

Solution Manual for International Economics 4th Edition Feenstra Taylor 1319061710 9781319061715

Test bank: <https://testbankpack.com/p/test-bank-for-international-economics-4th-edition-feenstra-taylor-1319061710-9781319061715/>

Solution Manual: <https://testbankpack.com/p/solution-manual-for-international-economics-4th-edition-feenstra-taylor-1319061710-9781319061715/>

Chapter 2 Trade and Technology: The Ricardian Model

1. In this problem you will use the World Development Indicators (WDI) database from the World Bank to compute the comparative advantage of two countries in the major sectors of gross domestic product (GDP): agriculture, industry (which includes manufacturing, mining, construction, electricity, and gas), and services. Go to the WDI website at <http://wdi.worldbank.org>, and choose –Online tables, where you will be using the sections on –People and on the –Economy.
 - a. In the –People section, start with the table –Labor force structure. Choose two countries that you would like to compare, and for a recent year write down their total labor force (in millions) and the percentage of the labor force that is female. Then calculate the number of the labor force (in millions) who are male and the number who are female.

Answer:

2014	Labor Force (million)	Female Labor (%)	Male Labor (million)	Female Labor (million)
France	30.1	47	15.95	14.15
Thailand	40.1	46	18.45	21.65

- b. Again using the –People section of the WDI, now go to the –Employment by sector table. For the same two countries that you chose in part (a) and for roughly the same

year, write down the percent of male employment and the percent of female employment in each of the three sectors of GDP: agriculture, industry, and services. (If the data are missing in this table for the countries that you chose in part (a), use different countries.)

Use these percentages along with your answer to part (a) to calculate the number of male workers and the number of female workers in each sector. Add together the number of male and female workers to get the total labor force in each sector.

Answer:

2011–2014	Agriculture		Industry		Service	
	Male %	Female %	Male %	Female %	Male %	Female %
France	4	2	31	10	65	88
Thailand	44	39	23	18	33	43

2011–2014 (million)	Agriculture		Industry		Service	
	Male	Female	Male	Female	Male	Female
France	0.64	0.28	4.95	1.42	10.37	12.45
Thailand	8.12	8.44	4.24	3.90	6.09	9.31

c. In the –Economyll section, go to the table –Structure of output. ll There you will find GDP (in \$ billions) and the % of GDP in each of the three sectors: agriculture, industry, and services. For the same two countries and the same year that you chose in part (a), write down their GDP (in \$ billions) and the percentage of their GDP accounted for by agriculture, by industry, and by services. Multiply GDP by the percentages to obtain the dollar amount of GDP coming from each of these sectors, which is interpreted as the *value-added* in each sector, that is, the dollar amount that is sold in each sector minus the cost of materials (not including the cost of labor or capital) used in production.

Answer:

2014	GDP (billion \$)	Agriculture (%)	Industry (%)	Service (%)
France	2829.2	2	19	79
Thailand	404.8	20	37	53

d. Using your results from parts (b) and (c), divide the GDP from each sector by the labor force in each sector to obtain the *value-added per worker in each sector*. Arrange these numbers in the same way as the –Sales/Employee ll and –Bushels/Worker ll shown in Table 2-2. Then compute the absolute advantage of one country relative to the other in each sector, as shown on the right-hand side of Table 2-2. Interpret your results. Also compute the comparative advantage of agriculture/industry and agriculture/services (as shown at the bottom of Table 2-2), and the comparative advantage of industry/services. Based on your results, what should be the trade pattern of these two countries if they were trading only with each other?

Answer:

(\$1000)	France	Thailand	Absolute Advantage France/Thailand Ratio
Service	97.94	13.93	7.03
Industry	84.39	18.4	4.59
Agriculture	61.50	4.89	12.58
Comparative Advantage			
Agriculture/ Service	0.63	0.35	
Agriculture/ Industry	0.73	0.27	
Industry/Service	0.86	1.33	

Thailand has a comparative advantage in both Service and Industry. Suppose that a farmer spends 1,000 hours per year in agriculture production. Multiplying the marginal product of an hour of labor in agriculture by 1,000, to obtain the marginal production of labor per year and dividing by the marginal production of labor in Service gives us the opportunity cost of Service. In France, this ratio is 0.63, indicating that \$0.63 must be foregone to obtain an extra dollar of sales in Agriculture. In Industry, the ratio is 0.73 in France. These ratios are much smaller in Thailand, only 0.35 for Service and 0.27 for Industry. As a result, Thailand has a lower opportunity cost of both Industry and Service. Therefore, if assuming the two countries are trading only with each other, France will export Agriculture while Thailand will export Service and Industry.

2. At the beginning of the chapter, there is a brief quotation from David Ricardo; here is a longer version of what Ricardo wrote:

England may be so circumstanced, that to produce the cloth may require the labour of 100 men for one year; and if she attempted to make the wine, it might require the labour of 120 men for the same time. . . . To produce the wine in Portugal, might require only the labour of 80 men for one year, and to produce the cloth in the same country, might require the labour of 90 men for the same time. It would therefore be advantageous for her to export wine in exchange for cloth. This exchange might even take

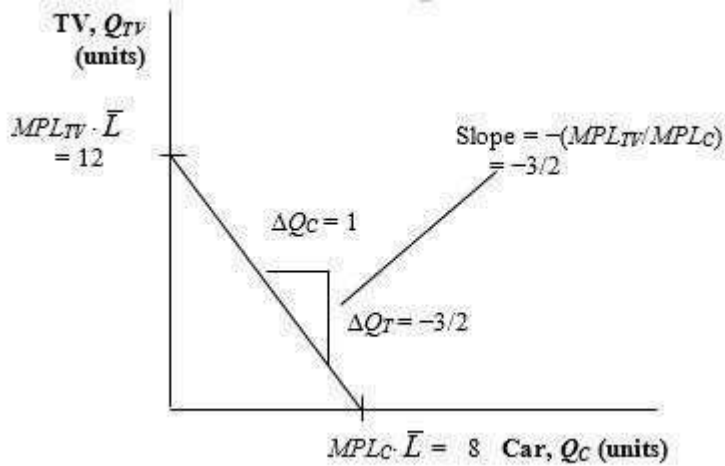
place, notwithstanding that the commodity imported by Portugal could be produced there with less labour than in England.

Suppose that the amount of labor Ricardo describes can produce 1,000 yards of cloth or 2,000 bottles of wine in either country. Then answer the following:

- a. What is England's marginal product of labor in cloth and in wine, and what is Portugal's marginal product of labor in cloth and in wine? Which country has absolute advantage in cloth, and in wine, and why? **Answer:** In England, 100 men produce 1,000 yards of cloth, so $MPL_C = 1,000/100 = 10$. 120 men produce 2,000 bottles of wine, so $MPL_W = 2,000/120 = 16.6$. In Portugal, 90 men produce 1,000 yards of cloth, so $MPL_C^* = 1,000/90 = 11.1$. Eighty (80) men produce 2,000 bottles of wine, so $MPL_W^* = 2,000/80 = 25$. So Portugal has an absolute advantage in both cloth and wine, because it has higher marginal products of labor in both industries than does England.
- b. Use the formula $P_W/P_C = MPL_C/MPL_W$ to compute the no-trade relative price of wine in each country. Which country has comparative advantage in wine, and why? **Answer:** For England, $P_W/P_C = MPL_C/MPL_W = 10/16.6 = 0.6$, which is the no-trade relative price of wine (equal to the opportunity cost of producing wine). So the opportunity cost of wine in terms of cloth is 0.6, meaning that to produce 1 bottle of wine in England, the country gives up 0.6 yards of cloth. For Portugal, $P_W^*/P_C^* = MPL_C^*/MPL_W^* = 11.1/25 = 0.4$, which is the no-trade relative price of wine (equal to the opportunity cost of producing wine). The no-trade relative price of wine is lower in Portugal, so Portugal has comparative advantage in wine, and England has comparative advantage in cloth. Portugal has comparative advantage in producing wine because it has lower opportunity cost ($P_W^*/P_C^* = 0.4$) than England in the production of wine ($P_W/P_C = 0.6$).

3. Suppose that each worker in Home can produce two cars or three TVs. Assume that Home has four workers.

- a. Graph the production possibilities frontier for Home. **Answer:** See the following figure.

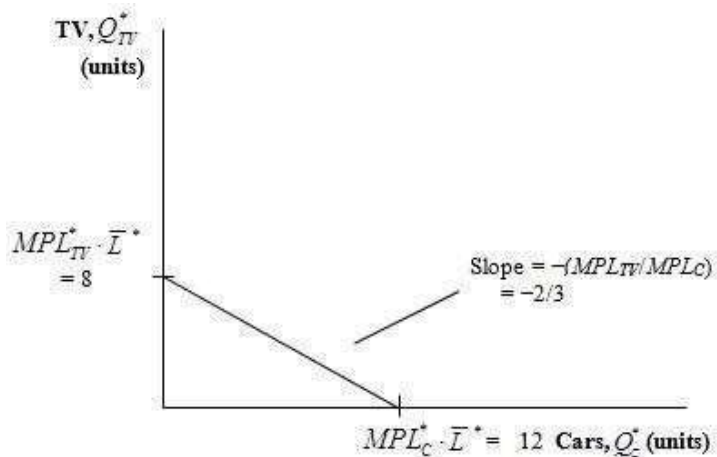


- b. What is the no-trade relative price of cars in Home?

Answer: The no-trade relative price of cars at Home is $P_C/P_{TV} = 3/2 = MPL_{TV}/MPL_C$. It is the slope of the PPF curve for Home.

4. Suppose that each worker in Foreign can produce three cars or two TVs. Assume that Foreign also has four workers.

- a. Graph the production possibilities frontier for Foreign. **Answer:** See following figure.



b. What is the no-trade relative price of cars in Foreign?

