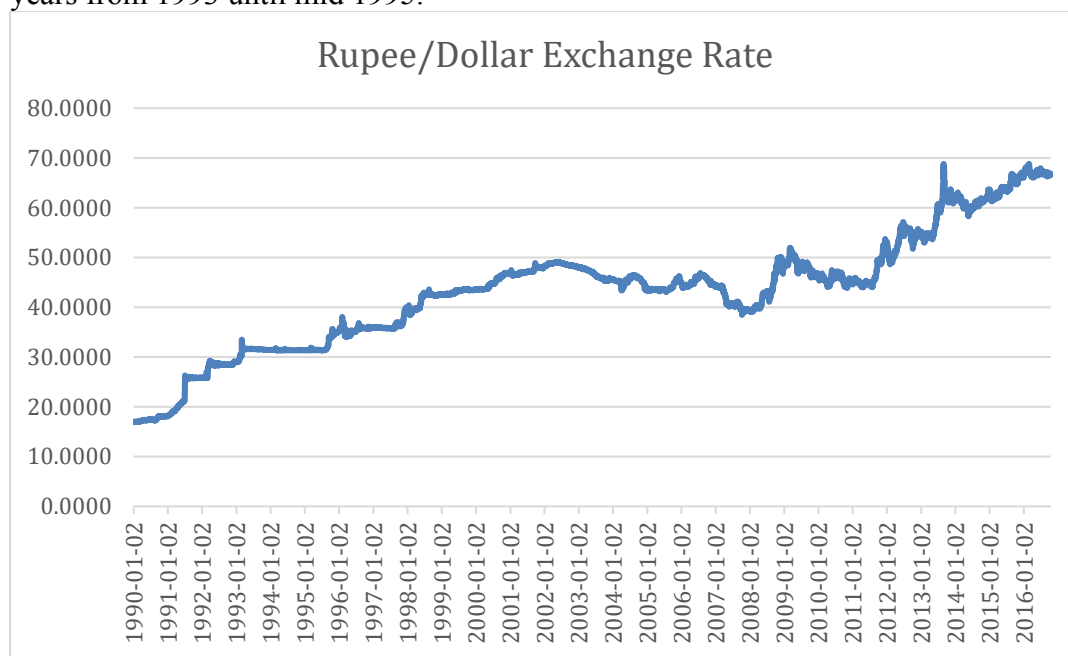


## 2 (13) Introduction to Exchange Rates and the Foreign Exchange Market

**1. Discovering Data** Not all pegs are created equal! In this question you will explore trends in exchange rates. Go to the St. Louis Federal Reserve's Economic Data (FRED) website at <https://research.stlouisfed.org/fred2/> and download the daily United States exchange rates with Venezuela, India, and Hong Kong from 1990 to present. These can be found most easily by searching for the country names and "daily exchange rate."

**a.** Plot the Indian rupee to U.S. dollar exchange rate over this period. For what years does the rupee appear to be pegged to the dollar? Does this peg break? If so, how many times?

**Answer:** The rupee appears to be pegged to the U.S. dollar at various rates from 1991 until about 1998 with intermittent volatility at places the peg appears to break. There are four distinct rates at which this peg remains, the longest of which lasting over two years from 1993 until mid 1995.

