10

The Macroeconomics of an Open Economy

All economies are of course open to trade and capital transactions with others; only the world economy is not. So in principle, the models we have dealt with to this point are all to be considered as models of the world economy. Even the United States, once blithely treated as 'closed' by the majority of macroeconomists, has been recognized in the past two decades at least to be importantly affected by international influences.

These influences are transmitted through the balance of payments which records the transactions of a country's residents with residents elsewhere. The current account records all transactions with non-residents which alter the net assets of residents, that is, transactions that require payment. Exports of goods and services and receipts of factor income from abroad (interest, profits and dividends, and remitted rents or wages) increase residents' net worth: if residents do not receive direct payment by cash or cheque, then they receive IOUs in some form. Imports decrease residents' net worth. Exports net of imports, the current account balance, therefore measures the change in residents' net worth as a result of transactions with 'foreigners', non-residents. This implies that movements in the current account have net wealth effects wherever in the domestic economy wealth matters — notably spending, possibly the demand for money and the supply of labour.

The capital account of the balance of payments records the capital counterpart of all current transactions (that is, payment in some form by a drawdown of assets against foreigners) and also all transactions with non-residents which do not alter net assets of residents but rather reshuffle them: for example, borrowing from or lending to them (a swap of a loan liability for cash), equity issues (a swap of the ownership of physical assets for cash), direct purchase of physical assets or 'direct investment' (a swap of physical assets for cash) or combinations of these

	Assets		Liabilities
1	Physical capital	4	Government bonds (inc. Treasury bills)
2	Value of cumulated current deficits	5	Currency in hands of banks and public
3	Reserves		

Table 10.1: Consolidated bank / government balance sheet

(like equity purchase financed by borrowing). It follows that the net change in the capital account (the rise in net assets) is exactly equal to the current account balance. By convention a rise in assets is recorded with a minus sign so that the capital and current account balances thus sum to zero.

Within the capital account, transactions with the central bank are singled out. The central bank's net foreign asssets, the 'foreign exchange reserves', can finance purchases and sales of the domestic currency, usually for reasons of exchange rate policy. Apart from net interest earned or capital gains, which are typically small enough to neglect, the reserves will only rise or fall because of these sales or purchases, that is, foreign exchange intervention.

The reserves have monetary significance. If we think of the central bank as the monetary arm of the government, issuing money and holding reserves for it, then we can write the consolidated bank/government balance sheet as in Table 10.1

Items 1 and 2 are the result of the government's past decisions to invest (1) and to consume more than its revenue (2). These are financed by borrowing (item 4) or currency issue (5). Changes in item 3, the acquisition of foreign assets (net), must be similarly financed by new borrowing or currency issue, given the inherited items 1 and 2. In change terms we can write:

$$\triangle M = \triangle R + DEF - \triangle B \tag{1}$$

where M = currency issue, R = reserves, DEF = the government's investment and consumption less revenue ('total' deficit, or 'borrowing requirement'), B = bonds outstanding. DEF and B can be computed either inclusive or exclusive of capital gains or losses. The essential point of (1) is that if there is foreign exchange intervention, $\triangle R$, to sell the domestic currency, this will increase the money supply, $\triangle M$, unless there is an offsetting open market operation, in this case the sale of bonds, $\triangle B$, for currency.

We can immediately link this to the exchange rate regime. Under fixed exchange rates, the central bank stands ready to maintain the exchange rate with whatever intervention is needed. At this exchange rate, the economy will throw up a current account, $CURBOP$, and a balance, $CAPBOP$, on all capital transactions not involving the central bank (or 'capital balance' for short). By definition the current account balance, being the net acquisition of foreign assets, must of course be equal to the balance of net foreign assets transactions recorded in the capital account, including transactions in the foreign exchange reserves. By the balance of payments convention noted above (an application of double-entry book-keeping), assets acquired are recorded with a negative sign in the capital account, liabilities with a positive sign. This implies that all non-reserve transactions which would increase the reserves, by requiring payments from foreigners, are positive, and vice versa.

Hence

$$CURBOP + CAPBOP = \triangle R \tag{2}$$

It follows that the supply of money is affected through (1) by whatever reserves movements are thrown up at the fixed exchange rate.

A floating exchange rate is defined by the absence of foreign exchange intervention: $\triangle R = 0$. Hence the rate has to move to whatever level will continuously force the current and capital accounts together to zero.

A useful way to approach the open economy aspects then is to set up models of the current and capital account respectively.

THE CURRENT ACCOUNT: TWO MODELS

There are two main models of trade flows in the short or medium run. The first assumes that products are non-homogeneous and produced under imperfect competition: the products of British firms differ from those of German firms, say, even in the same market. The second assumes that products are homogeneous and produced under perfect competition: prices for British and German output of the same product are equalized across all world markets (that is, in any given market they will be equal, though transport costs will cause prices of both to differ between markets).

Let us take each model in turn, in each case treating home costs and prices as given: we will revert to this 'supply' aspect shortly. All prices will be expressed in home currency so that the exchange rate is implicit in the foreign prices.

