Mundell-Fleming Model of a Small Open Economy

Dudley Cooke

Trinity College Dublin

Reading

- Mankiw and Taylor, Chapter 12.
- Also see Copeland, Chapters 4 and 6.

Plan

- Open Economy IS and LM equations
- Balance of Payments and Capital Mobility
- Fiscal/monetary policy under Fixed and Floating Exchange Rates.

Super Quick Historical Background

- **Pre-War Period** covers 1880-1914 (using the Classic Gold Standard) where countries pegged their exchange rate to the value of gold.
- **Inter-War Period** is roughly until 1931. Countries used US Dollars, Pounds Sterling or Gold to peg their exchange rate - this stopped when the UK departed from gold in the face of large capital outflows.
- **Bretton Woods Period** covers 1946-1971. Countries pegged their exchange rate to the US Dollar. This stopped when Nixon suspended convertibility.
- **Floating Period** - basically until now. However, this does not account for the launch of the Euro in 1999 and other current issues in Asia.

The Baseline Open Economy Model

- We study an economy similar to that used for the closed economy.
- IS and LM conditions as before, but also incorporate:

1. international trade/current account
2. capital account (balance of payments) and capital controls
3. Real (and nominal) exchange rate

The Open Economy IS Curve

- We now want to *incorporate the current account/real exchange rate response* into the IS. The national income identity is:

$$Y = \underbrace{C(Y - T) + I^p(r) + G}_{\text{closed economy}} + \underbrace{X - M}_{\text{net exports}}$$

- C denotes the Keynesian consumption function and I is investment demand.

- The IS curve still gives combinations of real output and the interest rate such that **planned and actual expenditures are equal.**
- However, we now know it is possible to borrow from or lend to the rest of the world via the current account.

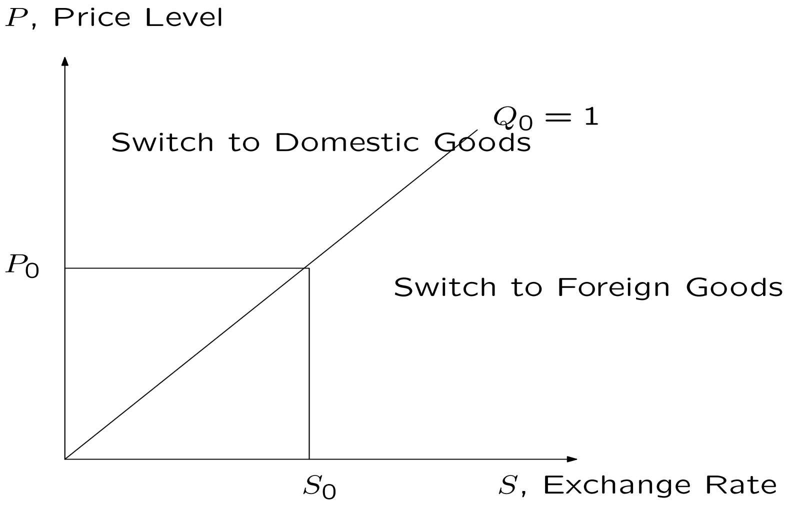
Current Account and Exchange Rate

- We assume that the current account is determined independently of the capital account.
- PPP does not hold, even in the long-run, and the size of the **current account surplus depends positively on the (real) exchange rate**:

$$CA = CA(Q, ...)$$

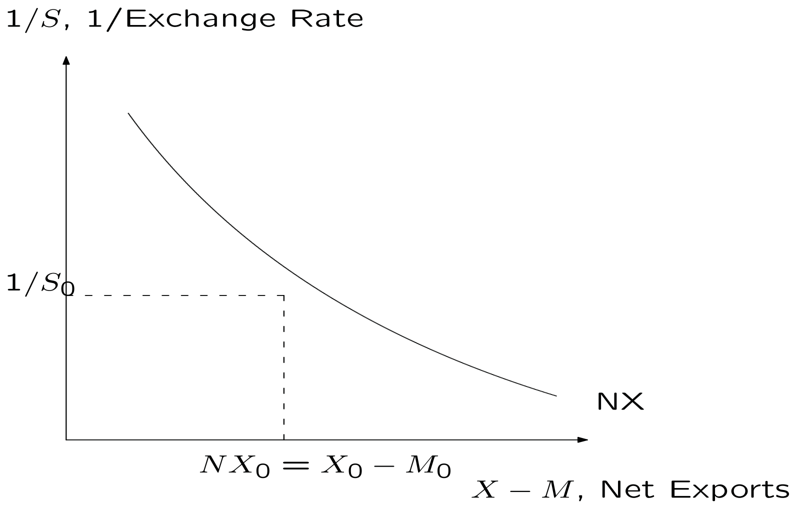
- If Q rises, our goods become **more competitive** abroad. Foreigners switch from buying their goods to our goods. This provides a boost to income. The process is called **expenditure switching**. It is a key mechanism in the open economy.

