Introduction to Exchange Rates and the Foreign Exchange Market

1. Refer to the exchange rates given in the following table.

<table>
<thead>
<tr>
<th>Country</th>
<th>Today June 25, 2010</th>
<th>One Year Ago June 25, 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per $</td>
<td>Per £</td>
</tr>
<tr>
<td>Australia</td>
<td>1.152</td>
<td>1.721</td>
</tr>
<tr>
<td>Canada</td>
<td>1.037</td>
<td>1.559</td>
</tr>
<tr>
<td>Denmark</td>
<td>6.036</td>
<td>9.045</td>
</tr>
<tr>
<td>Euro</td>
<td>0.811</td>
<td>1.215</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>7.779</td>
<td>11.643</td>
</tr>
<tr>
<td>India</td>
<td>46.360</td>
<td>69.476</td>
</tr>
<tr>
<td>Japan</td>
<td>89.350</td>
<td>134.048</td>
</tr>
<tr>
<td>Mexico</td>
<td>12.697</td>
<td>18.993</td>
</tr>
<tr>
<td>Sweden</td>
<td>7.740</td>
<td>11.632</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.667</td>
<td>1.000</td>
</tr>
<tr>
<td>United States</td>
<td>1.000</td>
<td>1.496</td>
</tr>
</tbody>
</table>


Answer:
June 25, 2009: $E_{\text{NY}} = 1 / (94.86) = 0.0105/¥$
June 25, 2010: $E_{\text{NY}} = 1 / (89.35) = 0.0112/¥$
June 25, 2009: $E_{\text{CS}} = 1 / (1.084) = 0.9225/C$
June 25, 2010: $E_{\text{CS}} = 1 / (1.037) = 0.9643/C$

b. What happened to the value of the U.S. dollar relative to the Japanese yen and Canadian dollar between June 25, 2009 and June 25, 2010? Compute the percentage change in the value of the U.S. dollar relative to each currency using the U.S. dollar–foreign currency exchange rates you computed in (a).

Answer: Between June 25, 2009 and 2010, both the Canadian dollar and the Japanese yen appreciated relative to the U.S. dollar. The percentage appreciation in the foreign currency relative to the U.S. dollar is:

$\% \Delta E_{\text{NY}} = \frac{(0.0112 - 0.0105)}{0.0105} = 6.17\%$
$\% \Delta E_{\text{CS}} = \frac{(0.9643 - 0.9225)}{0.9225} = 4.53\%$
c. Using the information in the table for June 25, 2010, compute the Danish krone–Canadian dollar exchange rate, $E_{\text{krone/C$}}$.

Answer: $E_{\text{krone/C$}} = (6.036 \text{ kr/}$)/(1.037 \text{ C$/}$) = 5.8206 \text{ kr/C$}.

d. Visit the Web site of the Board of governors of the Federal Reserve System at http://www.federalreserve.gov/. Click on “Economic Research and Data” and then “Statistics: Releases and Historical Data.” Download the H.10 release Foreign Exchange Rates (weekly data available). What has happened to the value of the U.S. dollar relative to the Canadian dollar, Japanese yen, and Danish krone since June 25, 2010?

Answer: Answers will vary.

e. Using the information from (d), what has happened to the value of the U.S. dollar relative to the British pound and the euro? Note: the H.10 release quotes these exchange rates as U.S. dollars per unit of foreign currency in line with long-standing market conventions.

Answer: Answers will vary.

2. Consider the United States and the countries it trades with the most (measured in trade volume): Canada, Mexico, China, and Japan. For simplicity, assume these are the only four countries with which the United States trades. Trade shares and exchange rates for these four countries are as follows:

<table>
<thead>
<tr>
<th>Country (currency)</th>
<th>Share of trade</th>
<th>$ per FX in 2009</th>
<th>Dollar per FX in 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada (dollar)</td>
<td>36%</td>
<td>0.9225</td>
<td>0.9643</td>
</tr>
<tr>
<td>Mexico (peso)</td>
<td>28%</td>
<td>0.0756</td>
<td>0.0788</td>
</tr>
<tr>
<td>China (yuan)</td>
<td>20%</td>
<td>0.1464</td>
<td>0.1473</td>
</tr>
<tr>
<td>Japan (yen)</td>
<td>16%</td>
<td>0.0105</td>
<td>0.0112</td>
</tr>
</tbody>
</table>

a. Compute the percentage change from 2009 to 2010 in the four U.S. bilateral exchange rates (defined as U.S. dollars per units of foreign exchange, or FX) in the table provided.