Imperfect Competition

The imperfect competition model is illustrated in figure 10.1. XX shows the demand for exports by non-residents (shifted by world trade, WT), MM that for imports by residents (shifted by domestic demand, D). The ϕM curve shows the real value of imports as $P_H/P_F(= 1/\phi)$ varies.

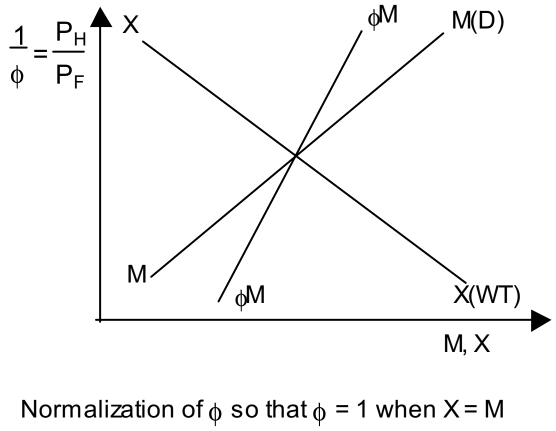


Figure 10.1: The imperfect competition model of the current account

This is the familiar model of import and export demand, encountered in the majority of macro models. The resulting current account equation is:

$$CURBOP = P_H X(WT, P_H/P_F) - P_F M(D, P_H/P_F) \tag{3}$$

In real terms

$$\frac{CURBOP}{P_H} = X - \phi M \tag{4}$$

where $\phi = P_F/P_H$ is the inverse of the terms of trade. It is usually found in empirical work (e.g. by Stern et al., 1976) that the current account improves after a few years when the terms of trade worsen (as could occur with a devaluation that is not fully offset by a rise in home prices), although in the short run because of lags in the response of trade volumes the current account may worsen (the ‘J-curve’). The condition for improvement (the Marshall-Lerner condition) can be written in terms of elasticities as:

$$\varepsilon_x + \varepsilon_m - 1 > 0 \tag{5}$$

This applies exactly when trade is initially in balance ($X = \phi M$) and is derived straightforwardly from:

$$0 < [\delta(\frac{CURBOP}{P_H})/\delta\phi] \cdot \phi/X = \frac{\delta X}{\delta\phi} \cdot \frac{\phi}{X} - \phi \cdot \frac{\delta M}{\delta\phi} \cdot \frac{\phi}{\phi M} - M \cdot \frac{\phi}{\phi M} = \varepsilon_x + \varepsilon_m - 1 \quad (6)$$

remembering that $\varepsilon_m = - \frac{\delta M}{\delta\phi} \cdot \frac{\phi}{M}$ is positive by the elasticity convention.

Perfect Competition

The perfect competition model is illustrated in figure 10.2. We take non-traded goods ('home') prices, P_{NT}, as given in this case; traded prices, P_T, are of course set by world market conditions. A devaluation, not offset fully by a rise in home prices, will raise P_T relative to P_{NT}. Domestic demand, D, depending overall on output, y, and wealth, θ, is split between traded and non-traded goods by relative prices, P_{NT}/P_T. The supply of non-traded goods, at given P_{NT}, rises or falls to meet demand for them (in practice market-clearing will require that P_{NT} move to equilibrate the two). The supply of traded goods will depend on traded prices relative to home prices (and costs): we will assume throughout that capital stocks are fixed (although this can easily be varied to obtain long run solutions; see the appendix).

The current account equation we obtain is:

$$CURBOP = P_T(Q_T[P_{NT}/P_T] - D_T[D, P_{NT}/P_T]) \quad (7)$$

where we have aggregated over exported and imported products; in fact $P_T Q_T = P_{XT} Q_{XT} + P_{MT} Q_{MT}$ (similarly $P_T D_T$), so if there is an improvement in the terms of trade, P_{XT}/P_{MT}, the current account would improve, with no consequence for trade volumes provided P_{NT}/P_T remained constant — unlike the imperfect competition model. A fall in P_{NT}/P_T (due say to a devaluation not fully offset by a rise in P_{NT}) will unambiguously improve the current account in both the short and the long run — unlike the effects of the analogue, a terms of trade change in the imperfect competition model.

HOME PRICES: THE SUPPLY SIDE

We held home prices constant to study the partial equilibrium determination of the current account, largely from the demand side. We now discuss how home prices in the two models are determined, and also the general demand-supply equilibrium of the model.