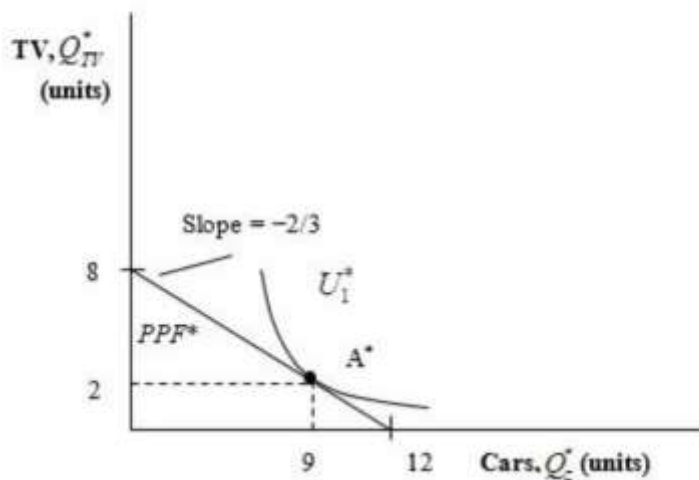
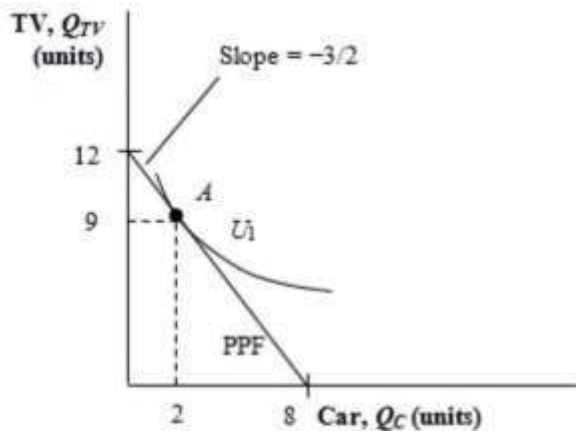
Answer: The no-trade relative price of cars in Foreign is $P_c^*/P_{TV}^* = 2/3 =$

c. Using the information provided in Problem 3 regarding Home, in which good does Foreign have a comparative advantage, and why?

Answer: Foreign has a comparative advantage in producing televisions because it has a lower opportunity cost than Home in the production of televisions.

5. Suppose that in the absence of trade, Home consumes two cars and nine TVs, while Foreign consumes nine cars and two TVs. Add the indifference curve for each country to the figures in Problems 3 and 4. Label the production possibilities frontier (PPF), indifference curve (U_1), and the no-trade equilibrium consumption and production for each country.

Answer: See following figures.



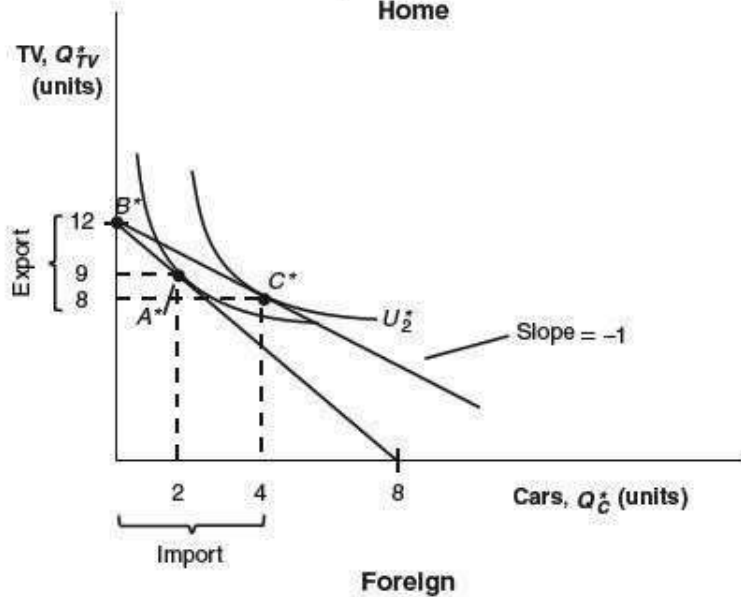
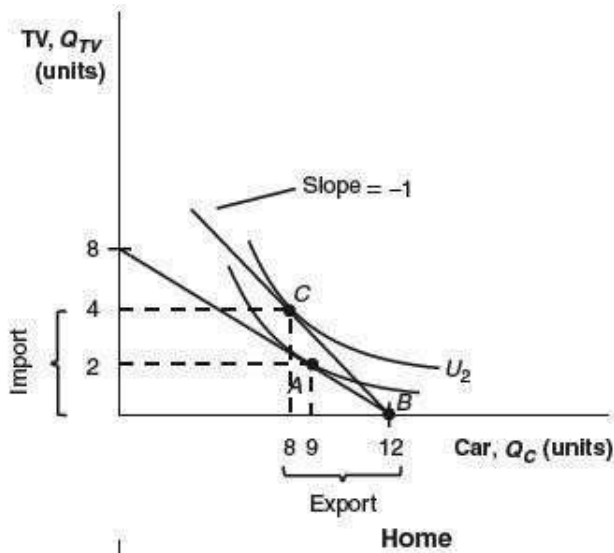
6. Now suppose the world relative price of cars is $P_C/P_{TV} = 1$.

a. In what good will each country specialize? Briefly explain why.

Answer: Home would specialize in TVs, export TVs, and import cars, whereas the Foreign country would specialize in cars, export cars, and import TVs. The reason is because Home has a comparative advantage in TVs and Foreign has a comparative advantage in cars.

b. Graph the new world price line for each country in the figures in Problem 5, and add a new indifference curve (U_2) for each country in the trade equilibrium.

Answer: See the following figures.



c. Label the exports and imports for each country. How does the amount of Home

exports compare with Foreign imports?

Answer: See graph in part (b). The amount of Home TV exports is equal to the amount of Foreign TV imports. In addition, Home imports of cars equal Foreign exports of cars. This is balanced trade, which is an essential feature of the Ricardian model.

- d. Does each country gain from trade? Briefly explain why or why not. **Answer:** Both Home and Foreign benefit from trade relative to their no-trade consumption because their utilities are both higher (consumption bundles located on higher indifference curves).

Work It Out

Answer the following questions using the information given by the accompanying table.

	Home	Foreign	Absolute Advantage
Number of bicycles produced per hour	4	6	?
Number of snowboards produced per hour	6	8	?
Comparative Advantage	?	?	

- a. Complete the table for this problem in the same manner as Table 2-2.
Answer: See previous table.
- b. Which country has an absolute advantage in the production of bicycles?
Which country has an absolute advantage in the production of snowboards?
Answer: Foreign has an absolute advantage in both production of bicycles and snowboards, because it is able to produce more in an hour than Home.
- c. What is the opportunity cost of bicycles in terms of snowboards in Home? What is the opportunity cost of bicycles in terms of snowboards in Foreign?
Answer: The opportunity cost of one bicycle is $3/2$ snowboards at Home ($P_B/P_S = MPL_S/MPL_B = 6/4 = 3/2$). The opportunity cost of one bicycle is $4/3$ snowboards in the Foreign country ($P_B/P_S = MPL_S/MPL_B = 8/6 = 4/3$).
- d. Which product will Home export, and which product does Foreign export? Briefly explain why.
Answer: The opportunity cost of one bicycle is $3/2$ snowboards at Home ($P_B/P_S = MPL_S/MPL_B = 6/4 = 3/2$). The opportunity cost of one bicycle is $4/3$ snowboards in the Foreign country ($P_B/P_S = MPL_S/MPL_B = 8/6 = 4/3$). Home has a smaller opportunity cost producing snowboards than the Foreign country. Home will export snowboards and Foreign will export bicycles.

7. Assume that Home and Foreign produce two goods, TVs and cars, and use the information below to answer the following questions:

In the No-Trade equilibrium:

Home		Foreign	
$Wage_{TV} = 12$	$Wage_C = ?$	$Wage_{TV} = ?$	$Wage_C = 6$
$MPL_{TV} = 4$	$MPL_C = ?$	$MPL_{TV} = ?$	$MPL_C = 1$
$P_{TV} = ?$	$P_C = 4$	$P_{TV} = 8$	$P_C = ?$

- a. What is the marginal product of labor for TVs and cars in Home? What is the no-trade relative price of TVs in Home?

Answer: $MPL_C = 3$, $MPL_{TV} = 4$, and $P_{TV}/P_C = MPL_C / MPL_{TV} = 3/4$

- b. What is the marginal product of labor for TVs and cars in Foreign? What is the no-trade relative price of TVs in Foreign?

Answer: $MPL_C = 1$, $MPL_{TV} = 3/4$, and $P_{TV}/P_C = MPL_C / MPL_{TV} = 4/3$

- c. Suppose the world relative price of TVs in the trade equilibrium is $P_{TV}/P_C = 1$. Which good will each country export? Briefly explain why.

Answer: Home will export TVs and Foreign will export cars because Home has a comparative advantage in TVs whereas Foreign has a comparative advantage in car. Each country will specialize in the goods with lower opportunity cost.

- d. In the trade equilibrium, what is the real wage in Home in terms of cars and in terms of TVs? How do these values compare with the real wage in terms of either good in the no-trade equilibrium?

Answer: Workers at Home are paid in terms of TVs because Home exports TVs. Home is better off with trade because its real wage in terms of cars has increased.

$$MPL_{TV} = 4 \text{ units of TV}$$

Home wages with trade=

$$(P_{TV}/P_C) \cdot MPL_{TV} = (1) \cdot 4 = 4 \text{ units of car}$$

$$MPL_{TV} = 4 \text{ units of TV}$$

Home wages w/o trade=

or

$$(P_{TV}/P_C) \cdot MPL_{TV} = (3/4) \cdot 4 = 3 \text{ units of car}$$

- e. In the trade equilibrium, what is the real wage in Foreign in terms of TVs and in terms of cars? How do these values compare with the real wage in terms of either good in the no-trade equilibrium?

