

THE MUNDELL-FLEMING MODEL

OPEN ECONOMY IS-LM FRAMEWORK

Central Assumptions

1. The domestic economy is “small” in relation to the rest of the world: values of world variables (world income, prices and interest rate) exogenous.
2. The domestic economy produces a single composite good, traded on world markets, but an imperfect substitute for world output.
3. Domestic output is demand-determined, with its price, P , constant.

The foreign currency price of world output, P^* , is also assumed constant.

Representation of the exchange rate

e = nominal exchange rate, measured as number of units of domestic currency per unit of foreign currency.

e.g. £0.645 = 1 Euro

Rise in e represents a depreciation of the domestic currency

Goods Market Equilibrium and the IS Schedule

Closed economy GME condition

$$Y = E$$

Y = Real Output

E = Real Expenditure

Open economy GME condition

$$Y = D$$

D = Demand for Domestic Output

$$D = \overbrace{C + I + G}^E + \overbrace{X - Z}^T$$

T = Real Trade Balance

Real Private Sector Consumption $C = c_0 + c_1 Y$

Real Private Sector Investment $I = i_0 - i_1 r$

Real Government Expenditure $G = \bar{G}$

X = Real value of exports

Z = Real value of imports (measured in terms of domestic output equivalent: see Open Economy Handout, pages 3-4)

Exports

$$X = X\left(\frac{eP^*}{P}, Y_w\right)$$

$\frac{eP^*}{P}$ Real Exchange Rate, or Domestic Competitiveness

Y_w Real World Income

The value of world income is assumed constant. With P and P^* also constant, these arguments can be suppressed in the function (note one-off changes in the values of these variables can be considered by reintroducing them into the function).

$$X = X(e), \quad \frac{dX}{de} > 0$$

Imports

$$Z = Z\left(\frac{eP^*}{P}, Y\right)$$

Again with P and P^* constant, this can be simplified

$$Z = Z(e, Y)$$

We use a specific form of the function

$$Z = z_0(e) + z_1 Y$$

$$\frac{dz_0}{de} < 0; \quad z_1 = \text{marginal propensity to import } 0 < z_1 < 1$$

Goods Market Equilibrium

$$Y = D \quad \text{or} \quad Y = C + I + G + X - Z \quad \text{or}$$

$$Y = c_0 + c_1 Y + i_0 - i_1 r + \bar{G} + X(e) - z_0(e) - z_1 Y$$

Rearranging:

$$r = \frac{c_0 + i_0 + \bar{G} + X(e) - z_0(e) - (1 - c_1 + z_1)Y}{i_1}$$

This equation describes the open economy IS Schedule.

Comparison with closed economy IS Schedule.

1. The open economy IS Schedule is steeper than its closed economy counterpart.

$$\left. \frac{dr}{dY} \right|_{IS} = \frac{-(1-c_1+z_1)}{i_1}$$

where $\frac{(1-c_1+z_1)}{i_1} > \frac{(1-c_1)}{i_1}$

2. The open economy multiplier is smaller than the corresponding closed economy multiplier.

$$\text{Open Economy Multiplier} = \frac{1}{1-c_1+z_1} < \frac{1}{1-c_1}$$

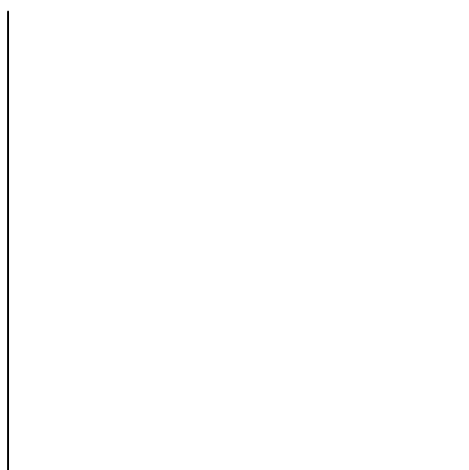
3. The position of the IS Schedule depends on the exchange rate

Depreciation of domestic currency (rise in e).

Domestic competitiveness improves, increasing exports and reducing imports, therefore increasing demand for domestic output: *IS shifts to right*

Appreciation of domestic currency (fall in e)

Domestic competitiveness deteriorates, reducing demand for domestic output: *IS shifts to left*



$$e_2 > e_1 > e_3$$

Horizontal shift of IS Schedule:

$$\frac{1}{(1-c_1+z_1)} \left(\frac{dX}{de} - \frac{dz_0}{de} \right) \Delta e$$

Money market equilibrium and the LM Schedule

Demand for real money balances

$$\frac{M^D}{P} = m_0 + m_1 Y - m_2 r$$

Real money supply

$$\frac{M^S}{P} = \frac{\bar{M}}{P}$$

Money market equilibrium

$$\frac{M^S}{P} = \frac{M^D}{P}$$

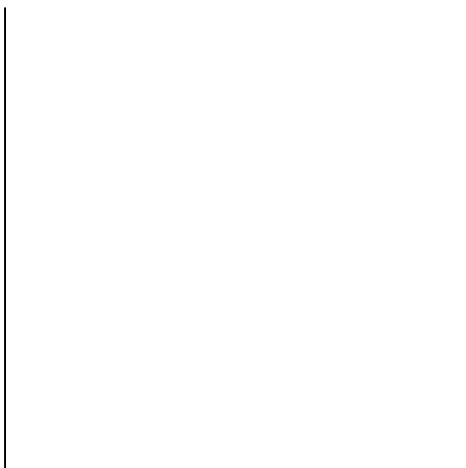
or

$$\frac{\bar{M}}{P} = m_0 + m_1 Y - m_2 r$$

Rearranging

$$r = \frac{m_0 - \frac{\bar{M}}{P} + m_1 Y}{m_2}$$

This equation describes the Open Economy LM Schedule



$$\left. \frac{dr}{dY} \right|_{LM} = \frac{m_1}{m_2}$$

BALANCE OF PAYMENTS EQUILIBRIUM AND THE BB SCHEDULE

The Overall Balance of Payments

$$B \equiv T + K$$

B = Overall Balance of Payments Surplus

T = Trade Balance/Current Account Surplus

K = Capital Account Surplus

(Note the capital account reflects international transactions in financial assets)

The Trade Balance

$$T = X - Z$$

or

$$T = X(e) - z_0(e) - z_1Y$$

The Capital Account

Capital flows are assumed to respond to interest rate differentials between domestic and foreign currency denominated assets.

$$K = k(r - r^*)$$

where

r = domestic rate of interest

r^* = world interest rate

$k(\geq 0)$ = interest sensitivity of international capital flows – represents “degree of capital mobility”

Overall BOP Equilibrium

$$B \equiv T + K = 0$$

i.e.

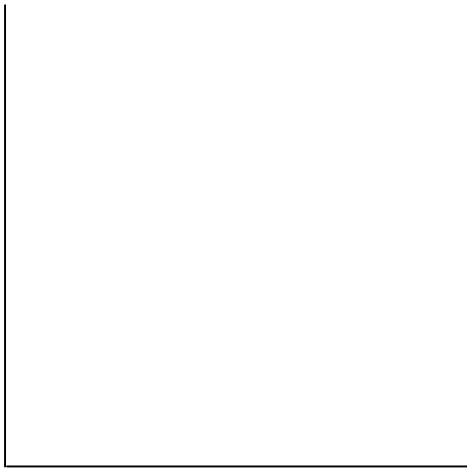
$$X(e) - z_0(e) - z_1Y + k(r - r^*) = 0$$

or

$$k(r - r^*) = z_0(e) - X(e) + z_1Y$$

$$r = r^* + \frac{z_0(e) - X(e) + z_1Y}{k}$$

This equation defines the BB (Balance of Payments Equilibrium) schedule



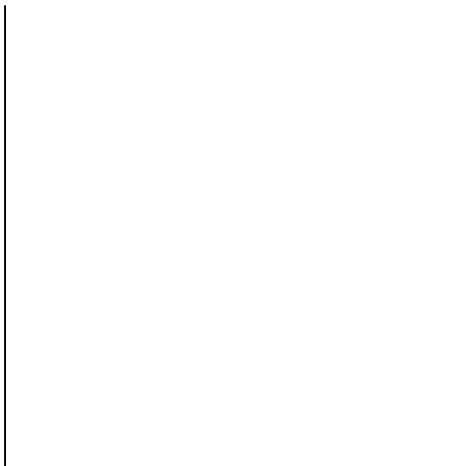
Slope of BB schedule

$$\left. \frac{dr}{dY} \right|_{BB} = \frac{z_1}{k}$$

As k increases BB becomes flatter

Limiting cases of capital mobility

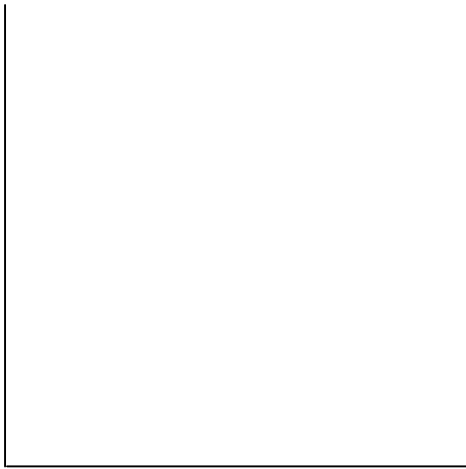
1. *Zero capital mobility: $k = 0$*



$$\left. \frac{dr}{dY} \right|_{BB} = \infty$$

$$Y_T = \frac{X(e) - z_0(e)}{z_1}$$

Perfect Capital Mobility: $k \rightarrow \infty$



$$\left. \frac{dr}{dY} \right|_{BB} = 0$$

Equation of BB Schedule becomes: $r = r^*$

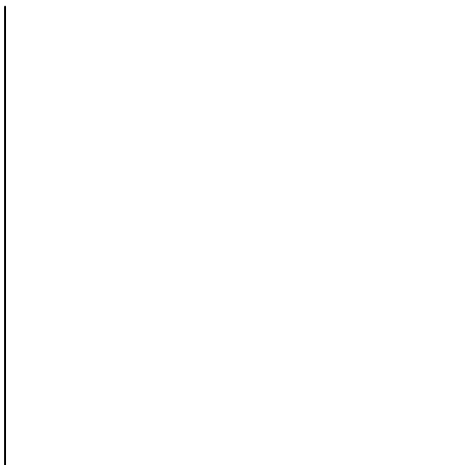
In general, the position of the BB Schedule depends on e and r^*

$$r = r^* + \frac{z_0(e) - X(e) + z_1 Y}{k}$$

Effect of e

A depreciation of the domestic currency (rise in e) shifts BB to the right

An appreciation of the domestic currency (fall in e) shifts BB to the left



$$e_2 > e_1 > e_3$$

Extent of horizontal shift of BB:

$$\frac{1}{z_1} \left(\frac{dX}{de} - \frac{dz_0}{de} \right) \Delta e$$

For a given Δe , the horizontal shift of BB exceeds the horizontal shift of IS

$$\frac{1}{z_1} \left(\frac{dX}{de} - \frac{dz_0}{de} \right) \Delta e > \frac{1}{1 - c_1 + z_1} \left(\frac{dX}{de} - \frac{dz_0}{de} \right) \Delta e$$