Answer:

$\%\Delta E_{\text{C$/}} = \frac{(0.9643 - 0.9225)}{0.9225} = 4.53\%$

$\%\Delta E_{\text{peso}} = \frac{(0.0788 - 0.0756)}{0.0756} = 4.23\%$

$\%\Delta E_{\text{yuan}} = \frac{(0.1473 - 0.1464)}{0.1464} = 0.61\%$

$\%\Delta E_{\text{yen}} = \frac{(0.0112 - 0.0105)}{0.0105} = 6.67\%$

b. Use the trade shares as weights to compute the percentage change in the nominal effective exchange rate for the United States between 2009 and 2010 (in U.S. dollars per foreign currency basket).

Answer: The trade-weighted percentage change in the exchange rate is:

$\%\Delta E = 0.36(\%\Delta E_{\text{C$/}}) + 0.28(\%\Delta E_{\text{peso}}) + 0.20(\%\Delta E_{\text{yuan}}) + 0.16(\%\Delta E_{\text{yen}}) = 4.01\%$

c. Based on your answer to (b), what happened to the value of the U.S. dollar against this basket between 2009 and 2010? How does this compare with the change in the value of the U.S. dollar relative to the Mexican peso? Explain your answer.

Answer: The dollar depreciated by 4.01% against the basket of currencies. Vis-à-vis the peso, the dollar depreciated by 4.23%.

3. Go to the Web site for Federal Reserve Economic Data (FRED): http://research.stlouisfed.org/fred2/. Locate the monthly exchange rate data for the following:
a. Canada (dollar), 1980–2009
   Answer: Floating exchange rate
e. Venezuela (bolivar), 2003–2009
   Answer: Fixed exchange rate (with occasional adjustments)

4. Describe the different ways in which the government may intervene in the foreign exchange market. Why does the government have the ability to intervene in this way whereas private actors do not?
   Answer: The government may participate in the forex market in a number of ways: capital controls, official market (with fixed rates), and intervention. The government has the ability to intervene in a way that private actors do not because (1) it can impose regulations on the foreign exchange market, and (2) it can implement large-scale transactions that influence exchange rates.

5. Suppose quotes for the dollar–euro exchange rate, $E_{\text{$/€}}$, are as follows: in New York, $1.50$ per euro; and in Tokyo, $1.55$ per euro. Describe how investors use arbitrage to take advantage of the difference in exchange rates. Explain how this process will affect the dollar price of the euro in New York and Tokyo.
   Answer: Investors will buy euros in New York at a price of $1.50$ each because this is relatively cheaper than the price in Tokyo. They will then sell these euros in Tokyo at a price of $1.55$, earning a $0.05$ profit on each euro. With the influx of buyers in New York, the price of euros in New York will increase. With the influx of traders selling euros in Tokyo, the price of euros in Tokyo will decrease. This price adjustment continues until the exchange rates are equal in both markets.

6. Consider a Dutch investor with 1,000 euros to place in a bank deposit in either the Netherlands or Great Britain. The (one-year) interest rate on bank deposits is 2% in Britain and 4.04% in the Netherlands. The (one-year) forward euro–pound exchange rate is 1.575 euros per pound and the spot rate is 1.5 euros per pound. Answer the following questions, using the exact equations for UIP and CIP as necessary.
   a. What is the euro-denominated return on Dutch deposits for this investor?
      Answer: The investor's return on euro-denominated Dutch deposits is equal to €1,040.04 (\(= \€1,000 \times (1 + 0.0404)\)).
b. What is the (riskless) euro-denominated return on British deposits for this investor using forward cover?

**Answer:** The euro-denominated return on British deposits using forward cover is equal to €1,071 (\(= €1,000 \times (1.575 / 1.5) \times (1 + 0.02)\)).

c. Is there an arbitrage opportunity here? Explain why or why not. Is this an equilibrium in the forward exchange rate market?

