Chapter 6
International Parity Conditions

International Parity Conditions
- The economic theories which link exchange rates, price levels, and interest rates together are called international parity conditions
- These theories may not always work out to be “true” when compared to what students and practitioners observe in the real world, but they are central to any understanding of how multinational business is conducted

International Parity Conditions: Learning Objectives
- Examine how price levels and price level changes (inflation) in countries determine the exchange rate at which their currencies are traded
- Show how interest rates reflect inflationary forces within each country and currency
- Explain how forward markets for currencies reflect expectations held by market participants about the future spot rate
- Analyze how, in equilibrium, the spot and forward currency markets are aligned with interest differentials

Prices and Exchange Rates
- The Law of one price states that all else being equal (no transaction costs) a product’s price should be the same in all markets
- Even if prices for a particular product are in different currencies, the law of one price states that

\[ P^S \times S = P^¥ \]

Where the price of the product in US dollars (P$), multiplied by the spot exchange rate (S, yen per dollar), equals the price of the product in Japanese yen (P¥)

Prices and Exchange Rates
- Conversely, if the prices were stated in local currencies, and markets were efficient, the exchange rate could be deduced from the relative local product prices

\[ S = \frac{P^¥}{P^S} \]

Purchasing Power Parity & The Law of One Price
- If the Law of One Price were true for all goods, the purchasing power parity (PPP) exchange rate could be found from any set of prices
- Through price comparison, prices of individual products can be determined through the PPP exchange rate
- This is the absolute theory of purchasing power parity
- Absolute PPP states that the spot exchange rate is determined by the relative prices of similar basket of goods
The "Big Mac Index," as it has been christened by The Economist, is a prime example of this law of one price:

- Assuming that the Big Mac is identical in all countries, it serves as a comparison point as to whether or not currencies are trading at market prices.
- Big Mac in China costs Yuan 11.0 (local currency), while the same Big Mac in the US costs $3.41.
- The actual exchange rate was Yuan 7.60/$ at the time.

The price of a Big Mac in Chinese Yuan in US dollar-terms was therefore:

\[
\frac{\text{Yuan 11.0}}{\text{Yuan 7.60/$}} = \text{Yuan 3.23/$}
\]

The Economist then calculates the implied purchasing power parity rate of exchange using the actual price of the Big Mac in China over the price of the Big Mac in US dollars:

\[
\frac{\text{Yuan 11.0}}{\text{Yuan 7.60/$}} = \frac{\text{Yuan 3.23/$}}{\text{Yuan 7.60/$}} - 58\%
\]

If the assumptions of absolute PPP theory are relaxed, we observe relative purchasing power parity:

- This idea is that PPP is not particularly helpful in determining what the spot rate is today, but that the relative change in prices between countries over a period of time determines the change in exchange rates.
- Moreover, if the spot rate between 2 countries starts in equilibrium, any change in the differential rate of inflation between them tends to be offset over the long run by an equal but opposite change in the spot rate.
Relative Purchasing Power Parity

- Empirical tests of both relative and absolute purchasing power parity show that for the most part, PPP tends to not be accurate in predicting future exchange rates.
- Two general conclusions can be drawn from the tests:
  - PPP holds up well over the very long term but is poor for short term estimates.
  - The theory holds better for countries with relatively high rates of inflation and underdeveloped capital markets.

Exchange Rate Indices: Real and Nominal

- In order to evaluate a single currency’s value against all other currencies in terms of whether or not the currency is “over” or “undervalued,” exchange rate indices were created.
  - These indices are formed by trade-weighting the bilateral exchange rates between the home country and its trading partners.
- The nominal exchange rate index uses actual exchange rates to create an index on a weighted average basis of the value of the subject currency over a period of time.

The real effective exchange rate index indicates how the weighted average purchasing power of the currency has changed relative to some arbitrarily selected base period.
- Example: The real effective rate for the US dollar (E$...) is found by multiplying the nominal rate index (E$...) by the ratio of US dollar costs (C$) over foreign currency costs (CFC).

\[ E_R = E_N \times \frac{C^S}{C^{FC}} \]

Exchange Rate Indices: Real and Nominal

- If changes in exchange rates just offset differential inflation rates – if purchasing power parity holds – all the real effective exchange rate indices would stay at 100.
- If a rate strengthened (overvalued) or weakened (undervalued) then the index value would be ± 100.
### Exchange Rate Pass-Through

- **Incomplete exchange rate pass-through** is one reason that a country’s real effective exchange rate index can deviate from its PPP equilibrium point.
- The degree to which the prices of imported & exported goods change as a result of exchange rate changes is termed pass-through.
- **Example:** Assume BMW produces a car in Germany and all costs are incurred in euros. When the car is exported to the US, the price of the BMW should be the euro value converted to dollars at the spot rate.
- Where $P_S$ is the BMW price in dollars, $P_€$ is the BMW price in euros and $S$ is the spot rate.