Answer: Foreign workers are paid in terms of cars because Foreign exports cars. Foreign gains in terms of cars with trade.

$$\left(\frac{P_C}{P_{TV}}\right) \cdot MPL_C^* = (1) \cdot 1 = 1 \text{ units of TV}$$

or

Foreign wages with trade = $MPL_C^* = 1 \text{ units of car}$

$$\left(\frac{P_C^*}{P_{TV}^*}\right) \cdot MPL_C^* = (3/4) \cdot 1 = 3/4 \text{ unit of TV}$$

or

Foreign wages w/o trade = $MPL_C^* = 1 \text{ units of car}$

- f. In the trade equilibrium, do Foreign's workers earn more or less than Home's workers, measured in terms of their ability to purchase goods? Explain why.

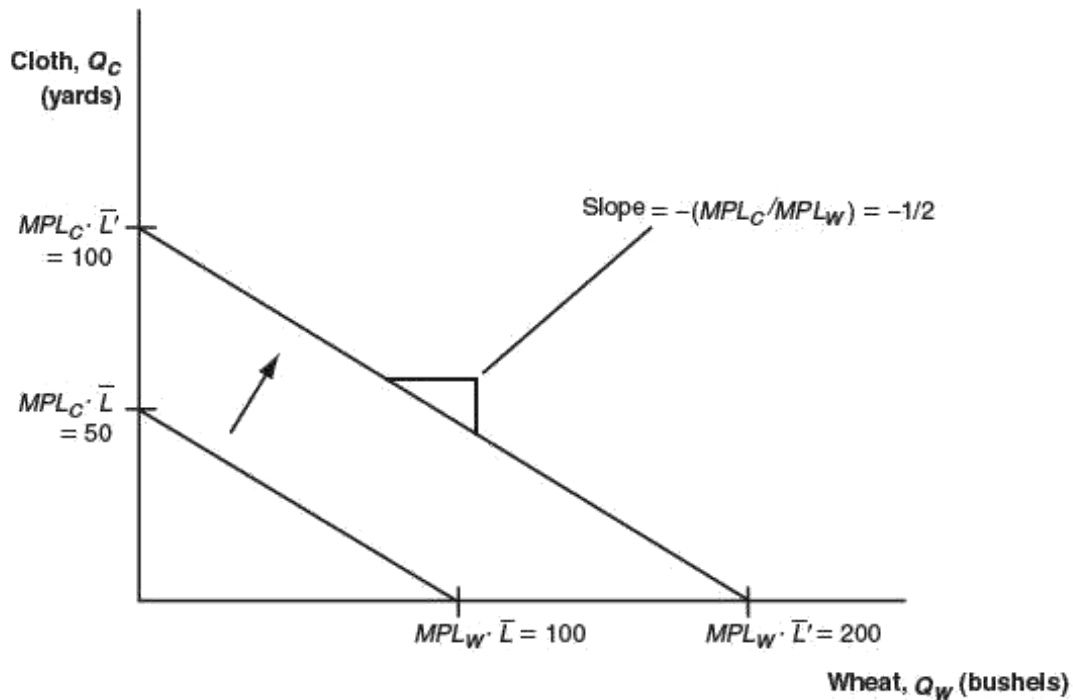
Answer: Foreign workers earn less than workers at Home in terms of cars because Home has an absolute advantage in the production of cars. Home workers also earn more than Foreign workers in terms of TVs

8. Why do some low-wage countries, such as China, pose a threat to manufacturers in industrial countries, such as the United States, whereas other low-wage countries, such as Haiti, do not?

Answer: To engage in international trade, a country must have a minimal threshold of productivity. Countries such as China have the productivity necessary to compete successfully, but Haiti does not. China can enter the world market because it beats other industrial countries with a lower price. Under perfect competition, price is determined by both wage rate and productivity; that is, $P = Wage/MPL$. So the lower price in China comes from both a low wage rate and high MPL . Haiti has a low wage rate, but also low MPL . So Haiti's price is not low enough to enter the world market.

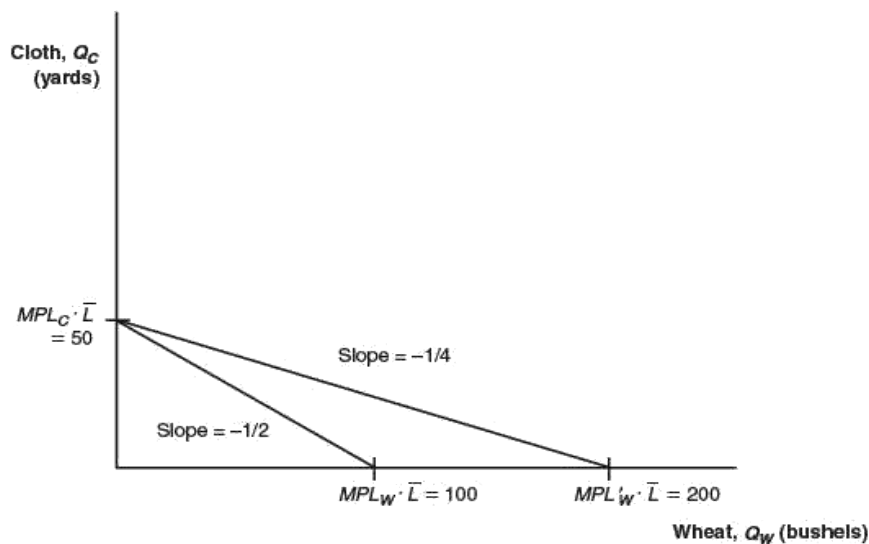
Answer Problems 9 to 11 using the chapter information for Home and Foreign.

9. a. Suppose that the number of workers doubles in Home. What happens to the Home PPF and what happens to the no-trade relative price of wheat?



Answer: With the doubling of the number of workers in Home, it can now produce $200 = 4 \cdot 50$ bushels of wheat if it concentrates all resources in the production of wheat, or it could produce $100 = 2 \cdot 50$ yards of cloth by devoting all resources to the production of cloth. The PPF shifts out for both wheat and cloth. The no-trade relative price of wheat remains the same because both MPL_W and MPL_C are unchanged.

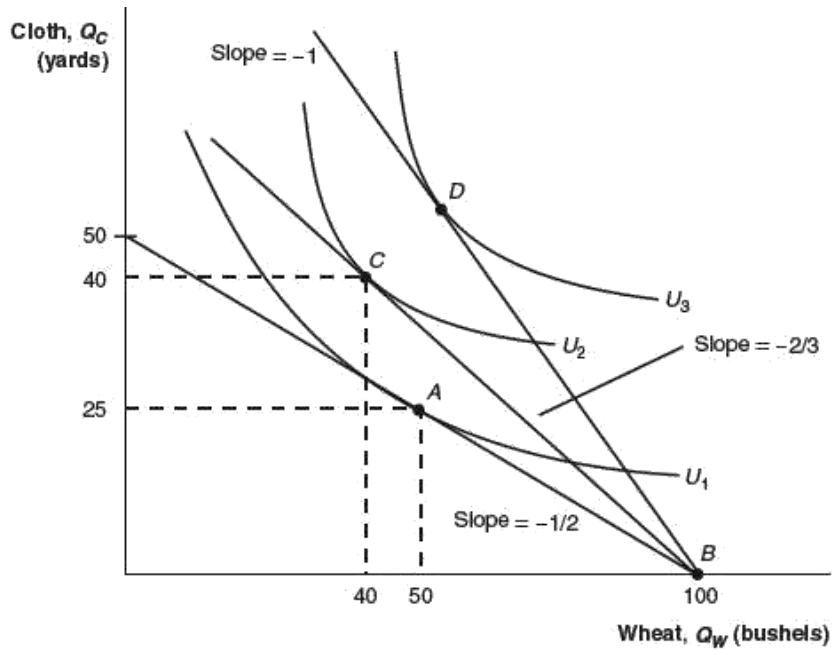
- b. Suppose that there is technological progress in the wheat industry such that Home can produce more wheat with the same amount of labor. What happens to the Home PPF and what happens to the relative price of wheat? Describe what would happen if a similar change occurred in the cloth industry.



Answer: Because the technological progress is only in the wheat industry, Home's production of cloth remains the same if it devotes all of its resources to producing cloth. If instead Home produces only wheat, it is able to produce more wheat using the same amount of labor. Home's PPF shifts out in the direction of wheat production. Recall that the relative price of wheat is given by $P_W/P_C = MPL_C/MPL_W$. With the technological progress in wheat, the marginal product of labor in the wheat production increases. Thus, the relative price of wheat decreases. As shown in the graph, the relative price of wheat drops from $1/2$ to $1/4$.

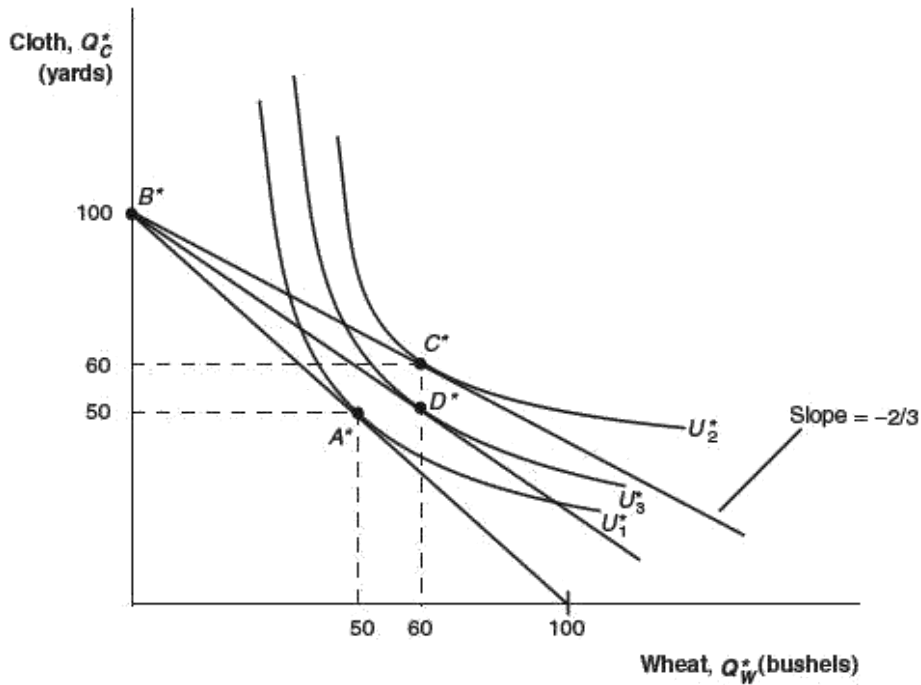
If instead the technological progress is in the cloth industry, we would have the opposite results. Home's PPF would shift out in the direction of cloth production and the relative price of wheat would increase.

