiv p^f - p^f_{-1}, \qquad \pi \equiv p - p_{-1}$$

The variable π^f is the foreign inflation rate, π is the domestic inflation rate, and Δe is the percentage devaluation of the domestic currency (the percentage rise in the price of foreign currency).

Under a hard currency peg where the authorities abstain from devaluations, we have $\Delta e = 0$. Equation (22) then simplifies to

$$e^r = e^r_{-1} + \pi^f - \pi \tag{23}$$

which shows that the real exchange rate can only remain stable over time if the domestic inflation rate corresponds to the foreign inflation rate. Under a policy regime where exchange rates are credibly fixed, it therefore seems reasonable to assume that the foreign inflation rate will serve as an 'anchor' for domestic inflation expectations. For example, firms and households will realize that domestic inflation cannot systematically exceed foreign inflation for a long period of time, since this would undermine the international competitiveness of domestic producers and lead to an ever-increasing trade deficit. An ever-growing trade deficit would ultimately force the domestic authorities to bring down domestic inflation in order to protect the country's foreign exchange reserves. Similarly, if domestic inflation were systematically lower than foreign inflation, the persistent fall in the relative price of domestic goods would lead to ever-increasing demand for domestic output which would ultimately force an increase in domestic inflation.

If firms and households understand these basic relationships and believe that the authorities are firmly committed to maintaining fixed exchange rates, they will realize that on average the domestic inflation rate will have to equal the foreign inflation rate. We wil formalize this by assuming that the expected domestic inflation rate for the current and for the next period (π^e and π^e_{+1}) is simply equal to the foreign inflation rate π^f which we take to be constant:

$$\pi^e = \pi^e_{+1} = \pi^f \tag{24}$$

Moreover, credibly fixed exchange rates imply that the expected nominal exchange rate for next period equals the actual current exchange rate ($e^e_{+1} = e$), so with perfect capital mobility we have $i = i^f$, as we explained earlier. Since the domestic real interest rate is defined as $r \equiv i - \pi^e_{+1}$, it then follows from (24) that

$$r = r^f, \qquad r^f \equiv i^f - \pi^f \tag{25}$$

where r^f is the exogenous foreign real interest rate (since $i^f - \pi^f_{+1} = i^f - \pi^f$ when π^f is constant). In other words, under credibly fixed exchange rates and perfect capital mobility, the domestic **real** interest rate is tied to the foreign real interest rate, just as the domestic **nominal** interest rate is given by the foreign nominal rate.

We may choose our units of measurement such that the real exchange rate $\overline{E}^r = 1$ in the initial long-run equilibrium, implying $\overline{e}^r \equiv \ln \overline{E}^r = 0$. Assuming that the initial natural output rate $\overline{y}$ equals trend output $\overline{y}_o$, and inserting (23) and (25) into (20), we then obtain the following simple expression for the **aggregate demand curve for the open economy with fixed exchange rates**:

$$y - \overline{y}_o = \beta_1 \left(e^r_{-1} + \pi^f - \pi \right) + z \tag{26}$$

$$z \equiv -\beta_2 (r^f - \overline{r}^f) + \beta_3 \left(g - \overline{g} \right) + \beta_4 \left(y^f - \overline{y}^f \right) + \beta_5 \left(\ln \varepsilon - \ln \overline{\varepsilon} \right) \tag{27}$$

The variable z captures so-called real shocks to aggregate demand. In the open economy, these shocks include changes in foreign real output y^f and in the foreign real interest rate r^f, as well as changes in domestic real government spending g and in domestic private sector confidence ε. A change in any of these variables will cause a shift in the aggregate demand curve. In addition, equation (26) shows that the domestic economy may be exposed to a so-called nominal shock in the form of a change in the foreign inflation rate π^f. Such a shock will also shift the AD curve.

Remembering that $\beta_1 > 0$, we see from (26) that an increase in domestic inflation will ceteris paribus reduce aggregate demand for domestic output. In the closed economy the negative impact of inflation on demand stems from the fact that higher inflation induces the central bank to raise the real interest rate. In the open economy with fixed exchange rates this mechanism is suppressed, because the domestic interest rate is tied to the foreign interest rate via perfect capital mobility. Instead, the reason for the negative slope of the AD curve (26) is that higher domestic inflation erodes the international competitiveness of domestic producers by reducing the real exchange rate. Thus, a rise in π raises the relative price of domestic goods, thereby reducing net exports. To see that this is indeed the mechanism, note that the term $\left(e^r_{-1} + \pi^f - \pi \right)$ on the right-hand side of (26) is simply the current real exchange rate, e^r.

In the closed economy, the slope of the aggregate demand curve is determined by the central bank's interest rate response to a rise in inflation. In the open economy the slope of the AD curve depends on the price elasticities of export and import demand (η_X and η_M)

which are incorporated in β_1 (see the appendix). The higher the value of these elasticities, the stronger is the reaction of net exports to a change in the real exchange rate, and the flatter is the aggregate demand curve.

A final important observation is that the AD curve defined by (26) will change position from one period to the next whenever the domestic inflation rate deviates from the foreign inflation rate. This follows from (23) which shows that the real exchange rate will change over time whenever $\pi \neq \pi^f$. Hence the value of the lagged real exchange rate e^r_{-1} appearing on the right-hand side of (26) will also change from one period to the next when domestic inflation is out of line with foreign inflation. This will cause the AD curve to shift even if the shock variable z remains constant.

The aggregate supply curve

To complete our AS-AD model for the open economy, we need to confront the aggregate demand curve with the aggregate supply curve. In accordance with our theory of wage and price formation in Chapters 18 and 19, we continue to assume that domestic inflation depends on the state of excess demand, measured by the output gap, and on the expected rate of inflation. Hence we still have

$$\pi = \pi^e + \gamma\left(y - \overline{y}_o\right) - \gamma s \tag{28}$$

where s captures aggregate supply shocks. Inserting our assumption (24) on expectations formation, we then obtain the short-run aggregate supply curve for the open economy with credibly fixed exchange rates:

$$\pi = \pi^f + \gamma\left(y - \overline{y}_o\right) - \gamma s \tag{29}$$

Determining output and inflation under fixed exchange rates

We now have a complete dynamic model of the open economy with fixed exchange rates. The model consists of the three equations (23), (26) and (29) which determine the three endogenous variables e^r, y and π, given the exogenous variables s, z, π^f and $\overline{y}_o$, and given the predetermined value of last period's real exchange rate, e^r_{-1}.

Before studying the dynamic adjustment of the endogenous variables over time, it is useful to consider the long run macroeconomic equilibrium implied by the model. In a long run equilibrium, the real exchange rate must be constant. According to (23) this implies that the domestic inflation rate must equal the foreign inflation rate. Denoting long-run equilibrium values by bars, we thus have

$$\overline{\pi} = \pi^f \tag{30}$$

Since $\pi^e = \pi^f$, a long run equilibrium also means that actual inflation corresponds to expected inflation. Inserting (30) into (29), we find that output must equal its natural rate in long run equilibrium:

$$y = \overline{y} = \overline{y}_o + s \tag{31}$$

These properties of the long run equilibrium are illustrated in Figure 24.7 where we assume that the aggregate supply shock s in (31) is zero. Note that in long run equilibrium the real exchange rate must assume a value $\overline{e}^r$ which ensures that the AD curve intersects with the SRAS curve at a rate of inflation corresponding to foreign inflation rate.

