Exchange Rates I: The Monetary Approach in the Long Run

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Introduction

The goal of this chapter is to set out the long-run relationships between money, prices, and exchange rates. The theory we will develop has two parts:

• 1) The theory of purchasing power, which links the exchange rate to price levels in each country in the long run.

• 2) How price levels are related to monetary conditions in each country.

• Combining the monetary and the purchasing power theory we will develop a long-run theory known as the monetary approach to exchange rates.
Arbitrage occurs in the international goods markets, the prices of goods in different countries expressed in a common currency tend to be equalized.

• Applied to a single good, this idea is referred to as the **law of one price**.

• Applied to an entire basket of goods, it is called the **theory of purchasing power parity**.

• We will develop a simple theory based on an idealized world of *frictionless trade* where transaction costs can be neglected.
The Law of One Price

The law of one price (LOOP) states that in the absence of trade frictions and under free competition and price flexibility, identical goods sold in different locations must sell for the same price when expressed in a common currency.

We can state the law of one price as follows, for the case of any good \( g \) sold in two locations:

\[
q_{US/EUR}^g = \left( \frac{E_{$/€}}{P_{EUR}^g} \right) / P_{US}^g
\]

Where \( E_{$/€} \) expresses the rate at which currencies can be exchanged.
We can rearrange the equation for price equality

\[ E_{\$/\text{€}} \cdot P_{EUR}^g = P_{US}^g \]

to show that the exchange rate must equal the ratio of the goods’ prices expressed in the two currencies:

\[ E_{\$/\text{€}} \frac{P_{US}^g}{P_{EUR}^g} \]

Exchange rate \quad Ratio of goods’ prices
The principle of purchasing power parity (PPP) is the macroeconomic counterpart to the microeconomic law of one price (LOOP). To express PPP algebraically, we can compute the relative price of the two baskets of goods in each location:

\[ \frac{q_{US/EUR}}{P_{US}} = \frac{(E_{$/\text{EUR}} P_{EUR})}{P_{US}} \]

- There is no arbitrage when the basket is the same price in both locations \( q_{US/EUR} = 1 \).
- PPP holds when price levels in two countries are equal when expressed in a common currency. This is called Absolute PPP.
The real exchange rate is the relative price of the baskets.

- The U.S. real exchange rate $q_{US/EUR} = \frac{E_{\$/\€} P_{EUR}}{P_{US}}$ tells us how many U.S. baskets are needed to purchase one European basket.

- The exchange rate for currencies is a *nominal* concept. The real exchange rate is a *real* concept.

The real exchange rate has terminology similar to the nominal exchange rate:

- If the real exchange rate rises (more Home goods are needed in exchange for Foreign goods), Home has experienced a *real depreciation*.

- If the real exchange rate falls, Home has experienced a *real appreciation*.
Absolute PPP and the Real Exchange Rate

Purchasing power parity states that the real exchange rate is equal to 1.

• If the real exchange rate $q_{US/EUR}$ is below 1 then Foreign goods are relatively cheap.
  o In this case, the Home currency is said to be *strong*, the euro is *weak*, and we say the euro is *undervalued*.

• If the real exchange rate $q_{US/EUR}$ is above 1, then Foreign goods are relatively expensive.
  o In this case, the Home currency is said to be *weak*, the euro is *strong*, and we say the euro is *overvalued*.
We can rearrange the no-arbitrage equation for the equality of price levels, $E_{$/€}^{P^g_{EUR}} = P^g_{US}$ to allow us to solve for the exchange rate that would be implied by Absolute PPP:

Absolute PPP:

$$E_{$/€} = \frac{P_{US}}{P_{EUR}}$$

Exchange rate \hspace{1cm} Ratio of price levels

Purchasing power parity implies that the exchange rate at which two currencies trade equals the relative price levels of the two countries.
Building Block: Price Levels and Exchange Rates in the Long Run According to the PPP Theory

In this model, the price levels are treated as known exogenous variables (in the green boxes). The model uses these variables to predict the unknown endogenous variable (in the red box), which is the exchange rate.
Relative PPP, Inflation, and Exchange Rate Depreciation

We now examine the implications of PPP for the study of inflation (the rate of change of the price level)

\[
E_{$/€} = \frac{P_{US}}{P_{EUR}}
\]