PPP



P, Price Level
$Q_0 = 1$
Switch to Domestic Goods
P_0
Switch to Foreign Goods
S_0
S, Exchange Rate

Exchange Rate and Net Exports



Comments

- Diagram 1: We implicitly assume that we cannot be on the "$Q = 1$ line"; i.e. PPP does not hold. In reality, this could happen for any number of reasons. Here we will assume this because the ISLM-cum-Mundell-Fleming model is a short-run model.
- Diagram 2: In Mankiw and Taylor, "S" appears on the vertical axis. Note that we have defined the exchange rate differently. That is, because the exchange rate is a relative price, we have two possible ways to write it (sometimes be very confusing).
- Remember: an increase in S is a: weaker domestic currency/depreciation in the domestic currency

Current Account

- **We also assume that the CA depends on GDP (income levels).** The more income the more imports we buy:

$$CA = CA\left(Y, ...\right)$$

- Recall that P is fixed and note P^* is exogenous from the point of the view of the domestic economy.
- We re-write the overall expression for the current account in the following way:

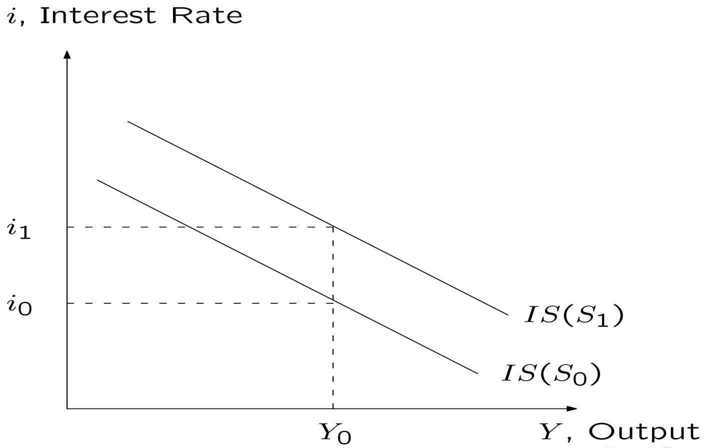
$$CA\left(Q, Y\right) = CA\left(\underset{+}{S}, \underset{-}{Y}\right)$$

- **Again:** due to sticky prices the real and nominal exchange rates move in the same direction.

The IS and Exchange Rate

- Open econ IS looks like closed econ IS, but is,

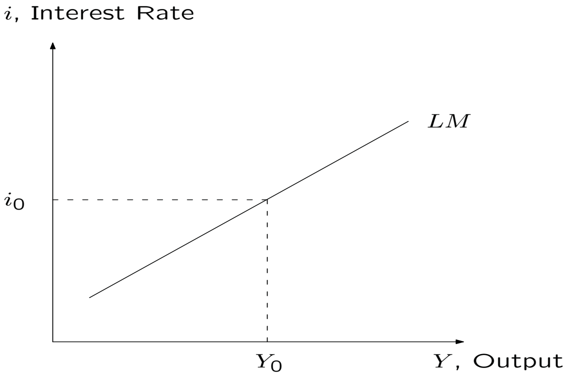
$$Y = \underbrace{C(Y-T) + I^p(r) + G}_{\text{closed economy}} + CA\left(\underset{+}{S}, \underset{-}{Y}\right).$$



Open Economy LM Curve

- The closed and open economy LM curve are the same.

$$LM \equiv \frac{M^s}{P} = \frac{M^d}{P} = L(\underset{+}{Y}, \underset{-}{i})$$



Domestic and Foreign Bonds

- Although the LM is unchanged, the exchange rate does matter for the asset market because there are **domestic and foreign bonds**.
- The exchange rate determines equilibrium in the foreign exchange market; i.e. the domestic and foreign bond markets.
- If we assume that expectations are static, **under perfect capital mobility**:

$$i = i^*$$

- Where i^* is exogenous for the small open economy, e.g. i^* is the US interest rate.

Capital Account and Capital Mobility

- If there is imperfect capital mobility UIP may fail to hold:

$$i \neq i^*$$

- Flows of capital depend on interest rate differentials between countries:

$$KA = KA\left(i - i^*\right); \, \Delta KA/\Delta\left(i - i^*\right) > 0$$

- If $i > i^*$ there is a capital inflow, i.e. foreign residents want to buy home assets.
- If $i < i^*$ there is a capital outflow.