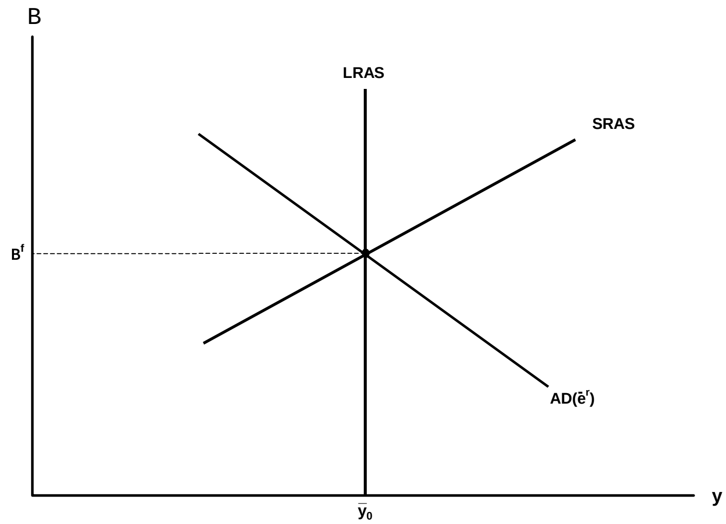

Figure 24.7: Long run macroeconomic equilibrium in the open economy with fixed exchange rates

To see how the economy adjusts to the long run equilibrium, let us rearrange the aggregate demand curve (26) and restate the model as follows:

$$\text{AD curve:} \qquad \pi = e^r_{-1} + \pi^f - \left(\frac{1}{\beta_1}\right)(y - \overline{y}_o - z) \tag{32}$$

$$\text{SRAS curve:} \qquad \pi = \pi^f + \gamma\,(y - \overline{y}_o) - \gamma s \tag{29}$$

$$\text{Evolution of real exchange rate:} \qquad e^r = e^r_{-1} + \pi^f - \pi \tag{23}$$

As the economy enters the current period, last period's real exchange rate e^r_{-1} is a predetermined constant. The current rates of output and inflation (y and π) are then determined simultaneously by equations (32) and (29). The current level of inflation in turn determines the current real exchange rate via (23). If $\pi^f \neq \pi$ it follows that $e^r \neq e^r_{-1}$, and the economy will then enter the next period with a new predetermined real exchange rate. According to (32) this means that the position of the AD curve will shift from the current period to the next one. This will generate new short-run values of output and inflation during the next period which in turn will change the level of the real exchange rate, and so on.

Figure 24.8 illustrates this dynamic adjustment process. In period 1 the economy is in recession, with low levels of output and inflation (y_1 and π_1). But this is only a short run equilibrium: since domestic inflation is lower than foreign inflation, the real exchange rate increases during period 1 so that $e_1^r > e_o^r$. Because of the resulting improvement in the international competitiveness of domestic producers, the AD curve shifts upwards as the economy moves from period 1 to period 2, and domestic output and inflation increase. However, since domestic inflation is still lower than foreign inflation in period 2, there is a further gain in domestic competitiveness ($e_2^r > e_1^r$). Hence the AD curve shifts upwards once more when the economy enters period 3, causing a further increase in output and inflation. In this way the gradual improvements in domestic competitiveness will continue to pull the economy up along the short run aggregate supply curve until domestic output reaches its trend level $\overline{y}_o$. At that point domestic inflation catches up with foreign inflation so that no further changes in the real exchange rate will take place, that is, the economy will be in long run equilibrium.

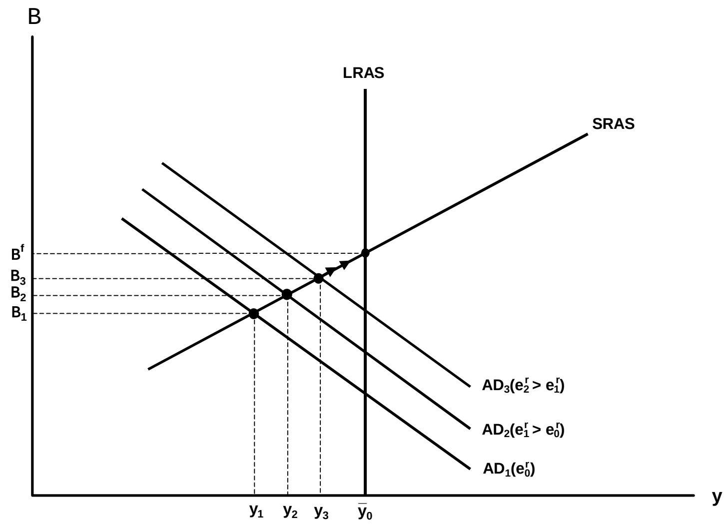

Figure 24.8: The adjustment to long run equilibrium under fixed exchange rates

Notice the difference between the dynamic adjustment mechanism in the closed and in the open economy. In the closed economy, a recession will lead to falling inflation which induces the central bank to cut the real interest rate so that aggregate demand recovers. Thus economic policy is crucial for the dynamic adjustment of the closed economy. In the open economy with fixed exchange rates a recession drives domestic inflation below foreign inflation, causing a gradual recovery of demand by lowering the relative price of domestic goods. This endogenous adjustment of the real exchange rate will pull the open economy towards long run equilibrium even if economic policy remains passive[3].

Stability and speed of adjustment in the open economy

What determines the speed of adjustment to long run equilibrium in the open economy

[3]The different adjustment mechanisms in the closed and in the open economy are also reflected by the differences between Figure 19.9 in Chapter 19 and Figure 24.8 in the present chapter. In Figure 19.9, which illustrates the closed economy, adjustment to long run equilibrium takes place via gradual shifts in the SRAS curve, as the expected inflation rate changes over time. In Figure 24.8 the adjustment occurs via shifts in the AD curve, whereas the SRAS curve stays put, given our assumption that the expected domestic inflation rate is tied to the foreign inflation rate.

with fixed exchange rates? To investigate this, we will now solve the model analytically. We start by defining the output gap $\widehat{y}$ and the inflation gap $\widehat{\pi}$ as

$$\widehat{y}_t \equiv y_t - \overline{y}_o, \qquad \widehat{\pi}_t \equiv \pi_t - \pi^f \tag{33}$$

We may then rewrite the model consisting of (32), (29) and (23) as

$$\widehat{\pi}_t = e_{t-1}^r - \left(\frac{1}{\beta_1}\right)(\widehat{y}_t - z_t) \tag{34}$$

$$\widehat{\pi}_t = \gamma\left(\widehat{y}_t - s_t\right) \tag{35}$$

$$e_t^r = e_{t-1}^r - \widehat{\pi}_t \tag{36}$$

Now insert (35) into (34) and solve for e_{t-1}^r to get

$$e_{t-1}^r = \left(\frac{1+\gamma\beta_1}{\beta_1}\right)\widehat{y}_t - \gamma s_t - \left(\frac{1}{\beta_1}\right)z_t \tag{37}$$