*Effect of r^**

An increase in r^* shifts BB upwards and to the left. A fall in r^* shifts BB down and to the right.

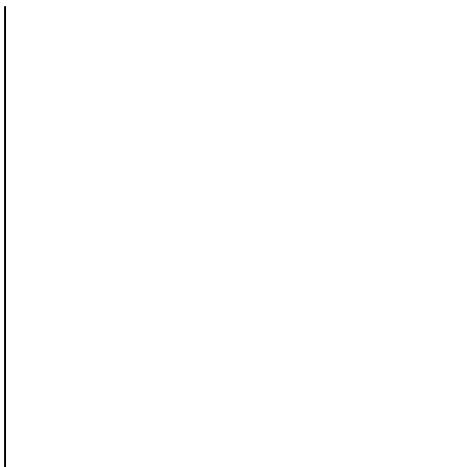
Extent of vertical shift: Δr^*

Extent of horizontal shift: $\frac{k}{z_1} \Delta r^*$

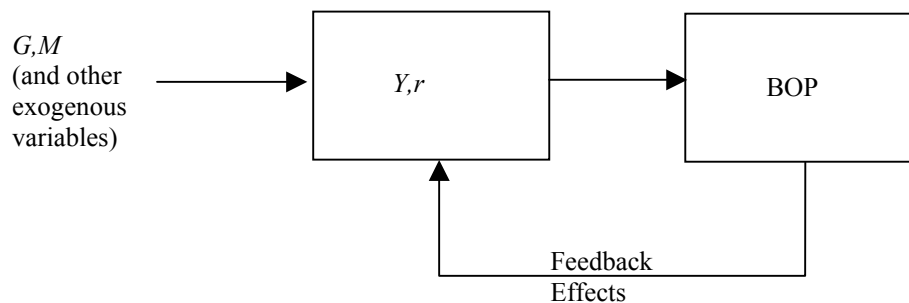
OVERALL EQUILIBRIUM

Overall equilibrium requires:

1. Internal equilibrium, i.e. simultaneous goods and money market equilibrium
2. External equilibrium, i.e. BOP equilibrium



The BOP and the income-determination process



THE EXCHANGE RATE REGIME AND THE BOP

BOP disequilibria give rise to disequilibrium on the foreign exchange market

BOP Surplus

Excess demand for domestic currency on the foreign exchange market.
Foreign residents wish to buy domestic goods, services and assets greater in value than domestic residents wish to buy from overseas.

BOP Deficit

Excess supply of domestic currency on the foreign exchange market.

Domestic residents wish to buy foreign goods, services and assets greater in value than foreign residents wish to buy from the domestic economy.

Flexible exchange rate

BOP Surplus

Excess demand for domestic currency
Domestic currency appreciates: $\Delta e < 0$

BOP Deficit

Excess supply of domestic currency
Domestic currency depreciates : $\Delta e > 0$

Exchange rate adjustments induced by incipient BOP disequilibria produce shifts in the IS schedule

BOP Surplus: $\Delta e < 0 \Rightarrow$ IS shifts to left

BOP Deficit: $\Delta e > 0 \Rightarrow$ IS shifts to right

Fixed Exchange Rate

BOP Surplus

Excess demand for domestic currency
Domestic central bank sells domestic currency on the foreign exchange market
Domestic money supply increases: $\Delta M > 0$

BOP Deficit

Excess supply of domestic currency
Domestic central bank buys domestic currency on the foreign exchange market
Domestic money supply falls: $\Delta M < 0$

Money supply changes associated with foreign exchange market intervention lead to shifts in the LM schedule

BOP surplus: $\Delta M > 0 \Rightarrow$ LM shifts to right
 BOP deficit: $\Delta M < 0 \Rightarrow$ LM shifts to left

The effect of BOP disequilibria on a country's money supply via foreign exchange market intervention is referred to as the monetary adjustment mechanism

The Central Bank's Balance Sheet

Liabilities	Assets
M	R
	D
M	$R+D$

M = Central Bank Issued Money

R = Foreign Exchange Reserves

D = Central Bank Holdings of Government Debt, or Domestic Credit

By the balance sheet identity:

$$\underline{M \equiv R + D}$$

\therefore with no change in D :

$$\underline{\Delta M = \Delta R}$$

Sterilisation Operations

These are central bank purchases or sales of government debt, made with the intention of offsetting the impact of foreign exchange market intervention on the domestic money stock.

e.g. BOP Deficit

In absence of sterilisation $\Delta M = \Delta R < 0$

However, suppose the central bank enters the domestic money market and buys government debt at the same rate as it is buying domestic currency in the foreign exchange market

$$\Delta D = -\Delta R \Rightarrow \Delta D + \Delta R = 0$$

$$\therefore \underline{\Delta M = 0}$$

Is sterilisation sustainable?

