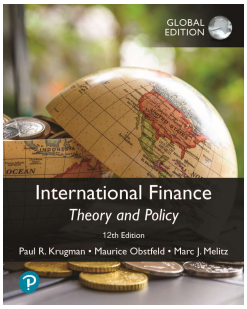
International Finance



Chapter 5

Price Levels and the Exchange Rate in the Long Run

Learning Objectives

5.1 Explain the purchasing power parity theory of exchange rates and the theory's relationship to international goods-market integration.

5.2 Describe how monetary factors such as ongoing price level inflation affect exchange rates in the long run.

5.3 Discuss the concept of the real exchange rate.

5.4 Understand factors that affect real exchange rates and relative currency prices in the long run.

5.5 Explain the relationship between international real interest rate differences and expected changes in real exchange rates.

Preview

- Law of one price
- Purchasing power parity
- Long-run model of exchange rates: monetary approach
- Relationship between interest rates and inflation: Fisher effect
- Shortcomings of purchasing power parity
- Long-run model of exchange rates: real exchange rate approach
- Real interest rates

The Behavior of Exchange Rates (1 of 2)

- What models can predict how exchange rates behave?
  - In last chapter we developed a short-run model and a long-run model that used movements in the money supply.
  - In this chapter, we develop two more models, building on the long-run approach from last chapter.
  - Long run means a sufficient amount of time for prices of all goods and services to adjust to market conditions so that their markets and the money market are in equilibrium.
  - Because prices are allowed to change, they will influence interest rates and exchange rates in the long-run models.

The Behavior of Exchange Rates (2 of 2)

- The long-run models are not intended to be completely realistic descriptions about how exchange rates behave, but ways of representing how market participants may form expectations about future exchange rates and how exchange rates tend to move over long periods.

Law of One Price (1 of 3)

- The **law of one price** simply says that the **same** good in different competitive markets must sell for the same price, when transportation costs and barriers between those markets are not important.
  - Why? Suppose the price of pizza at one restaurant is $20, while the price of the **same** pizza at an identical restaurant across the street is $40.
  - What do you predict will happen? Many people will buy the $20 pizza, few will buy the $40 one.

Law of One Price (2 of 3)

- Due to the price difference, entrepreneurs would have an incentive to buy pizza at the cheap location and sell it at the expensive location for an easy profit.
- Due to strong demand and decreased supply, the price of the $20 pizza would tend to increase.
- Due to weak demand and increased supply, the price of the $40 pizza would tend to decrease.
- People would have an incentive to adjust their behavior and prices would tend to adjust until one price is achieved across markets (across restaurants).

Law of One Price (3 of 3)

- Consider a pizza restaurant in Seattle and one across the border in Vancouver.
- The law of one price says that the price of the same pizza (using a common currency to measure the price) in the two cities must be the same if markets are competitive and transportation costs and barriers between markets are not important.

$$P^{pizza}_{US} = \left(E_{US\$/C\$}\right) \times \left(P^{pizza}_{Canada}\right)$$

P^{pizza}_{US} = price of pizza in Seattle

P^{pizza}_{Canada} = price of pizza in Vancouver

$E_{US\$/C\$}$ = U.S. dollar / Canadian dollar exchange rate

Purchasing Power Parity (1 of 3)

- **Purchasing power parity** is the application of the law of one price across countries for **all** goods and services, or for representative groups ("baskets") of goods and services.

$$P_{US} = \left(E_{US\$/C\$}\right) \times \left(P_{Canada}\right)$$

P_{US} = level of average prices in the U.S.

P_{Canada} = level of average prices in Canada

$E_{US\$/C\$}$ = U.S. doller / Canadian doller exchange rate

Purchasing Power Parity (2 of 3)

- Purchasing power parity (PPP) implies that the exchange rate is determined by levels of average prices

$$E_{\frac{\text{US\$}}{\text{C\$}}} = \frac{P_{\text{US}}}{P_{\text{Canada}}}$$

  - If the price level in the United States is US$200 per basket, while the price level in Canada is C$400 per basket, PPP implies that the C$/US$ exchange rate should be C$400 / US$200 = C$2 / US$1.
  - Predicts that people in all countries have the same purchasing power with their currencies: 2 Canadian dollars buy the same amount of goods as 1 U.S. dollar, since prices in Canada are twice as high.

