Monetary Approach to E

Chapter 4: Price Levels and the Exchange Rate in the Long Run

Learning Goals

This chapter focuses on the long-run determination of exchange rate.

- Explain the concept of purchasing power parity (PPP).
- Determine the long-run exchange rate using PPP – the monetary approach.
- Discuss the concept of the real exchange rate and factors that determine the real exchange rate in the long run.
- Examine the effects of money market and/or output market disturbance on the exchange rate in the long run – the generalized approach.
- Derive real interest rate parity.

Purchasing Power Parity (PPP)

- ***Purchasing power parity:*** a theory states that exchange rates are determined by the amount of different currencies required to purchase a representative bundle of goods. In other words, it is the concept that explains movements in the exchange rate between two currencies by changes in the countries' price levels.
- When PPP holds, an individual will be indifferent to buy an identical good at home or abroad because it will cost the same amount of money in different countries when measured in the same currency.
- There are two forms of PPP – the absolute form and the relative form.

Absolute Purchasing Power Parity (APPP)

- ***APPP*** tells us that in the absence of frictions such as transportation costs and tariffs, an identical basket of goods should be sold for the same amount of money in different countries when expressed in the same currency.

  ⇒ It looks at the relationship between **price levels** and **exchange rate**.
- Let P = # of DC per basket of goods at home

  P* = # of FC per basket goods abroad

  APPP implies: $P = E_{DC/FC} \times P^*$ ⇒ $E = \dfrac{P}{P^*}$

$$E_{DC/FC} = \frac{P}{P^*}$$

$$P = E_{DC/FC} \times P^*$$

Relative Purchasing Power Parity (RPPP)

- **RPPP** states that percentage change in the exchange rate between two currencies over any period equals to the inflation rate differentials between the two countries.

  ⇒ It looks at the relationship between **inflation rates** and **changes in exchange rates**.

- RPPP implies: $\dfrac{E^e - E}{E} = \pi - \pi^*$

- ***Example***: Suppose domestic inflation is 2% while foreign inflation is 5%. What is the rate of change in the exchange rate if RPPP holds?

- Note: RPPP tells us that the rate of a country's currency depreciates by the excess of its inflation over that of another country.

<u>A Long-Run Exchange Rate Model Based on PPP – The Monetary Approach to the Exchange Rate</u>

- ***The Monetary approach to the exchange rate:*** a model of exchange rate determination which shows factors that affect money supply and money demand will play a role in determining the exchange rate.

Assumptions of the Monetary Approach to the exchange rate

1) PPP holds continuously, i.e., $E = \dfrac{P}{P^*}$.
2) Money market is always in equilibrium and prices are fully flexible. Thus,

$$P = \frac{MS}{L(R, Y)} \quad \text{and} \quad P^* = \frac{MS^*}{L^*(R^*, Y^*)}$$

- Given these assumptions, equilibrium exchange rate is

$$E = \frac{P}{P^*} = \frac{MS/L(R, Y)}{MS^*/L^*(R^*, Y^*)} = \left(\frac{MS}{MS^*}\right)\left(\frac{L^*(R^*, Y^*)}{L(R, Y)}\right)$$

- It shows that exchange rate is fully determined by the relative supplies of monies and the relative real demands for monies.

- Predictions (assume other things are held constant):

1) Domestic level of money supply, MS: deliberate change in monetary policy.

$MS\uparrow \Rightarrow P\uparrow = \frac{MS\uparrow}{L(\bar{R},\bar{y})}$ proportional change in the price level

expansionary money policy

$\Rightarrow \uparrow E = \frac{P\uparrow}{\bar{P^*}}$ (DC dep).

2) Foreign level of money supply, MS*:

Federal reserve running a more expansionary money policy.

$MS^*\uparrow \Rightarrow \uparrow P^* = \frac{MS^*\uparrow}{L(\bar{R^*},\bar{y^*})} \Rightarrow \downarrow E = \frac{\bar{P}}{P^*\uparrow}$ (DC appreciates).

3) Domestic interest rate, R:

$R\uparrow \Rightarrow$ the opportunity cost of holding money $\uparrow \Rightarrow L(R,y)\downarrow \Rightarrow \uparrow P = \frac{\bar{MS}}{L(R,y)\downarrow}$

holding more other assets, less money.