In the case of a BOP deficit sterilisation, in the absence of changes in other policies, will be associated with a continuous loss of reserves.

Therefore it can only continue until reserves are exhausted

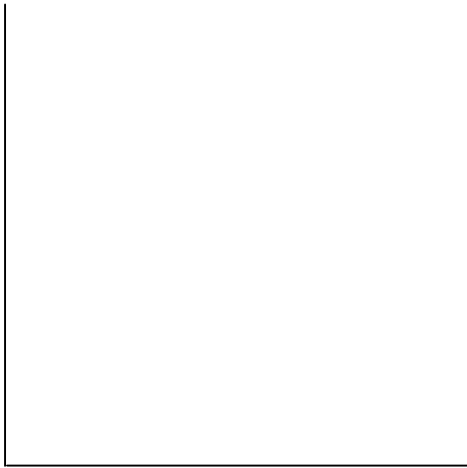
For the case of a surplus, reserves are being accumulated and there is no upper limit to a country's reserves

As the degree of capital mobility increases, sterilisation operations become more difficult to sustain, for both deficits and surpluses

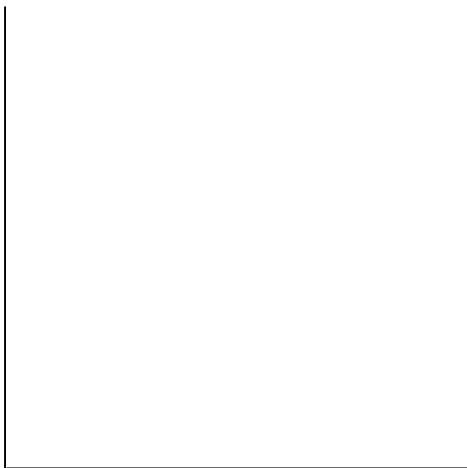
THE DEGREE OF INTERNATIONAL CAPITAL MOBILITY AND THE EFFECTIVENESS OF FISCAL AND MONETARY POLICIES

Direct effects of monetary and fiscal policies on internal equilibrium

Fiscal Policy



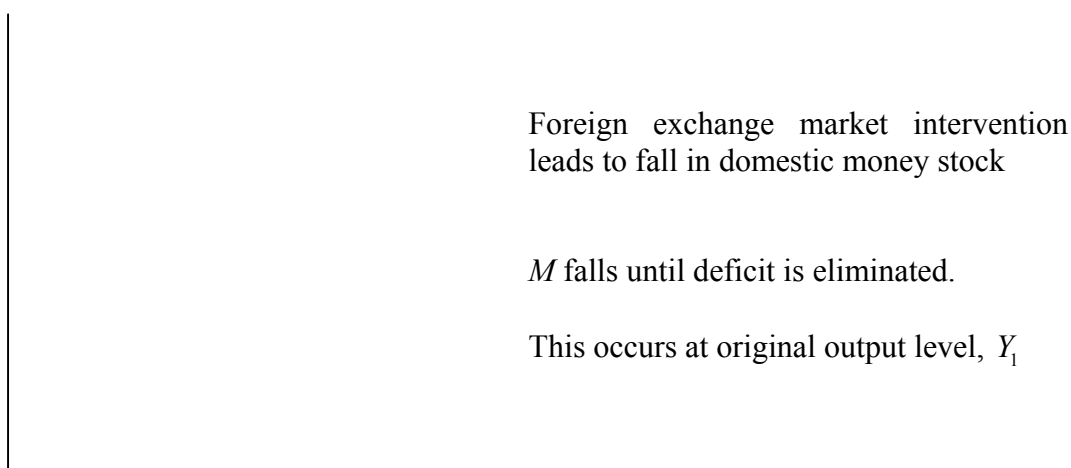
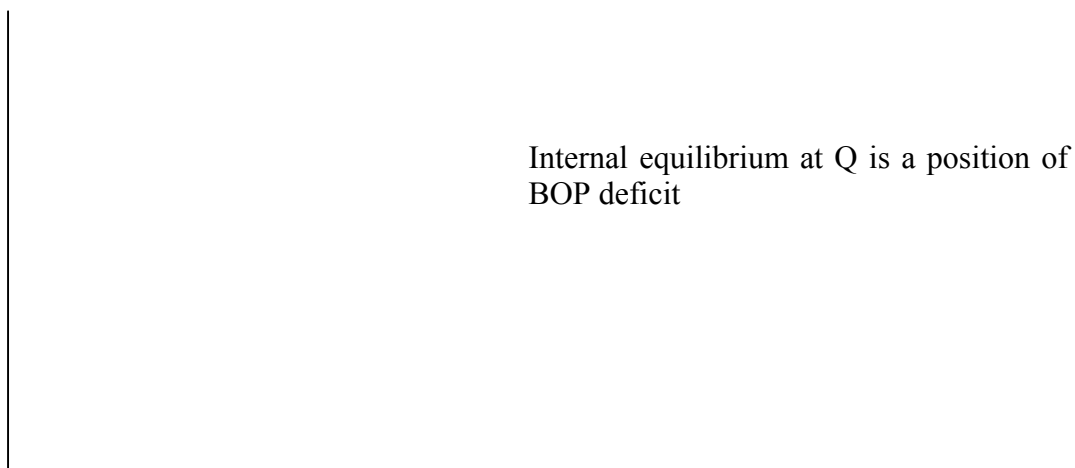
Monetary Policy