Purchasing Power Parity (3 of 3)

- Purchasing power parity (PPP) comes in two forms:
- **Absolute PPP**: purchasing power parity that has already been discussed. Exchange rates equal the **level** of relative average prices across countries.

$$E_{\$/€} = \frac{P_{\text{US}}}{P_{\text{EU}}}$$

- **Relative PPP**: **changes** in exchange rates equal **changes** in prices (inflation) between two periods:

$$\frac{(E_{\$/€,t} - E_{\$/€,t-1})}{E_{\$/€,t-1}} = \pi_{\text{US},t} - \pi_{\text{EU},t}$$

where π_t = inflation rate from perid $t-1$ to t

Monetary Approach to Exchange Rates (1 of 5)

- **Monetary approach to the exchange rate**: uses monetary factors to predict how exchange rates adjust in the long run, based on the absolute version of PPP.
  - It predicts that levels of average prices across countries adjust so that the quantity of real monetary assets supplied will equal the quantity of real monetary assets demanded:

$$P_{\text{US}} = \frac{M^S{}_{\text{US}}}{L(R_\$, Y_{\text{US}})}$$

$$P_{\text{EU}} = \frac{M^S{}_{\text{EU}}}{L(R_€, Y_{\text{EU}})}$$

Monetary Approach to Exchange Rates (2 of 5)

- To the degree that PPP holds and to the degree that prices adjust to equate the quantity of real monetary assets supplied with the quantity of real monetary assets demanded, we have the following prediction:
  - The exchange rate is determined in the long run by prices, which are determined by the relative supply and demand of real monetary assets in money markets across countries.

Monetary Approach to Exchange Rates (3 of 5)

Predictions about changes in

1. **Money supply**: a permanent rise in the domestic money supply
   - causes a proportional increase in the domestic price level,
   - thus causing a proportional depreciation in the domestic currency (through PPP).
   - This is same prediction as long-run model without PPP.
2. **Interest rates**: a rise in domestic interest rates
   - lowers the demand of real monetary assets,
   - and is associated with a rise in domestic prices,
   - thus causing a proportional depreciation of the domestic currency (through PPP).

Monetary Approach to Exchange Rates (4 of 5)

3. **Output level:** a rise in the domestic level of production and income (output)
   - raises domestic demand of real monetary assets,
   - and is associated with a decreasing level of average domestic prices (for a fixed quantity of money supplied),
   - thus causing a proportional appreciation of the domestic currency (through PPP).

- All three changes affect money supply or money demand, and cause prices to adjust so that the quantity of real monetary assets supplied matches the quantity of real monetary assets demanded, and cause exchange rates to adjust according to PPP.

Monetary Approach to Exchange Rates (5 of 5)

- A change in the money supply results in a change in the level of average prices.
- A change in the **growth rate** of the money supply results in a change in the **growth rate** of prices (inflation).
  - A constant growth rate in the money supply results in a persistent growth rate in prices (persistent inflation) at the same constant rate, when other factors are constant.
  - Inflation does not affect the productive capacity of the economy and real income from production in the long run.
  - Inflation, however, does affect nominal interest rates. How?

The Fisher Effect (1 of 2)

- The **Fisher effect** (named affect Irving Fisher) describes the relationship between nominal interest rates and inflation.
  - Derive the Fisher effect from the interest parity condition:

$$R_{\$} - R_{€} = \frac{\left(E^{e}_{\$/€} - E_{\$/€}\right)}{E_{\$/€}}$$

  - If financial markets expect (relative) PPP to hold, then expected exchange rate changes will equal expected inflation between countries:

$$R_{\$} - R_{€} = \frac{\left(E^{e}_{\$/€} - E_{\$/€}\right)}{E_{\$/€}} = \pi^{e}_{US} - \pi^{e}_{EU}$$

The Fisher Effect (2 of 2)

  - Therefore, $R_{\$} - R_{€} = \pi^{e}_{US} - \pi^{e}_{EU}$
  - The Fisher effect: a rise in the domestic inflation rate causes an equal rise in the interest rate on deposits of domestic currency in the long run, when other factors remain constant.