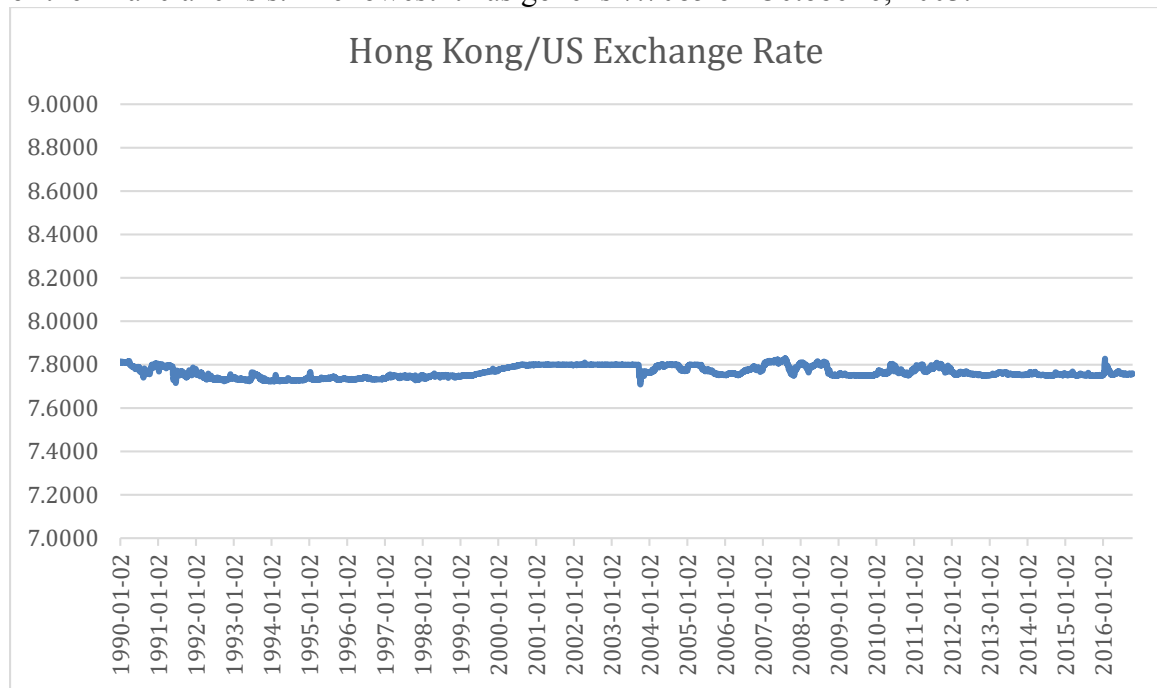


**b.** How would you characterize the relationship between the rupee and the dollar from 1998–2008? Does it appear to be fixed, crawling, or floating during this period? How would you characterize it from 2008 onward?

**Answer:** Over this period the exchange rate appears to be a crawling peg. Although this crawl is relatively flat for a few years at the beginning of this period, it appears free to move. However, the lack of short-term volatility suggests that the exchange rate is still being controlled and is hence crawling. From 2008 onward this appears to be a freely floating currency. The line becomes more erratic with a greater deal of short-term volatility.

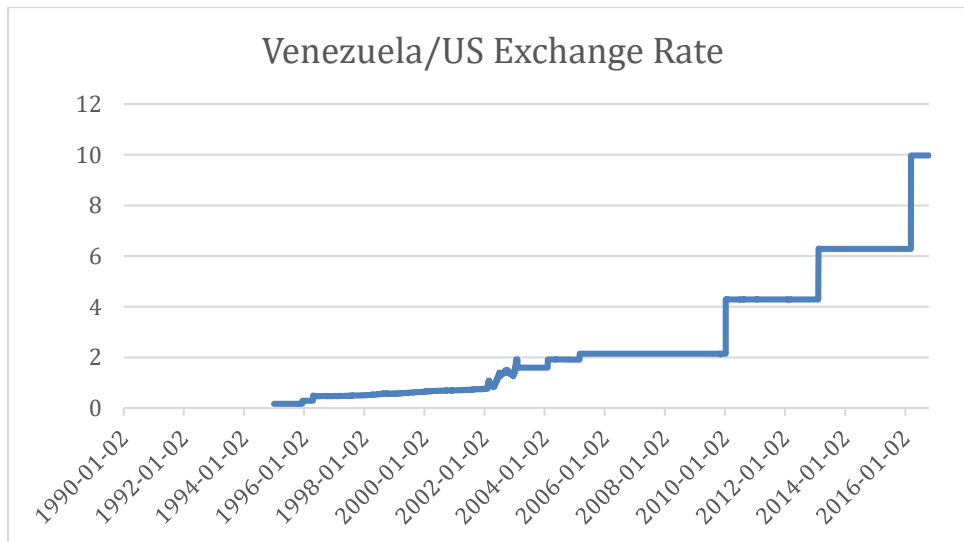
**c.** The Hong Kong dollar has maintained its peg with the United States dollar since 1983. Over the course of the period that you have downloaded what are the highest and lowest values for this exchange rate?

