FETP/MPP8/Macroeconomics/Riedel

Money, Prices and the Exchange Rate in the Long Run

Introduction

We have studied the link between exchange rates and interest rates and subsequently the link between interest rates and money. Prices did not play an important role in our analysis because we were focused on the short-run, when prices are inflexible. In this lecture we shift focus to the long-run—that is, when prices are flexible and hence when inflation becomes a central issue.

Topics

1. Law of one price
2. Purchasing power parity
3. Monetary approach to the exchange rate determination
4. The Fisher effect—the relation between interest rates and inflation
5. The real exchange rate approach
6. Real interest rates

Note: the long-run models developed in this lecture do not provide a very realistic description of how exchange rates behave, but they do explain how market participants form expectations about future exchange rates and the exchange rate tends to move over the long-run.

Law of One Price and Purchasing Power Parity

Purchasing Power Parity is the application of the **law of one price** across countries for all goods and service, or for a representative bundles (or baskets) of goods and services:

$$P_H = E_{H/F} \times P_F$$

where

$P_H = level\ of\ average\ prices\ in\ the\ home\ (H)\ country$

$P_F = level\ of\ average\ prces\ in\ a\ foreign\ country\ or\ group\ of\ foreign\ countries\ (F)$

$E_{H/F} = home\ currency\ per\ unit\ of\ the\ foreign\ currency$

Purchasing Power Parity (PPP) implies that the exchange rate is determined by levels of average prices at home and in foreign countries:

$$E_{H/F} = P_H / P_F$$

Purchasing Power Parity comes in two forms:

1. Absolute PPP: $E_{H/F} = P_H / P_F$
2. Relative PPP: $\left(E_{H/F,\,t} - E_{H/F,\,t-1}\right) / E_{H/F,\,t-1} = \pi_{H,t} - \pi_{F,t}$

where $\pi_t = inflation\ rate\ from\ period\ t-1\ to\ t\ \ldots i.e.\ \ \Delta P/P = \pi$

Monetary Approach to Exchange Rates

The theory of **Absolute PPP** argues that exchange rates reflect differences in price levels across countries.

$$(1) \quad E_{H/F} = P_H / P_F$$

The quantity theory of money argues that differences in price levels reflect differences in money supply relative to demand across countries:

$$(2) \quad \frac{P_H}{P_F} = \frac{M_H^S / L(R_H, Y_H)}{M_F^S / L(R_F, Y_F)}$$

From (1) and (2) it follows the exchange rates are determined by relative supply and demand for money across countries (the monetary approach to the exchange rate):

$$(3) \quad E_{H/F} = M_H^S / M_F^S - L_H / L_F$$

In terms of **Relative PPP** the monetary approach states that :

$$(4) \quad \hat{E}_{H/F} = (\hat{M}_H^S - \hat{M}_F^S) - \left(\hat{L}_H - \hat{L}_F\right) \approx (\hat{M}_H^S - \hat{M}_F^S) - \left(\hat{Y}_H - \hat{Y}_F\right)$$

where a “hat” over a variable indicates the rate of change of that variable.

The Fisher Effect

The Fisher Effect (after Irving Fisher, 1867-1947) describes the relationship between inflation and interest rates.

The Fisher Effect is derived from the Uncovered Interest Parity Condition:

$$R_H - R_F = \left(E'_{H/F} - E_{H/F}\right)/E_{H/F} = \pi'_H - \pi'_F$$

In words, the expected rate of change of the exchange rate is equal to the difference in the expect rates of inflation between two counties (H and F).

A rise in the domestic rate of inflation causes and equal rise in the interest rate on domestic deposits in the long run, other things equal.

Intuition: If you lend money for one period, the value of the money you lend will decline by the rate of inflation over the period. You will there for demand compensation for the lost value of your money due to inflation. The borrower will be willing to make compensation for inflation because the value of the borrower's debt falls by the rate of inflation over the period of the loan. The nominal interest rate will therefore be the expected rate of inflation (π') plus the real return (r) on the loan: $R = \pi' + r$.

Illustration of the Fisher Effect

Suppose the home (US) central bank unexpectedly increases the rate of growth of the money supply at time t_0.

Suppose the inflation rate in the US is π before t_0 and is $\pi + \Delta\pi$ after t_0. Further suppose that the foreign (EU) inflation rate is zero before and after.

