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The IS-LM-BP=0 Model (aka "Mundell-Fleming") under Fixed Rates

This set of notes extends the IS-LM-TB=0 model to incorporate a role for endogenous private capital inflows. This contrasts with the approach in the IS-LM-TB=0 model, wherein private capital flows were zero (or a constant). Policy under fixed exchange rates is examined.

1. The Model

To allow for a role for money, let's first modify the model. On the real side of the economy, everything is the same.

(1)	$Y = AD$	Output equals aggregate demand – an equilibrium condition
(2)	$AD \equiv C + I + G + EX - IM$	Definition of aggregate demand
(3)	$C = \overline{C}\,\overline{O} + c(Y - T)$	Consumption function, c is the marginal propensity to consume
(4)	$T = \overline{TA} + tY$	Tax function; $\overline{TA}$ is lump sum taxes, t is tax rate.
(5)	$I = \overline{IN} - bi$	Investment function
(6)	$G = \overline{G}\,\overline{O}$	Government spending on goods and services
(7)	$EX = \overline{EXP} + vq$	Export spending
(8)	$IM = \overline{IMP} + mY - nq$	Import spending

The only essential difference is that investment spending now depends on the interest rate. The coefficient b is the interest sensitivity of investment. Since income now depends on interest rates, which is endogenous, then solving equations (1)-(8) yields an equation of a line.

(9) $Y = \overline{\alpha}[\overline{A} + \overline{EXP} - \overline{IMP} + (n+v)q - bi]$ <IS curve>

(9') $\boxed{i = \dfrac{\overline{A} + \overline{EXP} - \overline{IMP} + (n+v)q}{b} - \left(\dfrac{1 - c(1-t) + m}{b}\right)Y}$ <IS curve>

This expression means that for lower levels of interest rates, investment, a component of aggregate demand, is higher, and thus income is also higher.

The monetary sector is unchanged from before.

Eq.No.	Equation	Description
(10)	$\frac{M^d}{P} = \frac{M^s}{P}$	Equilibrium condition
(11)	$\frac{M^s}{P} = \frac{\overline{M}}{P}$	Money supply
(12)	$\frac{M^d}{P} = kY - hi$	Money demand

Substitute (11) and (12) into (10), and rearrange to obtain:

(13) $i = -\frac{1}{h}\left(\frac{\overline{M}}{P}\right) + \frac{k}{h}Y$ <LM curve>

Equilibrium at any given time is given by the solution to (9) and (13), i.e., the intersection of the IS and LM curves.

Now we derive the BP=0 schedule. The idea of this is simple – it's analogous to the TB=0 schedule, except that now KA (private capital inflows) are now allowed to respond to other variables. Recall the definition of the Balance of Payments accounting identity.

(14) $CA + KA + ORT \equiv 0$

where the "balance of payments", BP, is given by:

(15) $CA + KA = BP \approx TB + KA$

When BP=0, the ORT=0. In other words, external equilibrium in this model holds when the sum of the current account (approximately the trade balance) *and* private capital inflows balance to zero. To get an idea of what this schedule looks like, one has to state what KA depends upon.

(16) $KA = \overline{KA} + \kappa(i - i^*)$

Where κ is the interest differential sensitivity of capital flows. Substituting in the expressions for the trade balance (exports minus imports) and the capital flows into (15), one obtains:

(17) $TB + KA = [(\overline{EXP} + vq) - (\overline{IMP} - mY - nq)] + [\overline{KA} + \kappa(i - i^*)] = 0$

Solve for i holding i^* constant.

(18) $$\boxed{i = -\left(1/\kappa\right)[(\overline{EXP} - \overline{IMP} + \overline{KA}) + (n + v)q] + \bar{i}^{*} + \left(\frac{m}{\kappa}\right)Y}$$ <BP=0 curve>

Notice that the slope of this curve is positive (m/κ), and that anything that changes the autonomous components of exports, imports and capital flows will change the position of the schedule. Also note that changes in *q* will shift the curve.

The interpretation of the BP=0 schedule is as follows. Along all points on this curve, the trade balance and private capital flows are such that the overall balance of payments (in an economic sense) equals zero, so ORT equals zero. The slope of the BP=0 schedule is positive because higher income is associated with higher imports and a lower trade balance; hence capital inflows must be higher, and this occurs when the interest differential is more positive (and this in turn occurs when the interest rate is higher, holding foreign interest rates constant).