Monetary Approach to Exchange Rates (1 of 2)

- Suppose that the U.S. central bank unexpectedly increases the growth rate of the money supply at time t_0.
- Suppose also that the inflation rate is π in the United States before t_0 and $\pi + \Delta\pi$ after this time, but that the European inflation rate remains at 0%.
- According to the Fisher effect, the interest rate in the United States will adjust to the higher inflation rate.

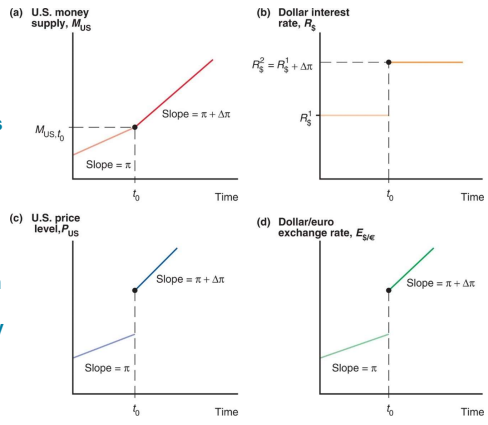


Figure 5.1 Long-Run Time Paths of U.S. Economic Variables After a Permanent Increase in the Growth Rate of the U.S. Money Supply

Monetary Approach to Exchange Rates (2 of 2)

- The increase in nominal interest rates decreases the demand of real monetary assets.
- In order for the money market to maintain equilibrium in the long run, prices must jump so that

$$P_{US} = \frac{M^s_{US}}{L(R_\$, Y_{US})}$$

- In order to maintain PPP, the exchange rate must jump (the dollar must depreciate) so that

$$E_{\$/€} = \frac{P_{US}}{P_{EU}}$$

- Thereafter, the money supply and prices are predicted to grow at rate $\pi + \Delta\pi$ and the domestic currency is predicted to depreciate at the same rate.

The Role of Inflation and Expectations (1 of 3)

In the long-run model without PPP:

- Changes in money supply lead to changes in the **level** of average prices.
- No inflation is predict to occur in the long run, but only during the transition to the long-run equilibrium.
- During the transition, inflation causes the nominal interest rate to increase to its long-run value.
- **Expectations of higher domestic inflation** cause the expected return on foreign currency deposits to increase, making the domestic currency **depreciate before** the transition period.

The Role of Inflation and Expectations (2 of 3)

- In the monetary approach (with PPP), the rate of inflation increases permanently when the **growth rate** of the money supply increases permanently.
- With persistent domestic inflation (above foreign inflation), the monetary approach also predicts an increase in the domestic nominal interest rate.
- **Expectations of higher domestic inflation** cause the expected purchasing power of domestic currency to decrease relative to the expected purchasing power of foreign currency, thereby making the domestic currency **depreciate**.

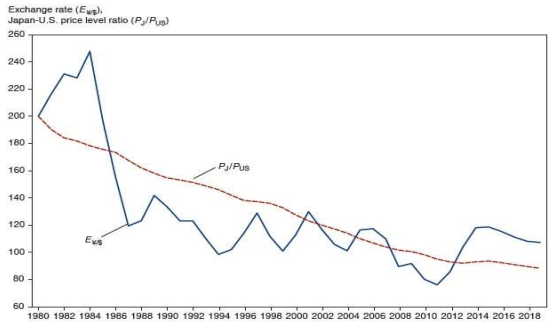
The Role of Inflation and Expectations (3 of 3)

- In the long-run model without PPP, the level of average prices does not immediately adjust even if expectations of inflation adjust,
  - causing the exchange rate to overshoot (causing the domestic currency to depreciate more than) its long-run value.
- In the monetary approach (with PPP), the level of average prices adjusts with expectations of inflation,
  - causing the domestic currency to depreciate, but with no overshooting.