$\Rightarrow \uparrow E = \frac{P\uparrow}{\bar{P^*}}$ (DC depreciates)

4) Foreign interest rate, R*:

$R^*\uparrow \Rightarrow L^*(R^*,y^*)\downarrow \Rightarrow \uparrow P^* = \frac{\bar{MS^*}}{\downarrow L^*(R^*,y^*)} \Rightarrow \downarrow E = \frac{\bar{P}}{P^*\uparrow}$

$\Rightarrow$ the opportunity cost of holding money $\uparrow$ $\Rightarrow$ DC appreciates.

in the LR 5) Domestic output: Y: = National Income.

Production Function $Y = F(A, k, L)$

Suppose $Y\uparrow \Rightarrow C\uparrow \Rightarrow L(R,y)\uparrow \Rightarrow \downarrow P = \frac{\bar{MS}}{L(R,y)\uparrow} \Rightarrow \downarrow E = \frac{P\downarrow}{\bar{P^*}}$

(output = income) need a larger amount of money to facilitate a larger volume of transactions. (DC app)

6) Foreign output, Y*

in the LR, $y^* = F^*(A^*, K^*, L^*)$

Suppose $Y^*\uparrow \Rightarrow C^*\uparrow \Rightarrow L^*(R^*,y^*)\uparrow \Rightarrow \downarrow P^* = \frac{\bar{MS^*}}{L^*(R^*,y^*)\uparrow}$

$\Rightarrow \uparrow E = \frac{\bar{P}}{P^*\downarrow}$ (i.e. Depreciates of DC)

QTM: $M \cdot V = P \cdot Y$

The Monetary Approach for the Case of Ongoing Inflation

- Consider how changes in the growth rate of money supply, μ, affect the exchange rate.
- ***Example:*** Suppose the economy is currently producing at its full-employment level of output.

  in other words, at its long-run equilibrium.

  The growth rates of different variables ***before*** T_0 are:

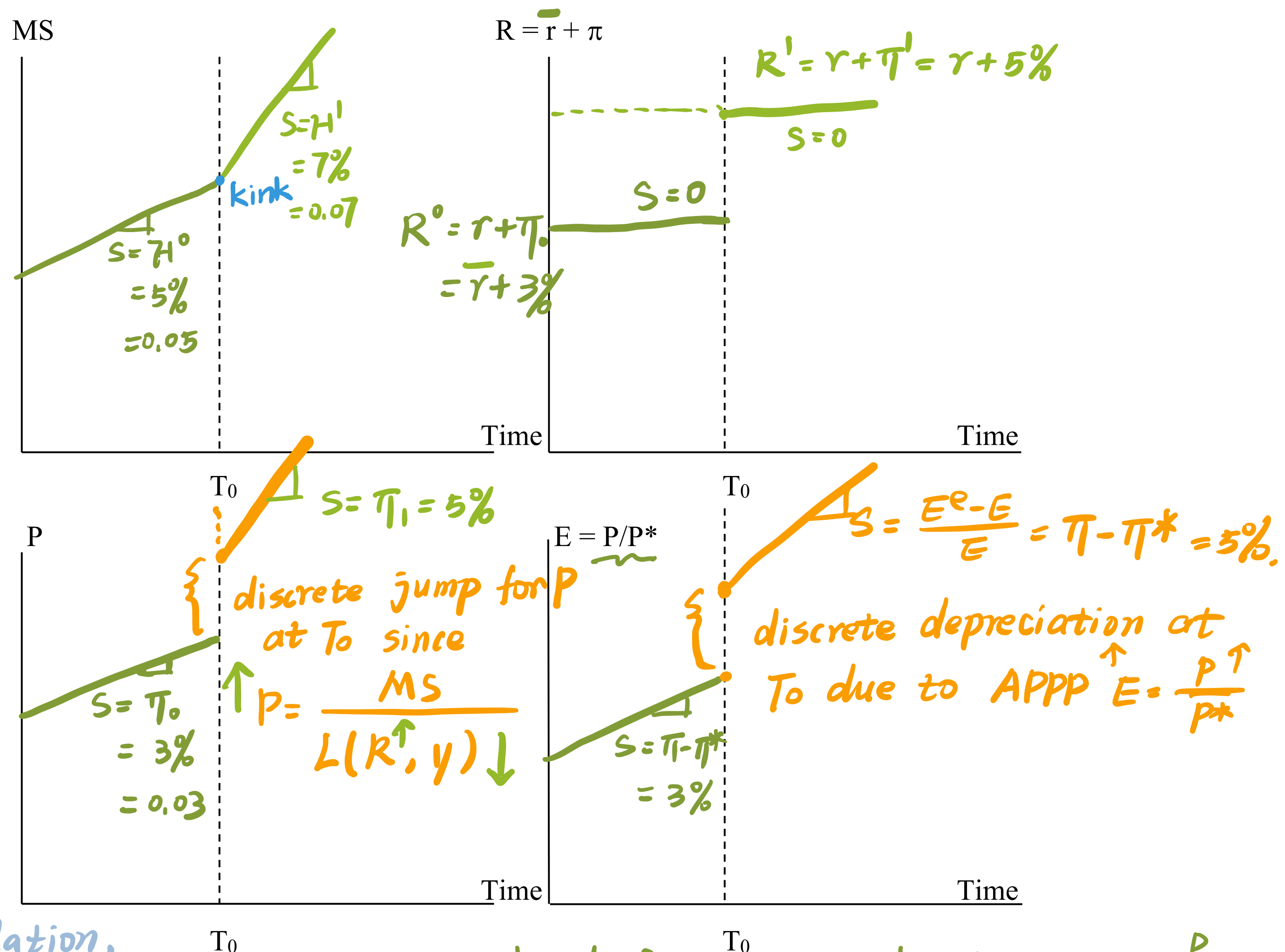
  % Δ in MS = μ^0 = 5%   % Δ in MS* = 0%