**Answer:** Yes, there is an arbitrage opportunity. The euro-denominated return on British deposits is higher than that on Dutch deposits. The net return on each euro deposit in a Dutch bank is equal to 4.04% versus 7.1% (\(= (1.575 / 1.5) \times (1 + 0.02)\)) on a British deposit (using forward cover). This is not an equilibrium in the forward exchange market. The actions of traders seeking to exploit the arbitrage opportunity will cause the spot and forward rates to change.

d. If the spot rate is 1.5 euros per pound, and interest rates are as stated previously, what is the equilibrium forward rate, according to CIP?

**Answer:** CIP implies:

\[
F_{\text{€/£}} = E_{\text{€/£}} (1 + i_\text{£}) / (1 + i_\text{€}) = 1.5 \times 1.0404 / 1.02 = €1.53\text{ per £.}
\]

e. Suppose the forward rate takes the value given by your answer to (d). Calculate the forward premium on the British pound for the Dutch investor (where exchange rates are in euros per pound). Is it positive or negative? Why do investors require this premium/discount in equilibrium?

**Answer:** Forward premium \(= (F_{\text{€/£}} / E_{\text{€/£}} - 1) = (1.53 / 1.50) - 1 = 0.03 = 3\%\). The existence of a positive forward premium would imply that investors expect the euro to depreciate relative to the British pound. Therefore, when establishing forward contracts, the forward rate is higher than the current spot rate.

f. If UIP holds, what is the expected depreciation of the euro against the pound over one year?

**Answer:** According to the UIP approximation, \(\Delta E_{\text{€/£}} / E_{\text{€/£}} = i_\text{£} - i_\text{€} = 2.04\%\). Therefore, the euro is expected to depreciate by 2.04%. Using the exact UIP condition, we first need to convert the exchange rates into pound–euro terms to calculate the depreciation in the euro. From UIP, \(\Delta E_{\text{€/£}} = E_{\text{€/£}} \times (1 + i_\text{£}) / (1 + i_\text{€}) = (1 / 1.5) \times (1 + 0.02) / (1 + 0.0404) = L0.654\text{ per £.}\) Therefore, the depreciation in the euro is equal to 1.95% (0.654 – 0.667)/0.667.

g. Based on your answer to (f), what is the expected euro–pound exchange rate one year ahead?

**Answer:** Using the exact UIP (not the approximation), we know that the following is true: \(F_{\text{€/£}} = E_{\text{€/£}} \times (1 + i_\text{£}) / (1 + i_\text{€}) = 1.5 \times 1.0404 / 1.02 = (€1.53\text{ per £.})\). Using the approximation, \(E_{\text{€/£}}\) decreases by 2.04% from 0.667 to 0.653. This implies the new spot rate, \(F_{\text{€/£}} = 1.53\).

7. You are a financial adviser to a U.S. corporation that expects to receive a payment of 40 million Japanese yen in 180 days for goods exported to Japan. The current spot rate is 100 yen per U.S. dollar (\(E_{\text{¥/£}} = 0.0100\)). You are concerned that the U.S. dollar is going to appreciate against the yen over the next six months.

a. Assuming that the exchange rate remains unchanged, how much does your firm expect to receive in U.S. dollars?

**Answer:** The firm expects to receive $400,000 (\(= ¥40,000,000 / 100\)).

b. How much would your firm receive (in U.S. dollars) if the dollar appreciated to 110 yen per U.S. dollar (\(E_{\text{¥/£}} = 0.00909\))?

**Answer:** The firm would receive $363,636 (\(= ¥40,000,000 / 110\)).
Exchange Rates I: The Monetary Approach in the Long Run

1. Suppose that two countries, Vietnam and Côte d’Ivoire, produce coffee. The currency unit used in Vietnam is the dong (VND). Côte d’Ivoire is a member of Communauté Financière Africaine (CFA), a currency union of West African countries that use the CFA franc (XOF). In Vietnam, coffee sells for 5,000 dong (VND) per pound of coffee. The exchange rate is 30 VND per 1 CFA franc, $E_{\text{VND/XOF}} = 30$.

   a. If the law of one price holds, what is the price of coffee in Côte d’Ivoire, measured in CFA francs?