10. a. Using Figure 2-5, show that an increase in the relative price of wheat from its world relative price of $1/3$ will raise Home's utility.



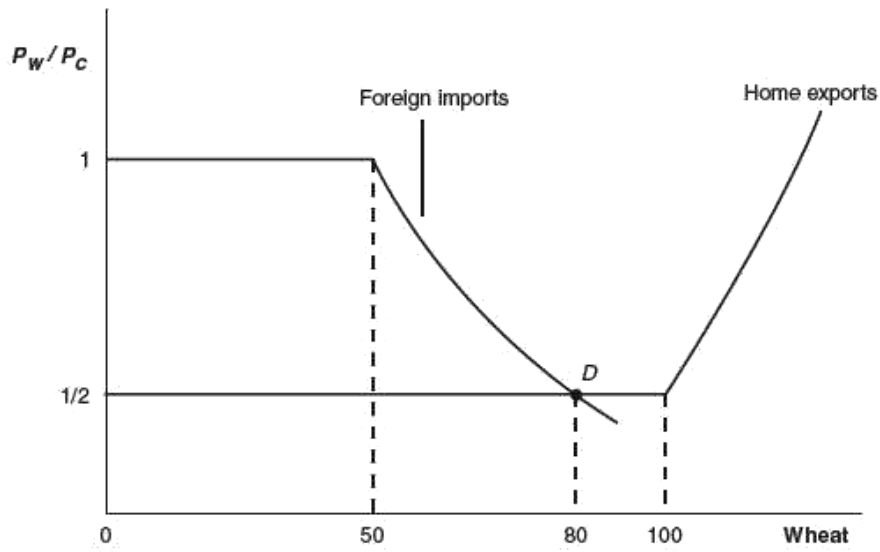
Answer: The increase in the relative price of wheat from its international equilibrium of $2/3$ allows Home to consume at a higher utility, such as at point D .

- b. Using Figure 2-6, show that an increase in the relative price of wheat from its world relative price of $2/3$ will lower Foreign's utility. What is Foreign's utility when the world relative price reaches 1, and what happens in Foreign when the world relative price of wheat rises above that level?

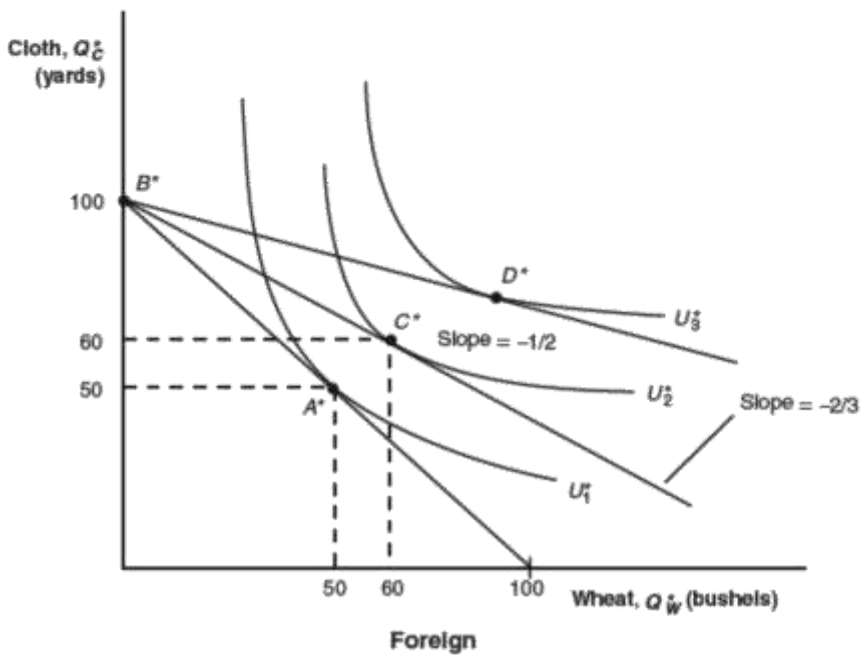
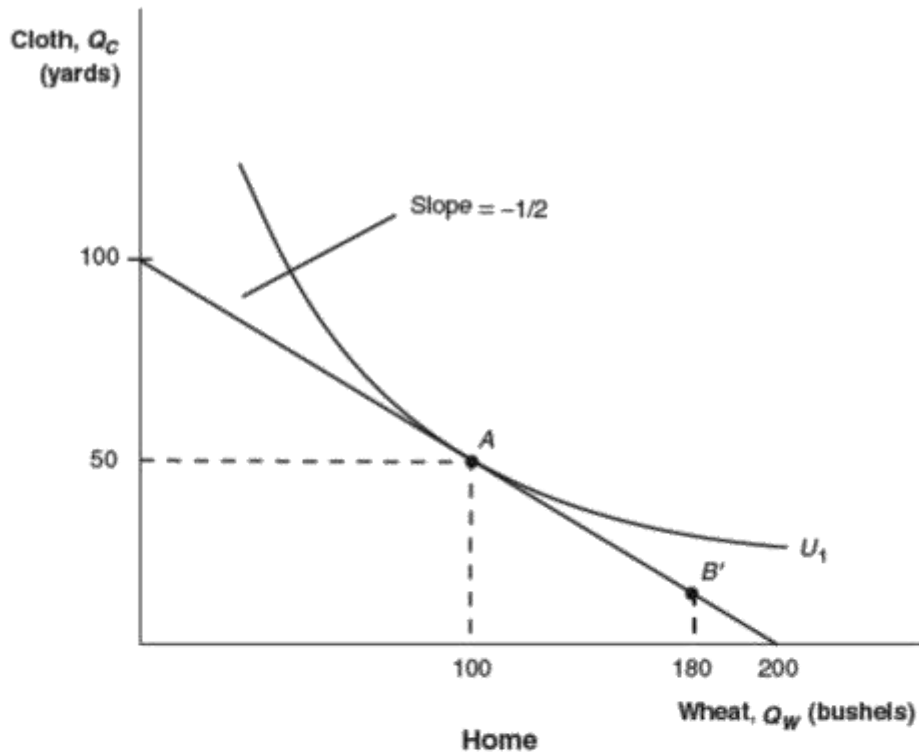


Answer: The increase in the relative price of wheat from its international equilibrium of 3 lowers Foreign's utility to U_3^* with consumption at D^* . When the international price reaches 1, it becomes the same as Foreign's no-trade relative price of wheat. Thus, Foreign consumes at point A^* , the no-trade equilibrium. If the international price rises above 1, then it would be greater than Foreign's no-trade relative price of wheat. In this case, Foreign would switch to exporting wheat instead of exporting cloth. The world price line now moves inside the PPF, which will lower the no trade relative price of wheat.

11. (This is a harder question.) Suppose that Home is much larger than Foreign. For example, suppose we double the number of workers in Home from 25 to 50. Then, suppose that Home is willing to export up to 100 bushels of wheat at its no-trade price of $P_w/P_c = 2$, rather than 50 bushels of wheat as shown in Figure 2-11. In the following figure, we draw a new version of Figure 2-11, with the larger Home.
- a. From this figure, what is the new world relative price of wheat (at point D)? **Answer:** The intersection of the Foreign imports and Home's exports gives the new international equilibrium relative price of wheat, which is 2.



- b. Using this new world equilibrium price, draw a new version of the trade equilibrium in Home and in Foreign, and show the production point and consumption point in each country. ¹
- Answer:** The international price of 2 is the same as Home's no-trade relative price of wheat. Home would consume at point *A* and produce at point *B'*. The difference between these two points gives Home exports of wheat of 80 units. (Notice that workers earn equal wages in the two industries, so production can occur anywhere along the PPF.)



Because the international price of $1/2$ is lower than Foreign's no-trade relative price of wheat, Foreign is able to consume at point D^* , which gives higher gains from trade than at point C^* .

c. Are there gains from trade in both countries? Explain why or why not.

Answer: The Foreign country gains a lot from trade, but the home country neither gains nor loses: Its consumption point A is exactly the same as what it would be in the absence of trade. This shows that in the Ricardian model, a *small* country can gain the most from trade, whereas a *large* country may not gain (although it will not lose) because the world relative price might equal its own no-trade relative price. So the large country does not see a terms of trade (TOT) gain. This special result will not arise in other models that we study, but illustrates how being small can help a country on world markets!

12. Using the results from Problem 11, explain why the Ricardian model predicts that Mexico would gain more than the United States when the two countries signed the North American Free Trade Agreement, establishing free trade between them.