FISCAL AND MONETARY POLICIES WITH A FIXED EXCHANGE RATE

Zero Capital Mobility

(i) *Fiscal Policy*



The Monetary Adjustment Mechanism

Automatic mechanism working through changes in the money supply which ultimately restores BOP equilibrium

The operation of the mechanism means that, for the case of zero capital mobility, fiscal policy cannot, at least in the medium-long run, affect the level of output

How long is the “medium-long run”?

Two issues:

1. What are the relative speeds of the income-expansion process and the monetary adjustment mechanism?

How far does Y expand beyond Y_1 in the short run?

2. For how long can the money supply be maintained at \bar{M}_1 by sterilisation operations?

If sterilisation is undertaken how large are the country's foreign exchange reserves?

(ii) *Monetary Policy*



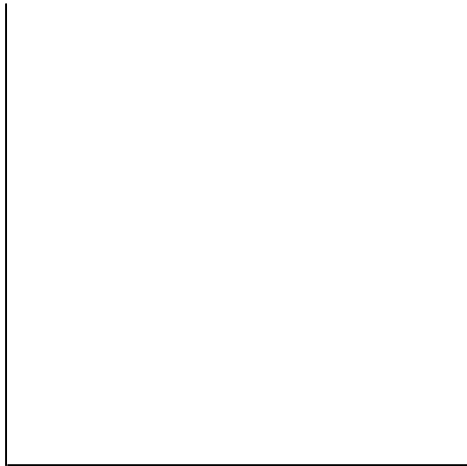
As with expansionary fiscal policy, internal equilibrium is a position of BOP deficit



The monetary adjustment mechanism leads the economy to return to original output level, Y_1

The conflict between internal and external balance with a fixed exchange rate and zero capital mobility

Demand management policies alone are not sufficient, given a fixed exchange rate and zero capital mobility, to achieve full employment equilibrium
(Tinbergen's Principle: two objectives, only one independent instrument)



Initial equilibrium
P-less than full employment, BOP equilibrium

Exchange rate adjustment can resolve the conflict between internal and external balance



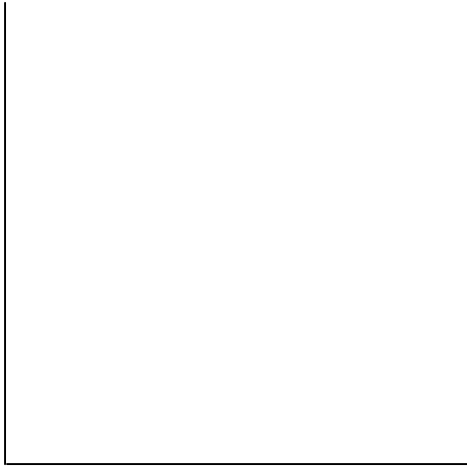
A devaluation of appropriate magnitude ensures BOP equilibrium at full employment



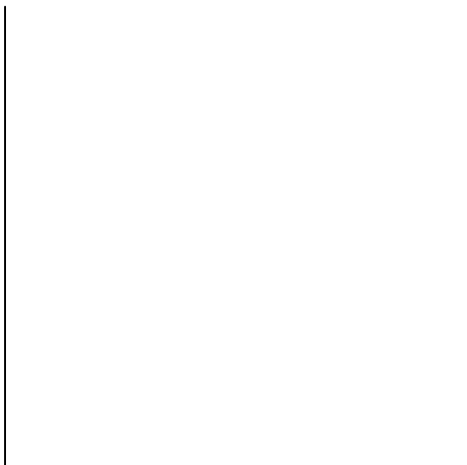
Equilibrium at full employment achieved by:

1. Expansionary fiscal policy-equilibrium at R
2. Expansion of domestic credit-equilibrium at S
3. Operation of monetary adjustment mechanism-equilibrium at S
4. Some combination of the above – equilibrium between R and S

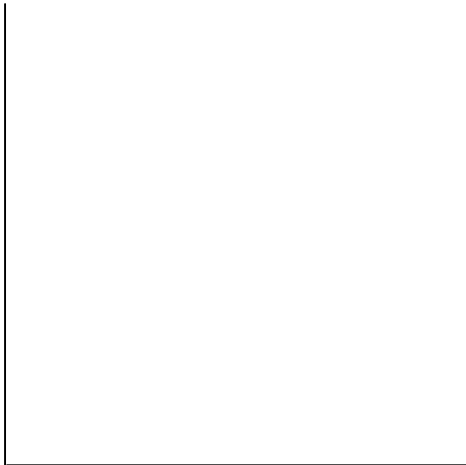
Fixed Exchange Rate: fiscal policy and different degrees of imperfect capital mobility