According to the Fisher Effect the interest rate in the US will adjust to the higher inflation rate:

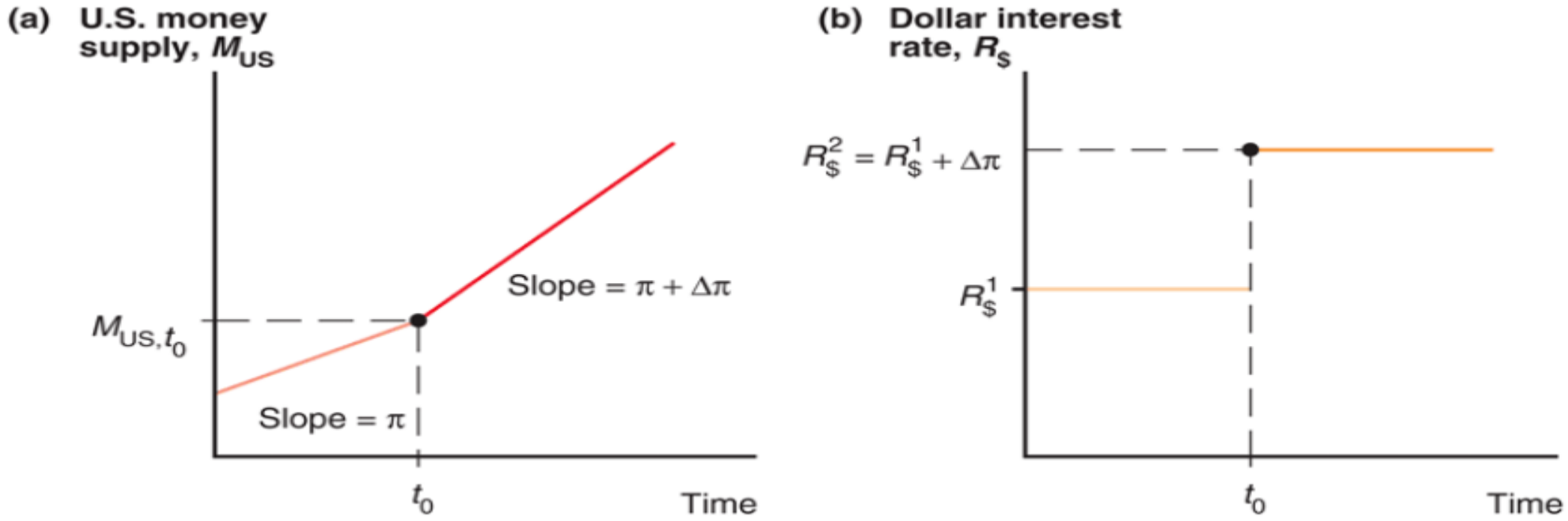
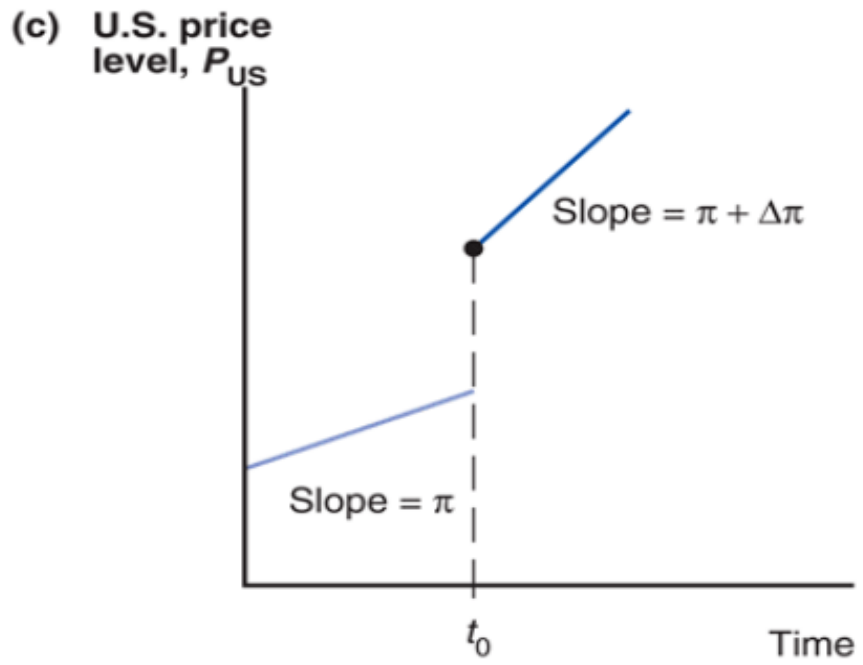
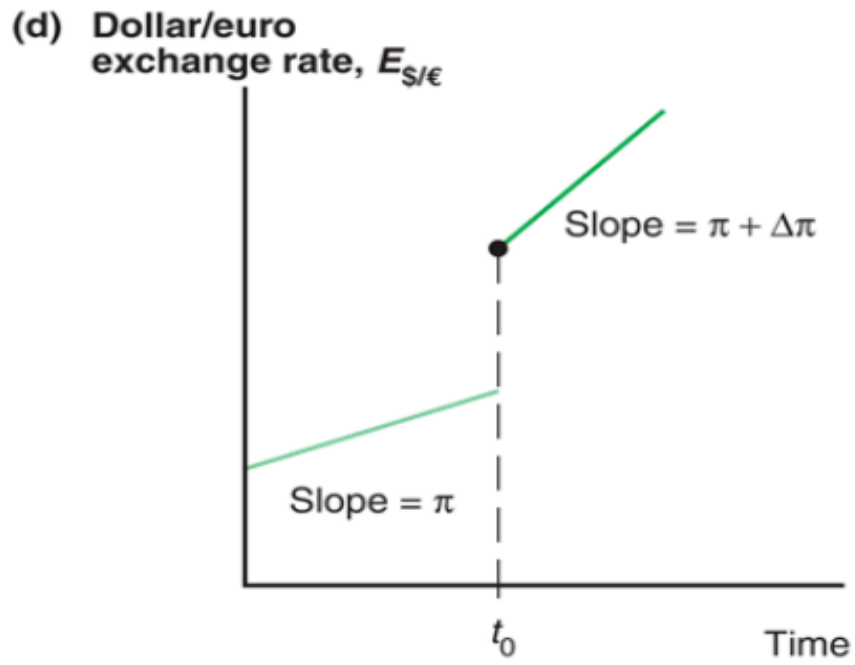