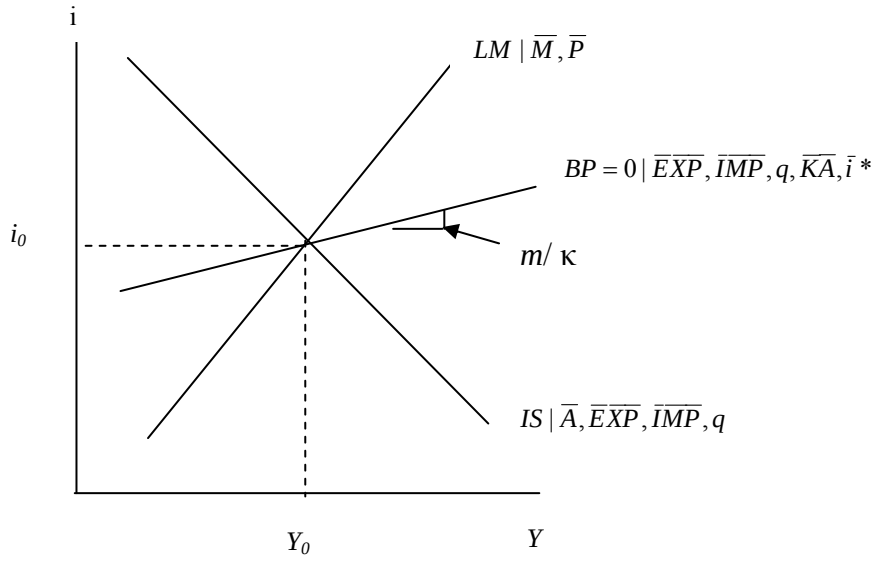

Figure 1: IS-LM-BP=0 in equilibrium

2. Fiscal and Monetary Policies under Fixed Exchange Rates

In the fixed exchange rate situation, *q* is not changed unless the government devalues or revalues the currency. This simplifies the mechanics of the model, and so we examine this situation first.

Shifts in the IS and LM curves occur for the same reasons as before. Consider what happens if one increases government spending.

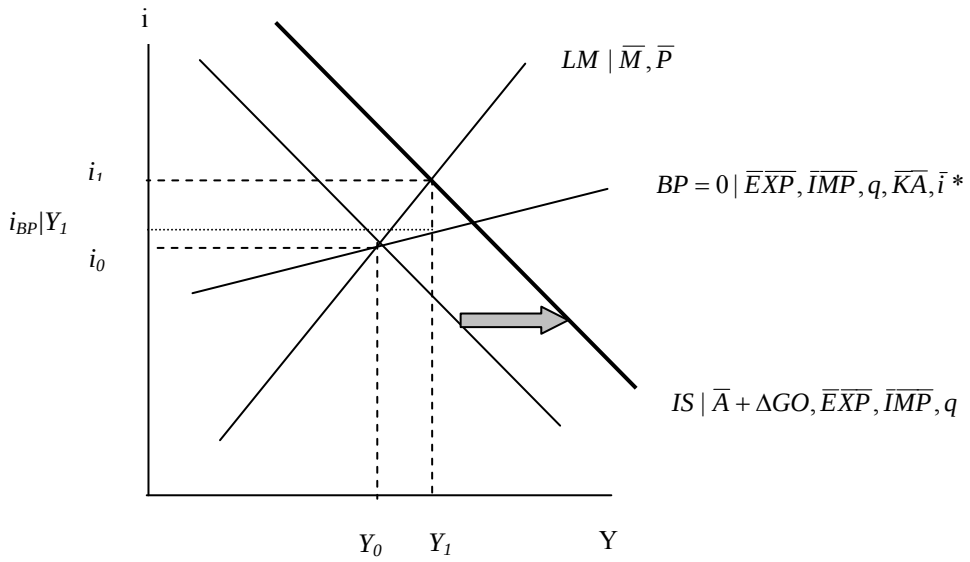

Figure 2: Expansionary fiscal policy under fixed exchange rates, high capital mobility

In this case, equilibrium income and interest rates rise. Notice that the equilibrium interest rate is higher than that consistent with external equilibrium (i.e., BP=0). As a consequence, the balance of payments is in surplus, so ORT < 0, and foreign exchange reserves are increasing. In the absence of sterilized intervention, the LM curve will shift out. However, if the central bank sterilizes the inflow, then the LM remains where it is.