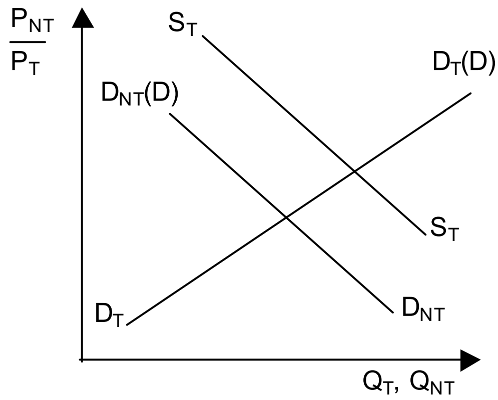


Figure 10.2: The perfect competition model of the current account

Imperfect competition

Figure 10.3 illustrates this in the imperfect competition model (it is a diagram adapted from the earlier Parkin and Bade diagram of figure 3.2). In the bottom left hand quadrant, the labour supply curve slopes upward as the real consumer wage, W deflated by the consumer price index, π, rises. $\pi = P_H^{\alpha} P_F^{1-\alpha.}$, that is, it is a weighted average of home goods prices and imported prices. The demand for labour however reacts to the real producer wage,

$$\frac{W}{P_H} = \frac{W}{\pi} \cdot \frac{\pi}{P_H} = \frac{W}{\pi} \cdot (\frac{P_F}{P_H})^{1-\alpha}$$

so as $(P_H/P_F) = e$ rises, $\frac{W}{P_H}$ the real producer wage falls relative to the real consumer wage and the demand for labour rises, shifting DD rightwards. The higher employment is translated, by the production function and the 45° line in the top two quadrants, into an open economy supply curve, OS in the bottom right-hand quadrant. Finally, we use figure 10.1 to derive a curve showing combinations of e and D that give current account equilibrium: that is, where the XX and ϕM curves cross each other as D is varied. The resulting curve is the XM in the bottom right quadrant of Figure 10.3: note that since along it, $D = y$ (implied by current account equilibrium), we can draw it in e, y space.

When these relationships are put together, we can see in figure 10.3. that e_0, y_0, L_0, $(W/\pi)_0$ are the general equilibrium, conditional on the capital stock (we can also let this vary: for this long-run case, see the appendix).

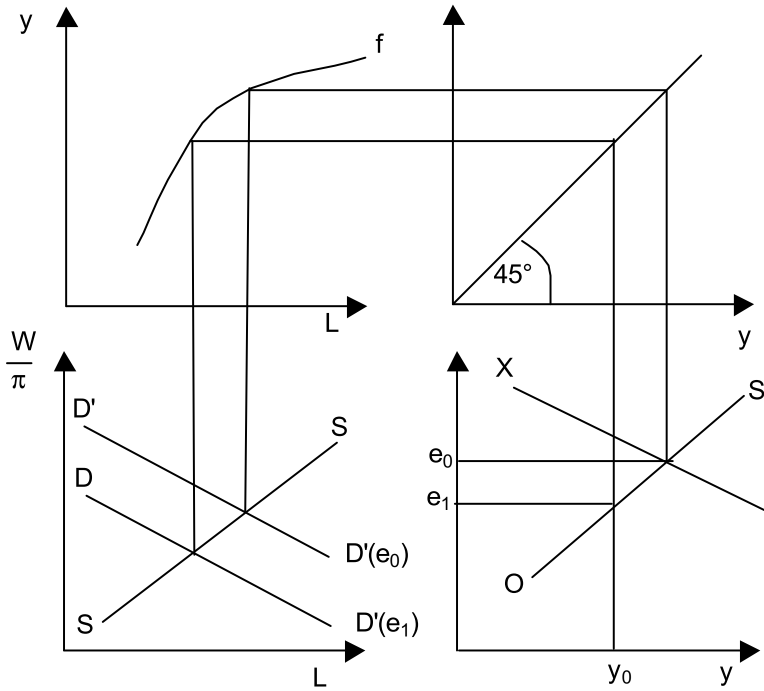


Figure 10.3: Supply and Demand in the Open Economy under imperfect competition (capital stock fixed)

Perfect Competition

Figures 10.4 and 10.5 explain how the perfect competition open economy supply curve is derived. Figure 10.4 shows the demand for labour by traded and non-traded goods industries: the non-traded demand is assumed to be more elastic that the traded, because factor proportions are more malleable, given the capital stock, than in manufacturing (hotel porters versus machine operatives). Since

$$\pi = P_{NT}^{1-\alpha} P_T$$

it follows that

$$W/\pi = (W/P_{NT})(P_{NT}/P_T)^{\alpha}$$

and also that

$$W/\pi = (W/P_T)(P_{NT}/P_T)^{-(1-\alpha)}$$

This implies that if P_{NT}/P_T (which now becomes the real exchange rate, e) rises, then at a given W/π, producer real wages rise for the traded goods sector, to w'_T, but fall for the non-traded sector, to w'_{NT}. Overall, under our assumption, the demand for labour would then rise, just as in figure 10.3.

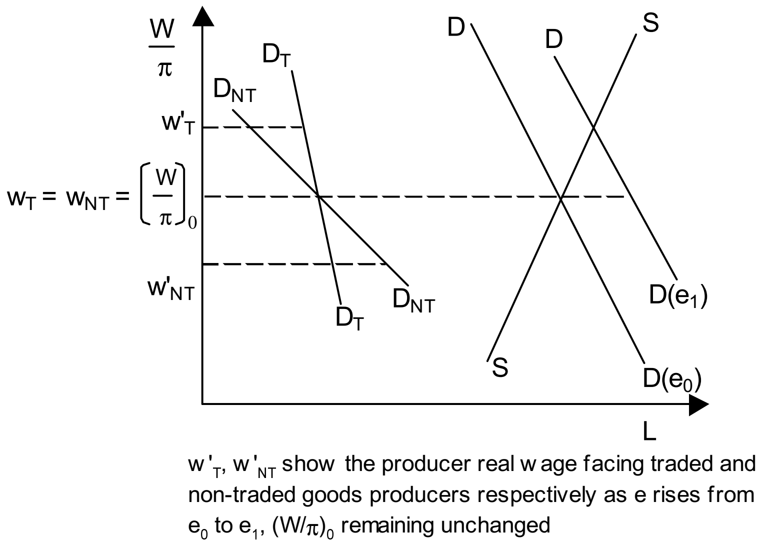


Figure 10.4: The labour market under perfect competition (capital stock fixed)