Substituting (37) and the analogous expression for e_t^r into (36) along with the expression for $\widehat{\pi}_t$ given in (35), we get the following first-order linear difference equation in the output gap:

$$\overbrace{\left(\frac{1+\gamma\beta_1}{\beta_1}\right)\widehat{y}_{t+1} - \gamma s_{t+1} - \left(\frac{1}{\beta_1}\right)z_{t+1}}^{e_t^r} = \overbrace{\left(\frac{1+\gamma\beta_1}{\beta_1}\right)\widehat{y}_t - \gamma s_t - \left(\frac{1}{\beta_1}\right)z_t}^{e_{t-1}^r} - \overbrace{\gamma\left(\widehat{y}_t - s_t\right)}^{\widehat{\pi}_t} \Longleftrightarrow$$

$$\widehat{y}_{t+1} = \beta\widehat{y}_t + \beta\left(z_{t+1} - z_t\right) + \gamma\beta_1\beta s_{t+1}, \qquad \beta \equiv \frac{1}{1+\gamma\beta_1} \tag{38}$$

Equation (38) has exactly the same structure as the difference equation for the output gap in the closed economy given in equation (16) in Chapter 20. Indeed, the only difference between the two equations is that the parameter α in the closed economy model is replaced by the parameter β_1 in the open economy model. This reflects the difference in the macroeconomic adjustment mechanisms: in the closed economy, the parameter α incorporates the central bank's interest rate response to a change in the rate of inflation as well as the interest elasticity of aggregate goods demand. In the open economy, the parameter β_1 includes the price elasticities of export and import demand which determine the effect of a change in domestic inflation on the demand for domestic goods.

For constant values of z and s the solution to (38) is

$$\widehat{y}_t = s + (\widehat{y}_o - s)\,\beta^t, \qquad t = 0, 1, 2, ... \tag{39}$$

We see from (38) that the parameter $\beta \equiv 1/\left(1 + \gamma\beta_1\right)$ is positive but less than one. According to (39) this ensures that the economy will indeed converge towards a long run equilibrium, provided the shock variables z and s stay constant over time. In other words the open economy with fixed exchange rates is **stable**. The speed of convergence to long run equilibrium will be higher, the smaller the value of β. Hence the adjustment to equilibrium will be faster, the greater the value of β_1, that is, the larger the price elasticities in foreign trade. This is intuitive: if exports and imports are very sensitive to relative prices, a negative shock which drives domestic inflation below foreign inflation will lead to a large increase in net exports which will quickly pull the domestic economy out of recession. The magnitude of the price elasticities in foreign trade will depend on the structure of product markets. If competition in international markets is tough, the price elasticities will tend to be large, and the economy's adjustment to equilibrium will then be relatively fast.

Let us consider a numerical example to get a feel for the likely order of magnitude of the open economy's speed of adjustment. In the appendix to this chapter we show that

$$\beta_1 = \frac{\left(M_o/\overline{Y}\right)\left(\eta_X + \eta_M - 1\right) - \left(D/\overline{Y}\right)\eta_D}{1 - \widetilde{D}_Y}, \qquad \eta_D \equiv -\frac{\partial D}{\partial E^r}\frac{E^r}{D}$$

where η_D is the numerical elasticity of total private goods demand with respect to the real exchange rate, $M_o/\overline{Y}$ is the ratio of imports to GDP, and $D/\overline{Y}$ is the ratio of total private demand to GDP (which in turn equals one minus the ratio of government consumption to GDP). Empirical studies indicate that if the length of the time period is one year, the relative price elasticities in export and import demand are almost always greater than one. For concreteness, suppose that

$$\eta_X = \eta_M = 2 \qquad \eta_D = 0.3 \qquad M_o/\overline{Y} = 0.3 \qquad D/\overline{Y} = 0.8 \qquad \widetilde{D}_Y = 0.5$$

These parameter values are not implausible for a relatively open economy. The motivation for the choice of the value of η_D is that if about 30 percent of demand is directed towards imports, then a 1 percent rise in the relative price of imported goods should erode the real purchasing power of domestic consumers by about 0.3 percentage points and lead to a similar percentage fall in demand. In Chapter 20 we assumed that the Phillips curve parameter $\gamma = 0.05$ when the length of the time period is one quarter. We therefore assume that $\gamma = 0.2$ on an annual basis. Using these parameter values, we find that

$$\beta = \frac{1}{1 + \gamma\beta_1} \approx 0.79$$

From the analysis in Chapter 20 we know that the number of time periods t^h which must elapse before half of the economy's adjustment to long run equilibrium is completed is given by

$$t^h = -\frac{\ln 2}{\ln \beta} = -\frac{0.693}{\ln \beta}$$

For $\beta = 0.79$ this implies that $t^h \approx 2.96$. In other words, given the parameter values assumed above, it will take slightly less than three years before the economy has moved half way towards the long run equilibrium.

3 Economic policy under fixed exchange rates

We will now use the AS-AD model developed above to study the effects of macroeconomic policy under fixed exchange rates. As we have already seen, when fixed exchange rates are coupled with high capital mobility, there is no role for an independent monetary policy. This leaves fiscal policy and discretionary changes in the exchange rate parity as the two major remaining instruments of macroeconomic policy. The following sections therefore analyse the effects of fiscal policy and exchange rate policy.

Fiscal policy

Figure 24.9 shows how the open economy with fixed exchange rates will react to expansionary fiscal policy. In period 0 the economy is in long run equilibrium at E_o where output is at its trend level and domestic inflation equals foreign inflation. In period 1 the government increases its demand for goods and services. This is a positive demand shock which increases z, so the AD curve shifts upwards from AD_o to AD_1, causing output and inflation to rise. But since domestic inflation is now higher than the foreign inflation rate, the competitiveness of domestic producers will be gradually eroded, and the AD curve will be pushed back towards its original position as the real exchange rate falls over time. This process will continue until the economy is back at its original level of output and inflation. When the economy returns to long run equilibrium, the rise in public goods demand has crowded out an equivalent amount of private demand for domestic output. This crowding out of private demand occurs via a fall in net exports, as the government stimulus to aggregate demand drives up the relative price of domestic goods. By contrast, in the closed economy the crowding-out effect of expansionary fiscal policy takes place via a rise in the real interest rate which depresses private investment and possibly also private consumption.

