Chapter 8

Relationships among Inflation, Interest Rates, and Exchange Rates

J. Gaspar: Adapted from Jeff Madura, International Financial Management
International Finance Theories (cont)

- Purchasing Power Parity (PPP): At equilibrium, the future spot rate of a foreign currency will differ (in %) from the current spot rate by an amount that equals (in %) the inflation differential between the home and foreign countries.

- International Fisher Effect (IFE): At equilibrium, the future spot rate of a foreign currency will differ (in %) from the current spot rate by an amount that equals (in %) the nominal interest rate differential between the home and foreign countries.
Chapter Objectives

- To explain Purchasing Power Parity (PPP) and International Fisher Effect (IFE) theories, and their implications on exchange rate changes; and
- To compare and show linkage between PPP, IFE, and Interest Rate Parity (IRP) theories.
Purchasing Power Parity (PPP)

• When a country’s inflation rate rises relative to that of another country, decreased exports and increased imports depress the high-inflation country’s currency because of worsening trade and current account balances.

• Purchasing Power Parity (PPP) theory attempts to quantify this inflation – exchange rate relationship.
Interpretations of PPP

- The **absolute form of PPP** is an extension of the **law of one price**. It suggests that the prices of the same products in different countries should be equal when measured in a common currency.

- The **relative form of PPP** accounts for market distortions like transportation costs, labor costs, tariffs, taxes, and quotas. It states that **the rate of price changes** should be similar.
Rationale behind PPP Theory

Suppose U.S. inflation > U.K. inflation.

⇒ ↑ U.S. imports from U.K. and

↓ U.S. exports to U.K., and U.S. current account ↓

⇒ Downward pressure (depreciation) is placed on the $

This shift in consumption and the $’s depreciation will continue until

1. in the U.S.: \( \text{price}_{\text{U.K. goods}} \geq \text{price}_{\text{U.S. goods}} \)
2. in the U.K.: \( \text{price}_{\text{U.S. goods}} \leq \text{price}_{\text{U.K. goods}} \)
Derivation of PPP

Assume that PPP holds.

Over time, as inflation occurs exchange rates adjusts to maintain PPP:

\[ P_{h1} \to P_{h0} (1 + I_h) \]

Where \( P_{h1} \) = home country’s price index, year-1 end
\( I_h \) = home country’s inflation rate for the year

\[ P_{f1} \to P_{f0} (1 + I_f)(1 + e_f) \]

where \( P_f \) = foreign country’s price index
\( I_f \) = foreign country’s inflation rate
\( e_f \) = foreign currency’s % \( \Delta \) in value
Derivation of PPP

If PPP holds ⇒

\[ P_{h1} = P_{f1} \text{ and } P_{h0} (1 + I_h) = P_{f0} (1 + I_f) (1 + e_f) \]

Solving for \( e_f = \frac{(1 + I_h)/(1 + I_f) - 1}{1} \)

If \( I_h > I_f \) ⇒ \( e_f > 0 \) i.e. foreign currency appreciates
If \( I_h < I_f \) ⇒ \( e_f < 0 \) i.e. foreign currency depreciates

**Example**: Suppose \( I_{U.S.} = 9\% \) and \( I_{U.K.} = 5\% \).

Then \( e_f = \frac{(1 + .09)}{(1 + .05)} - 1 = 3.81\% \)
Simplified PPP Relationship

When the inflation differential is small, the PPP relationship can be simplified as

\[ e_f \approx I_h - I_f \]

Example: Suppose \( I_{\text{U.S.}} = 9\% \) and \( I_{\text{U.K.}} = 5\% \). Then \( e_\text{£} \approx 9 - 5 = 4\% \)

U.S. consumers: \( \Delta P_{\text{U.S.}} = I_{\text{U.S.}} = 9\% \)
\( \Delta P_{\text{U.K.}} = I_{\text{U.K.}} + e_\text{£} = 9\% \)

U.K. consumers: \( \Delta P_{\text{U.K.}} = I_{\text{U.K.}} = 5\% \)
\( \Delta P_{\text{U.S.}} = I_{\text{U.S.}} - e_\text{£} = 5\% \)
Graphic Analysis of Purchasing Power Parity

Inflation Rate Differential (%)
home inflation rate – foreign inflation rate

Increased purchasing power of foreign goods

Decreased purchasing power of foreign goods

%Δ in the foreign currency’s spot rate

PPP line
Testing the PPP Theory

Conceptual Test

• Plot actual inflation differentials and spot exchange rate changes for two or more countries on a graph.

