Williamson (versão em inglês)

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example, that the price of oil rises, thus worsening the country's terms of trade, and that it is necessary to adjust this deficit as has been assumed so far in this chapter. That adjustment would require either a fall in real income or a real depreciation. Ruling out the former as involving an irrational waste of real resources, it becomes necessary in this case to depreciate more than is indicated by (10.6). How much more? That cannot be answered by PPP: it requires instead a knowledge of the elasticities. The moral is that PPP should not be applied blindly, but that consideration needs to be given as to whether there are real shocks that create a need for changes in π. The need to exercise such care does not constitute a reason for refusing to exploit such guidance as the theory can give.

10.3 The Mundell-Fleming Model

The model that now bears the name of Robert Mundell and the British economist J. Marcus Fleming (1911–76) was introduced more or less simultaneously and apparently independently by the two of them in the early 1960s, shortly after they ceased to be colleagues in the IMF's Research Department because of Mundell's move to Chicago. It advances on the work so far discussed in this chapter in introducing capital mobility, in the form of the flow theory examined in chapter 9.2.

The other assumptions are conventional enough. The basic framework is the IS/LM/BP model, with prices (or at least wages) assumed to be fixed. The balance on current account is determined by income and relative prices, ep^*/p. There are no lags: the economy moves to its new equilibrium immediately. The exchange rate floats freely, so that the current deficit is equal to the capital inflow (or vice versa) with no change in reserves. Finally, expectations are static: agents always expect the indefinite perpetuation of the present. The last assumption is crucial in enabling one to treat the interest rates in the two countries as representing the opportunity costs of holding assets in the one country rather than the other, and thus continuing to use a capital flow equation of the form $f(i,i^*)$ introduced in chapter 9.2. In general, of course, one would expect that investors will be interested in comparing their total expected yields from holding foreign rather than domestic assets, which points to the need for a specification $f(i, i^* + E\hat{e})$. This generalization is introduced in the following section. For the moment, one just has to imagine that investors never have any expectation that the exchange rate is more likely to rise than to fall.

A lot of attention is paid in the literature to the case of perfect capital mobility—perhaps more than it deserves. With a floating exchange rate, capital mobility could be perfect only if investors had complete confidence in the future maintenance of today's exchange rate, or else if they were completely risk neutral. The former assumption is totally implausible, given that actual floating rates are forever bobbing around. The latter assumption is usually regarded as a very strong one. Accordingly, the case of perfect capital mobility should be treated more as a point of intellectual reference —like the case of perfect immobility, the current balance model of chapter 10.1—than as a model to be seriously applied in understanding the real world or giving policy advice. The important case is the intermediate one of finite capital mobility.