Exchange rate ratio of price levels

On the left-hand side, the rate of change of the exchange rate in Home is the rate of exchange rate depreciation in Home given by

\[
\frac{\Delta E_{$/€,t}}{E_{$/€,t}} = \frac{E_{$/€,t+1} - E_{$/€,t}}{E_{$/€,t}}
\]

Rate of depreciation of the nominal exchange rate
Relative PPP, Inflation, and Exchange Rate Depreciation

We now examine the implications of PPP for the study of inflation (the rate of change of the price level).

\[
\frac{E_{\$/\epsilon}}{E_{\$/\epsilon}} = \frac{P_{US}}{P_{EUR}}
\]

Exchange rate

Ratio of price levels

On the right, the rate of change of the ratio of two price levels equals the rate of change of the numerator minus that of the denominator:

\[
\frac{\Delta(P_{US} / P_{EUR})}{(P_{US} / P_{EUR})} = \frac{\Delta P_{US,t}}{P_{US,t}} - \frac{\Delta P_{EUR,t}}{P_{EUR,t}}
\]

\[
= \left( \frac{P_{US,t+1} - P_{US,t}}{P_{US,t}} \right) - \left( \frac{P_{EUR,t+1} - P_{EUR,t}}{P_{EUR,t}} \right) = \pi_{US,t} - \pi_{EUR,t}
\]

Rate of inflation in U.S.

Rate of inflation in Europe

\[\pi_{US,t}\]

\[\pi_{EUR,t}\]
Relative PPP, Inflation, and Exchange Rate Depreciation

If equation (3-1) holds for *levels* of exchange rates and prices, then it must also hold for *rates of change* in these variables. By combining the last two expressions, we obtain:

\[
\frac{\Delta E_{\$/\text{€},t}}{E_{\$/\text{€},t}} = \pi_{\text{US},t} - \pi_{\text{EUR},t}
\]

This way of expressing PPP is called **Relative PPP**, and it implies that the rate of depreciation of the nominal exchange rate equals the difference between the inflation rates of two countries.
Evidence for PPP in the Long Run and Short Run

This scatterplot shows the relationship between the rate of exchange rate depreciation against the U.S. dollar and the inflation differential against the United States over the long run, for a sample of 82 countries. The correlation between the two variables is strong and bears a close resemblance to the prediction of PPP that all data points would appear on the 45-degree line.

Inflation Differentials and the Exchange Rate, 1975-2005
Evidence for PPP in the Long Run and Short Run

Exchange Rates and Relative Price Levels  Data for the U.S. and the UK for 1975 to 2010 show that the exchange rate and relative price levels do not always move together in the short run. Relative price levels tend to change slowly and have a small range of movement; exchange rates move quickly and experience large fluctuations. Therefore, relative PPP does not hold in the short run. It is a better guide to the long run, and we can see that the two series do tend to drift together over the decades.
How Slow Is Convergence to PPP?

• Research shows that price differences—the deviations from PPP—can be quite persistent.

• Estimates suggest that these deviations may die out at a rate of about 15% per year. This kind of measure is often called a speed of convergence.

• Approximately half of any PPP deviation still remains after four years: economists would refer to this as a four-year half-life.
Forecasting When the Real Exchange Rate Is Undervalued or Overvalued

• When relative PPP holds, forecasting exchange rate changes is simple: just compute the inflation differential.

• But how do we forecast when PPP doesn’t hold, as is often the case? Knowing the real exchange rate and the convergence speed may still allow us to construct a forecast of real and nominal exchange rates.

• The rate of change of the nominal exchange rate equals the rate of change of the real exchange rate plus home inflation minus foreign inflation:

\[
\frac{\Delta E_{\$/\epsilon,t}}{E_{\$/\epsilon,t}} = \frac{\Delta q_{US/EUR,t}}{q_{US/EUR,t}} + \frac{\pi_{US,t} - \pi_{EUR,t}}{\text{Inflation differential}}
\]

\(\Delta E_{\$/\epsilon,t}\) Rate of depreciation of the nominal exchange rate

\(E_{\$/\epsilon,t}\) Rate of depreciation of the real exchange rate