  % Δ in Y = 2%   % Δ in Y* = 0%

  At T_0, the growth rate of domestic money supply increases from μ^0 (= 5%) to μ^1 (= 7%).

⇒ **Note: Slope of the time path = % change or growth rate of the variable.**

Assumption: V is held constant ⇒ % Δ in V = 0% & % Δ in V* = 0%.



if deflation, slope would be negative.

Level of E is given by APPP : $E = \frac{P}{P^*}$

E over time will be given by RPPP:

$\Delta\%$ in E : $\frac{E^e - E}{E} = \pi - \pi^*$

Before T_0:

$\Delta\%$ in E = $\pi_H^0 - \pi_F^0$ = 3% − 0% = 3%

Step 1: Find the new inflation rate, π^1, *after T_0*:

QTM: $\Rightarrow$ Quantity theory of money: % Δ in MS + % Δ in V = % Δ in P + % Δ in Y

H: Before T_0: $\%\Delta$ in MS + $\%\Delta$ in V = $\%\Delta$ in P + $\%\Delta$ in Y

$5\% + 0\% = \pi_0 + 2\% \Rightarrow \pi_H^0 = 3\%$.

H: After T_0: $\%\Delta$ in MS + $\%\Delta$ in V = $\%\Delta$ in P + $\%\Delta$ in Y

$7\% + 0\% = \pi_1 + 2\% \Rightarrow \pi_H^1 = 5\%$

F: Before T_0 → $0\% + 0\% = \pi_F^0 + 0\% \Rightarrow \pi_F^0 = 0\%$

After T_0 → $\pi_F^1 = \pi_F^0 = 0\%$

Step 2: Find the new (nominal) interest rate, R^1, *at T_0*:

$\Rightarrow$ Fisher equation: $R = r + \pi$

- $\bar{r}$ b/c money is neutral in the LR

when $\mu\uparrow$, $R_1 = \bar{r} + \pi_H^1 = \bar{r} + 5\%$

$\Rightarrow$ at T_0, $\uparrow R = \bar{r} + \pi\uparrow \Rightarrow R\uparrow$ to $R' = r + 5\%$.

(at T_0, discrete ↑ in R)

Step 3: Price level *at T_0* and *after T_0*:

$\Rightarrow$ The growth rate of price level *after T_0*:

- when $\mu\uparrow$ to 7%, $\pi\uparrow$ to 5% after T_0 (from step 1).

$\Rightarrow$ The level of price *at T_0* when μ rises:

at T_0, $\mu\uparrow$ to 7%

at T_0, $\uparrow P = \dfrac{MS}{L(R\uparrow, Y)\downarrow}$

find what happened to MS, R, Y at T_0.

$F(\bar{A}, \bar{K}, \bar{L})$

↳ $\overline{MS}$, ↳ R↑ to R' (from step 2) ⇒ the opportunity cost of holding money ↑ ⇒ demand for money ↓

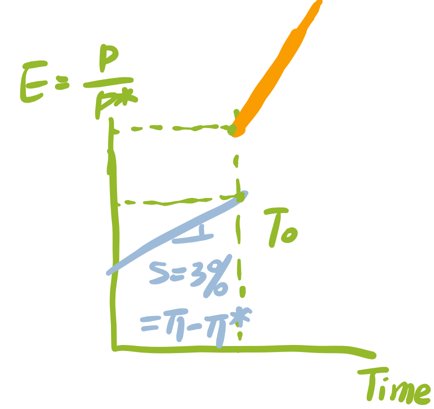
R

discrete increase

↳ $\bar{Y} = F(\bar{A}, \bar{K}, \bar{L})$

at T_0, discrete ↑ in P,

after T_0, $\pi\uparrow$ to 5%.