Balance of Payments

- The balance of payments condition is:

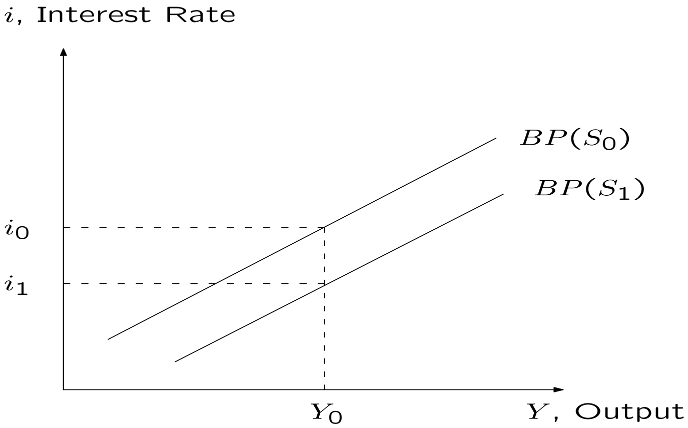
$$CA\left(Q, Y\right) + KA\left(i - i^{*}\right) - \Delta R = BP$$

- Here, we denote foreign exchange reserves, R.[1]
- Equilibrium obtains when the flow of capital finances the current account deficit or absorbs the surplus, i.e. $BP = 0$.
- As income rises, given Q, the CA deteriorates as import demand grows. To preserve $BP = 0$, the KA must improve.
- This net capital inflow can only be achieved by an increase in the domestic interest rate.

[1] We don't need to worry about this until we consider a fixed exchange rate so, for now, $R = 0$, and $CA = -KA$.

BP Curve with Imperfect Capital Mobility

- When there is perfect capital mobility the BP curve is horizontal in (i, Y)-space - it does not depend on the exchange rate and is given by, $i = i^*$

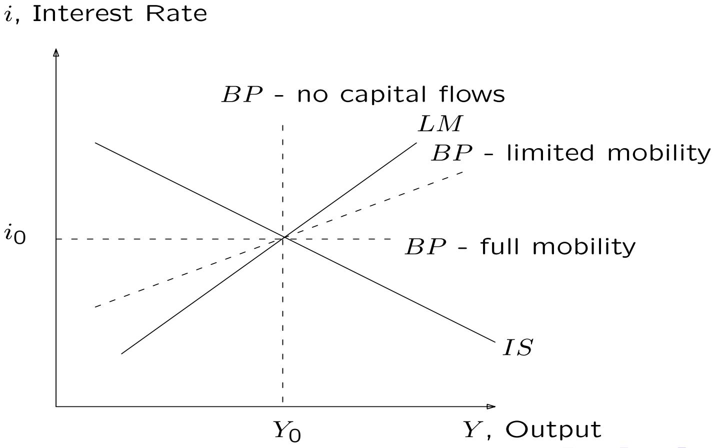


Other Comments

- 'Internal equilibrium' occurs when $IS = LM$, i.e. the markets for goods and for money are in equilibrium.
- 'External equilibrium' occurs when $BP = 0$, i.e. the flow of capital is sufficient to finance $CA \lesseqgtr 0$.
- We would also expect an interest rate differential to produce only a finite change in capital flows - i.e. there is some capital immobility.
- Perfect capital markets is a benchmark situation.

IS-LM-BP Equilibrium

- The more restricted are capital flows, the larger the rise in the interest rate, for a given change in output. The BP is then steeper in (i, Y)-space.



Functional Forms and Recap

- So far we have been general. We can also adopt some functional forms.
- As in the closed economy (same notation): $L(i, Y)$, $I^p(r)$ and $C(Y - T)$.
- We also have $CA(Q, Y)$. We suppose that, in linear terms, $CA(q, y) = \lambda q - \beta y$. Then, IS and LM are:

$$y = \underbrace{a + \delta(y - t)}_{\text{consn function}} + \overbrace{(h_0 - \gamma i)}^{\text{invest't d'd}} + \underbrace{\lambda q - \beta y}_{\text{CA}} + \overbrace{g}^{\text{FP}}$$