Of course, there is nothing that guarantees that the BP=0 line is flatter than the LM curve. Recall the slope of the LM curve is (k/h), while that of the BP=0 curve is (m/κ), and one can imagine that for a small, developing country, international investors might not wish to place their financial capital in the country without a very high rate of return; in other words financial capital may not be very sensitive to interest differentials, so that κ is small. Then the slope of the BP=0 curve will be steep, perhaps steeper than the LM curve.

As depicted below in Figure 3, the fiscal expansion shifts out the IS curve, output and interest rates rise as before. Now, however, the equilibrium interest rate is not as high as that required for external equilibrium. Hence, BP < 0, ORT > 0, and foreign exchange reserves decline. If the central bank does not sterilize the foreign reserves decline, then the LM curve will shift in, until external equilibrium is restored. If the central bank does sterilize, then the LM remains where it was. Of course, this must come to an end when foreign exchange reserves are depleted.

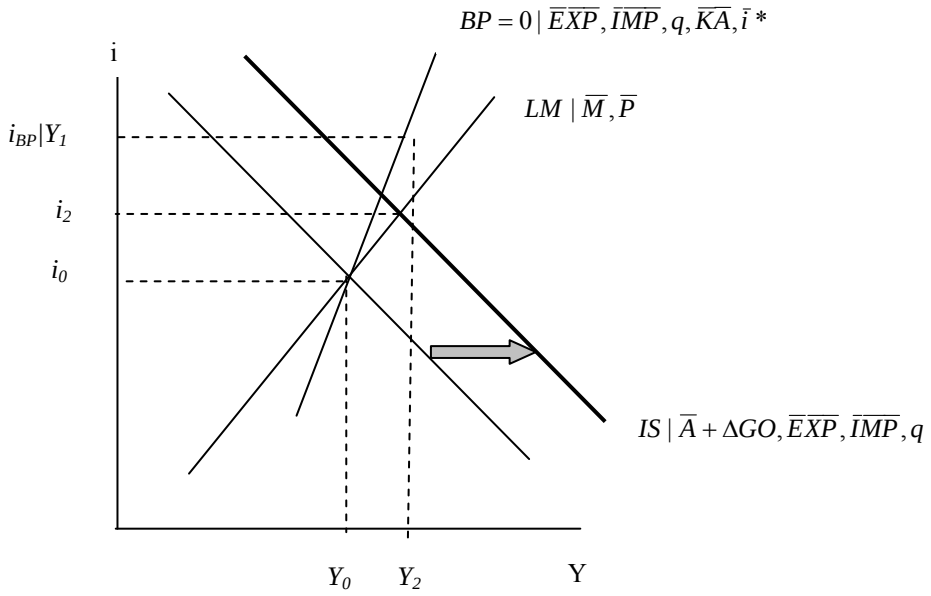

Figure 3: Expansionary fiscal policy under fixed exchange rates, low capital mobility

It is instructive to consider what happens if a monetary expansion is undertaken. Examine the high capital mobility case (although qualitatively, the low mobility case is the same).