Figure 10.5 then takes up the rest of the story, as in figure 10.3. In the top left-hand quadrant is shown the production function for the whole economy (f) as well as those for traded and non-traded goods: clearly one can trace out production in each of these two sectors as well, from their demands for labour in figure 10.4.

The XM curve in figure 10.5 is derived from figure 10.2 by varying D and tracing out the P_{NT}/P_T values for which there is an intersection between demand and supply for traded goods (current account equilibrium). As with the derivation of the XM in figure 10.3, $D = y$ at these values so that we can draw the relationship as between P_{NT}/P_T and y. General equilibrium is at the intersection of the XM and OS curves, at e_0, y_0, L_0, $(W/\pi)_0$.

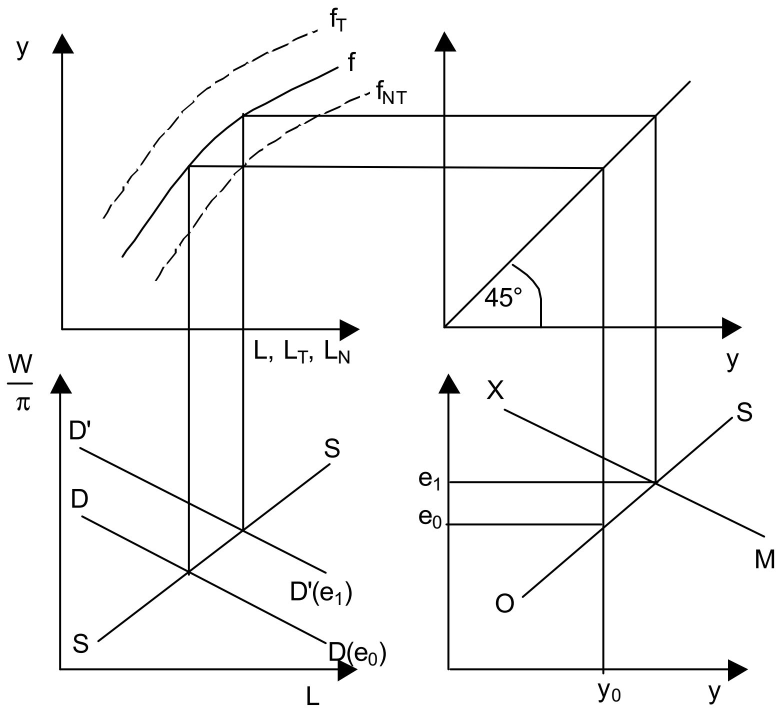


Figure 10.5: Supply and Demand under perfect competition (capital stock fixed)

The open economy supply curve (OS) and the effect of prices

The OS curve we have just derived can be thought of as the equivalent of y^* in the closed economy Phillips curve: that is, it is the state of the economy when there are no price surprises (including prices different from those built into wage contracts for the New Keynesian case).

The analysis when there are price surprises is the same as in the closed economy case, only here the OS curve shifts in e, y space — a presentational difference only. Figure 10.6 illustrates the resulting open economy 'Phillips curve' effect.

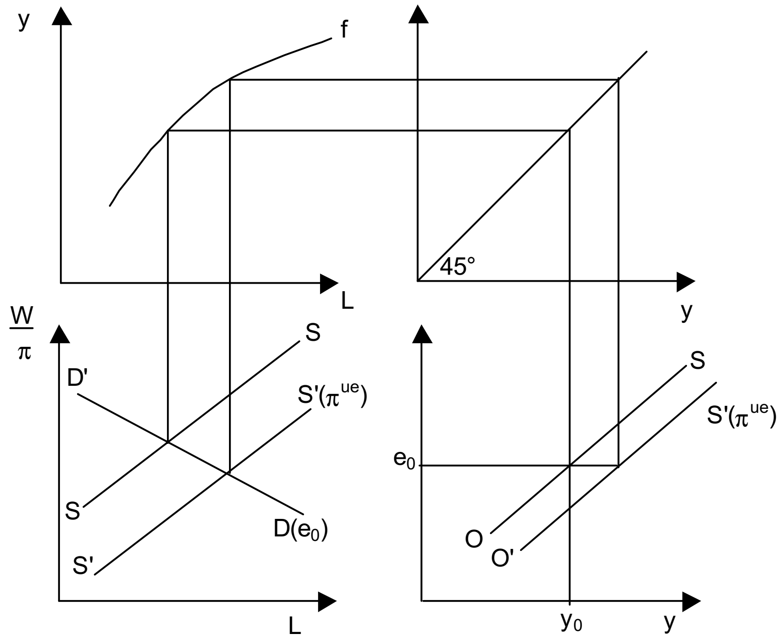


Figure 10.6: A price surprise shifts the OS curve: the open economy Phillips curve effect