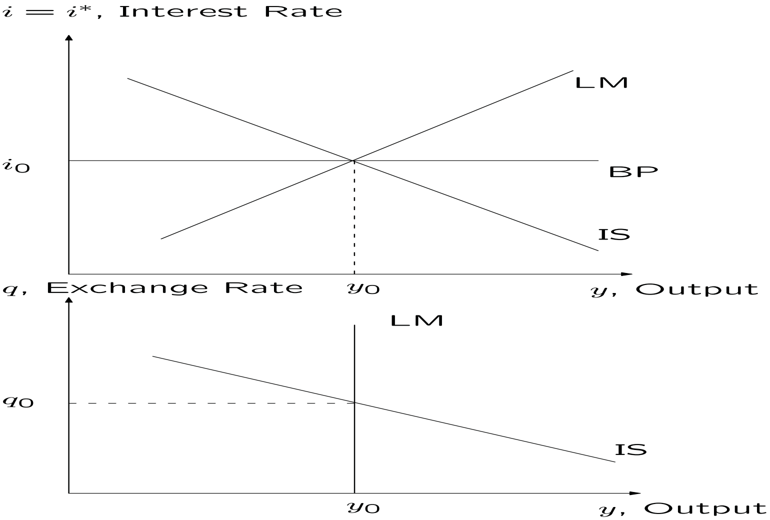
$$\underbrace{m^s}_{\text{MP}} - \overbrace{p}^{\text{exog.}} = ky - \epsilon i$$

- The form of the BP depends on what we assume regarding capital mobility. We won't be explicit about the form of $KA(i - i^*)$.

Representations of IS-LM-BP with Perfect Capital Mobility

- Under perfect capital mobility the BP curve is horizontal in (i, y)-space. We can then draw the IS and LM conditions as we did in the closed economy. **Copeland uses this approach**.
- **Mankiw takes a different approach**: He uses the BP equation in the IS and LM equations and draws IS and LM curves in (q, y)-space.
- **These are totally equivalent**. We will follow the first as it allows us to look at **Imperfect Capital Mobility (i.e. a non-horizontal BP) more easily**.

Mankiw's Alternative MF Model



Fixed and Floating Exchange Rate Regimes

- **Floating exchange rate**: the nominal exchange rate, s, adjusts in order to maintain equilibrium ($CA = -KA$). **E.g. UK now**.
- **Fixed exchange rate**: the nominal exchange rate, s, is fixed, so the central bank has to intervene in foreign exchange markets in order to maintain the parity. **E.g. UK in 1990 (ERM)**.
- Obviously, Ireland is "fixed" against, say, Germany, and floating against the US.
- We can also vary the degree of capital mobility. **E.g.** Ireland has no real restrictions, China has capital controls (i.e. immobile).

Exogenous/Endogenous Variables Revisited

- The exchange rate (q or s) and reserves (R) are the extra variables vs. the closed economy.
- **Again:**

1. the exchange rate may float (be endogenous), with M exogenous, and $R = 0$
2. or be fixed, *using* R, with M endogenous (more on that later)

- The domestic interest rate is exogenous if there is perfect capital mobility ($i = i^*$) but may move if capital is immobile ($i \neq i^*$).

What Ex-Rate Regimes do Countries Adopt?

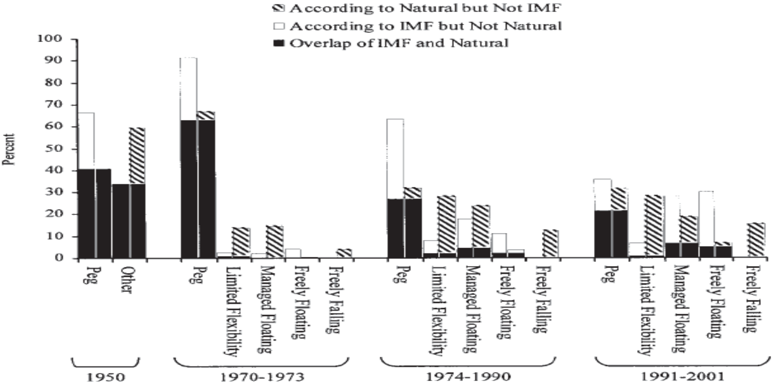


FIGURE VII
Comparison of Exchange Rate Arrangements According to the IMF Official and Natural Classifications, 1950–2001

Sources: International Monetary Fund, *Annual Report on Exchange Arrangements and Exchange Restrictions and International Financial Statistics;* Pick and Sédillot [1971]; International Currency Analysis, *World Currency Yearbook,* various issues.

Who uses Capital Controls and Why?

- Some recent examples of capital controls:
  - Chilean “encaje” to stop excessive inflows of capital - required inflows to be deposited at the central bank for a given period of time.
  - Malaysian controls imposed in September 1998 after the Asian crisis hit in 1997-98.
- Capital controls are often seen as ‘bad’ as they are like a distorting tax on savings decisions.
- Very recently the IMF, and even the Economist, have been suggesting that capital controls are useful in some situations.
- **We care about this because controls on capital can affect the policy conclusions.**

Effects of Government Policy in the MF Model

- First we'll try and develop some intuition for the way the MF model works.
- Basic strategy:

1. for a given policy, we call what would happen in the closed economy the temporary equilibrium
2. from this we will then move to the permanent (new) equilibrium

- For simplicity, we will always start from the position in which the current account and balance of payments are in equilibrium. That is, $CA = KA = 0$.