Illustration of the Fisher Effect

Continuing… **(1)** the increase in the nominal interest rate decreases the demand for real money balances ($L \downarrow$)… **(2)** money market equilibrium ($P = M^S/L(R, Y)$ requires that as $L \downarrow$ the price level must jump ($P \uparrow$) … **(3**) in order to maintain PPP ($E = P_H/P_F$), as $P_H \uparrow$ the nominal exchange rate must rise (depreciate) $E_{H/F} \uparrow$… thereafter, **(4)** money supply and prices are expected to increase at the rate $\pi + \Delta\pi$ and the currency is expected to depreciates at the same rate $\hat{E}'_{H/F} = \pi + \Delta\pi$.





Inflation and Expectations

When considering the long-run adjustment to monetary shocks, we have to differentiate the effect of changes in the LEVEL of the money supply and changes in the RATE OF CHANGE of the money supply.

- When there is a change in the **level** of money supply, inflation occurs only during the transition from short-run to long-run, but not in the long-run. In the long-run the level of prices is higher, but not the rate of change of prices (i.e. inflation).

- When the growth rate of money increases permanently, the rate of inflation increases permanently, the nominal interest rate increases permanently and the nominal exchange rate increases (depreciates) at the rate of inflation.

- However, in the long-run, real money balances are constant ($\widehat{M}^S - \pi = 0$), the real interest rate is constant ($R - \pi = r$) and the real exchange rate is constant $\left(\hat{e} = \hat{P}_H - \hat{P}_F = 0\right)$.