THE CAPITAL ACCOUNT AND THE REST OF THE OPEN ECONOMY MODEL

We shall see in Chapter 14 (where we deal with efficient markets) that, as a result of portfolio diversification, the equilibrium price or return on an internationally traded asset is (possibly totally) insensitive to variations in its supply. In the case of interest rates, this gives rise to the uncovered interest parity condition:

$$R_t = R_{F,t} - (E_t S_{t+1} - S_t) \tag{8}$$

This safe return on one-period bonds (in domestic currency terms) is the benchmark for all other domestic asset returns: if the yield is sensitive to the supply of domestic assets, one can add to (8) an extra term in the stock of net foreign assets, and possibly also total assets, inclusive too of the physical capital stock. However, empirically such terms are rarely significant and we ignore them here.

It is useful to rewrite (8) in real terms:

$$r_t = R_t - E_t\pi_{t+1} + \pi_t = R_{F,t} - E_t\pi F_{,t+1} + \pi_{F,t}$$
$$- (E_tS_{t+1} + E_t\pi_{t+1} - E_t\pi_{F,t+1}) + (S_t + \pi_t - \pi_{F,t})$$
$$= r_{f,t} - E_te_{t+1} + e_t \quad (9)$$

where r is the real interest rate and e the real exchange rate defined in this section as the (log) ratio of the consumer price deflators. (9) is the 'BB curve' of the Mundell-Fleming model (Mundell, 1960; Fleming, 1962) along which the foreign exchange market is always clearing.

Whether we have the perfect competition model or the imperfect competition model, this definition of the real exchange rate will do equally well. In the perfect competition model, $\pi - \pi_F = (1-\alpha)P_{NT} + \alpha P_T - \pi_F$ (all prices are now expressed in logs). If $\pi_F = P_T$, then $\pi - \pi_F = (1-\alpha)(P_{NT} - P_T)$. In general $\pi_F = \delta P_T + (1-\delta)P_{F,NT}$ and $\pi - \pi_F = (1-\alpha)(P_{NT} - P_T) + (1-\delta)(P_T - P_{F,NT})$. Clearly in all cases $\pi - \pi_F$ picks up the movement of domestic non-traded prices relative to foreign traded prices converted into domestic currency. In some circumstances there will also be an error reflecting an equivalent movement abroad.

In the imperfect competition model,

$$\begin{aligned}\pi - \pi_F \quad &= \quad \alpha P_H + (1-\alpha)P_F - \delta P_F - (1-\delta)P_H = \\ &\quad\; (\alpha + \delta - 1)(P_H - P_F)\end{aligned}$$

where $\alpha > 0.5 < \delta$. Here $\pi - \pi_F$ is a transform of the terms of trade, the real exchange rate in this model.

In either case we will incorporate coefficients $(1-\alpha)$ and $(\alpha+\delta-1)$ into the coefficients of e_t in the IS, XM and OS curves in the rest of the model, to which we now turn. We can modify the IS curve as:

$$y_t = -\alpha r_t - \delta e_t + k\theta_t + \overline{d} \quad (10)$$

where θ = net nominal wealth, including now net foreign assets, and e enters because of the effect on demand of the current account. The LM curve becomes:

$$m_t = \pi_t + ny_t - \beta R_t \quad (11)$$

Now let us ignore government bonds as net wealth; we can then write the current account as

$$\triangle\theta_t = -qe_t - \mu y_t \quad (12)$$

Add the definition

$$e_t = \pi_t + S_t - \pi_{F,t} \quad (13)$$

the open economy supply curve:

$$y_t = \sigma e_t + p(\pi_t - E_{t-1}\pi_t) \tag{14}$$

and the definition of real interest rates:

$$r_t = R_t - (E_t\pi_{t+1} - \pi_t) \tag{15}$$

Equations (9) to (15) make up a seven equation model determining y, e, r, θ, π, R and either m (S fixed: fixed rates) or S (m fixed: floating rates). The solution can be found by the methods in chapter 2: it turns out that the characteristic equation is second order. We will assume that the solution is well-behaved, with both forward and backward roots stable.

Here, rather than find the solution algebraically, we use a graphical method. We can note (from the solution) that $E_te_{t+1} = je_t + \varepsilon_t$ where ε_t is a combination of the current shocks to the model and j is the stable backward root. Now use (9), the BB curve, to eliminate r_t in favour of e_t throughout the model. When we do this substitution in the IS curve we are obtaining Parkin and Bade's (1988) $ISBB$ curve, the IS curve when the foreign exchange market is cleared. Notice that this $ISBB$ curve shifts with θ_{t-1}, the previous stock of net foreign assets (we eliminate θ_t in terms of e_t, y_t and θ_{t-1} in (12).