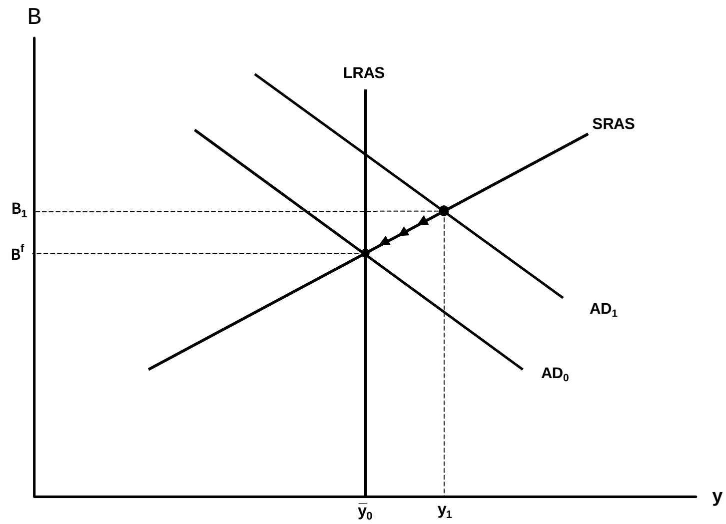

Figure 24.9: Effects of expansionary fiscal policy under fixed exchange rates

An important assumption underlying Figure 24.9 is that the fiscal expansion does not undermine the credibility of the fixed exchange rate regime. In that case the expected domestic inflation rate remains tied to the foreign inflation rate even though the fiscal expansion erodes the competitiveness of domestic producers and causes a deterioration of the trade balance. If the fiscal expansion and the resulting trade deficit is so large that the private sector begins to question the sustainability of the fixed exchange rate, a fear of devaluation may arise. As we shall see below, this may drive the domestic real interest rate above the foreign real interest rate, thereby dampening the expansionary effect of higher public spending.

The short run effects of exchange rate policy

In the previous part of the chapter we analyzed a 'hard' currency peg where the government does not use changes in the nominal exchange rate as an instrument of economic policy. We will now consider a 'softer' type of fixed exchange rate regime where the authorities may occasionally adjust the exchange rate. This is sometimes referred to as fixed but adjustable exchange rates. In practice most countries with such a policy regime have tended to devalue their currencies from time to time in order to compensate for the impact of high domestic inflation on international competitiveness or to stimulate domestic economic activity by raising the relative price of foreign goods.

Analyzing the impact of devaluations on the domestic economy is a complex matter, because recurrent devaluations are likely to affect private sector expectations. If the authorities devalue the domestic currency from time to time, households and firms will start to incorporate the risk of future devaluation in their forecasts of inflation and asset returns. A realistic analysis of exchange rate policy must include such effects on expectations.

To illustrate this point, we will consider an economy which is in equilibrium in period 0 and which undertakes a devaluation in period 2. Because this economy has previously devalued on several occasions, we assume that fears of a future devaluation arise in the private sector already in period 1. The actual percentage rate of devaluation implemented in period 2 is Δe_2. We introduce a parameter δ to indicate the ratio between the rate of devaluation which is expected to occur in period 2 and the rate of devaluation which actually occurs. In period 1, the percentage devaluation which is expected to take place in period 2 $(e_2^e - e_1)$ is therefore given by

$$e_2^e - e_1 = \delta \Delta e_2, \qquad 0 \leq \delta \leq 1 \tag{40}$$

where e_2^e is the log of the nominal exchange rate expected to prevail in period 2. In the borderline case where the parameter δ is equal to zero the devaluation is completely unanticipated, whereas $\delta = 1$ reflects another borderline case where the devaluation is fully foreseen. In principle, it is of course possible that the private sector overestimates the rate of devaluation so that $\delta > 1$, but this case will not be considered here.

Since perfect capital mobility implies that the expected returns to domestic and foreign assets must be the same, it follows from (40) and the arbitrage condition (2) that the domestic nominal interest rate in period 1 will be

$$i_1 = i^f + e_2^e - e_1 = i^f + \delta \Delta e_2 \tag{41}$$

Thus the domestic interest rate must equal the foreign interest rate i^f (assumed to be constant throughout our analysis) plus the expected exchange rate gain $\delta \Delta e_2$ on foreign assets.

A devaluation raises the price of imported goods, and we will assume that households and firms expect this to lead to a temporary increase in the domestic inflation rate. As we shall see, our analysis will in fact justify such an expectation. Specifically, we assume that investors in period 1 expect the inflation rate for period 2 to be

$$\pi_2^{eb} \equiv p_2^{eb} - p_1 = \pi^f + \theta_2 \delta \Delta e_2, \qquad 0 \le \theta_2 \le 1 \tag{42}$$

The superscript eb in (42) indicates that the expectation is formed **before** the magnitude of the devaluation is known with certainty. The parameter θ_2 measures the extent to which the anticipated devaluation in period 2 is expected to drive the domestic inflation rate for period 2 above the foreign inflation rate. In general we assume that $\theta_2 < 1$ so that the devaluation is not expected to be fully reflected in the domestic inflation rate in the short run. Since the domestic real interest rate in period 1 depends on the expected rate of price increase between periods 1 and 2, it follows from (41) and (42) that

$$r_1 \equiv i_1 - \pi_2^{eb} = r^f + \delta (1 - \theta_2) \Delta e_2, \qquad r^f \equiv i^f - \pi^f \tag{43}$$

We see that when the anticipated devaluation is not expected to be fully and immediately passed through to the domestic inflation rate (that is, when $\theta_2 < 1$), **the domestic real interest rate will rise above the foreign real interest rate prior to the devaluation**, provided the devaluation is at least partly anticipated so that $\delta > 0$. To see how this will affect the macroeconomy, we go back to the goods market equilibrium condition (20). Since we are focusing on exchange rate policy, we will neglect other shocks and set $g = \overline{g}$, $y^f = \overline{y}^f$ and $\varepsilon = \overline{\varepsilon}$. We will also choose units such that the initial real exchange rate $e_o^r = 0$, and we will assume that in the initial period (before the fear of devaluation arises) the economy is in a long run equilibrium with $\overline{r} = r^f$ and $s = 0$[4]. According to equation (20) the goods market equilibrium condition for period 1 may then be written as

$$y_1 - \overline{y}_o = \beta_1 e_1^r - \beta_2 (r_1 - r^f) \tag{44}$$

From (23) we have $e_1^r = e_o^r + \pi^f - \pi_1 = \pi^f - \pi_1$, given $e_o^r = 0$. Inserting this along with (43) into (44) and rearranging, we get the following expression for the aggregate demand curve for period 1:

$$\text{AD curve for period 1:} \qquad \pi_1 = \pi^f - (1/\beta_1)(y_1 - \overline{y}_o) - (\beta_2 \delta / \beta_1)(1 - \theta_2)\Delta e_2 \tag{45}$$

In period 0 when there is no expectation of a future devaluation and the economy is in a long run equilibrium with $e_{-1}^r = z = 0$, it follows from (32) that the equation for the AD curve is simply $\pi_o = \pi^f - (1/\beta_1)(y_1 - \overline{y}_o)$. Comparing this expression to (45), we see that **the aggregate demand curve will shift downwards in period 1** when expectations of a future devaluation emerge, because the fear of devaluation pushes the domestic real interest rate above the foreign real interest rate. The downward shift in the AD curve between periods 0 and 1 is illustrated in Figure 24.10. Since the devaluation does not occur until period 2, it does not affect the short run aggregate supply curve for period 1, because the position

[4] If the economy is initially in an equilibrium where output equals its natural rate, you may wonder why the authorities would want to devalue the currency. One reason may be that the natural rate of output is considered to be unsatisfactorily low, say, because of a high natural rate of unemployment. By devaluing, the authorities may hope to push actual output and employment above their natural levels, at least for a while.

of this curve depends on the expected increase in prices from period 0 to period 1.[5] Hence we see from Figure 24.10 that the downward shift in the AD curve will cause output in period 1 to fall to the level y_1, while inflation in period 1 will fall to π_1. In other words, when the private sector starts to expect a future devaluation, the fear of devaluation may well push the economy into recession because it feeds into the domestic real interest rate.