Floating Exchange Rates - Monetary Policy - Imperfect Capital Mobility

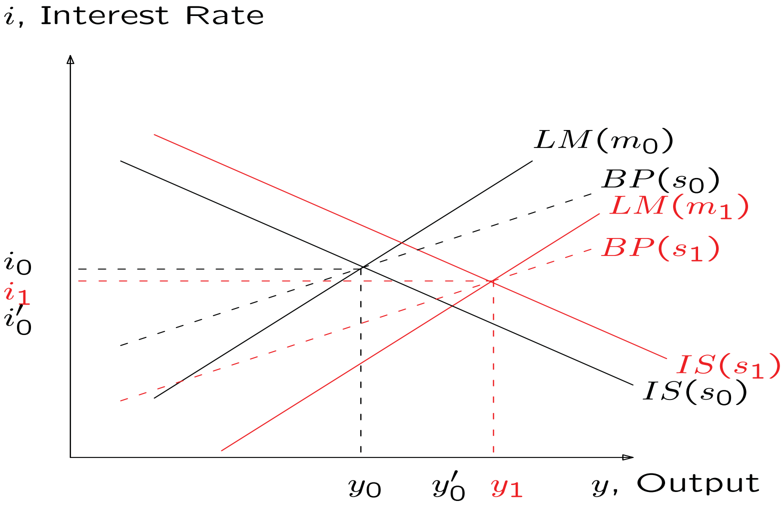
- Consider $\uparrow m^s$. Prices are fixed, so real balances rise. **The LM shifts right**, output rises, and the interest rate falls. **This equilibrium is temporary**.
- As the interest rate falls there is a capital outflow ($KA < 0$).
- The exchange rate rises (domestic currency depreciates), boosting exports, and improving the current account ($CA > 0$).
- Output rises causing a deterioration in the current account ($CA < 0$).
- But, $BP = CA + KA = 0$ for equilibrium.

Moving to the Permanent Equilibrium

- The change in the exchange rate causes the **IS to shift**, this raises the interest rate a little and stops some of the capital outflow. The **BP also shifts**.
- All this stops when the ΔKA covers the ΔCA, which is positive.
- Overall:

1. We start at: $CA = KA = BP = 0$.
2. We end at: $CA > 0$, $KA < 0$, and $BP = 0$.

Floating - MP - Imperfect Mobility



Same Situation BUT with Perfect Capital Mobility

- We now consider perfect capital mobility. This is the same as keeping i fixed, as we have $i = i^*$. **Now we can also get some clear analytical solutions.**
- From the LM equation we can see immediately that:

$$\Delta m^s - \Delta p = k\Delta y - \epsilon \Delta i^*$$
$$\Rightarrow \frac{\Delta y}{\Delta m^s} = \frac{1}{k} > 0$$

- **We don't need to use the IS to get this.** Why? In the closed economy, $\Delta m^s \Rightarrow \Delta i$. This influences the IS via investment. Since $\Delta i^* = \Delta i = 0$ we don't need to worry about that in this case.

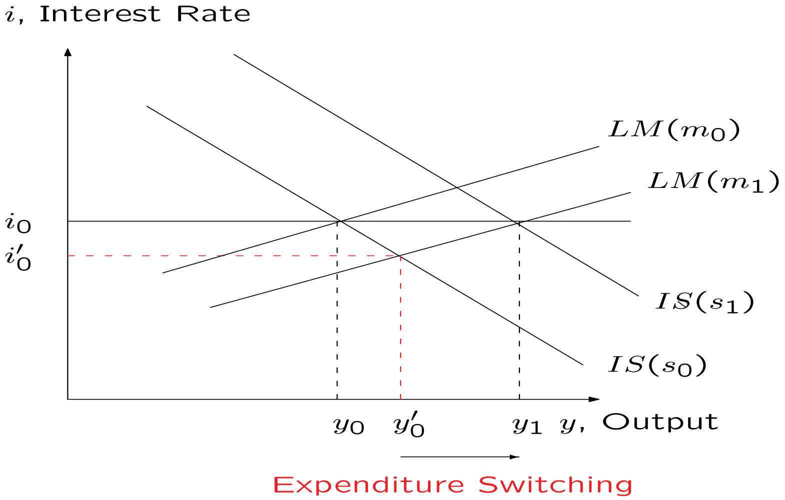
The Exchange Rate

- We also need also to explain what happens to the exchange rate.
- For this we need the IS equation as q appears there.
- Use the IS and LM to eliminate output. This implies:

$$\lambda q = [m^s - p + \epsilon i^*] \frac{1}{k} (1 - \delta) - [...]$$
$$\Rightarrow \frac{\Delta q}{\Delta m^s} = \frac{1 - \delta}{k \lambda} > 0$$

- $\Delta q > 0$ is a real depreciation. I.e. domestic goods are more competitive.
- **This is the reason why** $\Delta y / \Delta m^s > 0$.
- There is 'expenditure switching' with sticky prices (as opposed to a liquidity effect).