The XM and OS curves have been derived earlier. This leaves the determination of prices in the right-hand quadrant. Under fixed exchange rates ($S = \overline{S}$) we can use (13) to obtain prices along the 45° line, FX. Under floating, prices are determined by (11) using (9) as follows:

$$\pi_t = m_t - ny_t + \beta(r_{F,t} + E_t\pi_{t+1} - \pi_t + (1-j)e_t - \varepsilon_t) \tag{16}$$

So the slope of the FL curve is (given by the solution $E_t\pi_{t+1} = j\pi_t + \eta_t$ η_t being a combination of shocks, like ε_t in the analogous solution of $E_te_{t+1} = je_t + \varepsilon_t$)

$$\frac{\delta e_t}{\delta \pi_t} = \frac{1 + \beta(1-j)}{\beta(1-j)} > 1$$

Finally we can illustrate how the model works, with a temporary fiscal shock, shifting the $ISBB$ curve temporarily to the right. This is shown under floating in Figure 10.7 by the dashed lines. The $ISBB$ shifts out the $ISBB_1$. This raises output, shifting the FL curve to F_1L_1, lowering prices and so shifting the OS curve left to O_1S_1. This creates a current account deficit (equilibrium in period 1 is to the right of the XM curve); note that the XM curve partitions the e, y space between falling θ (to its right) and rising θ (to its left). Thus θ falls so that next period, the $ISBB$ shifts leftwards to $ISBB_2$. Also in period 2 the OS

curve returns to OS_1 (π^{ue} now being zero), while the FL curve shifts to the right with falling output. From period 2, the $ISBB$-OS intersection lies to the left of the XM; so θ continues to rise (at the rate $1-j$, along the stable path) until eventually it reaches the XM curve.

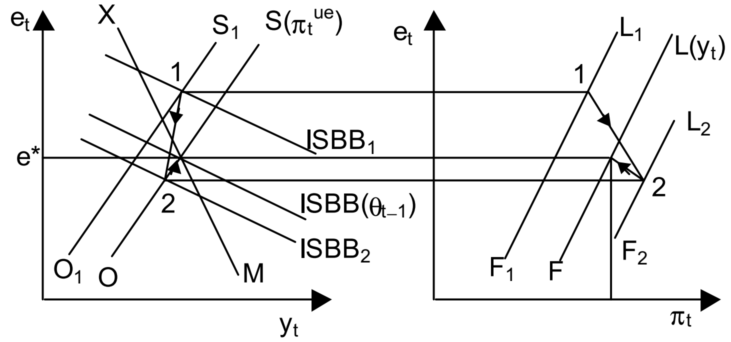


Figure 10.7: The full open economy and a fiscal shock under floating rates

The same fiscal shock is shown for fixed rates in figure 10.8. It can be seen that apart from the effect on prices, which may fall under floating but must rise under fixed, the effects are quite similar. The real exchange rate, real interest rates and output rise; and these rises are later reversed.

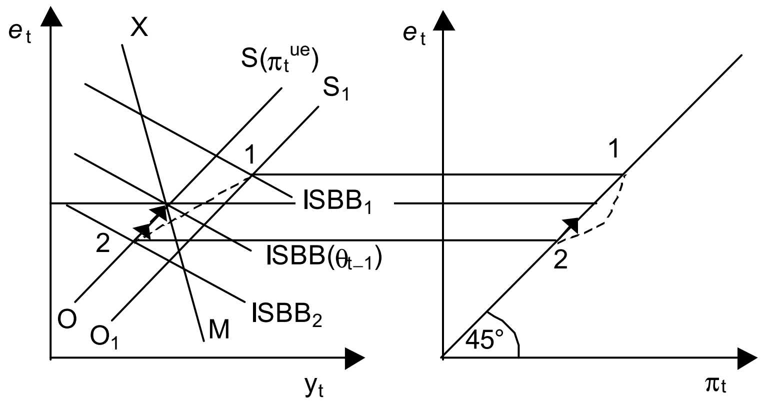


Figure 10.8: A fiscal shock under fixed rates

Needless to say, this model represents just the barest bones of a fully specified open economy model. But it should clarify the key elements, before the encrustation of complications from adjustment lags, contracts and the rest.

CONCLUSIONS

The open economy model is of key importance in applied macroeconomics, since all economies (except the world) are open! This chapter has extended the earlier analysis to capture the main essentials of openness.

The current account determines movements in net foreign assets, a key element of national wealth; these impact on spending. The current account depends on demand and relative prices; either relative home/foreign prices (under imperfect competition) or relative traded/non-traded prices (perfect competition). These relative prices are in turn determined by supply conditions interacting with demand: the open economy supply curve is derived analogously to the Phillips curve in the closed economy, but wages react additionally to the changing relative foreign prices.