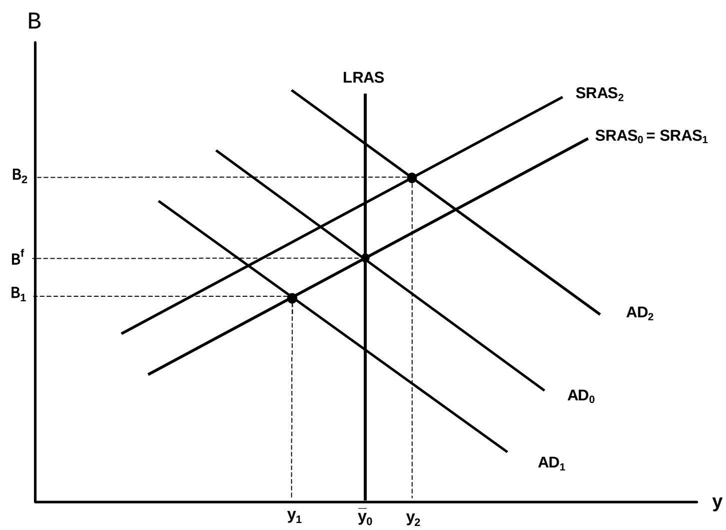

Figure 24.10: Short run effects of a devaluation which is partly anticipated

Suppose now that the domestic currency is actually devalued by the amount Δe_2 at the beginning of period 2, right before wages and prices for that period have to be set, and just before the investment decisions for period 2 are made. Since workers and firms are thus able to form their expectations for period 2 after the magnitude of the devaluation has become known, the setting of wages and prices for period 2 will be based on an expected inflation rate equal to

[5] Wages are assumed to be renegotiated each period. Hence wage setters do not have to worry about the expected inflationary impact of the devaluation already in period 1, since this effect can be accounted for when wages are renegotiated at the start of period 2.

$$\pi_2^e \equiv p_2^e - p_1 = \pi^f + \theta_2 \Delta e_2 \tag{46}$$

In the absence of supply shocks ($s = 0$) the domestic inflation rate is given by the Phillips curve $\pi_2 = \pi_2^e + \gamma\,(y_2 - \overline{y}_o)$. Inserting (46) into this expression, we get the

$$\text{SRAS curve for period 2:} \qquad \pi_2 = \pi^f + \theta_2 \Delta e_2 + \gamma\,(y_2 - \overline{y}_o) \tag{47}$$

Compared to the SRAS curve for period 1, equation (47) contains the additional term $\theta_2 \Delta e_2$. This shows that the short run aggregate supply curve will shift upwards in the period when the devaluation occurs, as illustrated in Figure 24.10.

But what happens to the aggregate demand curve? By analogy to (44), the AD curve for period 2 is given by the general expression

$$y_2 - \overline{y}_o = \beta_1 e_2^r - \beta_2 (r_2 - r^f) \tag{48}$$

Accounting for the effect of the devaluation, the real exchange rate for period 2 is

$$e_2^r = e_1^r + \Delta e_2 + \pi^f - \pi_2 \tag{49}$$

We assume that the implementation of the devaluation in period 2 eliminates any fears of a further devaluation in the near future. When the exchange rate is expected to stay constant between periods 2 and 3, perfect capital mobility ensures that $i_2 = i^f$. If investors expect that the devaluation which occurred in period 2 will continue to have an impact on domestic inflation in period 3 so that $\pi_3^e = \pi^f + \theta_3 \Delta e_2$, the domestic real interest rate for period 2 will then be

$$r_2 \equiv i_2 - \pi_3^e = i^f - \pi^f - \theta_3 \Delta e_2 = r^f - \theta_3 \Delta e_2, \qquad 0 \leq \theta_3 \leq 1 \tag{50}$$

Substituting (49) and (50) into (48), we obtain the

AD curve for period 2: $\pi_2 = \pi^f + e_1^r + \Delta e_2 - (1/\beta_1)(y_2 - \overline{y}_o) + (\beta_2\theta_3/\beta_1)\Delta e_2$ (51)

Comparing (51) to the AD curve for period 1 given in (45), recalling that the AD curve for period 0 is $\pi_o = \pi^f - (1/\beta_1)(y_1 - \overline{y}_o)$, and noting that $e_1^r = e_o^r + \pi^f - \pi_1 = \pi^f - \pi_1 > 0$ (since domestic inflation fell below π^f in period 1), we see that **the devaluation will cause the AD curve in period 2 to shift upwards to a position above the AD curves for periods 0 and 1**, as shown in Figure 24.10. There are two reasons for this. First of all, the devaluation as well as the temporary drop in domestic inflation in period 1 improve the international competitiveness of domestic producers, thereby inducing domestic and foreign consumers to substitute domestic for foreign goods. This expansionary effect is captured by the term $e_1^r + \Delta e_2$ in (51). Second, the expected inflationary effect of the devaluation causes the domestic real interest rate to fall, as there is no longer any fear of a future devaluation to drive up the domestic interest rate. This effect is reflected in the term $(\beta_2\theta_3/\beta_1)\Delta e_2$ in (51).

Although the SRAS curve also shifts upwards in period 2, the effect of the devaluation on the AD curve is sufficiently strong to ensure that output increases **above** the trend level in period 2, given the assumptions we have made. To prove this, you may solve (47) for $\pi^f - \pi_2$ and insert the resulting expression into (51) to get

$$y_2 - \overline{y}_o = \left(\frac{\beta_1}{1+\gamma\beta_1}\right) e_1^r + \left(\frac{\beta_1(1-\theta_2) + \beta_2\theta_3}{1+\gamma\beta_1}\right)\Delta e_2 \qquad (52)$$

Since e_1^r and Δe_2 are both positive, and since $0 \leq \theta_2 \leq 1$ by assumption, it follows from (52) that $y_2 - \overline{y}_o > 0$, as illustrated in Figure 24.10.

The basic insight from this complex analysis is that **anticipated devaluations may generate a 'bust-boom' movement in the domestic economy.** Prior to the adjustment of the exchange rate, when fears of a future devaluation build up, the impact on the economy is likely to be contractionary, as the perceived risk of devaluation and the associated capital outflow drives up the domestic real interest rate. But when the devaluation has occurred, the economy will expand, as domestic competitiveness improves and the domestic real interest rate falls (assuming that the exchange rate adjustment does not foster expectations of further imminent devaluations).

Although plausible, the devaluation scenario described above is not the only possible one. The exact short run effects of a devaluation will depend on the specific way in which private sector expectations are affected, and this in turn may depend very much on the specific historical and political context. In Exercise 24.2 you are invited to consider two other possible devaluation scenarios involving different effects on our expectations parameters δ and θ.