Floating - Monetary Expansion - Capital Mobility



Summary: Monetary Expansion Under Floating Exchange Rates

- Depreciation of the nominal (and real) value of domestic currency ($\uparrow q$).
- Increase in the level of income ($\uparrow y$) and fall in the interest rate (only if capital is not perfectly mobile).
- As $CA = CA(q, y)$ we see a $\uparrow CA$ even though the change in output and the exchange rate are offsetting.
- No change in the balance of payments (in constant equilibrium when the ex-rate floats), so $\downarrow KA$ (i.e. outflows).

Floating Exchange Rates - Fiscal Policy - Perfect Capital Mobility

- Recall the closed economy. There, $\uparrow g \Rightarrow \uparrow y$ but there is also $\uparrow i \Rightarrow \downarrow I$, which lowers output. **The full change in government spending is not passed through to output due to 'crowding out'.**
- There is a similar effect under floating exchange rates. However:

1. it involves a change in the exchange rate
2. the effect is stronger.

Determining the Change in Output due to a Fiscal Expansion

- Government spending enters the IS curve so:

$$
\begin{aligned}
y &= a + \delta\,(y - t) + h_0 - \gamma i^* + \lambda q - \beta y + g \\
&\Rightarrow (1 - \delta + \beta)\,\Delta y = \Delta g + \lambda \Delta q
\end{aligned}
$$

- **Now we have to again figure out what happens to the exchange rate.** Following the same logic as before (i.e. eliminate output in IS by the LM),

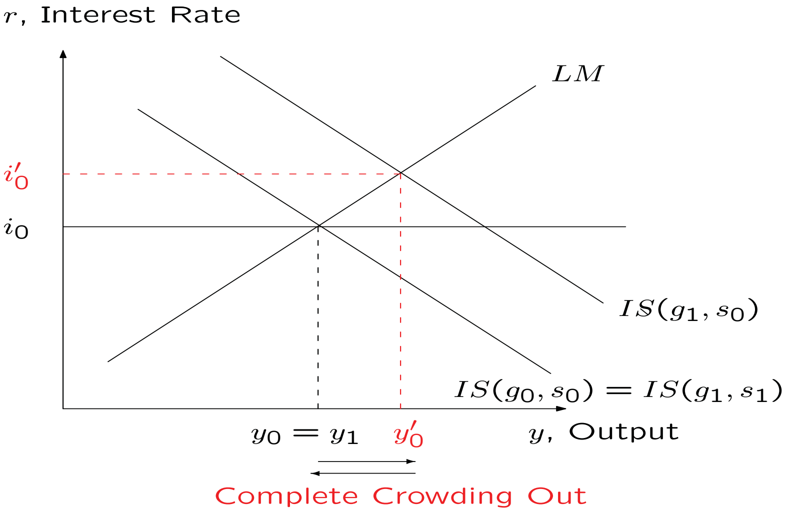
$$
\begin{aligned}
\lambda q &= [m^s - p + \epsilon i^*]\,\frac{1}{k}\,(1 - \delta) - [...] \\
&\Rightarrow \frac{\Delta q}{\Delta g} = -\frac{1}{\lambda} < 0
\end{aligned}
$$

- Now the value of our currency falls (an appreciation of the exchange rate due to govt. purchases).

Open Economy Mechanism for Fiscal Policy

- The IS can only move temporarily. Why? The *BP* and *LM* are unaffected by the change in g (and subsequent change in s).
- Essentially, the Δg is entirely funded by overseas borrowing as a $\$1\Delta g$ is equal to $\$1\Delta KA > 0$, which equilibrium requires to be offset by the change in net exports and exchange rate.
- Overall, there is a current account deficit (equiv. capital account surplus).

Floating - Fiscal Expansion - Capital Mobility



Summary: Fiscal Expansion Under Floating Exchange Rates

- A rise in the real exchange rate and the interest rate (if capital is not perfectly mobile - as considered above).
- A rise in income (if capital is not perfectly mobile) and a deterioration in the current account ($\downarrow CA$) as the income and exchange rate effects are reinforcing.
- No change in the balance of payments (in constant eqm when the ex-rate floats), so $\uparrow KA$ (i.e. capital inflows to cover $CA < 0$).