The capital account (excluding the central bank's operations) has monetary importance: together with the current account it determines the demand for and supply of money. If the central bank does not intervene in the foreign exchange market, then demand must equal supply: the exchange rate moves to ensure this — floating rates. Consumer prices are then determined by the domestically set money supply, interacting with the demand for money. If the central bank intervenes, to hold the exchange rate — fixed rates — the reserves will adjust to equal the gap between demand and supply: but changes in the reserves will change the money supply through the central bank's balance sheet. With market efficiency, the reserves will adjust so rapidly as capital flows to take immediate advantage of any uncovered interest differential, that the central bank loses all, even short term, control of the money supply. When all these factors are put together, the open economy model shows how the economy can be stimulated termporarily, with the real exchange rate and real interest rate moving in sympathy with output and the price level, but that losses of net foreign assets cause it to reverse this stimulus in order to restore the economy's original wealth.

It can be seen that under floating exchange rates an open economy has essentially the same structure as the closed-economy models we analysed earlier: the floating exchange rate adjusts to insulate domestic monetary policy from foreign monetary policy. The main differences are that the effects of interest rates are reinforced by the real exchange rate which rises with the real interest rate, and that there are additional spillovers from foreign shocks. However, the decision to fix the exchange rate causes a radical alteration in the behaviour of the economy by subordinating its monetary conditions to foreign monetary policy: its nominal interest rates are fixed abroad.

APPENDIX 10A LONG-RUN EQUILIBRIUM IN THE OPEN ECONOMY

In the long run, the capital stock is variable. It is natural to assume constant returns to scale, since there is a tendency for industries to be driven to operate at their lowest cost level by the processes of international competition: if there were decreasing returns to scale, industries would contract and if increasing, they would expand until constant returns were achieved. As for external returns to scale, there is pressure to internalize these externalities and similarly to drive industry operations to the minimum cost point: even if the externalities are at the national level, forces operate to internalize them through national policy.

Imperfect Competition

Assuming constant returns to scale and mobile international capital, figure 10.3 is redrawn for the long-run figure 10.9. Now in the labour market there is a unique feasible real consumer wage that can be paid given the terms of trade and the international cost of capital ($\overline{r}$). Because $P_H = W^\beta(\overline{r}P_F)^{1-\beta}$ and $\pi = P_H^\alpha P_F^{1-\alpha}$, therefore:

$$\frac{W}{\pi} = \frac{W}{P_H^\alpha P_F^{1-\alpha}} = \frac{P_H^{1/\beta}(\overline{r}P_F)^{-(1-\beta)/\beta}}{P_H^\alpha P_F^{1-\alpha}} = (P_H/P_F)^{(\frac{1}{\beta}-\alpha)}\overline{r}^{(1-\frac{1}{\beta})}$$

(note that $\frac{1}{\beta} > 1 > \alpha$; capital goods are assumed to be imported but this does not affect the essential argument).

As e rises from e_0 to e_1, so the feasible real consumer wage rises; labour supply increases. Also $\frac{W}{P_H} = [\frac{P_H}{\overline{r}P_F}]^{(\frac{1}{\beta}-1)}$ also rises, so that labour input per unit of output is reduced and the production function shifts upwards. The open economy supply curve is accordingly flatter in the long run than in the short.

Perfect competition

Figures 10.10 and 10.11 show the long run equilibrium of the perfect competition model. As in the short run we have $\pi = P_{NT}^{1-\alpha}P_T^\alpha$. But in the long run under constant returns we also have

$$P_T = W^\delta(\overline{r}P_T)^{1-\delta} \tag{1}$$

$$P_{NT} = W^\beta(\overline{r}P_T)^{1-\beta} \tag{2}$$

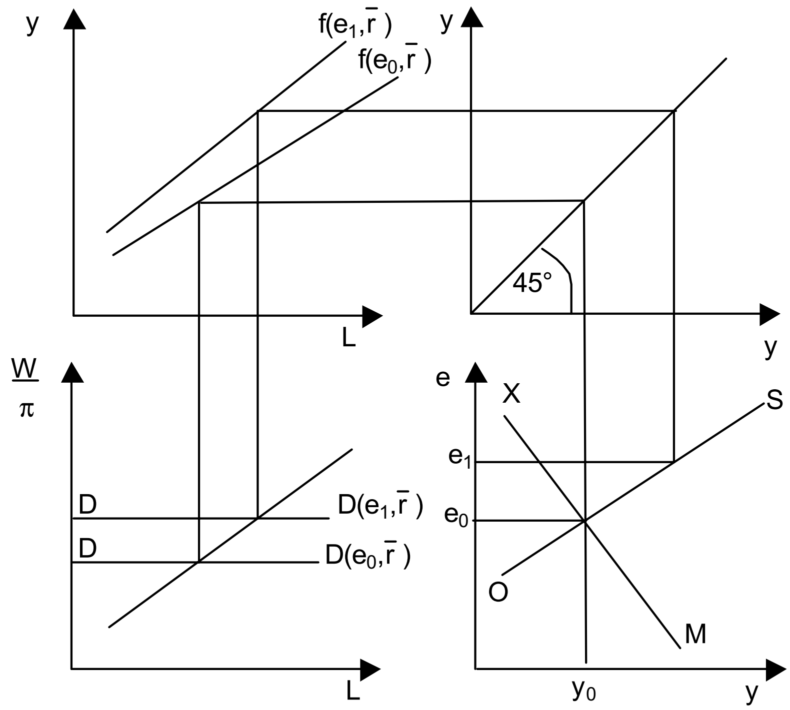


Figure 10.9: The open economy under imperfect competition in the long run

Together these two imply that $e = \frac{P_{NT}}{P_T} = \overline{r}^{1-(\beta/\delta)}$. Using the definition of π, they also imply that

$$W/\pi = \overline{r}^{-\frac{1-\beta+\alpha[\beta-\delta]}{\delta}} \qquad (3)$$