The long run neutrality of a devaluation

The analysis in the previous section focused on the short run effects of a devaluation. Let us now consider how the exchange rate adjustment will affect the economy in the longer run.

In the long run a devaluation will be neutral, having no effect on any real variables. This important result follows from the conditions for long run equilibrium given in equations (30) and (31). In particular, equation (31) says that a long run equilibrium requires $y = \overline{y}_o$ for $s = 0$. Since we have seen that the economy will actually converge towards the long run equilibrium, it follows that it must eventually return to the original output level $\overline{y}_o$ after a devaluation. Moreover, equation (30) implies that the devaluation can have no permanent effect on inflation.

The fact that output returns to its natural rate also means that a devaluation cannot affect the real exchange rate in the long run. The real exchange rate must return to its original level in order to generate a level of aggregate demand equal to the natural rate of output. Otherwise the long run equilibrium in the domestic goods market cannot be restored. The point is that although the devaluation implies a change in the **nominal** exchange rate e, the **real** exchange rate e^r is endogenously determined by market forces and cannot be permanently affected by a nominal exchange rate adjustment. However, the adjustment to long run equilibrium may take considerable time, and in the meantime a devaluation will in fact influence the real exchange rate.

As illustrated in Figure 24.10, a devaluation is likely to be expansionary in the period in which it occurs. Its effects in the subsequent periods depend on the exact way in which the AD curve and the SRAS curve will shift over time. After the devaluation (in period 2), we see from Figure 24.10 that the domestic inflation rate is higher than the foreign inflation rate. This will gradually erode the domestic economy's initial competitive gain from the devaluation. Hence the AD curve will gradually shift downward due to a falling real exchange rate e^r. Ceteris paribus, this will tend to push domestic output and inflation back towards their original levels $\overline{y}_o$ and π^f. As domestic inflation falls due to falling aggregate demand, and as the devaluation becomes an event of the past, firms and households will most likely reduce their estimate of the effect of the devaluation on next period's domestic inflation rate. This fall in expected inflation will cause the SRAS curve to shift downwards, back towards its original position. At the same time the lower expected rate of inflation and the associated rise in the domestic real interest rate will push the AD curve further down. As a result of these shifts in the two curves, the domestic inflation rate will continue to fall back towards the foreign inflation rate, and the downward-shifting AD curve will help to pull output back towards the natural rate.

Thus, although the devaluation does indeed raise the real exchange rate e^r in the short run, it will be followed by periods in which the domestic inflation rate exceeds the foreign inflation rate, and this situation will continue until the real exchange rate is back at its original level. Depending on the specific dynamics of expected domestic inflation, one can even imagine that output and inflation may fall below their original levels for a while before the economy ends up in the original long run equilibrium.

An empirical illustration: the Nordic devaluation cycles

The fact that devaluations cannot permanently improve a country's competitiveness is well illustrated by the experience of Sweden and Finland in recent decades. On several occasions, those two countries have undertaken major devaluations which initially led to a significant expansion of economic activity, but which were followed by a rise in domestic inflation that subsequently forced a contraction of output and employment.

Figure 24.11 illustrates two such devaluation cycles for Sweden. The horizontal axis measures the percentage deviation of real manufacturing output from trend, and the vertical axis indicates the change in the real unit labour costs of Swedish firms relative to the trade-weighted average real unit labour costs of their foreign competitors. A movement down the vertical axis thus implies an improvement of the international competitiveness of Swedish producers.

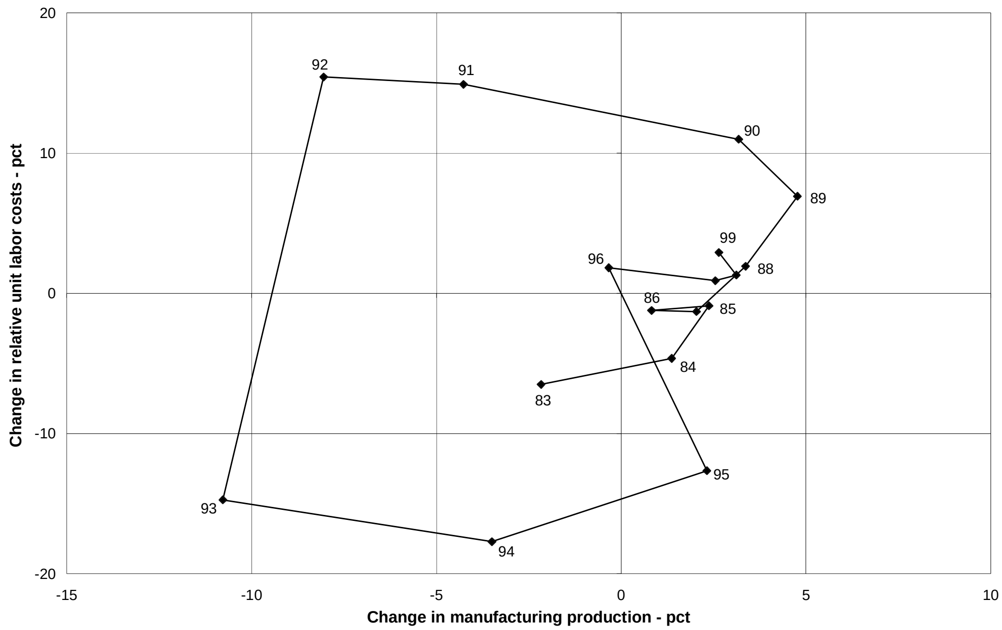

Figure 24.11: The Swedish devaluation cycle, 1983-1999

Note: The change in manufacturing output is measured as the percentage change relative to a long term trend estimated by the HP filter. Unit labour costs are measured relative to a trade-weigthed average of the unit labour costs of Sweden's trading partners.

Source: OECD Economic Outlook and Main Economic Indicators

In October 1982 Sweden devalued by 16 percent vis á vis the basket of currencies to which the Swedish krone had been pegged. In the short run this led to a significant fall in the relative production costs of Swedish firms, so between 1983 and 1989 Swedish manufacturing output increased by roughly 7 percent relative to trend. However, this expansion gradually pulled up Swedish wage inflation which in turn gradually drove up relative wage costs in Sweden. As a result, output fell back relative to trend in the period 1989-1992. Because of Sweden's weak competitive position, the Swedish krone was exposed to a heavy speculative attack during the European exchange rate crisis in 1992-93. The Swedish central bank (Riksbanken) initially responded by raising the short term interest rate to exorbitant heights in order to stem the outflow of capital, but this only worsened the serious recession caused by the lack of competitiveness. As the speculative attacks persisted, the Riksbank ultimately had to give up defending the currency, and between November 1992 and March 1993 the Swedish krone depreciated by about 30 percent. As shown in Figure 22.11, this lead to a strong recovery of output after 1993, but from the mid 1990s this expansion once again started to push up Swedish relative labour costs.