Fixed Exchange Rates: How is the Exchange Rate Fixed?

- Recall: $BP = CA + KA - \Delta R$. **With a float we said $R = 0$.**
- However, the exchange rate can be fixed ($s = \bar{s}$) by the central bank intervening in the foreign exchange market.
- Under a fixed exchange rate regime, the central bank buys and sells domestic currency. The money supply is,

$$M^s \equiv R + D$$

- Here, D is domestic credit, and is controlled by the central bank, and R are foreign currency reserves, held by the central bank.

The Balance of Payments and Reserves

- **Under a floating exchange rate**, the central bank does not use foreign reserves to intervene in currency markets, so say the domestic currency appreciates ($S \downarrow$),

$$\Delta M^s = \Delta D \Rightarrow \Delta R = 0$$

- **Under a fixed exchange rate**, the appreciation of the domestic currency can, for example, be prevented if the central bank sells some domestic currency using its foreign reserves,

$$\Delta M^s = \Delta D + \Delta R \Rightarrow \Delta R > 0$$

- **Important: ΔD captures Monetary Policy and ΔM^s is endogenous.**

A Balance-of-Payments Surplus, Deficit and Crisis

- If $BP = 0$ how can there be a 'balance-of-payments surplus' or 'deficit'?
- Basically, this terminology refers to the CA vs. KA position, which need not equal zero when the exchange rate is fixed.

$$CA\,(Q, Y) + KA\,(i - i^{*}) = \Delta R$$

- Example: If the CA deficit $>$ KA surplus $\Rightarrow$ a 'B-o-P deficit' where we need to sell reserves ($\Delta R < 0$) to keep $s = \bar{s}$.
- A 'B-o-P crisis' can occur when $\Delta R < 0$ is very large. However, our BP will always end up at $BP = 0$.

Duration of Fixed Ex-Rate Regimes

Countries that have Maintained Fixed Exchange Rates for Five Years or More[a]

Group 1: Major economies with open capital markets

Country	*Fixed against*	*Fixed since (± 2% bands)*	*Fixed since (± 1% bands)*
Austria	German mark	Sept. 1979	Jan. 1990
Hong Kong	U.S. dollar	Oct. 1983	Oct. 1983
Luxembourg	Belgian franc	1945	1945
The Netherlands	German mark	March 1983	Aug. 1992
Saudi Arabia	U.S. dollar	March 1985	June 1986
Thailand[b]	U.S. dollar	July 1990	March 1994

Group 2: Small economies pegging to or using the U.S. dollar

Country	*Fixed against*	*Fixed since (± 2% bands)*	*Fixed since (± 1% bands)*
Antigua & Barbuda	U.S. dollar	May 1976	May 1976
Bahamas	U.S. dollar	1949	1949
Bahrain	U.S. dollar	Jan. 1978	July 1979
Barbados	U.S. dollar	July 1975	July 1975
Belize	U.S. dollar	Jan. 1977	Jan. 1977
Djibouti	U.S. dollar	Feb. 1973	Feb. 1973
Dominica	U.S. dollar	May 1976	May 1976
Grenada	U.S. dollar	May 1976	May 1976
Marshall Islands[c]	U.S. dollar	1986	1986
Micronesia[c]	U.S. dollar	1986	1986
Oman[c]	U.S. dollar	Jan. 1986	Jan. 1986
Panama[c]	U.S. dollar	1934	1934
Qatar	U.S. dollar	May 1979	Nov. 1979
St. Kitts & Nevis	U.S. dollar	May 1976	May 1976
St. Lucia	U.S. dollar	May 1976	May 1976
St. Vincent & Grenadines	U.S. dollar	May 1976	May 1976
United Arab Emirates	U.S. dollar	June 1979	Jan. 1980

IS-LM-BP with Fixed Exchange Rates

- Now $q = \overline{q}$, so the IS and LM conditions are:

$$y = a + \delta\left(y - t\right) + h_0 - \gamma i^* + g + \lambda \overline{q} - \beta y$$

$$\underbrace{R + D}_{=m^s} - p = ky - \epsilon i^*$$

- **Note: any movement in the balance-of-payments is reflected in the change in reserves. So:**