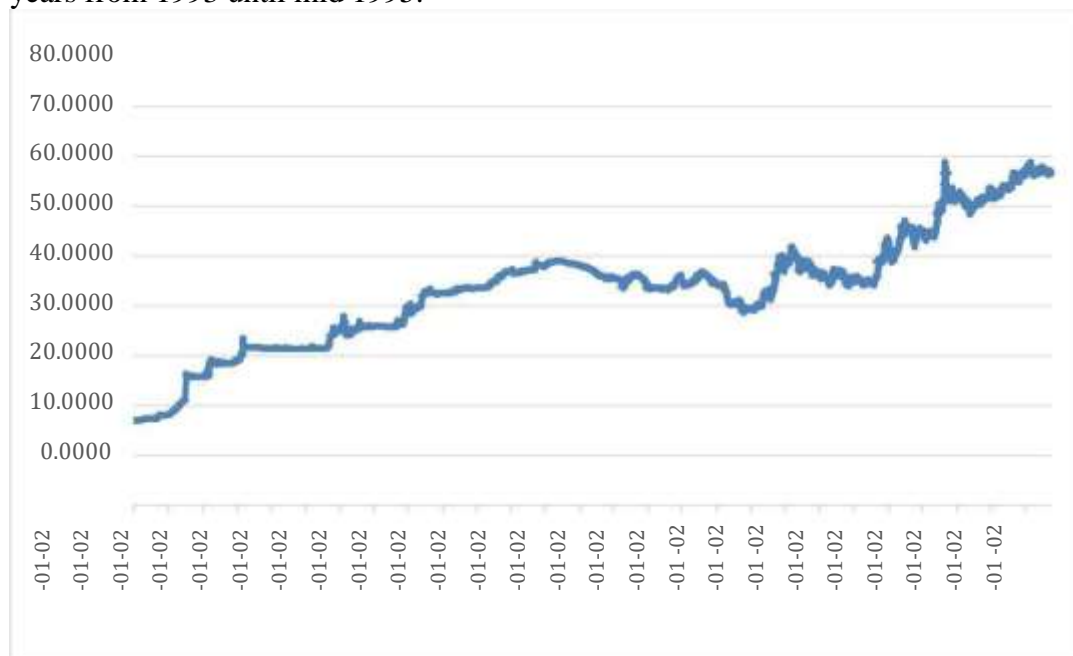
Answer: The Ricardian model predicts that Mexico would gain more than the United States when the two countries join the regional trade agreement because relative to the United States in terms of economic size, Mexico is a small country. For the United States, the world price of its exports is similar to the domestic price. Thus, there is not much TOT gain. But for Mexico, the world price is much higher than the domestic price of its exports, so Mexico sees a big TOT improvement.

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.

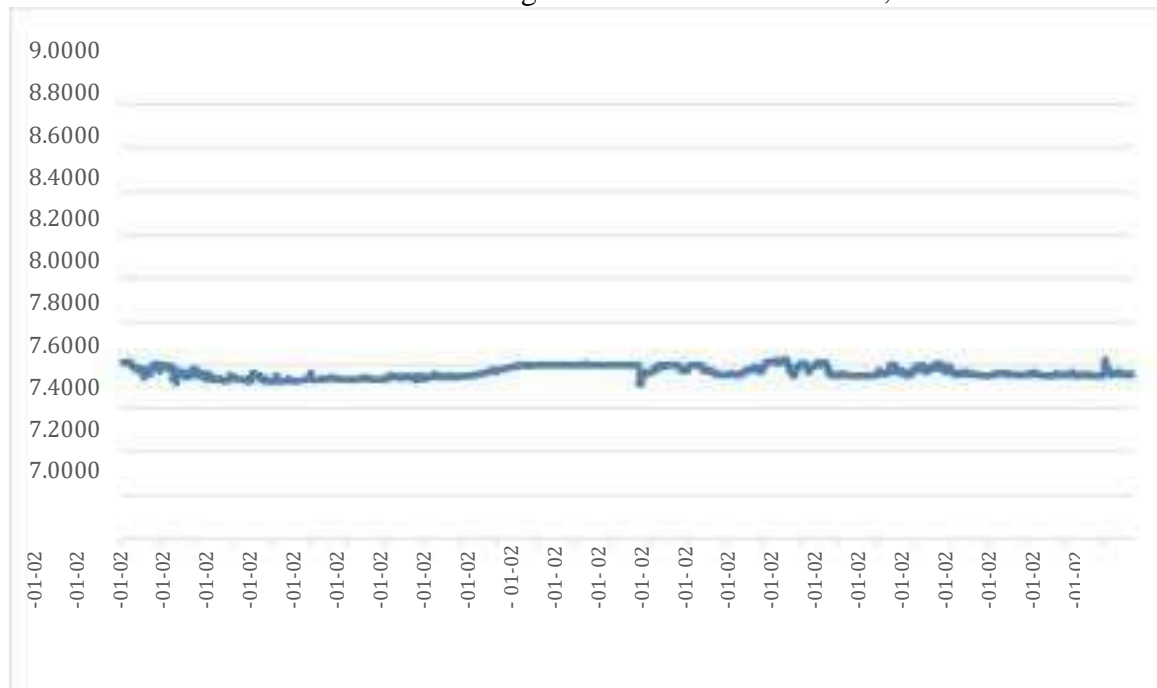


b. How would you characterize the relationship between the rupee and the dollar from 1998–2008? Does it appear to be fixed, crawling, or floating during this period? How would you characterize it from 2008 onward?

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.

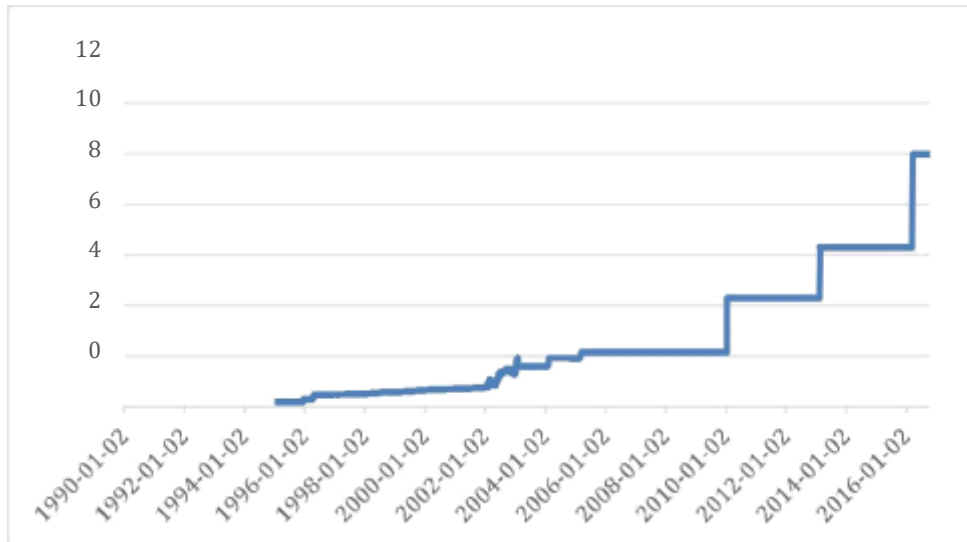
c. The Hong Kong dollar has maintained its peg with the United States dollar since 1983. Over the course of the period that you have downloaded what are the highest and lowest values for this exchange rate?

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–U.S. 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:

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

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

$$-21.23\% \quad \% \Delta E_{\$/\text{yuan}} = (0.1522 - 0.1608)/0.1608 =$$

$$-5.35\% \quad \% \Delta E_{\$/\text{¥}} = (0.0086 - 0.0080)/0.0080 = 7.50\%$$

- 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 $F_{\text{€/£}} = E_{\text{€/£}} (1 + i_{\text{€}})/(1 + i_{\text{£}}) = 1.50 \times 1.05/1.01 = \text{€}1.72$ 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 = $(F_{\text{€/£}}/E_{\text{€/£}} - 1) = (1.72/1.50) - 1 = 0.1467$ 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.

13 Introduction to Exchange Rates and the Foreign Exchange Market

Notes to the Instructor

Chapter Summary

This chapter introduces students to exchange rates, to the foreign exchange (*forex*) market, to the way foreign currency is exchanged in private and government transactions, and to arbitrage conditions in the forex market. The chapter begins with a discussion of the ways exchange rates affect international trade and asset transactions. After covering the basics, the chapter covers foreign exchange markets, spot exchange rates, interest rates, and arbitrage in both spot and asset markets.

Comments

Although most students have heard of exchange rates (either in the media or in previous economics classes), few will understand how the foreign exchange market works and how arbitrage is important in financial markets. This chapter serves two functions: (1) to provide information on how the foreign exchange market works in practice (Sections 1 through 3), and (2) to establish a foundation for model-building in subsequent chapters (Sections 4 and 5).

The chapter contains a large amount of detailed information. Because much of it is fundamental in the development of concepts and models throughout the text, it is worth spending more time on this material than might otherwise be devoted to a typical textbook chapter. There are optional advanced topics and case studies that the instructor may elect to skip without compromising material in later chapters.

An outline of the chapter follows.

1. Exchange Rate Essentials
 - a. Defining the Exchange Rate
 - b. Appreciations and Depreciations
 - c. Multilateral Exchange Rates
 - d. Example: Using Exchange Rates to Compare Prices in a Common Currency
 - i. Scenario 1
 - ii. Scenario 2
 - iii. Scenario 3
 - iv. Scenario 4
 - v. Generalizing
2. Exchange Rates in Practice
 - a. Exchange Rate Regimes: Fixed Versus Floating
 - b. Application: Recent Exchange Rate Experiences
 - i. Evidence from Developed Countries
 - ii. Evidence from Developing Countries
 - iii. Currency Unions and Dollarization
 - iv. Exchange Rate Regimes of the World
 - v. Looking Ahead
3. The Market for Foreign Exchange
 - a. The Spot Contract
 - b. Transaction Costs

- c. Derivatives
 - d. Application: Foreign Exchange Derivatives
 - i. Forwards
 - ii. Swaps
 - iii. Futures
 - iv. Options
 - e. Private Actors
 - f. Government Actions
4. Arbitrage and Spot Exchange Rates
- a. Arbitrage with Two Currencies b.
 - Arbitrage with Three Currencies
 - c. Cross Rates and Vehicle Currencies
5. Arbitrage and Interest Rates
- i. The Problem of Risk
 - b. Riskless Arbitrage: Covered Interest Parity
 - i. What Determines the Forward Rate?
 - c. Application: Evidence on Covered Interest Parity
 - d. Risky Arbitrage: Uncovered Interest Parity
 - i. Side Bar: Assets and Their Attributes
 - ii. What Determines the Spot Rate?
 - e. Application: Evidence on Uncovered Interest Parity
 - f. Uncovered Interest Parity: A Useful Approximation
6. Conclusions

Lecture Notes

The exchange rate affects both the price Americans pay for foreign goods and services and the price foreigners pay for U.S. goods and services. The exchange rate also affects the cost of investment across countries. For these reasons, policy makers are concerned with the value of the domestic currency relative to the rest of the world. Before examining how the exchange rate fits into the economy, this chapter begins with defining the exchange rate and then describes the market for foreign exchange.