**Answer:** This peg has never broken over this period (although there is some movement if you allow the axis to be small enough). The highest rate that it has attained is 7.8289 Hong Kong dollars per US dollar on August 6, 2007, at the height of the financial crisis. The lowest it has gone is 7.7085 on October 6, 2003.



**d.** Venezuela has been less successful in its attempts to fix against the dollar. Since 1995 how many times has the Venezuelan bolívar peg to the dollar broken? What is the average length of a peg? What is the average size of a devaluation?

**Answer:** I count seven breaks in this peg over this period. In 1998 they appear to move to a slow and managed crawl before floating for a short time and returning to a fixed rate. The longest period of any one peg appears to be when the exchange rate was set at 2.14 bolívar/dollar for about five years between 2005 and 2010.



2. Refer to the exchange rates given in the following table:

Country (currency)	January 20, 2016		January 20, 2015	
	FX per \$	FX per £	FX per €	FX per \$
Australia (dollar)	1.459	2.067	1.414	1.223
Canada (dollar)	1.451	2.056	1.398	1.209
Denmark (krone)	6.844	9.694	7.434	6.430
Eurozone (euro)	0.917	1.299	1.000	0.865
Hong Kong (dollar)	7.827	11.086	8.962	7.752
India (rupee)	68.05	96.39	71.60	61.64
Japan (yen)	116.38	164.84	136.97	118.48
Mexico (peso)	18.60	26.346	16.933	14.647
Sweden (krona)	8.583	12.157	9.458	8.181
United Kingdom (pound)	0.706	1.000	0.763	0.600
United States (dollar)	1.000	1.416	1.156	1.000

Data from: U.S. Federal Reserve Board of Governors, H.10 release: Foreign Exchange Rates.

Based on the table provided, answer the following questions:

- a. Compute the U.S. dollar–yen exchange rate  $E_{\$/¥}$  and the U.S. dollar–Canadian dollar exchange rate  $E_{\$/C\$}$  on January 20, 2016, and January 20, 2015.

**Answer:**

U.S. dollar–yen rates:

January 20, 2015:  $E_{\$/¥} = 1/(118.48) = \$0.0084/¥$

January 20, 2016:  $E_{\$/¥} = 1/(116.38) = \$0.0086/¥$

January 20, 2015:  $E_{\$/C\$} = 1/(1.209) = \$0.8271/C\$$

January 20, 2016:  $E_{\$/C\$} = 1/(1.451) = \$0.6892/C\$$

- b. What happened to the value of the U.S. dollar relative to the Japanese yen and Canadian dollar between January 20, 2015, and January 20, 2016? 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 January 20, 2015, and January 20, 2016, the Japanese yen appreciated, and the Canadian dollar depreciated relative to the U.S. dollar.

The percentage appreciation of the yen relative to the U.S. dollar is:

$$\% \Delta E_{\$/\text{¥}} = (\$0.0086 - \$0.0084) / \$0.0084 = 2.38\%$$

The percentage depreciation of the Canadian dollar relative to the U.S. dollar is:

$$\% \Delta E_{\$/\text{C\$}} = (\$0.6892 - \$0.8271) / \$0.8271 = -16.67\%$$

- c. Using the information in the table for January 20, 2016, compute the Danish krone–Canadian dollar exchange rate  $E_{\text{krone/C\$}}$ .

**Answer:**  $E_{\text{krone/C\$}} = (6.844 \text{ kr}/\$) / (1.451 \text{ C\$}/\$) = 4.7167 \text{ kr/C\$}$ .

- d. Visit the website of the Board of Governors of the Federal Reserve System at <http://www.federalreserve.gov/>. Click on “Economic Research and Data” and then “Data Download Program (DDP)” 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 January 20, 2016?

