

# Price Levels and Exchange Rates in the Long Run

Chapter 15

1. Purchasing Power Parity (PPP)
2. Monetary Approach to the Exchange Rate
3. Empirical Evidence on PPP
4. General model of long-run exchange rate
5. Real interest rate parity

# 1 Purchasing Power Parity

## 1.1 Law of one price (LOOP)

- Price of a particular good  $i$  should be the same when priced in the same currency

$$P_i = EP_i^*$$

- Arbitrage
- Ignores

- Barriers to trade like tariffs
- Transportation costs
- Costs of retailing

## 1.2 PPP from LOOP

- If LOOP holds, and if weights in consumption basket for goods are identical across countries, the PPP holds

$$P_{US} = EP_J$$

- Determine exchange rate from relative price levels

$$E = \frac{P_{US}}{P_J}$$

- Absolute PPP requires identical price levels – not likely to hold for real world baskets

$$\frac{EP_J}{P_{US}} = 1$$

- Relative PPP requires the relative price to be constant, but not unity

$$\frac{EP_J}{P_{US}} = \text{constant}$$

- Taking logarithms and differentiating

$$\frac{1}{E} \frac{dE}{dt} = \frac{1}{P_{US}} \frac{dP_{US}}{dt} - \frac{1}{P_J} \frac{dP_J}{dt}$$

## 2 Monetary Approach to the Exchange Rate

### 2.1 Building blocks

- Purchasing power parity (PPP)

$$E = \frac{P_{US}}{P_J}$$

- Money demand in each country

$$\frac{M_{US}}{P_{US}} = L(R_{\$}, Y_{US}) \quad \frac{M_J}{P_J} = L(R_{\text{¥}}, Y_J)$$

implying

$$P_{US} = \frac{M_{US}}{L(R_{\$}, Y_{US})} \quad P_J = \frac{M_J}{L(R_{\yen}, Y_J)}$$

- Combine

$$E = \frac{P_{US}}{P_J} = \frac{L(R_{\yen}, Y_J) M_{US}}{L(R_{\$}, Y_{US}) M_J}$$

- Take logarithms

$$\ln E = \ln M_{US} - \ln M_J + \ln L(R_{\yen}, Y_J) - \ln L(R_{\$}, Y_{US})$$

### 3 Comparative statics

$$\ln E = \ln M_{US} - \ln M_J + \ln L(R_{\text{¥}}, Y_J) - \ln L(R_{\text{§}}, Y_{US})$$

- $M_{US}$  increases (other variables constant)
- $Y_{US}$  increases (other variables constant)
- $R_{\text{§}}$  increases (other variables constant)
- Might not make sense to consider a change in a single variable with others constant

## 3.1 Characteristics of Long-Run Equilibrium

### 3.1.1 Monetary Neutrality

- Prices

$$\frac{P_{t+1} - P_t}{P_t} = \pi_{t+1} = \frac{M_{t+1} - M_t}{M_t}$$

- Exchange rates

$$\frac{E_{t+1} - E_t}{E_t} = \frac{P_{t+1,US} - P_{t,US}}{P_{t,US}} - \frac{P_{t+1,J} - P_{t,J}}{P_{t,J}} = \pi_{US} - \pi_J$$

### 3.1.2 Fisher effect

- Real interest rate is unaffected by inflation

$$R_{\$} - \pi_{US}$$

- When  $\pi_{US}$  increases,  $R_{\$}$  increases by the same amount

### 3.1.3 Graphs of effects of an increase in money growth with flexible prices

- $M_{US}$

- $R_{\$}$

- $P_{US}$

- $E$

## 3.2 Increase in money growth, interest rates, and exchange rates

- Interest rate parity

$$R_{\$} = R_{\text{¥}} + \frac{E_{t+1}^e - E_t}{E_t}$$

- Sticky prices (short run) – increase in money with price fixed reduces  $R_{\$}$ .  
Therefore  $E_t$  must rise by more than  $E_{t+1}^e$
- Flexible prices (long run) – the expected rate of change of the exchange rate and the expected rate of inflation equal the higher money growth, raising  $R_{\$}$