Step 4: Exchange rate *at T_0* and *after T_0*:

⇒ The growth rate of exchange rate *after T_0*:

RPPP: $\frac{E^e - E}{E} = \pi - \pi^*$

- when H↑ to 7%, π↑ to 5% (from step 1).

$$\Rightarrow \frac{E^e - E}{E} = 5\% - 0\% = 5\% \quad (\text{after } T_0)$$

⇒ The level of exchange rate *at T_0*:

APPP: $E\uparrow = \frac{P\uparrow}{P^*}$ Discrete depreciation of DC at T_0.

⇒ at T_0, P↑ (from step 3), & $\overline{P^*}$ ⇒ $E\uparrow = \frac{P\uparrow}{P^*}$

∴ at T_0, there is a discrete dep of DC

after T_0, DC is expected to dep at a rate of 5%.

The Real Exchange Rate (q)

- The ***real exchange rate (q)*** measures the **purchasing power** of a country's currency relative to another country's currency.
- In notational form, $q_{DC/FC} = E_{DC/FC}\left(\frac{P^*}{P}\right)$

$$\frac{\text{\# of baskets of domestic goods}}{\text{(one) basket of foreign goods}} = \frac{\text{\# of DC}}{\text{(one) FC}} \times \frac{\text{\# of FC / basket of foreign goods}}{\text{\# of DC / basket of domestic goods}}$$

- The real exchange rate, q, shows how many baskets of domestic goods are needed to exchange one basket of foreign goods.

- if q↑, more of baskets of domestic goods are needed to exchange for one basket of foreign goods. ⇒ real dep of DC.

- if q↓, real appreciation of DC.
(purchasing power of DC ↑)

Default: Exchange rate refers to nominal E unless

explicitly mentioned real Exchange rate.

Properties of q when PPP holds:

Property	Proof
q = 1	$q = E_{DC/FC} \cdot \left(\frac{P^*}{P}\right)$ APPP: $E = \frac{P}{P^*}$ if PPP holds. $q = \frac{P}{P^*} \cdot \frac{P}{P^*} = 1$
% Δ in q = 0	$\frac{q^e - q}{q} = \frac{E^e - E}{E} + \pi^* - \pi$ $\frac{q^e - q}{q} = \frac{E^e - E}{E} + \pi^* - \pi.$ RPPP: $\frac{E^e - E}{E} = \pi - \pi^*$ when PPP holds. $\frac{q^e - q}{q} = \pi - \pi^* + \pi^* - \pi = 0.$ If good market shock, PPP could fail.

Demand, Supply, and the Long-Run Real Exchange Rate – Factors that Affect q

- Since q measures the purchasing power of a currency, changes countries' output market would lead to changes in q.

  ⇒ In other words, changes in q capture changes in the output markets.

- The following factors affect q:

  1) Changes in relative demand for domestic products:

$$\underbrace{\frac{AD}{AD^*}}_{\text{relative demand}} = \frac{C + I + G + CA}{C^* + I^* + G^* + CA^*}$$

Suppose $\left(\frac{AD}{AD^*}\right) \uparrow$

⇒ domestic goods becomes more valuable

⇒ purchasing power of DC ↑

⇒ real appreciation of DC ($q \downarrow$)

In the LR,

2) Changes in relative supply of domestic products: $\underbrace{\frac{Y}{Y^*}}_{\text{relative supply}} = \frac{F(A,K,L)}{F^*(A^*,K^*,L^*)}$

Suppose $\left(\frac{Y}{Y^*}\right)\uparrow$

⇒ domestic goods become less valuable

⇒ purchasing power of DC ↓

⇒ real depreciation of DC ($q\uparrow$)

The Generalized Approach to the Long-Run Exchange Rate

- Now, we will develop a generalized model of exchange rate determination that considers how ***changes in both monetary and real sides*** of the economy affect the long run exchange rate.

money market shocks → output market shocks → changes in the relative supply or relative demand.

Assumptions of the Generalized Approach to the Long-Run Exchange Rate

since LR.