**Answer:** Answers will depend on the latest data update.

Based on the foreign exchange rates (H.10) released on March 20, 2017, the exchange rate for the Canadian dollar, yen, and krone was 1.3366, 112.67, and 6.9207, respectively. Thus, while the Canadian dollar–U.S. dollar and the yen–dollar exchange rates have depreciated by about 7.88% and 3.19%, respectively. The krone has appreciated by about 1.12%.

- 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 depend on the latest data update.

Based on the foreign exchange rates (H.10) released on March 20, 2017, the U.K. pound–U.S. dollar and euro–U.S. dollar rates were 0.808 and 0.931, respectively. Thus, relative to the U.S. dollar, the pound appreciated by 14.45% and the euro appreciated by 1.53%.

3. 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 (trade weights) and U.S. nominal exchange rates for these four countries are as follows:

Country (currency)	Share of Trade	\$ per FX in 2015	\$ per FX in 2016
Canada (dollar)	36%	0.8271	0.6892
Mexico (peso)	28%	0.0683	0.0538
China (yuan)	20%	0.1608	0.1522
Japan (yen)	16%	0.0080	0.0086

- a. Compute the percentage change from 2015 to 2016 in the four U.S. bilateral exchange rates (defined as U.S. dollars per unit of foreign exchange, or FX) in the table provided.

**Answer:**

$$\% \Delta E_{\$/\text{C}\$} = (0.6892 - 0.8271) / 0.8271 = -16.67\%$$

$$\% \Delta E_{\$/\text{pesos}} = (0.0538 - 0.0683) / 0.0683 = -21.23\%$$

$$\% \Delta E_{\$/\text{yuan}} = (0.1522 - 0.1608) / 0.1608 = -5.35\%$$

$$\% \Delta E_{\$/\text{¥}} = (0.0086 - 0.0080) / 0.0080 = 7.50\%$$

- b. Use the trade shares as weights to compute the percentage change in the nominal effective exchange rate for the United States between 2015 and 2016 (in U.S. dollars per foreign currency basket).

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

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

$$\% \Delta E = 0.36(-16.67\%) + 0.28(-21.23\%) + 0.20(-5.35\%) + 0.16(7.50\%) = -11.82\%$$

- c. Based on your answer to (b), what happened to the value of the U.S. dollar against this basket between 2015 and 2016? 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 appreciated by 11.82% against the basket of currencies. Vis-à-vis the peso, the dollar appreciated by 21.23%. The average depreciation is smaller because the dollar depreciated by only 5.35% against China with a 20% trade share and appreciated against the yen with a 16% trade share.

4. Go to the FRED website: <http://research.stlouisfed.org/fred2/>. Locate the monthly exchange rate data for the following:

Look at the graphs and make your own judgment as to whether each currency was fixed (peg or band), crawling (peg or band), or floating relative to the U.S. dollar during each time frame given.

- a. Canada (dollar), 1980–2012

**Answer:** Floating exchange rate

- b. China (yuan), 1999–2004, 2005–09, and 2009–10

**Answer:** 1999–2004: fixed exchange rate; 2005–09: gradual appreciation vis-à-vis the dollar; again fixed for 2009–10

- c. Mexico (peso), 1993–95 and 1995–2012

**Answer:** 1993–95: crawl; 1995–2012: floating (with some evidence of a managed

float)

- d. Thailand (baht), 1986–97 and 1997–2012

**Answer:** 1986–97: fixed exchange rate; 1997–2012: floating

- e. Venezuela (bolívar), 2003–12

**Answer:** fixed exchange rate (with occasional adjustments)

5. Describe the different ways in which the government may intervene in the forex market. Why does the government have the ability to intervene in this way, while private actors do not?

**Answer:** The government may participate in the forex market in a number of ways: capital controls, establishing an official market (with fixed rates) for forex transactions, and forex intervention by buying and selling currencies in the forex markets. The government has the ability to intervene in a way that private actors do not because through its central bank it has unlimited stock of its own currency and usually a large stock of foreign reserves. Its intervention is guided by policy rather than merely making profits on currency trade, which is the case with the private sector.