Shortcomings of PPP (1 of 5)

- There is little empirical support for absolute purchasing power parity.
  - The prices of identical commodity baskets, when converted to a single currency, differ substantially across countries.
- Relative PPP is more consistent with data, but it also performs poorly to predict exchange rates.

Figure 5.2 The Yen/Dollar Exchange Rate and Relative Japan–U.S. Price Levels, 1980–2019



Relative PPP does not track the yen/dollar exchange rate 1980-2015.

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

Shortcomings of PPP (2 of 5)

Reasons why PPP may not be accurate: the law of one price may not hold because of

1. Trade barriers and nontradable products
2. Imperfect competition
3. Differences in measures of average prices for baskets of goods and services

Shortcomings of PPP (3 of 5)

- **Trade barriers and nontradable products**
  - Transport costs and governmental trade restrictions make trade expensive and in some cases create nontradable goods or services.
  - Services are often not tradable: services are generally offered within a limited geographic region (e.g., haircuts).
  - The greater the transport costs, the greater the range over which the exchange rate can deviate from its PPP value.
  - One price need not hold in two markets.

Shortcomings of PPP (4 of 5)

- **Imperfect competition** may result in price discrimination: "pricing to market."
  - A firm sells the same product for different prices in different markets to maximize profits, based on expectations about what consumers are willing to pay.
  - One price need not hold in two markets.

Shortcomings of PPP (5 of 5)

- **Differences in the measure of average prices for goods and services**
  - Levels of average prices differ across countries because of differences in how representative groups ("baskets") of goods and services are measured.
  - Because measures of groups of goods and services are different, the measure of their average prices need not be the same.
  - One price need not hold in two markets.

Law of One Price for Hamburgers?

Why Price Levels Are Lower in Poorer Countries (1 of 3)

- When expressed in terms of a single currency, countries' price levels are positively related to the level of real income per capita.
  - A dollar, when converted to local currency at the market exchange rate, generally goes much further in a poor country than in a rich one.
  - Figure 5-3 illustrates the relation between price levels and income, with each dot representing a different country.
- Non-tradables tend to be more expensive (relative to tradables) in richer countries.

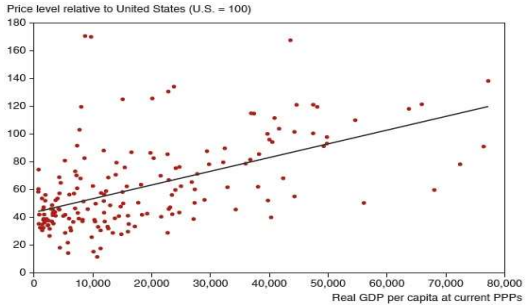
Why Price Levels Are Lower in Poorer Countries (2 of 3)

- The Balassa-Samuelson theory assumes labor productivity in poor countries is than in rich countries for tradables but not for non-tradables.
- If the prices of traded goods are roughly equal across countries, the lower labor productivity in the tradables industries of poor countries implies lower wages, lower production costs in non-tradables, and thus lower prices of non-tradables than rich countries.
- Productivity statistics support the Balassa-Samuelson differential productivity explanation.

Why Price Levels Are Lower in Poorer Countries (3 of 3)

- An alternative theory (by Bhagwati, Kravis, and Lipsey) relies on differences in the endowments of capital and labor, rather than productivity differences.
- The higher capital-labor ratios in rich countries compared to poor countries makes the marginal productivity of labor and hence the wage level higher in rich countries.
- Non-tradables are labor-intensive (use a higher ratio of labor to capital) relative to tradables, making non-tradables cheaper in poor, low-wage countries than they are in rich, high-wage countries.
- Rich countries thus have higher overall price levels.