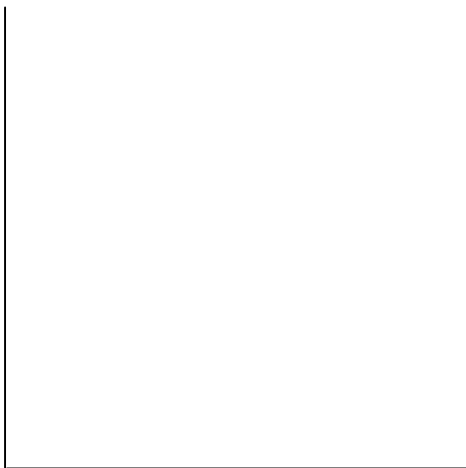
Point Q: BB_A - BOP deficit
 BB_B - BOP surplus



Fixed Exchange Rate: fiscal policy and perfect capital mobility

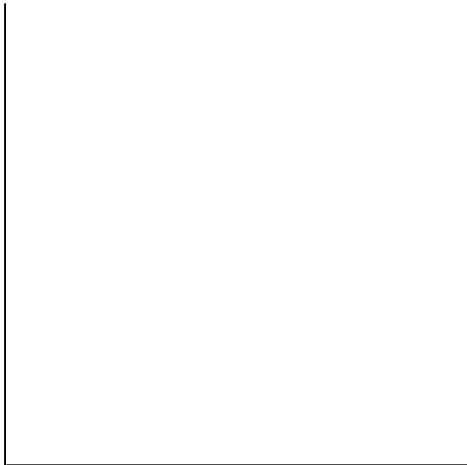


Fiscal expansion puts upward pressure on the domestic interest rate, leading to capital inflow

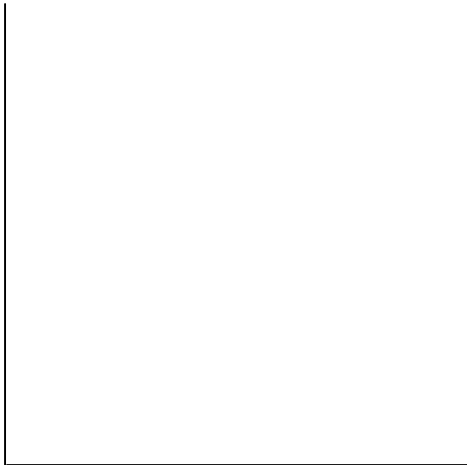


$$\Delta Y = \frac{\Delta \bar{G}}{(1 - c_1 + z_1)}$$

Fixed Exchange Rate: monetary policy and different degrees of capital mobility



Q is a position of BOP deficit, regardless of degree of capital mobility



$\Delta Y = 0$ regardless of degree of capital mobility

Fixed Exchange Rate: Summary of results

Fiscal Policy

1. The effectiveness of fiscal policy increases with the degree of capital mobility. It is totally ineffective with zero capital mobility (at least in the medium term) It achieves maximum effectiveness with perfect capital mobility
2. If the BB schedule is steeper (flatter) than the LM schedule, the monetary adjustment mechanism counteracts (reinforces) the direct impact of fiscal policy on equilibrium output

Monetary Policy

Regardless of the degree of capital mobility, monetary policy is totally ineffective given a fixed exchange rate

FISCAL AND MONETARY POLICIES WITH A FLEXIBLE EXCHANGE RATE

Zero Capital Mobility

A flexible exchange rate always adjusts to maintain overall balance of payments equilibrium

$$\therefore B = T + K = 0$$

But for zero capital mobility $K \equiv 0$

It follows that with a flexible exchange rate and zero capital mobility, the exchange rate always adjusts to maintain $T = 0$

But the condition for goods market equilibrium is:

$$T = D = E + T$$

With $T = 0$ as a consequence of exchange rate adjustments, the GME condition becomes:

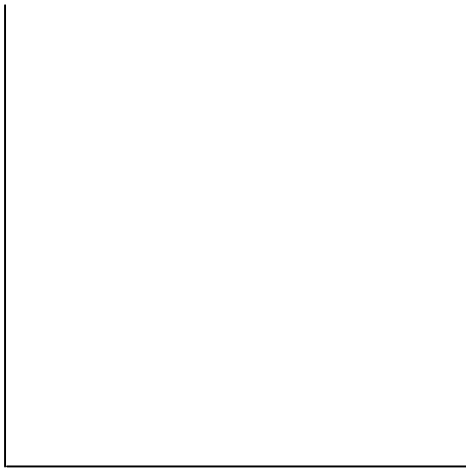
$$Y = E$$

i.e. identical to the condition in the closed economy

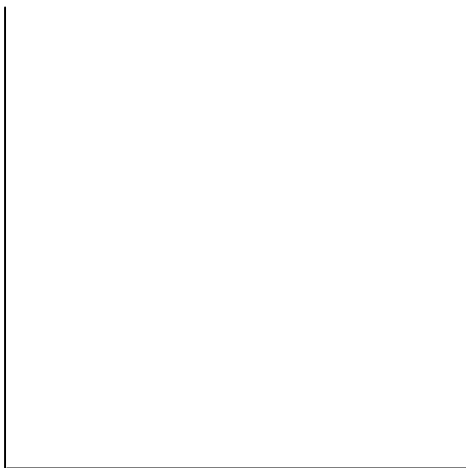
It follows that with a flexible exchange rate and zero capital mobility, output is determined as for a closed economy

Monetary and fiscal policies have the same impact on output (and the interest rate) as in a closed economy