1) The long-run level of output is determined by production function.

$$Y_{FE} = F(A, K, L) \quad \text{and} \quad Y^*_{FE} = F^*(A^*, K^*, L^*)$$

2) Relative output market is in equilibrium. since LR has sufficient time to adjust to clear the market. in the LR $q = f\left(\frac{AD}{AD^*}, \frac{Y}{Y^*}\right)$

$$\underbrace{\frac{AD}{AD^*}}_{\text{relative demand}} = \underbrace{\frac{Y}{Y^*}}_{\text{relative supply}}$$

3) Money market is always in equilibrium and prices are fully flexible.

$$P = \frac{MS}{L(R, Y)} \quad \text{money market equilibrium} \quad \text{and} \quad P^* = \frac{MS^*}{L^*(R^*, Y^*)}$$

money is the most liquid asset thus money market is always in equilibrium.
Also, in the LR, Prices are fully flexible

- According to the generalized approach, the long-run nominal exchange rate is

$$E = \underbrace{q}_{\text{good market}}\left(\frac{P}{P^*}\right)$$

P → domestic money market

P* → foreign money market.

In the LR, Δ in q (output market)
Δ in P (domestic money market)
and Δ in P* (foreign money market) } lead to Δ in E in the LR normal exchange rate.

must discuss q, P, P* before discussing E.

Factors that affect E in the long run:

- Disturbances from the money market (where PPP holds):
  1) Changes in level of domestic money supply, MS:

$$-MS\uparrow \Rightarrow \uparrow P = \frac{MS\uparrow}{L(R,y)}$$

$$\Rightarrow \uparrow E = \bar{q}\cdot\left(\frac{P\uparrow}{P^*}\right)$$ nominal dep of DC.

  2) Changes in level of foreign money supply, MS*:

$$MS^*\uparrow \Rightarrow \uparrow P^* = \frac{MS^*\uparrow}{L^*(R^*, y^*)}$$

$$\Rightarrow \downarrow E = \bar{q}\cdot\left(\frac{\bar{P}}{P^*\uparrow}\right)$$ nominal app of DC.

  3) Changes in the growth rate of domestic money supply, μ:

$$\mu\uparrow \Rightarrow \pi\uparrow \text{ (QTM)} \Rightarrow R\uparrow = \bar{r} + \pi\uparrow$$

$\Rightarrow$ opportunity cost of holding money $\uparrow$

$\Rightarrow L(R,y)\downarrow$

$$\Rightarrow \uparrow P = \frac{MS}{L(R,y)\downarrow} \Rightarrow \uparrow E = \bar{q}\cdot\left(\frac{P\uparrow}{P^*}\right)$$

(nominal dep of DC)

  4) Changes in the growth rate of foreign money supply, μ*:

$$\mu^*\uparrow \Rightarrow \pi^*\uparrow \text{ (QTM)} \Rightarrow R^*\uparrow = \bar{r} + \pi^*\uparrow$$

$\Rightarrow$ opportunity cost of holding money $\uparrow$

$\Rightarrow L^*(R^*,y^*)\downarrow$

$$\Rightarrow \uparrow P^* = \frac{MS^*}{L^*(R^*,y^*)\downarrow} \Rightarrow \downarrow E = q\cdot\left(\frac{\bar{P}}{P^*\uparrow}\right)$$

(nominal appreciation of DC)

- Disturbances from the output market (where PPP fails): $\nearrow \Delta$ in q

1) Changes in demand for domestic goods, AD:

$AD\uparrow \Rightarrow \left(\frac{AD}{AD^*}\right)\uparrow \Rightarrow$ domestic goods become more valuable

(might from C or I or G or CA)

$\Rightarrow$ purchasing power of DC $\uparrow$

$\Rightarrow$ real app of DC ($q\downarrow$)

2) Changes in demand for foreign goods, AD*:

Suppose $AD^*\uparrow \Rightarrow \left(\frac{AD}{AD^*}\right)\downarrow$ relative demand for D. good.