1 Exchange Rate Essentials

An exchange rate (E) is the price of a foreign currency expressed in terms of a home currency. Because an exchange rate is the relative price of two currencies, it may be quoted in either of two ways:

1. The number of home currency units that can be exchanged for one unit of foreign currency. For example, if the United States is considered home, the dollar/euro exchange rate might be \$1.15 per euro (or 1.15 \$/€). To buy one euro, you would have to pay \$1.15.
2. The number of foreign currency units that can be exchanged for one unit of home currency. For example, the \$1.15/€ exchange rate can also be expressed as €0.87 per U.S. dollar (or 0.87 €/ \$). To buy one dollar, you would have to pay €0.87.

The examples in this section of the Instructor's Manual parallel those in the text but use different currencies and exchange rates. In all cases, the United States is the home country. These examples are for instructors who don't want their lecture to explain only what's in the textbook.

Defining the Exchange Rate

By convention, the exchange rate is defined as units of domestic currency per unit of foreign currency. Thus, $E_{1/2}$ is the number of units of country 1's currency needed to buy one unit of country 2's currency.

Consider two countries: the United States and the United Kingdom. These regions use the U.S. dollar (\$) and the British pound (£), respectively.

$$E_{\$/\pounds} = 1.80$$

The exchange rate above implies an American must pay \$1.80 for each British pound.

We can use this exchange rate to determine how much a U.K. resident would pay for a U.S. dollar:

$$\frac{1}{1.80} = 0.56$$

This means a British resident must pay 0.56 British pounds to buy one U.S. dollar.

Appreciations and Depreciations

Appreciation and depreciation are terms used to describe how the value of a currency changes over time. Because we've defined the exchange rate as a bilateral exchange rate,

an increase in the value of one currency (**appreciation**) implies a decrease in the value of the other currency (**depreciation**). For example, if the dollar–pound exchange rate falls from $E_{\$/\text{£}} = 1.80$ to $E_{\$/\text{£}} = 1.60$, Americans must pay fewer U.S. dollars for the same British pound. Since it takes fewer dollars to buy one pound, the dollar has appreciated vis-à-vis the pound. And it must be true that the pound has depreciated vis-à-vis the dollar. At the initial American terms exchange rate of \$1.80/£, the European terms exchange rate was £0.56/\$. An exchange rate of \$1.60/£ implies £0.625/\$. Since it takes more pounds to buy one dollar (or, technically, a larger fraction of one pound), the pound has depreciated vis-à-vis the dollar.

To measure the degrees to which the currency appreciates or depreciates, we can calculate the percentage change in the exchange rate:

$$\% \Delta E_{\$/\text{£}} = \frac{\Delta E_{\$/\text{£}}}{E_{\$/\text{£}}} = \frac{1.80 - 1.60}{1.80} = 11.1\%$$

Using the American terms exchange rate, the dollar has appreciated 11.1% vis-à-vis the pound.

However, there is an asymmetry. Calculating the percentage depreciation of the pound using the European terms exchange rate, we get

$$\% \Delta E_{\text{£}/\$} = \frac{\Delta E_{\text{£}/\$}}{E_{\text{£}/\$}} = \frac{0.56 - 0.625}{0.56} = -11.6\%$$

When we use the European terms exchange rate, the pound has depreciated by 11.6% vis-

à-vis the dollar. But the pound's depreciation should be equal to the dollar's appreciation. Therefore, we adopt this convention when calculating percentage changes in exchange rates:

$$\% \Delta E_{\text{home/foreign},t} = \frac{\Delta E_{\text{home/foreign},t}}{E_{\text{home/foreign},t}} = \text{\% appreciation in home country currency relative to foreign currency}$$

Multilateral Exchange Rates

Because a currency may appreciate relative to some currencies while depreciating relative to others, we need a measure of the exchange rate that accounts for these changes. One such measure is the **effective exchange rate**, which uses the importance of trade to weight appreciation/depreciation in different bilateral exchange rates. For example, for simplicity, suppose that the United States trades only with three countries: Canada (Canadian dollars, C\$), Mexico (pesos), and Japan (yen). The percentage change in the nominal effective exchange rate would be calculated as

$$\% \Delta E_{\text{home/foreign},t} = \frac{\text{Trade}_{\text{Canada}}}{\text{Trade}} \frac{\Delta E_{\$/\text{C}\$,t}}{E_{\$/\text{C}\$,t}} + \frac{\text{Trade}_{\text{Mexico}}}{\text{Trade}} \frac{\Delta E_{\$/\text{pesos},t}}{E_{\$/\text{pesos},t}} + \frac{\text{Trade}_{\text{Japan}}}{\text{Trade}} \frac{\Delta E_{\$/\text{yen},t}}{E_{\$/\text{yen},t}}$$

We use the share of the foreign country's trade in the total trade to weight the relative importance of the appreciation/depreciation in the currency. If U.S. trade with Canada accounts for a large share of total U.S. trade, then an appreciation/depreciation with respect to the Canadian dollar will have a relatively larger effect on the overall value of

the U.S. dollar.

Example: Using Exchange Rates to Compare Prices in a Common Currency

This case study considers the price for a new tuxedo James Bond would pay in three countries—Hong Kong, the United States, and the United Kingdom—in four different scenarios.

Suppose James Bond is considering purchasing a tuxedo in three different markets.

The prices of a tuxedo in these three markets are:

London: £2,000

Hong Kong: HK\$30,000

New York: \$4,000

For comparison purposes, let's convert all prices into British pounds. The table below summarizes the calculations.

Scenario		1	2	3	4
Cost of the tuxedo in local currency	London	£2,000	£2,000	£2,000	£2,000
	Hong Kong	HK\$ 30,000	HK\$ 30,000	HK\$ 30,000	HK\$ 30,000
	New York	\$4,000	\$4,000	\$4,000	\$4,000
Exchange rates	HK\$/£	15	16	14	14
	\$/£	2	1.9	2.1	1.9
Cost of the	London	£2,000	£2,000	£2,000	£2,000

tuxedo in pounds					
	Hong Kong	£2,000	£1,875	£2,143	£2,143
	New York	£2,000	£2,105	£1,905	£2,105

- Scenario 1: The exchange rates make the pound price of the tuxedo the same in all three countries.
- Scenario 2: The pound has appreciated vis-à-vis the HKD but has depreciated vis-à-vis the dollar. Thus, the tuxedo's price has fallen in Hong Kong but is higher in New York.
- Scenario 3: This is the opposite of scenario 2. The pound depreciates vis-à-vis the HKD but appreciates vis-à-vis the dollar. The tuxedo is now cheaper in New York but more expensive in Hong Kong.
- Scenario 4: The pound has depreciated vis-à-vis both currencies. Bond might as well stay home and buy his tuxedo on Savile Row.

Generalizing The previous example highlights how changes in the exchange rate affect the relative price of goods (in this case, James Bond's tuxedo) across countries. There are two important lessons from this example:

1. When comparing goods and services across countries, we can use the exchange rate to compare prices in the same currency terms.
2. Changes in the exchange rate affect the relative prices of goods across countries but do not affect the domestic price of the good in domestic currency terms:

- An appreciation in the home currency leads to an increase in the relative price of its exports to foreigners and a decrease in the relative price of imports from abroad.
- A depreciation in the home currency leads to a decrease in the relative price of its exports to foreigners and an increase in the relative price of imports from abroad.

2 Exchange Rates in Practice

Changes in the exchange rate affect the relative prices of a country's exports to foreigners and imports from abroad. These changes can be dramatic and difficult to predict. Why? Exchange rates fluctuate over time. Some bilateral exchange rates can move as much as 10% or more over a year.

Exchange Rate Regimes: Fixed Versus Floating

Large changes in exchange rates have important implications for a country's exports and imports, prompting some governments to try to limit changes in the exchange rate. An **exchange rate regime** refers to a government's policy regarding the exchange rate. A **floating**, or **flexible**, exchange rate regime is one in which the government allows the value of the currency to change over time. A **fixed**, or **pegged**, exchange rate regime is one in which the government attempts to peg the value of its currency to another, thereby partially or entirely eliminating changes in the exchange rate. Fixed exchange rates are achieved through government intervention, whereas floating exchange rates involve minimal government intervention.

This description of exchange rate regimes is somewhat simplified. For instance, in

what is known as a —dirty float, governments may choose to intervene in the foreign exchange markets some of the time but allow the exchange rate to float at other times. Also, governments may announce one exchange rate policy and implement another in practice. It is important to look at data to determine a country's exchange rate regime.

APPLICATION

Recent Exchange Rate Experiences

This case study highlights exchange rate regimes in practice across developed and developing countries.

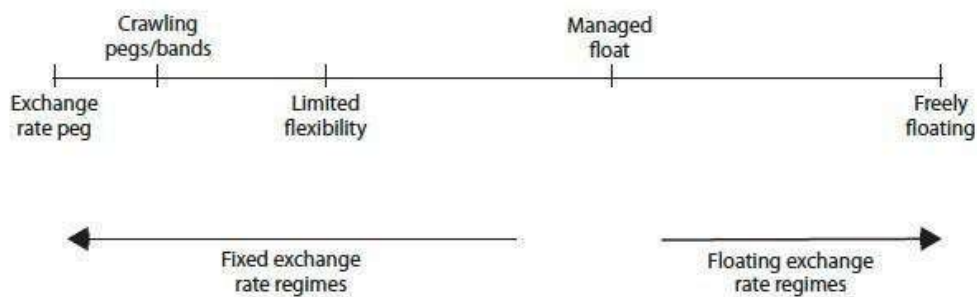
Evidence from Developed Countries Most currencies appear to float against each other.