      **Answer:** According to LOOP, the price of coffee should be the same in both markets:

      $$P_{\text{Coffee}} = \frac{P_{\text{Coffee}}^\text{VND}}{E_{\text{VND/XOF}}} = \frac{5,000}{30} = 166.7$$

   b. Assume the price of coffee in Côte d’Ivoire is actually 160 CFA francs per pound of coffee. Calculate the relative price of coffee in Côte d’Ivoire versus Vietnam. Where will coffee traders buy coffee? Where will they sell coffee? How will these transactions affect the price of coffee in Vietnam? In Côte d’Ivoire?

      **Answer:** The relative price of coffee in these two markets is:

      $$q_{\text{Coffee}} = \frac{(E_{\text{VND/XOF}}) \cdot P_{\text{Coffee}}^{\text{VND}}}{P_{\text{Coffee}}^{\text{XOF}}} = \frac{30 \times 160}{5,000} = 0.96 < 1$$

      Traders will buy coffee in Côte d’Ivoire because it is cheaper there. Traders will sell coffee in Vietnam. This will lead to an increase in the price of coffee in Côte d’Ivoire and a decrease in the price in Vietnam.

2. Consider each of the following goods and services. For each, identify whether the law of one price will hold, and state whether the relative price, $q$, is greater than, less than, or equal to 1. Explain your answer in terms of the assumptions we make when using the law of one price.

   a. Rice traded freely in the United States and Canada

      **Answer:** $q_{\text{Rice}} = 1$

      LOOP should hold in this case because its assumptions are met.

   b. Sugar traded in the United States and Mexico; the U.S. government imposes a quota on sugar imports into the United States

      **Answer:** $q_{\text{Sugar}} > 1$
If the U.S. government imposes a quota on sugar, this will lead to an increase in the relative price of sugar in the United States through restricting competition.

e. The McDonald's Big Mac sold in the United States and Japan

Answer: \( \frac{q_{US}}{q_{FOREIGN}} = 1 \)

The McDonald's Big Mac sold in the United States may sell for a different price compared with Japan because there are nontradable elements in the production of the Big Mac, such as labor and rent.

d. Haircuts in the United States and the United Kingdom

Answer: \( \frac{q_{US}}{q_{FOREIGN}} = 1 \)

Because haircuts cannot be traded across the United States and the United Kingdom, consumers will not arbitrage away differences in the prices of haircuts in these two regions.

3. Use the table that follows to answer this question. Treat the country listed as the home country and the United States as the foreign country. Suppose the cost of the market basket in the United States is \( P_{US} = $190 \). Check to see whether purchasing power parity (PPP) holds for each of the countries listed, and determine whether we should expect a real appreciation or real depreciation for each country (relative to the United States) in the long run.

<table>
<thead>
<tr>
<th>Country (currency measured in FX units</th>
<th>Price of market basket (in FX)</th>
<th>Price of U.S. basket in FX ((P_{US} \times E_{US/\text{FX}}))</th>
<th>Real exchange rate (q_{\text{COUNTRY/US}})</th>
<th>Does PPP hold? (yes/no)</th>
<th>Is FX currency overvalued or undervalued?</th>
<th>Is FX currency expected to have Real appreciation or depreciation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil (real)</td>
<td>2.1893</td>
<td>520</td>
<td>415.97</td>
<td>0.80</td>
<td>No</td>
<td>Real exchange rate will depreciate</td>
</tr>
<tr>
<td>India (rupee)</td>
<td>46.6672</td>
<td>12,000</td>
<td>8,766.77</td>
<td>0.74</td>
<td>No</td>
<td>Rupee overvalued Real exchange rate will depreciate</td>
</tr>
<tr>
<td>Mexico (peso)</td>
<td>11.0131</td>
<td>1,800</td>
<td>2,092.49</td>
<td>1.16</td>
<td>No</td>
<td>Peso undervalued Real exchange rate will appreciate</td>
</tr>
<tr>
<td>South Africa (rand)</td>
<td>6.9294</td>
<td>800</td>
<td>1,316.59</td>
<td>1.65</td>
<td>No</td>
<td>Rand undervalued Real exchange rate will appreciate</td>
</tr>
<tr>
<td>Zimbabwe (Z$)</td>
<td>101,347</td>
<td>4,000,00</td>
<td>19,225,930.00</td>
<td>4.81</td>
<td>No</td>
<td>ZW$ undervalued Real exchange rate will appreciate</td>
</tr>
</tbody>
</table>

Answer: See the following table. Note that the United States is treated as the foreign country relative to each “home” country listed in the table.
In the previous table:

- PPP holds only when the real exchange rate $q_{US/H} = 1$. This implies that the baskets in the home country and the United States have the same price in a common currency.