\[
P_€^{BMW} = P_€^{BMW} \times S^{€/}$

### Exchange Rate Pass-Through

- Incomplete exchange rate pass-through is one reason that a country’s real effective exchange rate index can deviate for lengthy periods from its PPP-equilibrium level.
- If the euro appreciated 20% against the dollar, but the price of the BMW in the US market rose to only $40,000, and not $42,000 as is the case under complete pass-through, the pass-through is partial.
- The degree of pass-through is measured by the proportion of the exchange rate change reflected in dollar prices.

\[
\frac{P_€^{BMW,2}}{P_€^{BMW,1}} = \frac{40,000}{35,000} = 1.1429, \text{ or } +14.29\%
\]

The degree of pass-through in this case is partial, 14.29% = 20.00% or approximately 0.71. Only 71.0% of the change has been passed through to the US dollar price.

### Exhibit 6.4 Exchange Rate Pass-Through

Exchange rate pass-through is the measure of response of imported and exported product prices to exchange rate changes. Assume that the price in dollars and euros of a BMW automobile produced in Germany and sold in the United States at the spot exchange rate is $55,000/€60,000.

If the euro were to appreciate 10% versus the US dollar from 60,000€/ $55,000, the price of the BMW in the US market should therefore be $49,500. But if the price of the BMW in the US does not rise by 10%, for example, it then only to $55,000—then the degree of pass-through is partial.

The degree of pass-through is measured by the proportion of the exchange rate change reflected in dollar prices. In this example, the dollar price of the BMW rose only 9.26%, whereas the euro appreciated 20% against the dollar. The degree of pass-through is partial: 9.26% / 20% or approximately 46.3% increase.

### Interest Rates and Exchange Rates

- Prices between countries are related by exchange rates and now we discuss how exchange rates are linked to interest rates.
- **The Fisher Effect** states that nominal interest rates in each country are equal to the required real rate of return plus compensation for expected inflation. As a formula, The Fisher Effect is

\[
i = r + \pi + r\pi
\]

Where $i$ is the nominal rate, $r$ is the real rate of interest, and $\pi$ is the expected rate of inflation over the period of time. The cross-product term, $r\pi$, is usually dropped due to its relatively minor value.

### Interest Rates and Exchange Rates

- Applied to two different countries, like the US and Japan, the Fisher Effect would be stated as

\[
i_1 = r_1 + \pi_1 + r_1\pi_1
\]

It should be noted that this requires a forecast of the future rate of inflation, not what inflation has been, and predicting the future can be difficult.

### Interest Rates and Exchange Rates

- The international Fisher effect, or Fisher-open, states that the spot exchange rate should change in an amount equal to but in the opposite direction of the difference in interest rates between countries.
- If we were to use the US dollar and the Japanese yen, the expected change in the spot exchange rate between the dollar and yen should be in approximate form

\[
\frac{S_2 - S_1}{S_2} \times 100 = i^\delta - i^¥
\]

Where $i^\delta$ is the US interest rate, $i^¥$ is the Japanese interest rate, and $S_1$ and $S_2$ are the spot exchange rates.
Interest Rates and Exchange Rates

• Justification for the international Fisher effect is that investors must be rewarded or penalized to offset the expected change in exchange rates.
• The international Fisher effect predicts that with unrestricted capital flows, an investor should be indifferent between investing in dollar or yen bonds, since investors worldwide would see the same opportunity and compete it away.

Interest Rates and Exchange Rates

• The Forward Rate
  – A forward rate is an exchange rate quoted today for settlement at some future date.
  – The forward exchange agreement between currencies states the rate of exchange at which a foreign currency will be bought or sold forward at a specific date in the future (typically 30, 60, 90, 180, 270 or 360 days).
  – The forward rate is calculated by adjusting the current spot rate by the ratio of euro currency interest rates of the same maturity for the two subject currencies.

Interest Rates and Exchange Rates

• The Forward Rate

\[ F_{FC S}^{90} = S_{FC S}^{90} \times \frac{1 + \left( i_{FC} \times \frac{90}{360} \right)}{1 + \left( i_{S} \times \frac{90}{360} \right)} \]

Interest Rates and Exchange Rates

• The forward premium or discount is the percentage difference between the spot and forward rates stated in annual percentage terms.
  – When stated in indirect terms (foreign currency per home currency units, FC/$) then formula is

\[ f_{FC} = \frac{\text{Spot - Forward}}{\text{Forward}} \times \frac{360}{\text{days}} \times 100 \]

For direct quotes ($/FC), then F-S/S should be applied.

Exhibit 6.5 Currency Yield Curves and the Forward Premium
Interest Rates and Exchange Rates

– Using the previous Sfr example, the forward discount or premium would be as follows:

\[ f^{FC} = \frac{\text{Spot} - \text{Forward}}{\text{Forward}} \times \frac{360}{\text{days}} \times 100 \]

\[ f^{SU} = \frac{\text{Sfr}1.4800 - \text{Sfr}1.4655}{\text{Sfr}1.4655} \times \frac{360}{90} \times 100 = +3.96\% \text{ p.a.} \]

The positive sign indicates that the Swiss franc is selling forward at a premium of 3.96% per annum (it takes 3.96% more dollars to get a franc at the 90-day forward rate).