This is known as a **free float**. A few European countries use an exchange rate band to manage their domestic currency against the euro. Exchange rates can exhibit high short-run volatility.

Evidence from Developing Countries Exchange rates in developing countries tend to be more volatile. Some countries tried adopting fixed exchange rate regimes but were forced to abandon them after coming under —speculative attack. For example, Thailand and Korea experienced an **exchange rate crisis**, or a sudden depreciation in their currencies when currency traders bet against the governments' abilities to maintain international payments. Many use variants of the exchange rate regimes mentioned previously, such as **managed float**, which is designed to prevent dramatic changes in the exchange rate without committing to a strict peg. Another variant is a **crawl**, in which the exchange rate follows a trend rather than a strict peg. In a few cases, countries that have experienced

exchange rate crises change their regimes to the most extreme form of a fixed exchange rate: abandoning their national currency and adopting another country's currency as their official medium of exchange. Ecuador did this in 2000. More recently, Zimbabwe broke out of a severe hyperinflation by –dollarizing its economy, using the U.S. dollar as its internal medium of exchange.

Currency Unions and Dollarization A currency union is a group of countries that agrees to adopt a common currency. The euro is, of course, the most recent example of such a monetary union. **Dollarization** occurs when a country gives up its independent currency and uses another country's money as its medium of exchange. The example given in the text is the Pitcairn Islands, whose 50 residents use the New Zealand dollar as their currency. As noted earlier, Ecuador and Zimbabwe have both resorted to dollarization in response to crises. (Note that this policy is called dollarization even if the currency being used is not the dollar.)



Exchange Rate Regimes of the World There are official and unofficial exchange rate regimes. The difference occurs because some countries that adopt one regime follow another in practice. Some countries have no currency of their own. Others have a strict

peg through the use of a **currency board**. In the countries with strict pegs, there are varying degrees of regimes between fixed and floating. Figure 13-4 in the text is very useful for describing the spectrum of exchange rate regimes in the world today.

Looking Ahead The data on exchange rates in practice have important implications for the models and analysis in the remainder of the textbook. First, the world is divided into fixed and floating regimes, so we must understand how both regimes work. Second, there are patterns in which countries float versus fix their exchange rates. Advanced countries are more likely to float, whereas the fixed exchange rate regime is relatively common among developing countries.

3 The Market for Foreign Exchange

The market for foreign exchange (forex market, or FX market) is where currencies are traded and the exchange rate is determined. Like any market, participants include individuals, businesses, governments, central banks, and nongovernmental organizations. This market is huge. In 2007, the Bank for International Settlements (BIS) estimated volume at \$3.21 *trillion per day*. (U.S. GDP is about \$15 trillion *per year*.) The most basic transactions in this market take place in the spot market, so we'll look at it first.

The Spot Contract

Spot contracts are contracts for immediate (–on-the-spot) delivery. In terms of volume, most spot contracts are executed by banks and other large financial intermediaries.

Naturally, when a tourist exchanges euros for dollars, that trade is executed in the spot market. Those transactions are a very small fraction of the total volume of spot trades.

The spot market price is called the **spot exchange rate**. Throughout the rest of the textbook, the term –exchange rate‖ when used without any modifier refers to the spot rate.

Today, spot trades are free of default risk (settlement risk). Modern technology means these trades clear in real time. Since 1997, this *continuously linked settlement* (CLS) system has been used by all major banks around the world.

Transaction Costs

Like most financial markets, there are huge economies of scale in the forex market. When a French tourist on vacation at Yosemite uses euros to buy dollars, the exchange rate will not be the same as the rate offered for the high-volume transactions mentioned earlier. Instead, the tourist will pay the retail price (exchange rate). Small transactions carry higher costs, meaning the bank will charge a higher price for those transactions. The **spread** is the difference between the –buy‖ and –sell‖ prices. To add that the banks try to buy low and sell high would be superfluous. However, it’s generally true that buying and selling major currencies will carry a lower spread than obscure currencies with thin trading volumes. Our French tourist will get one of the lowest spreads for trading two major currencies. (Naturally, the spread will be a bit higher when the transaction occurs at a tourist location such as Yosemite.) The retail spread is usually between 2% and 5%. Contrast this with the spreads on high-volume transactions. Those can be as low as 0.01%.

For example, suppose the –wholesale‖ exchange rate is 0.80 euro per dollar ($E_{\$/\epsilon} = \1.250). If our French tourist wants to buy dollars with euros, the bank is likely to charge slightly more than this, say, 0.81 euros per dollar. (This is called the ask price.) Thus, our

French tourist will receive \$1,234.57 in exchange for 1,000 €. But if the tourist immediately converts those dollars back to euros, the exchange rate will be slightly lower, say, 0.79 € per dollar. (This is called the bid price.) The tourist will only get 975.31 €. The round-trip cost is 24.69 €, about 2.5%.

If a currency is not heavily traded in the foreign exchange market, then banks may require a higher spread to compensate themselves for exchanging an asset with less liquidity. Therefore, the spread reflects market friction. In the foreign exchange markets, these frictions are generally very small (less than \$0.0001 for large trades of major currencies).

The spread is an example of a transaction cost, or market friction that creates a wedge between the price paid by the buyer and the price received by the seller. Fortunately, spreads can largely be ignored in macroeconomic analysis.

Derivatives

Derivatives are financial instruments that derive (i.e., are created from) a spot rate. There are many different foreign exchange rate derivatives discussed further in the following application. Derivatives are designed to increase flexibility, both in the exchange of goods and services across countries and in investor *hedging* and *speculation*.

APPLICATION

Foreign Exchange Derivatives

This application discusses four foreign exchange derivatives: **forwards, swaps, futures,** and **options**. Forwards and swaps are most often used as a hedge for foreign currency traders and for businesses engaged in high-volume transactions. Futures and options are

primarily used for foreign currency *speculation* and comprise a very small share of the foreign currency market.

Forwards allow two parties to exchange currency at an agreed-upon rate (forward rate) in the future. Swaps combine the spot sale of foreign currency with a forward repurchase of the same currency. These derivatives are very important for banks and businesses engaged in large-volume transactions that are scheduled to occur in the future (forwards), especially if they involve the same currency today and in the future (swaps).

Futures are essentially the same as forwards except they are standardized (in denomination and maturity date) and tradable in the foreign exchange market. Options give the buyer the right to buy (call) or sell (put) at a prespecified date and exchange rate.

Private Actors

There are three types of private actors in the foreign exchange markets: **commercial banks**, large **corporations**, and **non-bank financial institutions**. It is important to note that individuals do not directly engage in foreign exchange transactions—they go through banks or non-bank institutions to exchange currency.

Commercial banks account for the largest share of foreign currency operations. Many of these operations are through **interbank trading** of bank deposits. A large corporation may choose to engage in foreign currency operations rather than paying a bank for this service, especially if it regularly deals with the same businesses and banks abroad. Non-bank financial institutions include companies such as mutual fund companies that are investing in large volumes of foreign assets.

Government Actions

The government may participate in the forex market in a number of ways: **capital controls**, **official market** (with fixed rates), and **intervention**.

The government may establish capital controls to restrict the movement of forex operations either coming into the country or exiting the country. The government may establish an official market with fixed exchange rates, making it illegal to trade at any other exchange rate. This often gives rise to black markets (or parallel markets) as private parties seek to exchange foreign currency at a free market rate.

The government may intervene in the forex market, which is usually the central bank's responsibility. The central bank can use foreign exchange reserves to buy or sell the domestic currency, affecting its value in the forex market. For example, if China's central bank sees the value of the yuan rising against the U.S. dollar, it may sell yuan (and buy dollars, adding to its foreign exchange reserves) to prevent the yuan's appreciation. Fixed exchange rate regimes are costly because these countries must keep foreign reserves on hand as a buffer to buy/sell currency. If the central bank runs out of reserves, it will be forced to float.

4 Arbitrage and Spot Exchange Rates

The market **equilibrium** is determined by a **no-arbitrage condition**. **Arbitrage** is a strategy that exploits profit opportunities arising from differences in prices among markets. The equilibrium is defined as the price at which these opportunities are exhausted so that there is no tendency for change.

The examples below mirror those in the text but use different currencies and exchange rates. Also, these examples are numerical, whereas the text discusses the cases

generically.

Arbitrage with Two Currencies Consider the exchange rate between the U.S. dollar and the Mexican peso. These currencies are traded in both Tokyo and New York.

Case 1: $E^{NY}_{\$/\text{peso}} > E^{Tok}_{\$/\text{peso}}$

Suppose $E^{NY}_{\$/\text{peso}} = \0.095 and $E^{Tok}_{\$/\text{peso}} = \0.085 . An arbitrageur James can sell

10,000 Mexican pesos at a price of \$0.095 per peso in New York (generating \$950), then buy 10,000 pesos in Tokyo at \$0.085 (costing \$850). With this transaction, James has generated a \$100 profit. Notice that other arbitrageurs will do the same, flooding the New York market with pesos and reducing the availability of pesos in Tokyo. The result should be an increase in the price of pesos in Tokyo and a decrease in the New York price.

Case 2: $E^{NY}_{\$/\text{peso}} < E^{Tok}_{\$/\text{peso}}$

Suppose $E^{NY}_{\$/\text{peso}} = \0.095 and $E^{Tok}_{\$/\text{peso}} = \0.100 . James can buy 10,000 Mexican

pesos at a price of \$0.095 per peso in New York (costing \$950), then sell 10,000 pesos in Tokyo at \$0.100 (generating \$1,000). With this transaction, James has generated a \$50 profit. The Tokyo market will see a dramatic increase in pesos, pushing down their price in Tokyo. The reverse happens in New York: a decrease in the availability of pesos will push up the $E^{NY}_{\$/\text{peso}}$.