$$CA\left(Q, Y\right) + KA\left(i - i^*\right) = \Delta R = \text{B-o-P}$$

and,

$$CA \neq -KA$$

but,

$$BP = 0$$

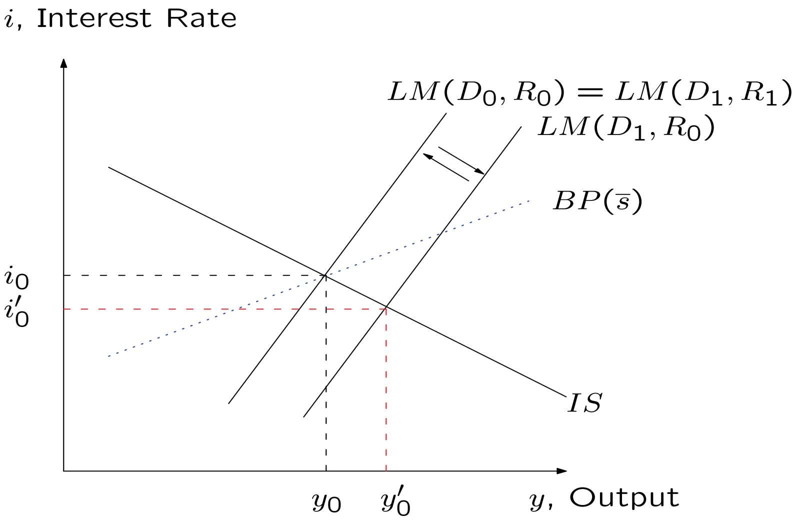
Preview: Fixed Exchange Rates and Perfect Capital Mobility

- Monetary Policy:
  - In a fix $\Delta y / \Delta D = 0$. This is a result of the trilemma problem.
  - But we will have less reserves. Since reserves are finite this policy could cause the fixed regime to be abandoned (eventually).
- Fiscal Policy:
  - Now $\Delta y / \Delta g > 0$, whereas with floating exchange rates not much happened.
  - This produces a CA deficit financed by capital inflows.
- Consider the 'more interesting' case of imperfectly mobile capital.

Fixed Exchange Rates - Monetary Expansion - Imperfect Capital Mobility

- In the short-run, if capital is not completely mobile, **the interest rate decreases**, *income increases*, and so the **capital** and *current* accounts deteriorate ($CA, KA < 0$). **The LM shifts left.**
- As $\downarrow r$, foreigners want to buy domestic currency, which puts **downward pressure on the exchange rate.**
- The central bank intervenes and **sells reserves** to stop this ($\Delta R < 0$) and continues until output and the interest rate are back to their previous level. **LM shifts back.**
- In the new equilibrium, the only difference is in the composition of the money stock (i.e. less reserves, $\Delta R < 0$, more domestic credit, $\Delta D > 0$, and $\Delta M^s = 0$)

Fixed Exchange Rates - Monetary Expansion - Imperfect Capital Mobility

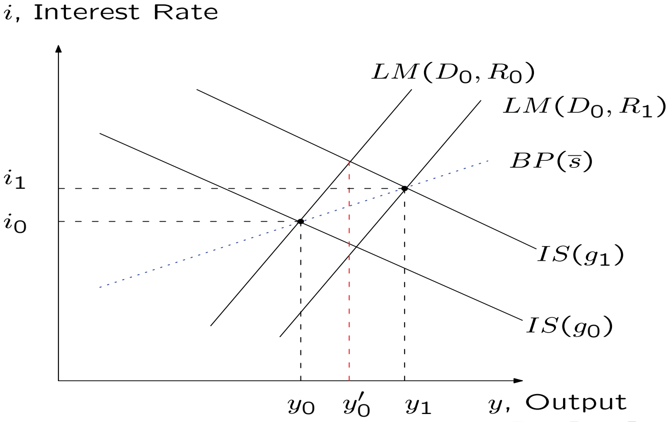


Fixed Exchange Rates - Fiscal Expansion - Imperfect Capital Mobility

- As a result of policy (i.e., $\uparrow g$), the **IS shifts right**. There is a rise in r which produces capital inflows ($KA > 0$) and a rise in y which causes a current account deficit ($CA < 0$).
- As $\uparrow r$, foreigners buy domestic currency, which puts **upward pressure on the exchange rate.**
- The central bank intervenes and **buys reserves** ($\Delta R > 0$). As $\Delta D = 0$, then $\Delta M^s > 0$. **The LM shifts right.**
- The interest rate falls a little, and some capital flows out. Output rises, worsening the current account position.

Fixed Exchange Rates - Fiscal Expansion - Imperfect Capital Mobility

- Fiscal policy is less effective (vs. full capital mobility) at changing output as the domestic interest rate has changed. Below; $D1 = D0$, $R1 < R0$ and $\Delta M^s > 0$.



Conclusions

- We have studied a small open economy:

1. We have looked at the effects of Fiscal and Monetary Policy under Fixed and Floating exchange rates.
2. We have considered the role of capital controls (i.e. imperfect capital mobility) in that context.