Interest Rate Parity (IRP)

– Interest rate parity theory provides the linkage between foreign exchange markets and international money markets.

– The theory states that the difference in the national interest rates for securities of similar risk and maturity should be equal to, but opposite sign to, the forward rate discount or premium for the foreign currency, except for transaction costs.

Interest Rate Parity (IRP)

– In the diagram in the following slide, a US dollar-based investor with $1 million to invest, is shown indifferent between dollar-denominated securities for 90 days earning 8.00% per annum, or Swiss franc-denominated securities of similar risk and maturity earning 4.00% per annum, when “cover” against currency risk is obtained with a forward contract.

Exhibit 6.6 Interest Rate Parity (IRP)

Covered Interest Arbitrage (CIA)

– Because the spot and forward markets are not always in a state of equilibrium as described by IRP, the opportunity for arbitrage exists.

– The arbitrageur who recognizes this imbalance can invest in the currency that offers the higher return on a covered basis.

– This is known as covered interest arbitrage (CIA).

– The following slide describes a CIA transaction in much the same way as IRP was transacted.

Exhibit 6.7 Covered Interest Arbitrage (CIA)
Covered Interest Arbitrage (CIA)

- A deviation from CIA is uncovered interest arbitrage, UIA, wherein investors borrow in currencies exhibiting relatively low interest rates and convert the proceeds into currencies which offer higher interest rates.
- The transaction is “uncovered” because the investor does not sell the currency forward, thus remaining uncovered to any risk of the currency deviating.

Rule of Thumb:
- If the difference in interest rates is greater than the forward premium (or expected change in the spot rate), invest in the higher yielding currency.
- If the difference in interest rates is less than the forward premium (or expected change in the spot rate), invest in the lower yielding currency.

Exhibit 6.8: Uncovered Interest Arbitrage (UIA): The Yen Carry Trade

Start
Investors borrow yen at 6.46% per annum.
Japanese Yen Money Market
5 = ¥100,000
360 Days
U.S. Dollar Money Market
$533,494.01
Invest dollars at 1.05% per annum.
End
£330,000

Exhibit 6.9: Interest Rate Parity (IRP) and Equilibrium

Percentage difference between foreign (F) and domestic (D) interest rates.

Exhibit 6.10: Forward Rate as an Unbiased Predictor for Future Spot Rate

Forward Rates as an Unbiased Predictor

- If the foreign exchange markets are thought to be “efficient” then the forward rate should be an unbiased predictor of the future spot rate.
- This is roughly equivalent to saying that the forward rate can act as a prediction of the future spot exchange rate, and it will often “miss” the actual future spot rate, but it will miss with equal probabilities (directions) and magnitudes (distances).
Prices, Interest Rates and Exchange Rates in Equilibrium

- **(A) Purchasing power parity**
  - forecasts the change in the spot rate on the basis of differences in expected rates of inflation
- **(B) Fisher effect**
  - nominal interest rates in each country are equal to the required real rate of return ($r$) plus compensation for expected inflation ($\pi$)
- **(C) International Fisher effect**
  - the spot exchange rate should change in an amount equal to but in the opposite direction of the difference in interest rates between countries
- **(D) Interest rate parity**
  - the difference in the national interest rates should be equal to, but opposite in sign to, the forward rate discount or premium for the foreign currency, except for transaction costs
- **(E) Forward rate as an unbiased predictor**
  - the forward rate is an efficient predictor of the future spot rate, assuming that the foreign exchange market is reasonably efficient

Exhibit 6.11
International Parity Conditions in Equilibrium (Approximate Form)

Summary of Learning Objectives

- Parity conditions have traditionally been used by economists to help explain the long run trend in an exchange rate
- Under conditions of free floating rates, the expected rate of change in the spot rate, differential interest and inflation rates, and the forward rate are all directional and proportional to each other
- If two products are identical across borders and there are no transaction costs, the product’s price should be the same in both countries. This is the law of one price
- The absolute theory of PPP states that the spot rate is determined by the relative prices of similar goods
- The relative theory of PPP states that if the spot rate starts in equilibrium, any change in the differential inflation rates should be offset over the long run by an opposite change in the spot rate

Summary of Learning Objectives

- The Fisher Effect states that nominal interest rates in each country are equal to the required real rate of return plus compensation for expected inflation
- The international Fisher effect (“Fisher open”) states that the spot rate should change in an equal amount but in the opposite direction to the difference in interest rates between two countries
- The IRP theory states that the difference between national interest rates for similar securities should be equal to, but opposite sign to, the forward discount or premium rate excluding transaction costs
- When the forward and spot market rates are not in equilibrium, the opportunity for risk free arbitrage exists. This is termed covered interest arbitrage
- If markets are believed to be efficient, then the forward rate is considered an “unbiased predictor” of the future spot rate