Figure 24.12 tells a similar story about Finland. The Finnish mark was devalued by 12 percent in September 1982, and this contributed to a strong boom in output in the following years. But towards the end of the 1980s the Finnish economy was overheating, causing a sharp rise in Finnish relative labour costs. As a consequence, output was already falling relative to trend when the collapse of the Soviet Union deprived Finland of an important export market in the early 1990s. The vulnerable state of the Finnish economy lead to a violent attack on the mark during the European exchange rate crisis of 1992-93, and the Bank of Finland had to give up its policy of pegging the mark to a basket of foreign currencies. Hence the Finnish currency declined by about 30 percent from September 1992 to March 1993. In the subsequent years Finland experienced a strong boom in output, but again this was followed by a gradual rise in Finnish relative labour costs.

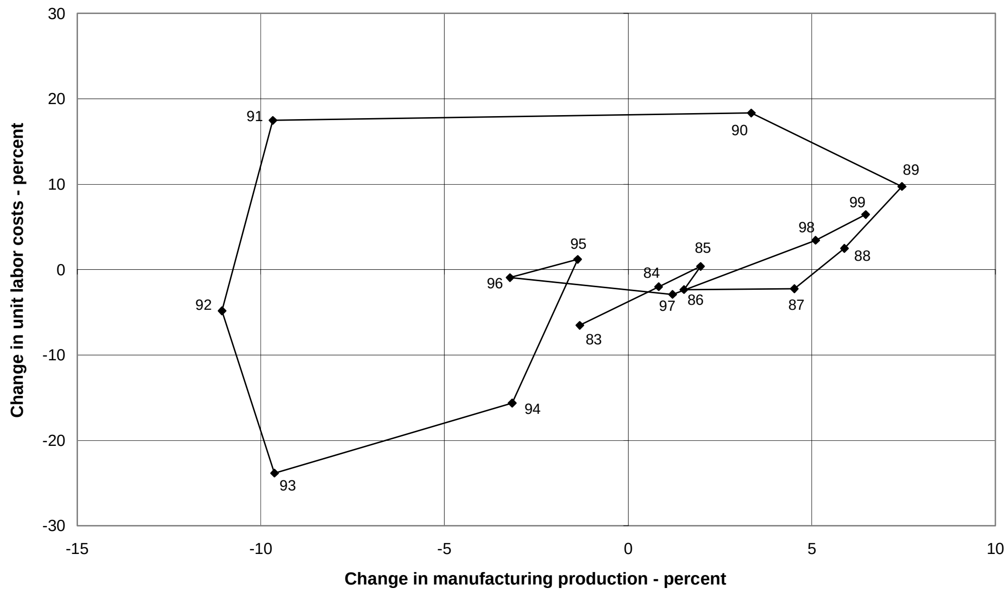

Figure 24.12: The Finnish devaluation cycle, 1983-1999

Note: The change in manufacturing output is measured as the percentage deviation from a long term trend estimated by the HP filter. Unit labour costs are measured relative to a trade-weigthed average of the unit labour costs of Finland's trading partners.

Source: OECD Economic Outlook and Main Economic Indicators

4 Appendix: Deriving the aggregate demand curve for the open economy

This appendix shows how to derive the log-linear approximation to the goods market equilibrium condition given in equation (20) of the main text. Our procedure will be similar to the one which was used to derive the aggregate demand curve for the closed economy in the appendix to Chapter 19.

We start by restating equation (13):

$$Y = \widetilde{D}\left(Y, G, r, \varepsilon, E^r, Y^f\right) + G \tag{A.1}$$

Assuming that we start out in a long run equilibrium, and using the notation for partial derivatives introduced in equations (15) through (18), we calculate the total differential of (A.1) to get the linear approximation

$$Y-\overline{Y}=\widetilde{D}_Y\left(Y-\overline{Y}\right)+\widetilde{D}_r\left(r-\overline{r}\right)+\widetilde{D}_E\left(E^r-\overline{E}^r\right)$$

$$+\widetilde{D}_{\varepsilon}\left(\varepsilon-\overline{\varepsilon}\right)+\widetilde{D}_{Y^f}\left(Y^f-\overline{Y}^f\right)+\left(1+\widetilde{D}_G\right)\left(G-\overline{G}\right)\qquad\Longleftrightarrow$$

$$Y-\overline{Y}=\left(\frac{\widetilde{D}_E}{1-\widetilde{D}_Y}\right)\left(E^r-\overline{E}^r\right)+\left(\frac{\widetilde{D}_r}{1-\widetilde{D}_Y}\right)\left(r-\overline{r}\right)$$

$$+\left(\frac{\widetilde{D}_{\varepsilon}}{1-\widetilde{D}_Y}\right)\left(\varepsilon-\overline{\varepsilon}\right)+\left(\frac{\widetilde{D}_{Y^f}}{1-\widetilde{D}_Y}\right)\left(Y^f-\overline{Y}^f\right)+\left(\frac{1+\widetilde{D}_G}{1-\widetilde{D}_Y}\right)\left(G-\overline{G}\right)\tag{A.2}$$

where long run equilibrium values are indicated by a bar above the variables. It is natural to assume that, other things equal, an increase in world economic activity will increase the domestic economy's export market in proportion to the domestic economy's initial weight in the world economy. In that case we have

$$\widetilde{D}_{Y^f}\equiv\frac{\partial NX}{\partial Y^f}=\frac{\overline{Y}}{\overline{Y}^f}\tag{A.3}$$

When a relationship like (A.3) holds for all countries, it simply means that an increase in world output Y^f does not in itself change the individual country's share of the world market.

Our next step is to rewrite (A.2) in terms of relative changes of the various variables (except the real interest rate which is already expressed in percentage terms). Doing this, and using (A.3), we get

$$\frac{Y-\overline{Y}}{\overline{Y}}=\left(\frac{\overline{E}^r\widetilde{D}_E}{\overline{Y}\left(1-\widetilde{D}_Y\right)}\right)\left(\frac{E^r-\overline{E}^r}{\overline{E}^r}\right)+\left(\frac{\widetilde{D}_r}{1-\widetilde{D}_Y}\right)\left(r-\overline{r}\right)$$

$$+\left(\frac{\overline{\varepsilon}\widetilde{D}_{\varepsilon}}{\overline{Y}\left(1-\widetilde{D}_{Y}\right)}\right)\left(\frac{\varepsilon-\overline{\varepsilon}}{\overline{\varepsilon}}\right)+\left(\frac{1}{1-\widetilde{D}_{Y}}\right)\left(\frac{Y^{f}-\overline{Y}^{f}}{\overline{Y}^{f}}\right)+\left(\frac{\overline{G}\left(1+\widetilde{D}_{G}\right)}{\overline{Y}\left(1-\widetilde{D}_{Y}\right)}\right)\left(\frac{G-\overline{G}}{\overline{G}}\right) \tag{A.4}$$