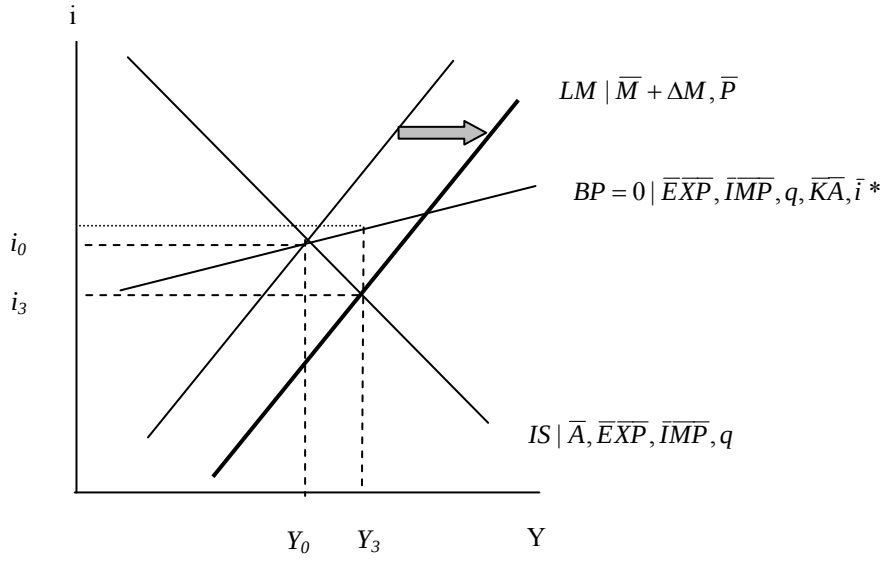

Figure 4: Expansionary monetary policy under fixed exchange rates, high capital mobility

In this case, the resulting equilibrium interest rate i_3 is less than required for external equilibrium. As a consequence, there is a balance of payments deficit, ORT > 0, and foreign exchange reserves are decumulated. In the absence of offsetting sterilization by the central bank, the money supply shrinks, and the LM curve shifts back. This process stops only when the interest rate is back at i_0. In other words, the monetary policy is undone. This happens because monetary policy is made subservient to the pegging of the exchange rate.

Another way of putting this is that a country loses monetary autonomy when it enters into a fixed exchange rate system. Since the loss of foreign exchange reserves is presumably faster when capital mobility is high, then the higher the degree of capital mobility, the greater the loss in monetary autonomy under a fixed exchange rate system. (This applies when countries use market forces to set the equilibrium exchange rate at the official pegged rate; sometimes countries use capital controls and other exchange restrictions to set the rate at the official rate, as in the case of China).

3. Devaluation

Notice that q enters into the BP=0 equation (and in the IS equation). A devaluation would then shift both curves. You can see that a devaluation would be particularly useful if one started in a position of balance of payments deficit.

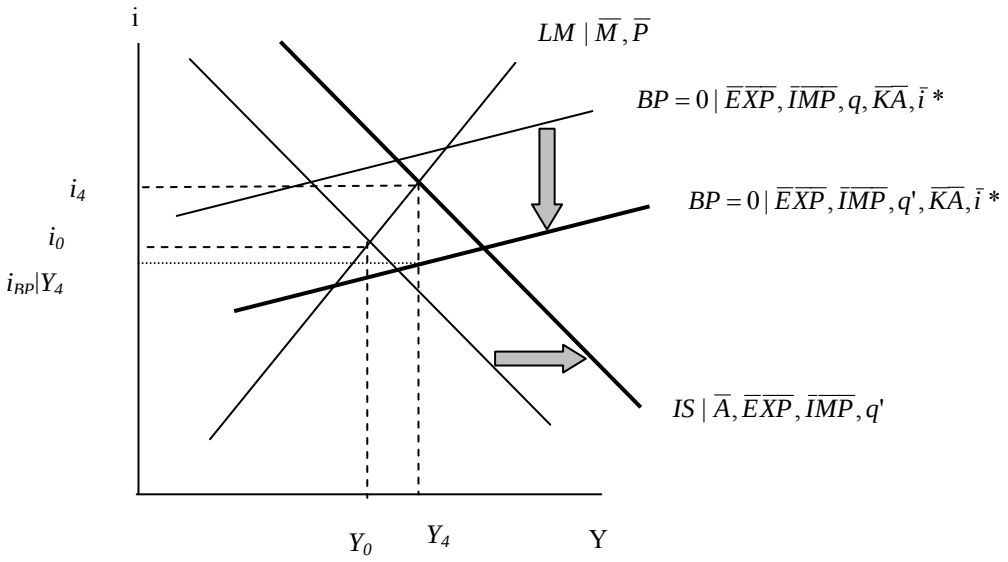

Figure 5: Devaluation from an initial balance of payments deficit

Notice that initially, the equilibrium interest rate is below that consistent with equilibrium. The devaluation shifts the BP=0 curve out (farther out than the IS curve). At the new equilibrium, the balance of payments is now in surplus. Hence, the balance of payments problem has been remedied.

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