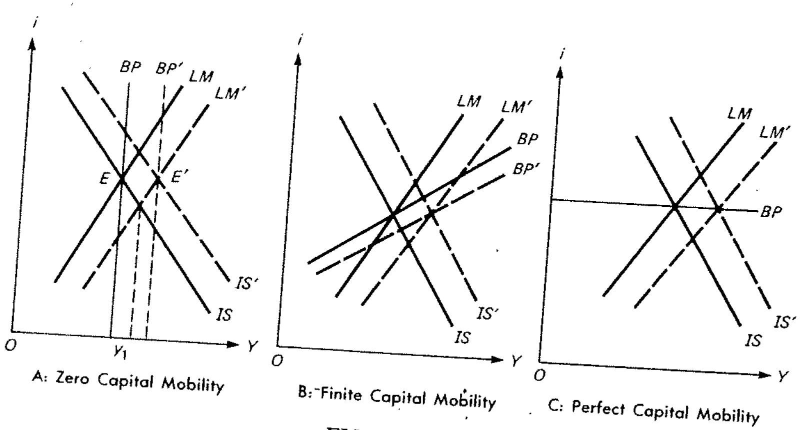

FIGURE 10–3
Monetary Policy in the Mundell-Fleming Model

The analysis of monetary policy in the Mundell-Fleming model is illustrated in figure 10–3 for the three cases of capital mobility. Consider first the case of zero capital mobility (shown in figure 10–3A), which is reflected in a vertical *BP* curve. Initial equilibrium is at *E*. The *BP* curve necessarily cuts the *IS/LM* intersection at *E* because of the assumption of a floating exchange rate, which guarantees that the balance of payments be in equilibrium. Now consider the effect of an expansionary monetary policy, that is, an increase in domestic credit. The effect of this is to push the *LM* curve to the right, to *LM′*. With a fixed exchange rate that would be the end of the story, at least in the short run:[8] income would expand by y_1 and the balance of payments would go into deficit. But with a floating exchange rate the story cannot end there, even in the short run, because the balance of payments cannot go into deficit. The incipient deficit instead causes the exchange rate to rise (that is, the domestic currency to depreciate), which pushes both *IS* and *BP* to the right as analyzed in the elasticities approach analysis of chapter 8.3. This continues until all three curves intersect at the same point, *E′*. (We can be sure that all three curves will intersect at the same point because we are requiring payments equilibrium, as well as equilibrium in the goods and money markets, and there is a third endogenous variable, *e*, to add to the pair *Y, i* of the fixed-rate case.) This necessarily occurs with a *Y* that has risen by more than Y_1, thus showing that monetary expansion is more effective in raising income with a floating exchange rate in the case of zero capital mobility.

8. In the long run, the payments deficit would lead to *LM* migrating leftward until it again intersected *IS* at *E*, assuming an absence of sterilization.

TABLE 10–1
Short-run Comparative Static Effects in the Mundell-Fleming Model

	Fixed Exchange Rate			*Floating Exchange Rate*		
Degree of capital mobility	0	+	∞	0	+	∞
Monetary expansion, $\Delta D > 0$	$y_1 > 0$	y_1	0	$> y_1$	$> y_1$	$> y_1$
Fiscal expansion, $\Delta G > 0$	$y_2 > 0$	y_2	$> y_2$	$> y_2$	$+, \gtreqless y_2$	0
Commercial restriction, $\Delta \tau > 0$	$y_3 > 0$	y_3	$> y_3$	0^a	0^a	0^a

[a] Or negative, if the Laursen-Metzler effect holds (see nn. 1 and 2)

Table 10–1 has been designed to combine the various results that will be established in this section. The results just established are entered in the first row, which shows the effects on *Y* of a monetary expansion ($\Delta D > 0$). The first column records that with a fixed rate and zero capital mobility the monetary expansion raises *Y* by an amount $y_1 > 0$ as illustrated in figure 10–3A. The fourth column records that with a floating rate the effect on *Y* is bigger than y_1, which is used as a standard of reference.

The analysis is little changed in the case of finite capital mobility shown by a positively sloping *BP* curve in figure 10–3B. Monetary expansion shifts the *LM* curve right exactly as before, and hence the short-run equilibrium is the same with finite capital mobility as with capital immobility. At the point where *IS* and *LM′* intersect there is again an incipient deficit, which implies that the exchange rate must increase. Equilibrium again occurs where the three curves intersect, with an income expansion larger than with fixed rates.

The case of perfect capital mobility differs in that, as already seen in chapter 9.2, a monetary expansion under fixed rates is immediately reversed through a capital outflow. Thus monetary policy is impotent to influence income with a fixed exchange rate, as reflected in the zero entry in table 10–1. With a floating rate, however, the monetary expansion causes a depreciation and an increase in income until such point as the demand for money has risen (because of the increased income) to match the rise in supply. At that point the country has developed a current account surplus matched by a capital outflow. It can be seen that income again expands by more than in the reference case.

Consider next the effects of a fiscal expansion (an increase in government spending or cut in taxes), illustrated in figure 10–4. The impact effect is to shift the *IS* curve right to *IS'*. With a fixed exchange rate and zero capital mobility short-run equilibrium would be at *E'*, with a payments deficit. The income expansion of y_2 thus provides our reference case. Since there is a deficit at *E'*, the currency must depreciate, pushing *IS* and *BP* to the right until their intersection falls on *LM* at *E"*. Thus income expands more than under fixed rates; the potency of fiscal as well as monetary policy is increased by floating, as we found in chapter 10.1.