(i) *Fiscal Policy*



Point Q is a position of (incipient) deficit

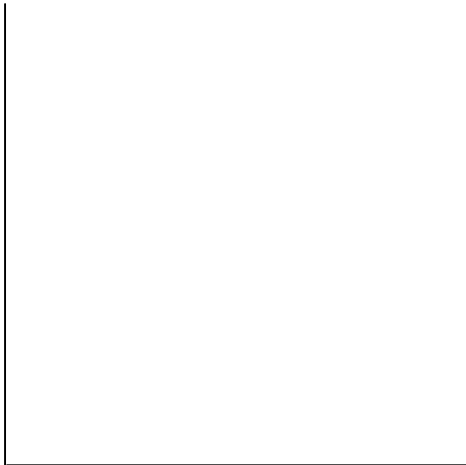


Domestic currency depreciates, shifting IS and BB right

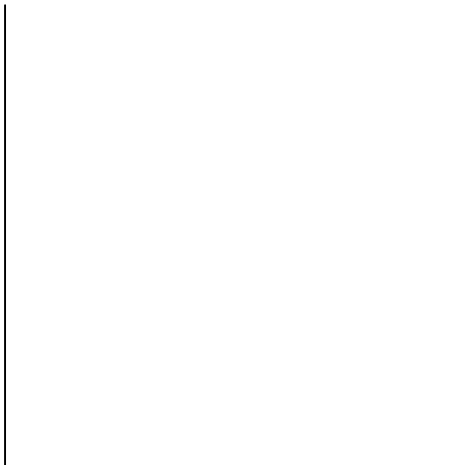
New equilibrium established at R

$$\Delta Y = \frac{\Delta \bar{G}}{\left[(1 - c_1) + \frac{i_1 m_1}{m_2} \right]}$$

(ii) *Monetary Policy*



Again, point Q is a position of incipient BOP deficit

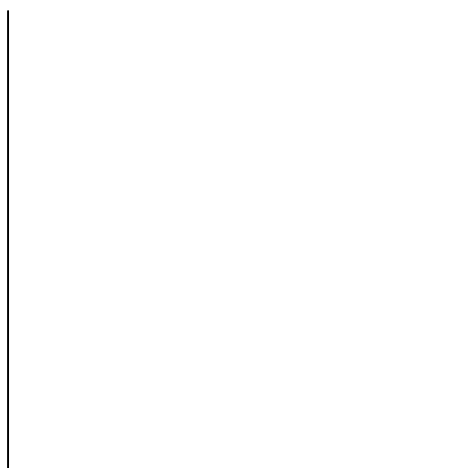


Domestic currency depreciates shifting IS and BB rightwards

New equilibrium lies at R

$$\Delta Y = \frac{\Delta \bar{M} / P}{\left[\frac{(1 - c_1)m_2}{i_1} + m_1 \right]}$$

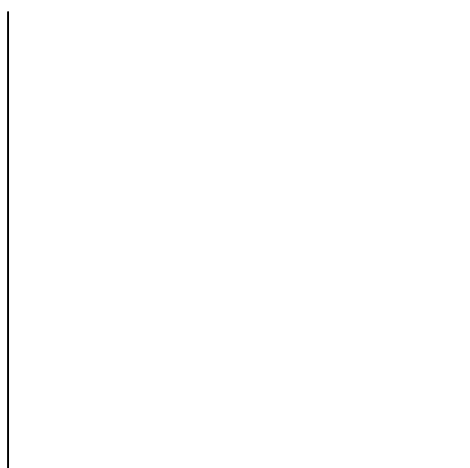
Flexible Exchange Rate: fiscal policy with imperfect capital mobility



$$BB_A : \frac{z_1}{k} > \frac{m_1}{m_2}$$

$$BB_B : \frac{z_1}{k} < \frac{m_1}{m_2}$$

Take case of $z_1 / k < m_1 / m_2$ at Q there is a BOP surplus



Domestic currency appreciates, shifting
IS and BB both leftwards

For $z_1 / k < m_1 / m_2$ exchange rate adjustment counteracts the direct impact of policy

If $z_1 / k > m_1 / m_2$, point Q is associated with an incipient balance of payments deficit.

(Deterioration of current account outweighs improvement in capital account).

Domestic currency depreciates, increasing demand for domestic output

Exchange rate adjustment reinforces the direct impact of the policy

Flexible Exchange Rate: fiscal policy with perfect capital mobility



Point Q is a position of incipient BOP surplus

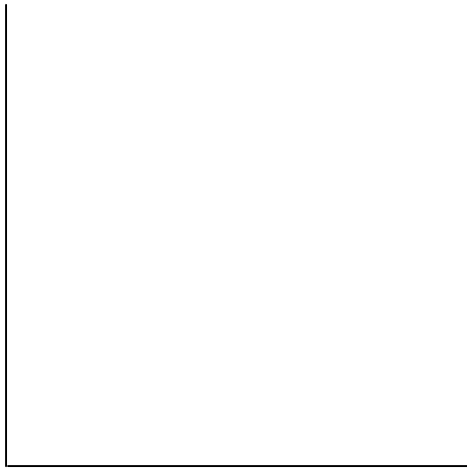


Domestic currency appreciates, shifting IS leftward

New equilibrium is at $R(=P)$

$$\Delta Y = 0$$

Flexible Exchange Rate: monetary policy with imperfect and perfect capital mobility



Regardless of degree of capital mobility
point Q is a position of incipient deficit



Domestic currency depreciates, shifting
IS (and for imperfect capital mobility
BB) to right

Final equilibrium: $BB_A - R; \frac{\Delta \bar{M} / P}{\left[\frac{(1 - c_1)m_2}{i_1} + m_1 \right]} < \Delta Y_A < \frac{\Delta \bar{M} / P}{m_1}$

$$BB_B - S; \Delta Y_B = \frac{\Delta M / P}{m_1}$$

Flexible Exchange Rate: Summary of Results

Fiscal Policy

1. The effectiveness of fiscal policy diminishes as the degree of capital mobility increases.

For the case of zero capital mobility its effect on equilibrium output is identical to that in a closed economy.