• If the points deviate significantly from the PPP line over time, then PPP does not hold.
Testing the PPP Theory

Statistical Test

• Apply regression analysis to historical exchange rates and inflation differentials:

\[ e_f = a_0 + a_1 \left[ \frac{(1+I_h)}{(1+I_f)} - 1 \right] + \mu \]

• Then apply t-tests to the regression coefficients. (Test for \( a_0 = 0 \) and \( a_1 = 1 \).)

• If any coefficient differs significantly from what was expected, PPP does not hold.
Testing the PPP Theory

• Empirical studies indicate that the relationship between inflation differentials and exchange rates is not perfect even in the long run.

• However, the use of inflation differentials to forecast long-run movements in exchange rates is supported.

☞ A limitation in the tests is that the choice of the base period will affect the result.
Why PPP Does Not Occur

PPP does not occur consistently due to:

1. confounding effects
   - Exchange rates are also affected by differences in inflation, interest rates, income levels, government controls and expectations of future rates.

2. a lack of substitutes for some traded goods
PPP in the Long Run

- PPP can be tested by assessing a “real” exchange rate over time (e.g., crawling pegs).
  - The real exchange rate is the actual exchange rate adjusted for inflationary effects in the two countries of concern.
- If the real exchange rate follows a random walk, it cannot be viewed as being a constant in the long run. Then PPP does not hold.
The Big Mac Index was invented by The Economist in 1986 as a lighthearted guide to whether currencies are at their “correct” level. It is based on the theory of purchasing-power parity (PPP), the notion that in the long run exchange rates should move towards the rate that would equalize the prices of an identical basket of goods and services (in this case, a burger) in any two countries. For example, the average price of a Big Mac in America in January 2015 was $4.79; in China it was only $2.77 at market exchange rates. So the "raw" Big Mac index says that the yuan was undervalued by 42% at that time.

http://www.economist.com/content/big-mac-index
International Fisher Effect (IFE)

• According to the Fisher Effect, nominal risk-free interest rates contain a real rate of return and anticipated inflation

\[ i_n = i_r + \text{inflation} \]

• If all investors require the same real return on assets of similar risk and maturity, then differentials in interest rates may be due to differentials in expected inflation.

• Recall that PPP theory suggests that exchange rate movements are caused by inflation rate differentials.
The International Fisher Effect (IFE) theory suggests that currencies with higher interest rates will depreciate because the higher nominal rates reflect higher expected inflation.

Hence, investors hoping to capitalize on a higher foreign interest rate should earn a return no higher than what they would have earned domestically.
### International Fisher Effect (IFE)

<table>
<thead>
<tr>
<th>Investors Residing in</th>
<th>Attempt to Invest in</th>
<th>$I_h$</th>
<th>$I_f$</th>
<th>$e_f$</th>
<th>$i_f$</th>
<th>Return in Home Currency</th>
<th>$I_h$</th>
<th>Real Return Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Japan</td>
<td>3 %</td>
<td>3 %</td>
<td>0 %</td>
<td>5 %</td>
<td>5 %</td>
<td>3 %</td>
<td>2 %</td>
</tr>
<tr>
<td></td>
<td>U.S.</td>
<td>3</td>
<td>6</td>
<td>-3</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>3</td>
<td>11</td>
<td>-8</td>
<td>13</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>U.S.</td>
<td>Japan</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>U.S.</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>6</td>
<td>11</td>
<td>-5</td>
<td>13</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>Japan</td>
<td>11</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>13</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>U.S.</td>
<td>11</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>13</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>11</td>
<td>11</td>
<td>0</td>
<td>13</td>
<td>13</td>
<td>11</td>
<td>2</td>
</tr>
</tbody>
</table>
According to the IFE, $E(r_f)$, the expected effective return on a foreign money market investment, should equal $r_h$, the effective return on a domestic investment.