This conclusion is critically dependent upon the assumption of zero capital mobility, as figure 10–4B shows. *E'* is now a position of payments *surplus,* not deficit; at least, that is, in the case illustrated, where *LM* is steeper than *BP*. In that case, the exchange rate must fall, pushing *IS* left and *BP* up till an equilibrium occurs somewhere on the segment of *LM* between *E* and *E'*. Income still expands as a result of the expansionary fiscal policy, but by *less* than under fixed rates. Had *BP* been steeper than *LM*, however (reflecting a lower degree of capital mobility), income would have

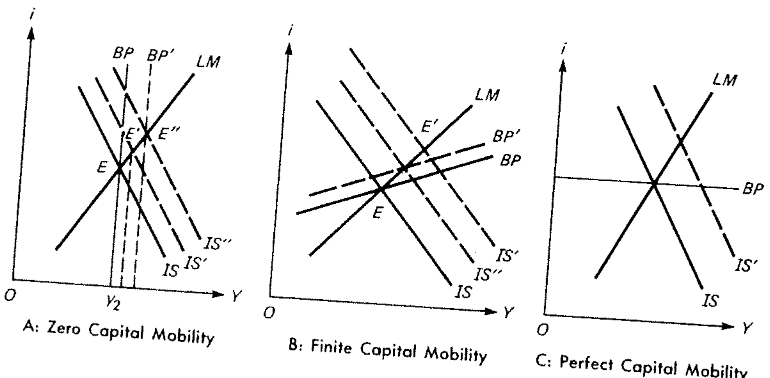

FIGURE 10–4
Fiscal Policy in the Mundell-Fleming Model

risen more than in the reference case. In either event income rises, but the rise may be greater than, equal to, or less than the rise in the reference case, as the entry in table 10–1 is intended to indicate.

With perfect capital mobility the situation is different again. With a fixed exchange rate the rightward move of the *IS* curve is matched by a rightward shift of the *LM* curve induced by a capital inflow, as seen in chapter 9.2: fiscal policy is thus very effective. With a floating rate, however, *LM* cannot move right—the money supply is fixed. Equilibrium therefore has to remain where it was, at the intersection of *LM* and *BP*, since neither move. The exchange rate makes this happen, by falling to the extent necessary to crowd out a volume of net export expenditures equal to the fiscal stimulus. Thus in this case fiscal policy is impotent to influence income. This provides the final element of a famous set of results: monetary policy is impotent under fixed rates but very effective under floating, while fiscal policy is the exact reverse—all, however, under the assumption of perfect capital mobility.

Consider now the effects of a restrictive commercial policy, for example, an increase in tariffs. The impact effect of this is to push both *IS* and *BP* to the right. The intersection of *IS'* and *LM* establishes our reference case, the rise in income that would be induced under a fixed rate, at *E'*. However, *BP* moves to the right by more than does *IS*: the *Y* that equilibrates the balance of payments increases by $(1/m)$ times the reduction in imports due to expenditure switching, while the *Y* that balances the goods market (for a given level of the interest rate) increases by only $1/(s + m)$ times the initial cut in imports. This means that *E'* is a point of payments surplus, and so the domestic currency must appreciate to restore equilibrium. In fact, since *BP'* lies to the right of *IS'* as long as *IS'* is to the right of *IS*, equilibrium must lie at point *E*. Commercial policy cannot increase income (as was already found in chapter 10.1) under a floating exchange rate with capital immobility.[9]

Figures 10–5B and 10–5C show that the analysis is essentially the same with finite or even perfect capital mobility. In both cases the exchange rate has to fall enough to crowd out completely the expenditure-switching induced by the rise in tariffs. Mr. Coyne's proposed policy mix cannot be saved by appealing to capital mobility.