So assuming that π is set by domestic monetary conditions, these three equations determine $W,\ P_T,\ P_{NT}$ as functions of π and $\overline{r}$; in other words, $\overline{r}$ determines real consumer wages (W/π), the real exchange rate, $e = P_{NT}/P_T$, and real product wages, $(W/P_T,\ W/P_{NT})$. Figure 10.A.2 shows how from e^* (given by $\overline{r}$), any slight rise in e would lead to an infinite expansion of the traded goods industry, and vice versa; assume for these purposes that labour is in infinitely elastic supply at some W and that P_{NT} is given by (2) so that non-traded industry expands to whatever is required by demand. As demand is varied, traded goods are made available by this process (P_T rising or falling) to keep the current account in balance. This yields the flat XM curve in Figure 10.11.

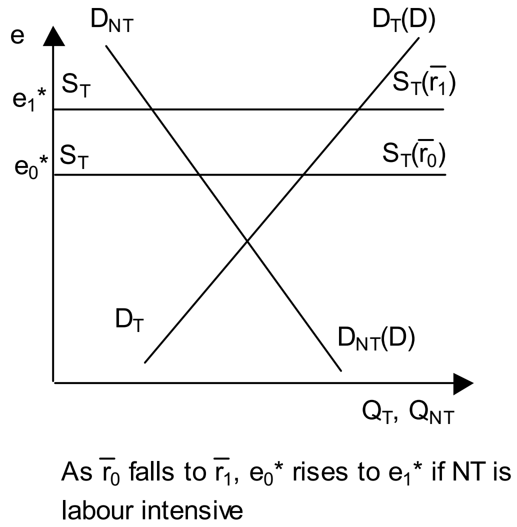
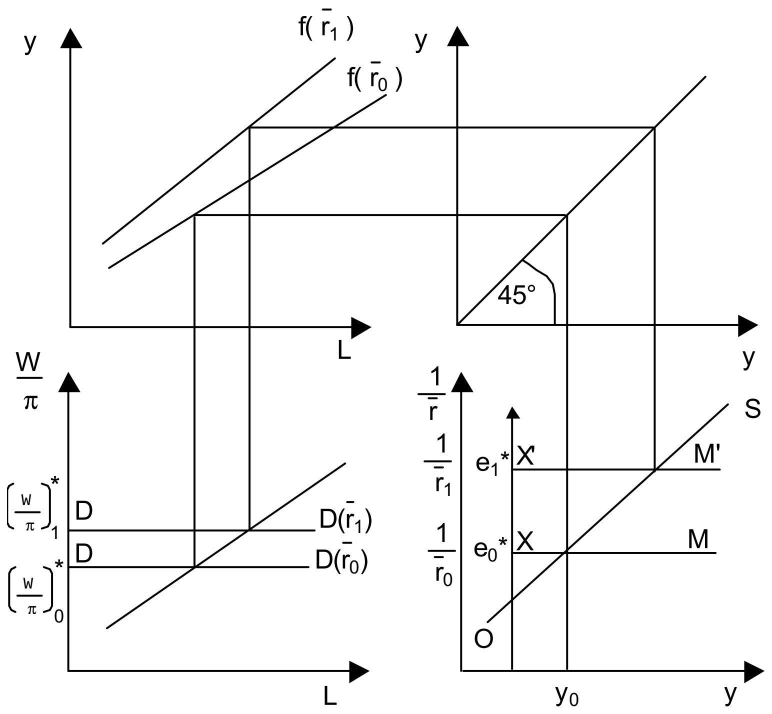


Figure 10.10: The perfect competition model of the current account in the long run

Turning now to constraints on labour supply, we see in Figure 10.A.3 how at each e^* (corresponding to a certain $\overline{r}$) there is a unique real consumer wage, $(W/\pi)^*$; any rise of $(W/\pi)^*$ above this reduces the output of both industries, and also their demand for labour, to zero, since it exceeds labour's long run unique marginal product. At this $(W/\pi)^*$ there is a particular labour supply which defines the level of employment and output. If we assume that the non-traded sector is labour-intensive (β is larger than δ), then as $\overline{r}$ rises, both e and W/π fall. This is the assumption made in Figures 10.10 and 10.11, giving an upward-sloping long-run OS curve (otherwise it would slope downwards). What we are seeing here is the standard Heckscher-Ohlin-Samuelson model result that a rise in the cost of capital raises the relative price of the capital-intensive industry and lowers the real wage.



As $\bar{r}_0$ falls to $\bar{r}_1$, e^*_0 rises to e^*_1 (assuming NT is labour-intensive)

Figure 10.11: Supply and demand under perfect competition in the long run