Figure 5.3 Price Levels and Real Incomes, 2017



Consumer price levels tend to rise as their real income rises. Each dot represents a country. The straight line represents a statistician's best prediction of a country's price level relative to that of the United States based on its real per capita income.

Source: Penn World Table, version 9.1.

The Real Exchange Rate Approach to Exchange Rates (1 of 10)

- Because of the shortcomings of PPP, economists have tried to generalize the monetary approach to PPP to make a better theory.
- The **real exchange rate** is the **rate of exchange for goods and services** across countries.
  - In other words, it is the relative value/price/cost of goods and services across countries.
  - For example, it is the dollar price of a European group of goods and services relative to the dollar price of an American group of goods and services:

$$q_{\frac{US}{EU}} = \frac{(E_{\$/€} \times P_{EU})}{P_{US}}$$

The Real Exchange Rate Approach to Exchange Rates (2 of 10)

$$q_{\frac{US}{EU}} = \frac{(E_{\$/€} \times P_{EU})}{P_{US}}$$

- If the EU basket costs € 100, the U.S. basket costs $120, and the nominal exchange rate is $1.20 per euro, then the real exchange rate is 1 U.S. basket per 1 EU basket.
- A real depreciation of the value of U.S. products means a fall in a dollar's purchasing power of EU products relative to a dollar's purchasing power of U.S. products.
  - This implies that U.S. goods become less expensive and less valuable relative to EU goods.
  - This implies that the value of U.S. goods relative to value of EU goods falls.

The Real Exchange Rate Approach to Exchange Rates (3 of 10)

$$q_{\frac{US}{EU}} = \frac{(E_{\$/€} \times P_{EU})}{P_{US}}$$

- A real appreciation of the value of U.S. products means a rise in a dollar's purchasing power of EU products relative to a dollar's purchasing power of U.S. products.
  - This implies that U.S. goods become more expensive and more valuable relative to EU goods.
  - This implies that the value of U.S. goods relative to value of EU goods rises.

The Real Exchange Rate Approach to Exchange Rates (4 of 10)

- According to PPP, exchange rates are determined by relative average prices:

$$E_{\$/€} = \frac{P_{US}}{P_{EU}}$$

- According to the more general real exchange rate approach, exchange rates may also be influenced by the real exchange rate:

$$E_{\$/€} = q_{\frac{US}{EU}} \times \frac{P_{US}}{P_{EU}}$$

- What influences the real exchange rate?

The Real Exchange Rate Approach to Exchange Rates (5 of 10)

- A **change in relative demand** of U.S. products
  - An increase in relative demand of U.S. products causes the value (price) of U.S. goods relative to the value (price) of foreign goods to rise.
  - A real appreciation of the value of U.S. goods: P_{US} rises relative to

$$E_{\$/€} \times P_{EU}$$

  - The real appreciation of the value of U.S. goods makes U.S. exports more expensive and imports into the U.S. less expensive (thereby reducing the relative quantity demanded of U.S. products).
  - A decrease in relative demand of U.S. products causes a real depreciation of the value of U.S. goods.

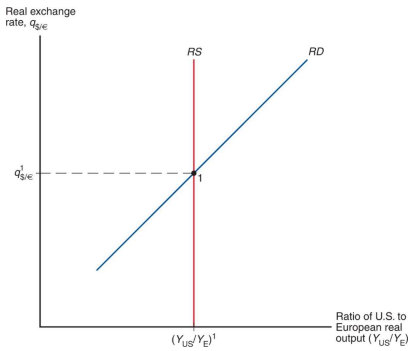
The Real Exchange Rate Approach to Exchange Rates (6 of 10)

- A **change in relative supply** of U.S. products
  - An increase in relative supply of U.S. products (caused by an increase in U.S. productivity) causes the price/cost of U.S. goods relative to the price/cost of foreign goods to fall.
  - A real depreciation of the value of U.S. goods: P_{US} falls relative to

$$E_{\$/€} \times P_{EU}$$

  - The real depreciation of the value of U.S. goods makes U.S. exports less expensive and imports into the United States more expensive (thereby increasing relative quantity demanded to match increased relative quantity supplied).
  - A decrease in relative supply of U.S. products causes a real appreciation of the value of U.S. goods.