- If $q_{US/H} > 1$, then the basket in the United States is more expensive than the basket in the home country. This implies the U.S. dollar is overvalued and the Home currency is undervalued. According to PPP, the Home country will experience a real appreciation (Mexico, South Africa, and Zimbabwe).

- If $q_{US/H} < 1$, then the basket in the home country is more expensive than the basket in the United States. This implies the U.S. dollar is undervalued and the Home currency is overvalued. According to PPP, the Home country will experience a real depreciation (Brazil and India).

4. Table 3-1 in the text shows the percentage undervaluation or overvaluation in the Big Mac, based on exchange rates in July 2009. Suppose purchasing power parity holds in the long run, so that these deviations would be expected to disappear. Suppose the local currency prices of the Big Mac remained unchanged. Exchange rates in January 4, 2010, were as follows (source: IMF):

<table>
<thead>
<tr>
<th>Country</th>
<th>Per-U.S.-$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia (A$)</td>
<td>0.90</td>
</tr>
<tr>
<td>Brazil (real)</td>
<td>1.74</td>
</tr>
<tr>
<td>Canada (C$)</td>
<td>1.04</td>
</tr>
<tr>
<td>Denmark (krona)</td>
<td>5.17</td>
</tr>
<tr>
<td>Eurozone (euro)</td>
<td>0.69</td>
</tr>
<tr>
<td>India (rupee)</td>
<td>46.93</td>
</tr>
<tr>
<td>Japan (yen)</td>
<td>95.05</td>
</tr>
<tr>
<td>Mexico (peso)</td>
<td>12.92</td>
</tr>
<tr>
<td>Sweden (krona)</td>
<td>7.14</td>
</tr>
</tbody>
</table>

Based on these data and Table 3-1, calculate the change in the exchange rate from July to January, and state whether the direction of change was consistent with the PPP-implied exchange rate using the Big Mac Index. How might you explain the failure of the Big Mac Index to correctly predict the change in the nominal exchange rate between July 2009 and January 2010?
**Answer:** (The complete table is included in the Excel workbook for this chapter in the solutions manual.)

<table>
<thead>
<tr>
<th>Big-Mac-prices</th>
<th>(local-currency per-U.S.-dollar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-local currency</td>
<td>In-U.S. dollars</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>United States $3.57</td>
<td>3.57</td>
</tr>
<tr>
<td>Australia A$4.34</td>
<td>3.3643</td>
</tr>
<tr>
<td>Brazil R$8.03</td>
<td>4.0150</td>
</tr>
<tr>
<td>Canada C$3.89</td>
<td>3.3534</td>
</tr>
<tr>
<td>Denmark Kr29.50</td>
<td>5.5243</td>
</tr>
<tr>
<td>Euro-area #2.34</td>
<td>4.5942</td>
</tr>
<tr>
<td>Japan ¥320.00</td>
<td>3.4557</td>
</tr>
<tr>
<td>Mexico Peso33.00</td>
<td>2.3813</td>
</tr>
<tr>
<td>Sweden Kr38.00</td>
<td>4.9367</td>
</tr>
</tbody>
</table>
We can see from the table that during this time, PPP correctly predicted the direction exchange rate movements for only three of these countries. The Big Mac Index may fail to predict exchange rate movements because there are nontradable inputs used in the production of Big Macs, such as labor and rent.

5. You are given the following information. The current dollar–pound exchange rate is $2 per British pound. A U.S. basket that costs $100 would cost $120 in the United Kingdom. For the next year, the Fed is predicted to keep U.S. inflation at 2% and the Bank of England is predicted to keep U.K. inflation at 3%. The speed of convergence to absolute PPP is 15% per year.

   a. What is the expected U.S. minus U.K. inflation differential for the coming year?
      Answer: The inflation differential is equal to \(-1\% (=2\% - 3\%)\).