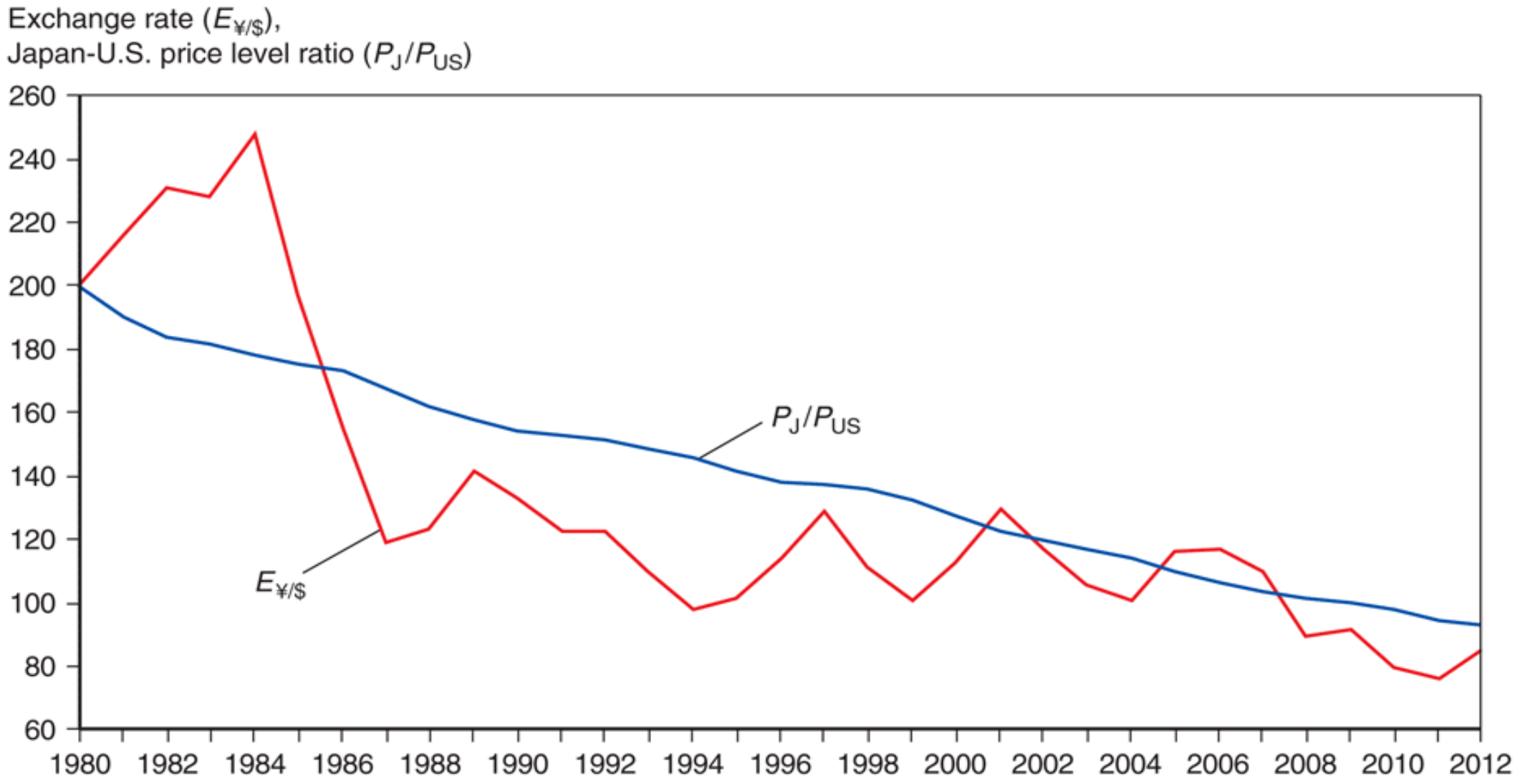
Empirical Evidence on PPP

There is little empirical support for ABSOLUTE PPP, but there is some support for RELATIVE PPP.

Recall the Big Mac PPP index:

Country	Price in domestic currency	Nominal exchange rate	Price in US dollars	PPP $ Exchange Rate	Dollar Over/under valuation
China	17	6.21	2.74	3.55	-42.84
Euro area	3.7	0.91	4.05	0.77	-15.37
Japan	370	123.94	2.99	77.24	-37.67
Thailand	108	34.09	3.17	22.55	-33.86
United States	4.79	1.00	4.79	1.00	0.00
Vietnam	60,000	21,810	2.75	12,526	-42.57

PPP between the US and Japan: Absolute PPP, weak; Relative PPP, fairly strong



Source: IMF, *International Financial Statistics*. Exchange rates and price levels are end-of-year data.

Explaining the shortcomings of PPP

The Law of One Price may not hold:

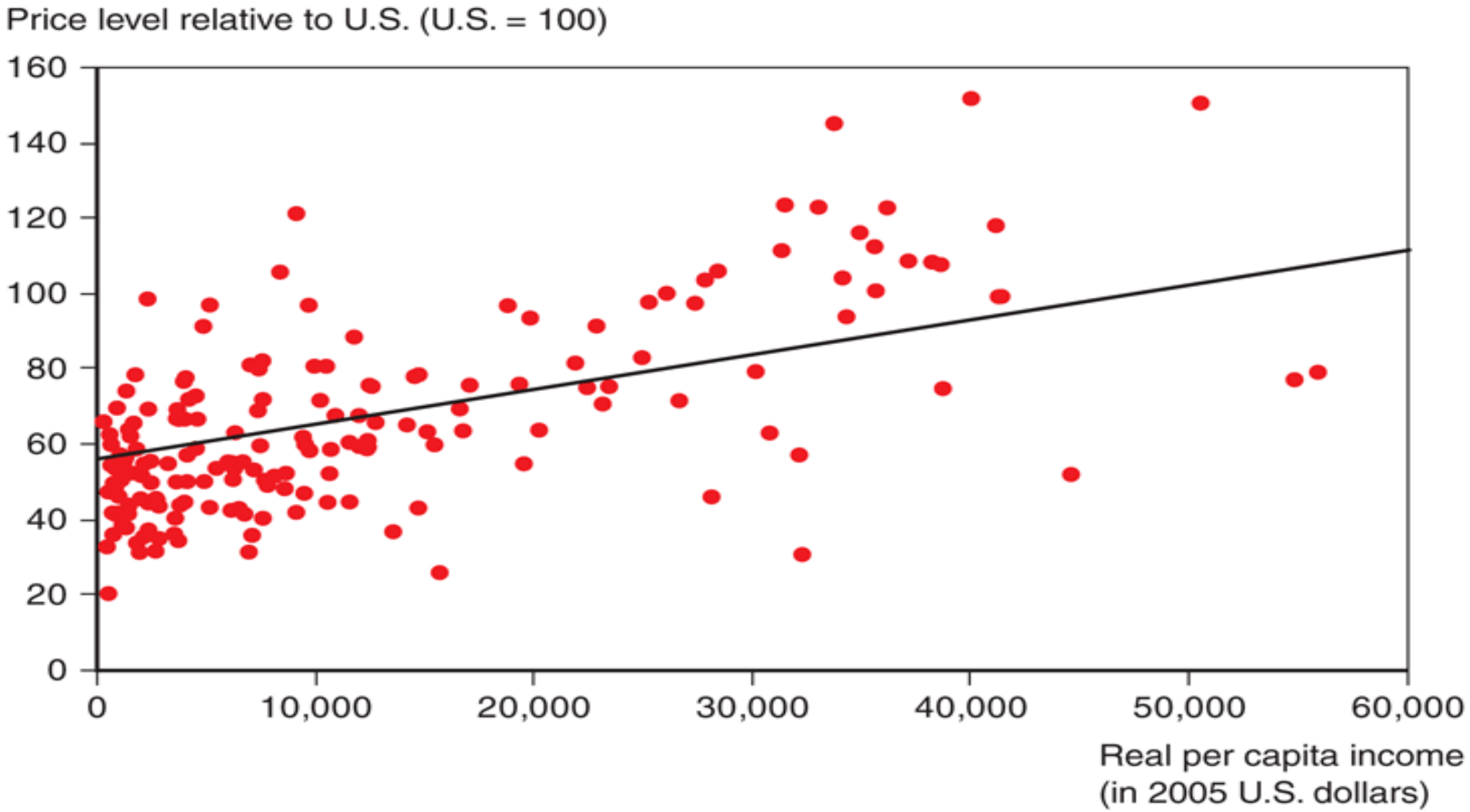
1. Trade barriers (transportation costs, government trade restrictions, border effects (exchange rate risk, legal risks, language differences, etc.)

2. Non-tradable goods (many services are non-tradable). Non-tradable goods have lower prices in relatively low-wage countries, which imparts a downward bias the average level of prices in low-wage, developing countries. (see the following slide)

3. Imperfect competition leads to "pricing to market." Price-discriminating monopolies may sell the same product at different prices in different markets.

4. Price measurement problems. Countries may use different methods to compute the average price of a representative bundle of goods.

The Relation between Relative Price Levels and Real Per Capita Income



Source: Penn World Table, version 7.1.

A New Approach—the Real Exchange Rate Approach

Because of the empirical shortcomings of PPP a broader framework has been developed, known as the "Real Exchange Rate Approach." In addition to monetary determinants this approach introduces "real" (non-monetary) effect due to shifts in the Relative Supply (RS) and relative demand (RD) for domestic goods separate from those due to relative price changes.

Recall the definition of the real exchange rate (e):

$$(1)\ \ e_{H/F} = E_{H/F} P_F / P_H$$

According to PPP, the nominal exchange rate is determined by relative prices:

$$(2)\ \ E_{H/F} = P_H / P_F$$

According to the new "Real Exchange Rate Approach" the nominal exchange rate may be influenced by the real exchange rate. Rearranging (1) we can get:

$$(3)\ \ E_{H/F} = e_{H/F} \times P_H / P_F$$

A New Approach—the Real Exchange Rate Approach

When economic changes are entirely due to monetary factors, and PPP holds, then the nominal exchange rate is determined by PPP (as in equation 2)

When economic changes are also caused by changes in real output (i.e. growth shocks) then the nominal exchange rate is affected by the real exchange rate (as in equation 3)

An increase in relative demand for domestic goods leads to a real and nominal appreciation, independent of monetary factors

An increase in relative demand for domestic goods leads to a real and nominal depreciation, independent of monetary factors