$\Rightarrow$ domestic goods become less valuable

$\Rightarrow$ purchasing power of DC $\downarrow$

$\Rightarrow$ real dep of DC ($q\uparrow$) $\Rightarrow \overline{P^*} = \frac{\overline{MS^*}}{L^*(R^*, y^*)}$, $\uparrow E = \uparrow q \cdot \left(\frac{\overline{P}}{\overline{P^*}}\right)$ (nominal dep of DC)

$q = E \cdot \left(\frac{P^*}{P}\right)$

$\overline{P} = \frac{\overline{MS}}{L(\overline{R}, \overline{y})}$, $\downarrow E = \downarrow q \cdot \left(\frac{\overline{P}}{\overline{P^*}}\right)$ (nomial app of DC)

3) Changes in domestic output, Y:

in the LR, $Y = F(A, k, L)$

- Suppose $Y\uparrow \Rightarrow \left(\frac{Y}{Y^*}\right)\uparrow \Rightarrow$ domestic goods become less valuable

$\Rightarrow$ purchasing power of DC $\downarrow \Rightarrow$ real dep of DC ($q\uparrow$)

- $y\uparrow \Rightarrow C\uparrow \Rightarrow L(R,y)\uparrow \Rightarrow \downarrow P = \frac{\overline{MS}}{L(R,y)\uparrow}$

? $E = \uparrow q \cdot \left(\frac{P\downarrow}{P^*}\right)$ ambiguous.

4) Changes in foreign output, Y*:

- in the LR, $Y^* = F^*(A^*, k^*, L^*)$

- suppose $Y^*\uparrow \Rightarrow \left(\frac{Y}{Y^*}\right)\downarrow \Rightarrow$ domestic goods becomes more valuable

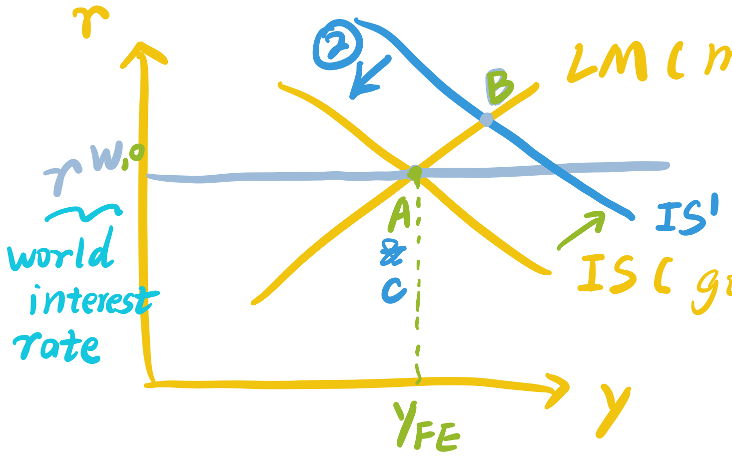
$\Rightarrow$ purchasing power of DC $\uparrow \Rightarrow$ real app of DC ($q\downarrow$)

- $y^*\uparrow \Rightarrow C^*\uparrow \Rightarrow L^*(R^*, y^*)\uparrow \Rightarrow \downarrow P^* = \frac{MS^*}{L^*(R^*, y^*)\uparrow}$

$\Rightarrow$? $E = \downarrow q \cdot \left(\frac{\overline{P}}{P^*\downarrow}\right)$ is ambiguous.

Mundell-Fleming Model:

developed by Robert Mundell & Marcus Fleming,
an extension of IS-LM model to an open economy.



Full-empolyment rate
= Long-run equilibrium.
(And SR equilibrium)

(AD↑ ⇒ rightward shift of IS)
temporary equi B, $r > r^w$,
capital inflow → DC app.
→ Ex↓, IM↑ → AD↓
⇒ IS shift back to original position
⇒ back to pt. A
⇒ $\overline{P}$

uncovered interest rate parity

Derivation of the Real Interest Rate Parity

- UIRP: $R = R^* + \frac{E^e - E}{E}$ $\Rightarrow$ $\frac{E^e - E}{E} = R - R^*$ — ①
- Expectation form of percentage in q: $\frac{q^e - q}{q} = \frac{E^e - E}{E} + \pi^* - \pi$ — ②
- Fisher effect: $R = r + \pi$ $\Rightarrow$ $r = R - \pi$ — ③

Derivation:

$r^* = R^* - \pi^*$ — ④

substitute ① into ②

$$\frac{q^e - q}{q} = \underbrace{R - R^*}_{\frac{E^e - E}{E}} + \pi^* - \pi$$

$$= (R - \pi) - (R^* - \pi^*) \quad \text{— ⑤}$$

$$= r - r^*$$

substitute ④

substitute ③

$$\left[\frac{q^e - q}{q} = r - r^* \Leftarrow \text{real interest rate parity} \right]$$

when RPPP holds, $\frac{q^e - q}{q} = 0 \Rightarrow r = r^* \Leftarrow$ real interest rate equalization

we assume RPPP holds on a continuous basis.