Using the definitions

$$y \equiv \ln Y, \qquad y^{f} \equiv \ln Y^{f}, \qquad e^{r} \equiv \ln E^{r}, \qquad g \equiv \ln G$$

and remembering that the relative change in some variable x is approximately equal to the change in the natural logarithm of x, we may write (A.4) as

$$y-\overline{y}=\beta_1(e^{r}-\overline{e}^{r})-\beta_2(r-\overline{r})+\beta_3\left(g-\overline{g}\right)+\beta_4\left(y^{f}-\overline{y}^{f}\right)+\beta_5\left(\ln\varepsilon-\ln\overline{\varepsilon}\right) \tag{A.5}$$

where

$$\beta_1 \equiv \frac{\overline{E}^{r}\widetilde{D}_{E}}{\overline{Y}\left(1-\widetilde{D}_{Y}\right)}, \qquad \beta_2 \equiv \frac{-\widetilde{D}_{r}}{1-\widetilde{D}_{Y}}, \qquad \beta_3 \equiv \frac{\overline{G}\left(1+\widetilde{D}_{G}\right)}{\overline{Y}\left(1-\widetilde{D}_{Y}\right)}$$

$$\beta_4 \equiv \frac{1}{1-\widetilde{D}_{Y}}, \qquad \beta_5 \equiv \frac{\overline{\varepsilon}\widetilde{D}_{\varepsilon}}{\overline{Y}\left(1-\widetilde{D}_{Y}\right)}$$

We see that (A.5) is identical to equation (20) in the main text.

As we saw in Part 2 of this chapter, the magnitude of the parameter β_1 is crucial for the speed with which the economy adjusts to long run equilibrium. It is therefore useful to rewrite the expression for β_1 to get an idea of its likely magnitude. According to (12), (13) and (18) we have

$$\widetilde{D}_{E} \equiv \frac{\partial D}{\partial E^{r}}+\frac{\partial NX}{\partial E^{r}}$$

$$\frac{\partial NX}{\partial E^r} = M_o \left(\eta_X + \eta_M - 1 \right)$$

Furthermore, let us specify the numerical elasticity of total private demand with respect to the real exchange rate as

$$\eta_D \equiv -\frac{\partial D}{\partial E^r} \frac{\overline{E}^r}{\overline{D}}$$

Using these relationships, and choosing units such that the intial real exchange rate $\overline{E}^r = 1$, you may verify that the expression for β_1 may be rewritten as

$$\beta_1 = \frac{\left(M_o / \overline{Y} \right) \left(\eta_X + \eta_M - 1 \right) - \left(\overline{D} / \overline{Y} \right) \eta_D}{1 - \widetilde{D}_Y} \tag{A.6}$$

which is the specification of β_1 used in the main text.

5 Exercises

Exercise 22.1. The effects of a global recession

This exercise asks you to use the AS-AD model of the small open economy with fixed exchange rates to analyse the effects of a recession in the world economy.

Question 1: Suppose that the foreign economy is hit by a negative demand shock. Use the AS-AD diagram for the small open economy to illustrate how this is likely to affect the domestic economy under fixed exchange rates (hints: which of the exogenous variables of the model are likely to be affected by the foreign recession, and how will the AS and AD curves of the domestic economy be affected? How is foreign monetary policy likely to react to the recession, and how will this impact on the domestic economy? How will the domestic economy adjust over time if the foreign recession lasts for several periods?)

Question 2: Suppose instead that the foreign recession is initiated by a negative foreign supply shock. Use the AS-AD diagram for the small open economy to illustrate how this is likely to affect the domestic economy under fixed exchange rates. Discuss how foreign monetary policy is likely to react in this scenario. Explain the similarities and differences between the effects of the two types of world recession on the domestic economy.

Exercise 22.2. The effects of devaluation: two benchmark scenarios

In this exercise you are invited to study the effects of a devaluation in two alternative borderline cases. In Scenario 1 the devaluation is assumed to be completely unanticipated and without any impact whatsoever on the expected rate of domestic inflation. In Scenario 2 the devaluation which occurs in period 2 is fully and corectly anticipated already from period 1, and the private sector expects that the rate of domestic inflation in period 2 will rise by the same amount as the percentage rate of devaluation (and that domestic inflation will fall back to the initial level π^f from period 3 and onwards).

Question 1: Use the AS-AD diagram for the open economy to illustrate the short run and long run effects of the devaluation in Scenario 1 (hint: what are the values of the parameters δ and θ (defined in the main text) in Scenario 1?). Explain how the economy adjusts over time to the change in the exchange rate. Discuss whether the assumptions underlying Scenario 1 are realistic. Can you think of a more realistic scenario? Explain.

Question 2: Use the AS-AD diagram for the open economy to illustrate the effects of a devaluation in Scenario 2 (hint: what are the values of the parameters δ and θ in Scenario 2?). Will the devaluation have any effects on real economic variables? Will there be any difference between the short run and the long run effects of the devaluation? Discuss the realism of the assumptions underlying Scenario 2.

Exercise 22.3. Active fiscal policy under fixed exchange rates

Suppose that the government wishes to minimize the deviation of domestic inflation from foreign inflation as well as the deviation of output from trend and that fiscal policy therefore follows the policy rule

$$g - \overline{g} = \alpha_1 \left(\pi^f - \pi\right) - \alpha_2 \left(y - \overline{y}_o\right), \qquad \alpha_1 \geq 0, \qquad \alpha_2 \geq 0 \tag{1}$$

Assuming that initial output equals trend output ($\overline{y} = \overline{y}_o$), and remembering that $r = r^f$ under perfect capital mobility and credibly fixed exchange rates, we may write the goods market equilibrium condition (20) in the main text as

$$y - \overline{y}_o = \beta_1(e^r - \overline{e}^r) + \beta_3 \left(g - \overline{g}\right) + \widetilde{z} \tag{2}$$

where the exogenous demand shock variable is given as

$$\widetilde{z} \equiv -\beta_2(r^f - \overline{r}^f) + \beta_4 \left(y^f - \overline{y}^f\right) + \beta_5 \left(\ln \varepsilon - \ln \overline{\varepsilon}\right) \tag{3}$$

Because the exchange rate is fixed, the real exchange rate evolves according to

$$e^r = e^r_{-1} + \pi^f - \pi \tag{4}$$

Finally, we have the short run aggregate supply curve

$$\pi = \pi^f + \gamma \left(y - \overline{y}_o\right) - \gamma s \tag{5}$$

Question 1: Use (1), (2) and (4) to derive the economy's aggregate demand curve (hint: you may simplify by setting $\overline{e}^r = 0$). How is the slope of the AD curve affected by the policy parameters α_1 and α_2? Give an economic explanation.

Question 2: Solve the model for the current values of output and inflation (y and π) in terms of the exogenous and predetermined variables $\widetilde{z}$, s and e^r_{-1}. Derive expressions for the short run effects on y and π of an aggregate demand shock. How do the effects depend on the policy parameters α_1 and α_2? Give an intuitive explanation. Is it desirable to choose high values of α_1 and α_2 when the shocks originate from the demand side?

Question 3: Suppose that the shocks to the economy mainly come from the economy's supply side. Discuss whether the government should choose high values of α_1 as well as α_2 in such circumstances (hint: use an AS-AD diagram to illustrate the implications of a high value of α_1 respectively α_2 for output variability and inflation variability when the shocks originate from the supply side).

Question 4: Discuss whether the policy rule (1) is realistic?