With perfect capital mobility fiscal policy is completely ineffective.

2. If the BB schedule is steeper (flatter) than the LM schedule exchange rate adjustments reinforce (counteract) the direct impact of policy on output
3. For the special case of $z_1/k = m_1/m_2$, the effect of fiscal policy on output is identical under fixed and flexible exchange rates

Monetary Policy

1. The effectiveness of monetary policy increases as the degree of capital mobility increases.

With zero capital mobility its effect on equilibrium output is identical to its impact in a closed economy.

With perfect capital mobility the change in equilibrium output is given by

$$\Delta Y = \frac{1}{m_1} \frac{\Delta \bar{M}}{P}$$

2. Regardless of the degree of capital mobility, exchange rate adjustments always reinforce the direct impact of policy on output.
3. Monetary policy is invariably more effective given a flexible exchange rate than with a fixed exchange rate.

Devaluation of domestic currency under a fixed exchange rate regime

Devaluation improves the BOP at each income-interest rate combination through its effect on domestic competitiveness, and increases the demand for domestic output

The BB and IS schedules shift to right (N.B. position of BB schedule is invariant to changes in e for case of perfect capital mobility)

Changes in world income and world prices

Both affect the trade balance directly and (at an unchanged exchange rate) lead to shifts in BB and IS schedules.

For fixed rate: rise in world income or rise in world prices have similar effects to devaluation

For flexible rate: exchange rate adjustment prevents any impact on domestic economy

Changes in the world interest rate

The direct effect is via the capital account alone and leads to a shift in the BB schedule.

Given a rise in r^* :

For fixed rate – the effect is contractionary

For flexible rate – the effect is expansionary

Magnitude of impact increases as the degree of capital mobility increases (with no impact for zero capital mobility).

IMPLICATIONS OF USING THE CONSUMER PRICE INDEX (CPI) AS THE DEFLATOR IN THE MONEY MARKET EQUILIBRIUM CONDITION

Closed economy MME condition

$$r = \frac{m_0 - \frac{\bar{M}}{P} + m_1 Y}{m_2} \quad \text{where } P = \text{price of domestic output or GDP inflator}$$

Open economy MME condition with CPI as deflator of nominal money balances

$$r = \frac{m_0 - \frac{\bar{M}}{P_I} + m_1 Y}{m_2} \quad \text{where } P_I = \text{CPI}$$

Why might CPI be the appropriate deflator?

With desired money holdings partly determined by the transactions motive, the demand for nominal money balances should depend on the prices of all goods purchased by domestic residents.

P_I depends on the domestic currency prices of both domestic and foreign-produced goods

$$P_I = P_I \left(\overset{+}{P}, \overset{+}{eP^*} \right)$$

where

$$\% \Delta P_I = \alpha \% \Delta P + (1 - \alpha) (\% \Delta e + \% \Delta P^*)$$

with

α = share of domestic goods in CPI

If P and P^* are constant:

$$\% \Delta P_I = (1 - \alpha) \% \Delta e$$

Depreciation of domestic currency

$$\uparrow e \Rightarrow \uparrow P_I \Rightarrow \downarrow \frac{M}{P_I} \Rightarrow \text{LM shifts to left}$$

Appreciation of domestic currency

$$\downarrow e \Rightarrow \downarrow P_I \Rightarrow \uparrow \frac{M}{P_I} \Rightarrow \text{LM shifts to right}$$

Note the argument is irrelevant to a fixed exchange, except if a devaluation or revaluation is undertaken

We consider the implications of using the CPI as the MME deflator of detail for the case of perfect capital mobility, but also point to the consequences for the case of zero capital mobility

(A good understanding of the issue will then allow you to infer the implications with imperfect capital mobility).

Fiscal expansion with a floating exchange rate



Q is a position of incipient BOP surplus

The domestic currency appreciates



The appreciation shifts IS left but, in addition, LM shifts to right

$$0 < \Delta Y < \frac{\Delta \bar{G}}{1 - c_1 + z_1}$$

The extent of the change in Y will be determined by (i) the sensitivity of net exports to the exchange rate; (ii) the share of foreign goods in the CPI.

Monetary expansion with a floating exchange rate



Q represents a position of incipient deficit

The domestic currency depreciates



As a consequence IS shifts rightwards,
while LM shifts to left

Implications for the case of zero capital mobility

With P as the deflator of nominal money balances in the MME condition, both monetary and fiscal policies have the same effect as in a closed economy

What are the implications of recognising the CPI as the appropriate deflator?

With zero capital mobility expansionary monetary and fiscal policies both induce a depreciation of the domestic currency