   b. What is the current U.S. real exchange rate, \(q_{UK/US}\), with the United Kingdom?
      Answer: The current real exchange rate is:
      \[ q_{UK/US} = \frac{(E_{UK/P_{UK}})}{P_{US}} = \frac{120}{100} = 1.2. \]

   c. How much is the dollar overvalued/undervalued?
      Answer: The British pound is undervalued by 20% and the U.S. dollar is overvalued by 20% (= 1.2 – 1 / 1).

   d. What do you predict the U.S. real exchange rate with the United Kingdom will be in one year’s time?
      Answer: We can use the information on convergence to compute the implied change in the U.S. real exchange rate. We know the speed of convergence to absolute PPP is 15%; that is, each year the exchange rate will adjust by 15% of what is needed to achieve the real exchange rate equal to 1 (assuming prices in each country remain unchanged). Today, the real exchange rate is equal to 1.2, implying a 0.2 decrease is needed to satisfy absolute PPP. Over the next year, 15% of this adjustment will occur, so the real exchange rate will decrease by 0.03. Therefore, after one year, the U.S. real exchange rate, \(q_{UK/US}\), will equal 1.17.

   e. What is the expected rate of real depreciation for the United States (versus the United Kingdom)?
      Answer: From (d), the real exchange rate will decrease by 0.03. Therefore, the rate of real depreciation is equal to \(-2.5\% (= -0.03 / 1.20)\). This implies a real appreciation in the United States relative to the United Kingdom.

   f. What is the expected rate of nominal depreciation for the United States (versus the United Kingdom)?
      Answer: The expected rate of nominal depreciation can be calculated based on the inflation differential plus the expected real depreciation from (e). In this case, the inflation differential is \(-1\%\) and the expected real appreciation is \(-2.5\%\), so the expected nominal depreciation is \(-3.5\%.\) That is, we expect a 3.5% appreciation in the U.S. dollar relative to the British pound.

   g. What do you predict will be the dollar price of one pound a year from now?
      Answer: The current nominal exchange rate is $2 per pound and we expect a 3.5% appreciation in the dollar (from [f]). Therefore, the expected exchange rate in one year is equal to $1.93 (= $2 \times (1 - 0.035).

6. Describe how each of the following factors might explain why PPP is a better guide for exchange rate movements in the long run versus the short run: (1) transactions costs, (2) nontraded goods, (3) imperfect competition, and (4) price stickiness. As markets become increasingly integrated, do you suspect PPP will become a more useful guide in the future? Why or why not?
**Answer:** Each of these factors hinders trade more in the short run than in the long run. Specifically, each is a reason to expect that the condition of frictionless trade is not satisfied. For this reason, PPP is more likely to hold in the long run than in the short run.

1. **Transactions costs.** Over longer periods of time, producers generally face decreasing average costs (as fixed costs become variable costs in the long run). Therefore, the average cost associated with a given transaction should decrease.

2. **Nontraded goods.** Goods that are not traded among countries cannot be arbitraged. Since intercountry arbitrage is required for PPP, nontraded goods will prevent exchange rates from completely adjusting to PPP. Examples of nontraded goods include many services that require a physical presence on site to complete the work. There are many of these, ranging from plumbers to hairdressers.

3. **Imperfect competition.** Imperfect competition implies that producers of differentiated products have the ability to influence prices. In the short run, these firms may either collude to prevent price adjustment, or they may engage in dramatic changes in price (e.g., price wars) designed to capture market share. These collusion agreements and price wars generally are not long-lasting.

4. **Price stickiness.** In the short run, prices may be inflexible for several reasons. Firms may face menu costs, or fear that price adjustments will adversely affect market share. Firms also may have wage contracts that are set in nominal terms. However, in the long run, these costs associated with changing prices dissipate, either because menu costs decrease over time or because firms and workers renegotiate wage contracts in the long run.

As markets become more integrated, PPP should become a better predictor of exchange rate movements. For PPP to hold, we have to assume frictionless trade. The more integrated markets are, the closer they are to achieving frictionless trade.

7. Consider two countries, Japan and Korea. In 1996, Japan experienced relatively slow output growth (1%), whereas Korea had relatively robust output growth (6%). Suppose the Bank of Japan allowed the money supply to grow by 2% each year, whereas the Bank of Korea chose to maintain relatively high money growth of 12% per year. For the following questions, use the simple monetary model (where $L$ is constant). You will find it easiest to treat Korea as the home country and Japan as the foreign country.

a. What is the inflation rate in Korea? In Japan?