Figure 5.4 Determination of the Long-Run Real Exchange Rate



The long-run equilibrium real exchange rate equates world relative demand to the full-employment level of relative supply.

The Real Exchange Rate Approach to Exchange Rates (7 of 10)

- The real exchange rate is a more general approach to explain exchange rates. Both monetary factors and real factors influence nominal exchange rates:
  - 1a. Increases in **monetary levels** lead to temporary inflation and changes in expectations about inflation.
  - 1b. Increases in **monetary growth rates** lead to persistent inflation and changes in expectations about inflation.
  - 2a. Increases in **relative demand** of domestic products lead to a real appreciation.
  - 2b. Increases in **relative supply** of domestic products lead to a real depreciation.

The Real Exchange Rate Approach to Exchange Rates (8 of 10)

- What are the effects on the nominal exchange rate?

$$E_{\$/€} = q_{\frac{US}{EU}} \times \frac{P_{US}}{P_{EU}}$$

- When only monetary factors change and PPP holds, we have the same predictions as before.
  - No changes in the real exchange rate occurs.
- When factors influencing real output change, the real exchange rate changes.
  - With an increase in relative demand of domestic products, the real exchange rate adjusts to determine nominal exchange rates.
  - With an increase in relative supply of domestic products, the situation is more complex.

The Real Exchange Rate Approach to Exchange Rates (9 of 10)

- With an increase in the relative supply of domestic products, the real exchange rate adjusts to make the price/cost of domestic goods depreciate, but the relative amount of domestic output also increases.
  - This second effect increases the demand of real monetary assets in the domestic economy:

$$P_{US} = \frac{M^{S}_{US}}{L(R_{\$}, Y_{US})}$$

  - Thus the level of average domestic prices is predicted to decrease relative to the level of average foreign prices.
  - The effect on the nominal exchange rate is ambiguous:

$$E_{\$/€} = q_{\frac{US}{EU}} \times \frac{P_{US}}{P_{EU}}$$
$$? \quad \uparrow \quad \downarrow$$

The Real Exchange Rate Approach to Exchange Rates (10 of 10)

- When economic changes are influenced only by monetary factors, and when the assumptions of PPP hold, nominal exchange rates are determined by PPP.
- When economic changes are caused by factors that affect real output, exchange rates are not determined by PPP only, but are also influenced by the real exchange rate.

Interest Rate Differences

- A more general equation of differences in nominal interest rates across countries can be derived from

$$\frac{\left(q^e_{\text{US/EU}} - q_{\text{US/EU}}\right)}{q_{\text{US/EU}}} = \left[\frac{\left(E^e_{\$/€} - E_{\$/€}\right)}{E_{\$/€}}\right] - \left(\pi^e_{\text{US}} - \pi^e_{\text{EU}}\right)$$

$$R_{\$} - R_{€} = \frac{\left(E^e_{\$/€} - E_{\$/€}\right)}{E_{\$/€}}$$

$$R_{\$} - R_{€} = \frac{\left(q^e_{\text{US/EU}} - q_{\text{US/EU}}\right)}{q_{\text{US/EU}}} + \left(\pi^e_{\text{US}} - \pi^e_{\text{EU}}\right)$$

- The difference in nominal interest rates across two countries is now the sum of
  - the expected rate of depreciation in the value of domestic goods relative to foreign goods, and
  - the difference in expected inflation rates between the domestic economy and the foreign economy.