- $r_f = (1 + i_f)(1 + e_f) - 1$
  - $i_f = \text{interest rate in the foreign country}$
  - $e_f = \% \text{ change in the foreign currency’s value}$
- $r_h = i_h = \text{interest rate in the home country}$
Derivation of the IFE

• Setting \( r_f = r_h \):
  \[
  (1 + i_f)(1 + e_f) - 1 = i_h
  \]

• Solving for \( e_f \):
  \[
  e_f = \frac{(1 + i_h)}{(1 + i_f)} - 1
  \]

• \( i_h > i_f \Rightarrow e_f > 0 \) i.e. foreign currency appreciates
  \( i_h < i_f \Rightarrow e_f < 0 \) i.e. foreign currency depreciates

**Example:** Suppose \( i_{U.S.} = 11\% \) and \( i_{U.K.} = 12\% \).

Then \[
 e_{U.K.} = \frac{(1 + .11)}{(1 + .12)} - 1 = -.89\% .
\]

This will make \( r_f = r_h \).
Derivation of the IFE

When the interest rate differential is small, the IFE relationship can be simplified as

\[ e_f \approx i_h - i_f \]

If the British rate on 6-month deposits were 2% above the U.S. interest rate, the £ should depreciate by approximately 2% over 6 months. Then U.S. investors would earn about the same return on British deposits as they would on U.S. deposits.
Graphic Analysis of the International Fisher Effect

Interest Rate Differential (%)

- Home interest rate
- Foreign interest rate

Lower returns from investing in foreign deposits

Higher returns from investing in foreign deposits

% \( \Delta \) in the foreign currency’s spot rate

IFE line
Tests of the IFE

• If actual interest rates and exchange rate changes are plotted over time on a graph, we can see whether the points are evenly scattered on both sides of the IFE line.

• Empirical studies indicate that the IFE theory holds during some time frames. However, there is also evidence that it does not hold consistently.
Tests of the International Fisher Effect

Interest Rate Differential (%)
home interest rate - foreign interest rate

IFE line

% Δ in the foreign currency’s spot rate
Tests of the IFE

• To test the IFE statistically, apply regression analysis to historical exchange rates and nominal interest rate differentials:

\[ e_f = a_0 + a_1 \left[ \frac{(1+i_h)}{(1+i_f)} - 1 \right] + \mu \]

• Then apply t-tests to the regression coefficients. (Test for \( a_0 = 0 \) and \( a_1 = 1 \).)

• IFE does not hold if any coefficient differs significantly from what was expected.
Why the IFE Does Not Occur

- Since the IFE is based on PPP, it will not hold when PPP does not hold.
- In particular, if there are factors other than inflation that affect exchange rates, exchange rates may not adjust in accordance with the inflation differential.
Comparison of the IRP, PPP, and IFE Theories

- Interest Rate Parity (IRP)
- Forward Rate Discount or Premium
- Interest Rate Differential
- Fisher Effect
- Inflation Rate Differential
- Purchasing Power Parity (PPP)
- International Fisher Effect (IFE)
- Exchange Rate Expectations
Comparison of the IRP, PPP, and IFE Theories

**Interest rate parity**
Forward rate premium $p$
Interest rate differential $i_h - i_f$

\[ p = \left( \frac{1 + i_h}{1 + i_f} \right) - 1 \approx i_h - i_f \]

**Purchasing power parity**
% $\Delta$ in spot exchange rate $e_f$
Inflation rate differential $I_h - I_f$

\[ e_f = \left( \frac{1 + I_h}{1 + I_f} \right) - 1 \approx I_h - I_f \]

**International Fisher effect**
% $\Delta$ in spot exchange rate $e_f$
Interest rate differential $i_h - i_f$

\[ e_f = \left( \frac{1 + i_h}{1 + i_f} \right) - 1 \approx i_h - i_f \]