Another question that is interesting to ask is whether the conclusion that a flexible exchange rate isolates a country from foreign shocks (to real income, the interest rate, or prices) remains valid under capital mobility. Unfortunately, this question cannot be answered by using the graphical analysis that has sufficed up to now, but requires slightly more advanced

9. Once again, with the Laursen-Metzler effect the new equilibrium would actually lie to the left of *E*.

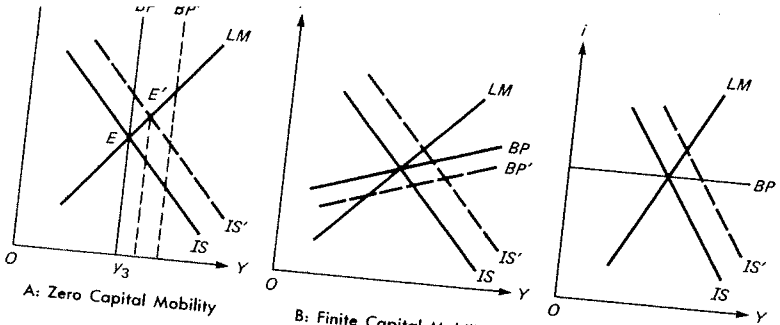

FIGURE 10–5
Commercial Policy in the Mundell-Fleming Model

mathematical techniques. (Those not familiar with elementary matrix algebra are advised to pass straight to the conclusions of the analysis.)

The model that has been analyzed graphically above may be represented algebraically by three equations: the first (*IS*) representing equilibrium in the market for goods, the second (*LM*) representing equilibrium in the market for money, and the third (*BP*) representing equilibrium in the market for foreign exchange. Letters have the same meanings as we have been giving them, except that all have been written in lower-case form and are to be interpreted as *logarithms* of the variables in question: this is because the specification supposes that the model is log linear. (An exception concerns the interest rate: i has to be interpreted as unity plus the rate of interest in fractional form—for example, a rate of interest of 5 percent is represented by $i = 1.05$ and not by log 5 or log 0.05.) Greek letters represent parameters, which are in fact elasticities in view of the log linear specification. Ignoring constant terms, that is, considering deviations from an initial equilibrium, the model is then:

$$y = \alpha(e + p^* - p) + \beta y^* - \gamma i \qquad (10.7)$$

$$h - p = \xi y - \eta i \qquad (10.8)$$

either $$i = i^* \qquad (10.9a)$$

or $$\alpha(e + p^* - p) + \beta y^* - \theta y + \lambda(i - i^*) = 0. \qquad (10.9b)$$

Equation (10.9a) represents the case of perfect capital mobility, while (10.9b) represents imperfect capital mobility (or complete immobility with $\lambda = 0$). Note that, while it is entirely natural to put the same coefficient

β in (10.7) and (10.9b), putting α in both involves assuming that the terms of trade are exogenous.

The simple case is that of perfect mobility. After substituting (10.9b) into (10.7) and (10.8), rearranging to put endogenous variables on the left-hand side and exogenous variables (which include h under floating rates) on the right, and putting in matrix form, one has

$$\begin{bmatrix} 1 & -\alpha \\ \xi & 0 \end{bmatrix} \begin{bmatrix} y \\ e \end{bmatrix} = \begin{bmatrix} \alpha(p^* - p) + \beta y^* - \gamma i^* \\ h - p + \eta i^* \end{bmatrix}.$$

Inverting the matrix to solve for the endogenous variables, one gets

$$\begin{bmatrix} y \\ e \end{bmatrix} = \frac{1}{\Delta} \begin{bmatrix} 0 & \alpha \\ -\xi & 1 \end{bmatrix} \begin{bmatrix} \alpha(p^* - p) + \beta y^* - \gamma i^* \\ h - p + \eta i^* \end{bmatrix} \qquad (10.10)$$

where $\Delta = \alpha\xi > 0$.