Table 5.1 Effects of Money Market and Output Market Changes on the Long-Run Nominal Dollar/Euro Exchange Rate, $E_{\$/€}$ (1 of 2)

Money market

Change	Effect on the Long-Run Nominal Dollar/Euro Exchange Rate, $E_{\$/€}$
1. Increase in U.S. money supply level	Proportional increase (nominal depreciation of $)
2. Increase in European money supply level	Proportional decrease (nominal depreciation of euro)
3. Increase in U.S. money supply growth rate	Increase (nominal depreciation of $)
4. Increase in European money supply growth rate	Decrease (nominal depreciation of euro)

Table 5.1 Effects of Money Market and Output Market Changes on the Long-Run Nominal Dollar/Euro Exchange Rate, $E_{\$/€}$ (2 of 2)

Table 5.1 [Continued]

Output market

Change	Effect on the Long-Run Nominal Dollar/Euro Exchange Rate, $E_{\$/€}$
1. Increase in demand for U.S. output	Decrease (nominal appreciation of $)
2. Increase in demand for European output	Increase (nominal appreciation of euro)
3. Output supply increase in the United States	Ambiguous
4. Output supply increase in Europe	Ambiguous

Real Interest Rates (1 of 2)

- Real interest rates are inflation-adjusted interest rates:

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

where π^e represents the expected inflation rate and

R represents a measure of nominal interest rates.

- Real interest rates are measured in terms of real output:
  - the quantity of goods and services that savers can purchase when their assets pay interest
  - the quantity of goods and services that borrowers cannot purchase when they must pay interest on their loans
- What are the predicted differences in real interest rates across countries?

Real Interest Rates (2 of 2)

- Real interest rate differentials are derived from

$$r^e_{US} - r^e_{EU} = \left(R_\$ - \pi^e_{US}\right) - \left(R_€ - \pi^e_{EU}\right)$$

$$R_\$ - R_€ = \frac{\left(q^e_{US/EU} - q_{US/EU}\right)}{q_{US/EU}} + \left(\pi^e_{US} - \pi^e_{EU}\right)$$

$$r^e_{US} - r^e_{EU} = \frac{\left(q^e_{US/EU} - q_{US/EU}\right)}{q_{US/EU}}$$

- The last equation is called **real interest parity**.
  - It says that differences in real interest rates (in terms of goods and services that are earned or forgone when lending or borrowing) between countries are equal to the expected change in the value/price/cost of goods and services between countries.

Summary (1 of 4)

1. The law of one price says that the same good in different competitive markets must sell for the same price, when transportation costs and barriers between markets are not important.
2. Purchasing power parity applies the law of one price for all goods and services among all countries.
   - Absolute PPP says that currencies of two countries have the same purchasing power.
   - Relative PPP says that changes in the nominal exchange rate between two countries equals the difference in the inflation rates between the two countries.

Summary (2 of 4)

3. The monetary approach to exchange rates uses PPP and the supply and demand of real monetary assets.
   - Changes in the growth rate of the money supply influence inflation and exchange rates.
   - Expectations about inflation influence the exchange rate.
   - The Fisher effect shows that differences in nominal interest rates are equal to differences in inflation rates.
4. Empirical support for PPP is weak.
   - Trade barriers, non-tradable products, imperfect competition, and differences in price measures may cause the empirical shortcomings of PPP.

Summary (3 of 4)

5. The real exchange rate approach to exchange rates generalizes the monetary approach.
   - It defines the real exchange rate as the value/price/cost of domestic products relative to foreign products.
   - It predicts that changes in relative demand and relative supply of products influence real and nominal exchange rates.
   - Interest rate differences are explained by a more general concept: expected changes in the value of domestic products relative to the value of foreign products plus the difference of inflation rates between the domestic and foreign economies.

Summary (4 of 4)

6. Real interest rates are inflation-adjusted interest rates, and show how much purchasing power savers gain and borrowers give up.
7. Real interest parity shows that differences in real interest rates between countries equal expected changes in the real value of goods and services between countries.

Figure 5A.1 How a Rise in U.S. Monetary Growth Affects Dollar Interest Rates and the Dollar/Euro Exchange Rate When Goods Prices Are Flexible