**Work it out.** 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 1% in Britain and 5% in the Netherlands. The (one-year) forward euro–pound exchange rate is 1.65 euros per pound and the spot rate is 1.5 euros per pound. Answer the following questions, using the *exact* equations for uncovered interest parity (UIP) and covered interest parity (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  $€1,050 = €1,000 \times (1 + 0.05)$ .

- 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  $€1,111 (= €1,000 \times (1.65/1.5) \times (1 + 0.01))$ .

- 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 5% versus 11.1% ( $= (1.65/1.5) \times (1 + 0.01)$ ) 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  $F_{\text{€}/\text{£}} = E_{\text{€}/\text{£}}(1 + i_{\text{€}})/(1 + i_{\text{£}}) = 1.65 \times 1.05/1.01 = \text{€}1.72$  per £.

- e. Suppose the forward rate takes the value given by your answer to (d). Compute 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 =  $(F_{\text{€}/\text{£}}/E_{\text{€}/\text{£}} - 1) = (1.72/1.50) - 1 = 0.1467$  or 14.67%. 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:** If UIP holds, the expected euro–pound exchange rate is the same as the forward rate, that is, € 1.72 per £ (see part (d) above). The expected depreciation of Euro against pound is therefore 14.67%.

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

**Answer:** Following the answer to parts (d) and (f), the expected euro–pound exchange rate is €1.72 per £ or  $1/1.72 = 0.5814$  £/€.

6. Suppose quotes for the dollar–euro exchange rate  $E_{\text{\$/€}}$  are as follows: in New York \$1.05 per euro, and in Tokyo \$1.15 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 \$1.05 each because this is relatively cheaper than the price in Tokyo. They will then sell these euros in Tokyo at a price of \$1.15, earning a \$0.10 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.

7. You are a financial adviser to a U.S. corporation that expects to receive a payment of 60 million Japanese yen in 180 days for goods exported to Japan. The current spot rate is 100 yen per U.S. dollar ( $E_{\text{\$/¥}} = 0.01000$ ). You are concerned that the U.S. dollar is going to appreciate against the yen over the next six months.

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

**Answer:** The firm expects to receive \$600,000 ( $= \text{¥}60,000,000/100$ ).

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

**Answer:** The firm would receive \$545,454 ( $= ¥60,000,000/110$ ).

- c. Describe how you could use an options contract to hedge against the risk of losses associated with the potential appreciation in the U.S. dollar.

**Answer:** The firm could buy ¥60 million in call options on dollars, say, for example, at a rate of 105¥ per dollar. A call option gives the buyer a right to buy dollars at the price agreed upon. If the dollar appreciates such that its price rises above 105¥, say to 110¥, the firm will exercise the option. This ensures the firm's yen receipts will at least be worth \$571,428 ( $= ¥60,000,000/105$ ).

8. Consider how transactions costs affect foreign currency exchange. Rank each of the following foreign exchanges according to their probable spread (between the “buy at” and “sell for” bilateral exchange rates) and justify your ranking.

- a. An American returning from a trip to Turkey wants to exchange his Turkish lira for U.S. dollars at the airport.
- b. Citigroup and HSBC, both large commercial banks located in the United States and United Kingdom, respectively, need to clear several large checks drawn on accounts held by each bank.
- c. Honda Motor Company needs to exchange yen for U.S. dollars to pay American workers at its Ohio manufacturing plant.
- d. A Canadian tourist in Germany pays for her hotel room using a credit card.

**Answer:** Ranking (highest spread first): (a), (d), (c), (b). Both (a) and (d) involve small transactions that will involve a go-between who will charge a premium to convert the currency. (d) involves a credit card company (a commercial bank or nonbank financial institution) that likely is involved in large volumes of transactions each day. (c) involves a corporation that can negotiate a better rate (versus an individual) because it will likely engage in a large currency exchange, or Honda could simply enter the market without going through a broker. Finally, (b) involves two large commercial banks that regularly engage in large-volume foreign exchange trading.