**Answer:**

\[
\begin{align*}
\pi_K &= \mu_K - g_K \rightarrow \pi_K = 12\% - 6\% = 6\% \\
\pi_J &= \mu_J - g_J \rightarrow \pi_J = 2\% - 1\% = 1\%
\end{align*}
\]

b. What is the expected rate of depreciation in the Korean won relative to the Japanese yen?

**Answer:**

\[
\%\Delta E_{\text{won/¥}} = (\pi_K - \pi_J) = 6\% - 1\% = 5\%.
\]

You can check this by using the following expression from the monetary model: \(\%\Delta E_{\text{won/¥}} = (\mu_K - g_K) \sim (\mu_J - g_J)\).

c. Suppose the Bank of Korea increases the money growth rate from 12% to 15%. If nothing in Japan changes, what is the new inflation rate in Korea?

**Answer:**

\[
\pi_{\text{new}} = \mu_K - g_K = 15\% - 6\% = 9\%
\]
d. Using time series diagrams, illustrate how this increase in the money growth rate affects the money supply, $M_K$; Korea’s interest rate; prices, $P_K$; real money supply; and $E_{won/¥}$ over time. (Plot each variable on the vertical axis and time on the horizontal axis.)

Answer: See the following diagrams.
e. Suppose the Bank of Korea wants to maintain an exchange rate peg with the Japanese yen. What money growth rate would the Bank of Korea have to choose to keep the value of the won fixed relative to the yen?

**Answer:** To keep the exchange rate constant, the Bank of Korea must lower its money growth rate. We can figure out exactly which money growth rate will keep the exchange rate fixed by using the fundamental equation for the simple monetary model (used above in [b]):

\[
\% \Delta E_{\text{won/¥}} = (\mu_K - \mu_J) - (g_K - g_J)
\]

The objective is to set \( \% \Delta E_{\text{won/¥}} = 0 \):

\[
(\mu^*_K - g_K) = (\mu_J - g_J)
\]

Plug in the values given in the question and solve for \( \mu^*_K \):

\[
(6\% - 6\%) = (2\% - 1\%)
\]

\( \mu^*_K = 7\% \)

Therefore, if the Bank of Korea sets its money growth rate to 7%, its exchange rate with Japan will remain unchanged.

f. Suppose the Bank of Korea sought to implement policy that would cause the Korean won to appreciate relative to the Japanese yen. What ranges of the money growth rate (assuming positive values) would allow the Bank of Korea to achieve this objective?

**Answer:** Using the same reasoning as previously, the objective is for the won to appreciate: \( \% \Delta E_{\text{won/¥}} < 0 \)

This can be achieved if the Bank of Korea allows the money supply to grow by less than 7% each year. The diagrams on the following page show how this would affect the variables in the model over time.

8. This question uses the general monetary model, in which \( L \) is no longer assumed constant and money demand is inversely related to the nominal interest rate. Consider the same scenario described in the beginning of the previous question. In addition, the bank deposits in Japan pay 3% interest; \( i_J = 3\% \).

a. Compute the interest rate paid on Korean deposits.

**Answer:**

Fisher effect: \( i_{\text{won}} = i_K = \pi_K - \pi_J \)

Solve for \( i_{\text{won}} = (6\% - 1\%) + 3\% = 8\% \)

b. Using the definition of the real interest rate (nominal interest rate adjusted for inflation), show that the real interest rate in Korea is equal to the real interest rate in Japan. (Note that the inflation rates you calculated in the previous question will apply here.)

**Answer:**

\( r_K = \pi_K - \pi_J = 2\% - 1\% = 1\% \)

\( r_{\text{won}} = i_{\text{won}} - \pi_K = 8\% - 6\% = 2\% \)

c. Suppose the Bank of Korea increases the money growth rate from 12% to 15% and the inflation rate rises proportionately (one for one) with this increase. If the nominal interest rate in Japan remains unchanged, what happens to the interest rate paid on Korean deposits?

**Answer:** We know that the inflation rate in Korea will increase to 9%. We also know that the real interest rate will remain unchanged. Therefore:

\( i_{\text{won}} = r_{\text{won}} + \pi_K = 1\% + 9\% = 10\% \).