## 4 Empirical Evidence on PPP

### 4.1 What is required for PPP to hold?

- Perfectly flexible prices – not in short-run
- LOOP
  - trade barriers
  - non-traded goods and services

- Belassa-Samuelson effect
  - \* labor force in poor countries is less productive than in rich countries for tradeables
  - \* labor force equally productive for non-tradeables
  - \* price of tradeables determined on world market
  - \* since  $wage = MPN \times P$  for traded goods, MPN lower and P the same, then wage is lower
  - \* non-traded goods have lower wage and world MPN, implying lower price of non-tradeables and lower price level
- All goods are tradeable and all countries have same goods with identical weights in baskets or absence of real shocks

- If all shocks were nominal, relative PPP would hold
  - Absolute PPP – holds in levels

$$P_{US} = EP_J$$

- Relative PPP – holds in proportionate rates of change

$$\frac{E_{t+1} - E_t}{E_t} = \frac{P_{t+1,US} - P_{t,US}}{P_{t,US}} - \frac{P_{t+1,J} - P_{t,J}}{P_{t,J}} = \pi_{US} - \pi_J$$

## 4.2 Does PPP hold?

- No
- Holds better in the long-run than in the short-run
- Even in the long-run, real shocks can require relative price changes

# 5 General Model of Long-Run Exchange Rate

## 5.1 Real Exchange Rate

- Relative price of foreign goods

$$q = \frac{EP_J}{P_{US}}$$

- Real domestic depreciation is an increase in  $q$  –Japanese goods become expensive relative to US goods

- Determined by relative demand and supply for foreign goods compared to US goods
- Real exchange rate could never change if PPP held

## 5.2 Changes in the Real Exchange Rate

- Increase in world demand for US goods relative to foreign goods –  $q$  falls  
– real appreciation
- US technological improvement increases relative supply of US goods –  $q$  rises – real depreciation

## 5.3 Adjust Monetary Approach to the Exchange Rate for Absence of PPP

- Real exchange rate replaces PPP

$$E = q \times \frac{P_{US}}{P_J}$$

- Money demand in each country solved for price

$$P_{US} = \frac{M_{US}}{L(R_{\$}, Y_{US})} \quad P_J = \frac{M_J}{L(R_{\yen}, Y_J)}$$

- Combine

$$E = q \frac{P_{US}}{P_J} = q \frac{M_{US} L(R_{\yen}, Y_J)}{M_J L(R_{\$}, Y_{US})}$$

- Comparative statics –  $q$  up raises  $E$

## 6 Real Interest Rate Parity

- Real exchange rate

$$q = \frac{EP_j}{P_{US}}$$

- Take logarithms

$$\ln q = \ln E + \ln P_j - \ln P_{US}$$

- Take time derivatives

$$\frac{1}{q} \frac{dq}{dt} = \frac{1}{E} \frac{dE}{dt} + \frac{1}{P_J} \frac{dP_J}{dt} - \frac{1}{P_{US}} \frac{dP_{US}}{dt}$$

This is approximately

$$\frac{q_{t+1} - q_t}{q_t} = \frac{E_{t+1} - E_t}{E_t} + \pi_J - \pi_{US}$$

- Real interest rate parity

- nominal interest rate parity

$$R_{\$} - R_{\text{¥}} = \frac{E_{t+1}^e - E_t}{E_t}$$

- definition of real exchange rate

$$\frac{q_{t+1}^e - q_t}{q_t} - \pi_J^e + \pi_{US}^e = \frac{E_{t+1}^e - E_t}{E_t}$$

- combine

$$R_{\$} - R_{\text{¥}} = \frac{q_{t+1}^e - q_t}{q_t} + \pi_{US}^e - \pi_J^e$$

the interest rate differential is the expected change in the real exchange rate plus the expected inflation differential

- define expected real interest rate

$$r^e = R - \pi^e$$

- real interest rate parity

$$r_{US}^e - r_J^e = \frac{q_{t+1}^e - q_t}{q_t}$$

the real interest rate differential is the expected rate of change of the real exchange rate