The question of interest is how y and e adjust when the foreign variables y^*, i^* and p^* change. One extracts from (10.10):

$$dy/dy^* = 0, \qquad de/dy^* = -\beta/\alpha < 0.$$

With perfect capital mobility an increase in foreign income still causes an appreciation of the domestic currency sufficient to prevent any increase in domestic income: the business cycle would be desynchronized internationally. Second,

$$dy/di^* = \eta/\xi > 0, \qquad de/di^* = \gamma/\alpha + \eta/\alpha\xi > 0.$$

The increase in the foreign interest rate is transmitted to the domestic economy by incipient interest arbitrage, which causes the currency to depreciate and income to rise by as much as is needed to restore the demand for money (which fell because of the higher interest rate) to equal the unchanged supply. Finally,

$$dy/dp^* = 0, \qquad de/dp^* = -1.$$

The currency appreciates to neutralize the foreign inflation and leave income unchanged. Thus with perfect capital mobility the only foreign shock that influences the domestic economy is one to the interest rate, and this has an effect *opposite* to that under fixed rates: a higher foreign interest rate stimulates domestic income.

Before leaving the case of perfect capital mobility, it is worth checking that a neutral domestic inflation, that is, an equal proportionate rise in the money stock h and domestic prices p, can be neutralized through a proportionate depreciation:

$$dy/dp\big|_{dp=dh} = 0, \qquad de/dp\big|_{dp=dh} = 1.$$

The case of imperfect capital mobility incorporating (10.9b) instead of (10.9a) is somewhat more complex, since we now have three endogenous variables y, e, and i and three equations:

$$\begin{bmatrix} 1 & -\alpha & \gamma \\ \xi & 0 & -\eta \\ \theta & -\alpha & -\lambda \end{bmatrix} \begin{bmatrix} y \\ e \\ i \end{bmatrix} = \begin{bmatrix} \alpha(p^* - p) + \beta y^* \\ h - p \\ \alpha(p^* - p) + \beta y^* - \lambda i^* \end{bmatrix}.$$

Matrix inversion yields

$$\begin{bmatrix} y \\ e \\ i \end{bmatrix} = \frac{1}{\Delta} \begin{bmatrix} -\alpha\eta & -\alpha(\lambda + \gamma) & \alpha\eta \\ \lambda\xi - \theta\eta & -(\lambda + \gamma\theta) & \eta + \gamma\xi \\ -\alpha\xi & \alpha(1 - \theta) & \alpha\xi \end{bmatrix} \begin{bmatrix} \alpha(p^* - p) + \beta y^* \\ h - p \\ \alpha(p^* - p) + \beta y^* - \lambda i^* \end{bmatrix}$$

where $\Delta = -\alpha\eta(1 - \theta) - \alpha\xi(\gamma + \lambda) < 0$, since $\theta < 1$. (10.11)

One again extracts the relevant total derivatives, from (10.11):

$$dy/dy^* = 0, \qquad de/dy^* = -\beta/\alpha$$
$$dy/di^* = -\alpha\lambda\eta/\Delta > 0, \qquad de/di^* = -\lambda(\eta + \gamma\xi)/\Delta > 0$$
$$dy/dp^* = 0, \qquad de/dp^* = -1$$
$$dy/dp\big|_{dh=dp} = 0, \qquad de/dp\big|_{dh=dp} = 1.$$

With the exception of the more complicated (but still qualitatively similar) formulae for the effect of a change in the foreign interest rate, these results are identical to those in the case of perfect mobility. A floating exchange rate still insulates the domestic economy from everything except interest rate changes, where the direction of effect remains the opposite of that in the fixed exchange rate case, and it still neutralizes the external effects of a neutral domestic inflation. The intuitive explanations given for the case of perfect mobility remain valid.

Students who have the technical ability to deal with the preceding mathematics will find it an excellent exercise to use the algebraic model (extending it as necessary) to confirm the theorems about the effects of changes in monetary, fiscal, and commercial policy that were previously established diagramatically.