Case 3: $E^{NY}_{\$/\text{peso}} = E^{Tok}_{\$/\text{peso}}$

Regardless of whether the market begins in Case 1 or Case 2, we know that it will settle here, where the exchange rates in both markets are the same. When the New York price of pesos is higher than the Tokyo price, arbitrage causes a decrease in the New York price and an increase in the Tokyo price. In this case, James cannot earn a profit from buying currency in one location and selling it in another.

Arbitrage with Three Currencies This occurs when an arbitrageur seeks to gain a profit from the triangular trade of three currencies. Consider two exchange rates. The first rate is between the U.S. dollar and the Mexican peso. The second is between the U.S. dollar and the Canadian dollar (C\$). These currencies are traded in both Tokyo and New York.

A triangular trade occurs in the following way. First, the arbitrageur buys Mexican pesos. Then, she sells her pesos in exchange for Canadian dollars. Finally, she sells Canadian dollars for U.S. dollars.

Case 1: $E_{\$/\text{peso}} > E_{\$/\text{C\$}} E_{\text{C\$/peso}}$

Suppose $E_{\$/\text{peso}} = \0.015 , $E_{\$/\text{C\$}} = \$0.80$, and $E_{\text{C\$/peso}} = \0.0125 . An arbitrageur Ava has \$400. She can sell her 400 U.S. dollars for 500 Canadian dollars (C\$500) at the rate $E_{\$/\text{C\$}} = \$0.80$. Ava then sells her 500 Canadian dollars for 40,000 pesos at the rate $E_{\text{C\$/peso}} = \0.0125 . Finally, she sells her 40,000 pesos for \$600. Ava generates a \$200 profit from arbitrage. As other arbitrageurs engage in similar transactions, this will put downward pressure on the $E_{\$/\text{peso}}$ rate because many arbitrageurs are selling pesos in exchange for U.S. dollars. Similarly, there will be upward pressure on the rates $E_{\$/\text{C\$}}$ and $E_{\text{C\$/peso}}$.

Case 2: $E_{\$/\text{peso}} < E_{\$/\text{C\$}} E_{\text{C\$/peso}}$

Suppose $E_{\$/\text{peso}} = \0.01 , $E_{\$/\text{C\$}} = \$0.80$, and $E_{\text{C\$/peso}} = \0.015 . In this case, Ava can sell her 400 U.S. dollars for 40,000 pesos at the rate $E_{\$/\text{peso}} = \0.01 . Ava then sells her 40,000 pesos for 600 Canadian dollars at the rate $E_{\text{C\$/peso}} = \0.015 . Finally, she sells her 600 Canadian dollars for \$480. Therefore, Ava generates an \$80 profit from arbitrage. Notice that her actions (and those of other arbitragers) will put upward pressure on the $E_{\$/\text{peso}}$ rate because many arbitragers are selling U.S. dollars in exchange for pesos. Similarly, there will be downward pressure on the rates $E_{\$/\text{C\$}}$ and $E_{\text{C\$/peso}}$.

Case 3: $E_{\$/\text{peso}} = E_{\$/\text{C\$}} E_{\text{C\$/peso}}$

Suppose $E_{\$/\text{peso}} = \0.01 , $E_{\$/\text{C\$}} = \$0.80$, and $E_{\text{C\$/peso}} = \0.0125 . In this case, arbitragers such as Ava will be unable to turn a profit from arbitrage.

In studying arbitrage among three currencies, we see that we can use ratios of exchange rates to convert between several different currencies:

$$E_{\$/\text{peso}} = E_{\$/\text{C\$}} E_{\text{peso/C\$}} = \frac{E_{\$/\text{C\$}}}{E_{\text{C\$/peso}}}$$

The term on the right-hand side of the previous expression is known as the **cross rate**.

Note that the Canadian dollars (C\$) cancel, leaving the U.S. dollar–Mexican peso exchange rate.

Cross Rates and Vehicle Currencies

The vast majority of currency pairs are exchanged through a third currency. This is

because some foreign exchange transactions are relatively rare, making it more difficult to exchange currency directly. When a third currency is used in these types of transactions, it is known as a **vehicle currency**. As of April 2007, the most common vehicle currency was the U.S. dollar, which was used in 86% of all foreign exchange transactions. The euro is the vehicle currency for 37% of all trades, with the yen and the British pound accounting for 17% and 15% respectively.

5 Arbitrage and Interest Rates

Recall that most foreign currency operations involve bank deposits. A bank deposit is an asset that generates interest for the depositor. The decision of where to maintain deposits is largely a matter of convenience for most. However, for investors, this decision is driven by the desire to generate a profit, or arbitrage.

The key difference between bank deposits at home and abroad is exchange rate risk. There is a chance that the exchange rate will change between when the funds are deposited abroad and when they are converted back into the home currency. When investors decide where to maintain deposits, their actions lead to a no-arbitrage condition known as **uncovered interest parity (UIP)**.

To hedge against exchange rate risk, investors can use derivatives such as forwards. In this way, the arbitrageur eliminates exchange rate risk, that is, he or she is **-covered**. Covered interest parity creates riskless arbitrage, whereas uncovered interest parity implies risky arbitrage. This leads to a no-arbitrage condition known as **covered interest parity (CIP)**. Covered interest parity creates riskless arbitrage, whereas uncovered interest parity implies risky arbitrage.

Riskless Arbitrage: Covered Interest Parity

This presentation mirrors the one in the text, but makes use of different exchange rates.

Riskless arbitrage refers to arbitrage that does not involve exchange rate risk. To eliminate this risk, investors will make use of a forward contract. This allows the investor to exchange foreign deposits at a predetermined rate (**forward exchange rate**) at a specified date in the future.

Suppose that an American investor Katya is considering whether to put her \$800 savings into a U.S. bank account or in a British bank account for the next year. She must evaluate the expected rate of return from these two investment strategies. (The numbers used in this example approximate the actual values of the variables as of October 12, 2010; the data tables at <http://www.wsj.com> were our source. Also, the calculations and data are included in the Excel workbook for this chapter, making it easy for instructors to update the table to current values.)

The return on the U.S. deposits is equal to one plus the U.S. interest rate ($1 + i_{\$}$). This is the gross dollar return Katya receives from her investment at the end of one year. For the purposes of our example, suppose $i_{\$}$ is 0.252%.

The return on the British deposits includes two components. Katya receives one plus the British interest rate ($1 + i_{\pounds}$) as gross pound return after one year. Suppose i_{\pounds} is 0.490%. But pounds are not money in the United States. Katya must convert her British pounds back into U.S. dollars. Therefore, any gain or loss she earns when she converts her pounds back into U.S. dollars affects her rate of return.

This gain or loss is determined by the forward exchange rate, $F_{\$/\pounds}$ (1.6090), and the current spot rate, $E_{\$/\pounds}$ (1.6114). Converting one U.S. dollar into British pounds would cost $1/E_{\$/\pounds}$ today. One year from today, converting the British pounds back into U.S. dollars at

the forward rate would yield $F_{\$/\pounds}$ dollars. Therefore, the return on British deposits, in U.S. dollars, is

$$(1+i_{\pounds}) \frac{F_{\$/\pounds}}{E_{\$/\pounds}}$$

At equilibrium, these two returns must be the same. If British deposits paid a higher return than U.S. deposits, investors would sell U.S. dollars in exchange for British pounds, causing the dollar to depreciate. For a given forward rate, this would lead to an increase in the exchange rate $E_{\$/\pounds}$, reducing the gain from converting British pounds into U.S. dollars. Similarly, if American deposits paid a higher return than British deposits, investors would sell British pounds for U.S. dollars, causing the pound to depreciate. This would increase the gain from converting pounds to dollars at a given forward rate.

Utilizing the figures given above, we can use any three variables to calculate the implied value of the remaining one. For example, the implied value of $F_{\$/\pounds}$ is 1.6076. The actual value was 1.6090. These tiny differences are most likely caused by transaction costs and other frictions.

Thus, we have derived the covered interest parity condition (CIP):

$$(1+i_{\$}) = (1+i_{\pounds}) \frac{F_{\$/\pounds}}{E_{\$/\pounds}}$$

Summary CIP provides a theory of how forward contracts are formed. Rewriting the CIP

condition yields

$$F_{\$/\text{€}} = E_{\$/\text{€}} \frac{(1+i_{\$})}{(1+i_{\text{€}})}$$

This highlights the reason forward contracts are known as -derivatives. || They are based on the spot rate and the current interest rates paid on bank deposits in the two countries.

APPLICATION

Evidence on Covered Interest Parity

To test whether covered interest parity holds, we can determine whether foreign exchange traders could, in fact, earn a profit through establishing forward and spot contracts. This application considers the German Deutsch Mark (GER) relative to the British pound (U.K.). (The text uses the Deutsch Mark because the discussion centers on the period immediately after the United States and Germany eliminated capital controls, 1979–1981.)

The profit from this type of arrangement is

$$\text{Profit} = (1+i_{\text{GER}}) \frac{F_{\text{UK/GER}}}{E_{\text{UK/GER}}} - (1+i_{\text{UK}})$$

The data illustrate that arbitrage led to zero profits in the absence of capital controls. When capital controls are removed, arbitrage profits decrease.

As financial systems become more liberalized, arbitrage opportunities disappear quickly. When governments imposed capital controls in the foreign exchange market, arbitrage opportunities were greater because it was more difficult to move currency from one country to another. When capital controls are removed, more investors are free to engage in arbitrage. With increased access, covered arbitrage opportunities have virtually disappeared.

Risky Arbitrage: Uncovered Interest Parity

Risky arbitrage does not cover investors with a forward contract. Instead, investors must make their decisions based on what they think the exchange rate will be in the future. The expected future exchange rate replaces the forward exchange rate in the CIP example shown previously, and repeated below.

$$\frac{E_{\$/\text{£}}^e}{E_{\$/\text{£}}}$$

Suppose that an American investor Katya is considering whether to put her \$800 savings into a U.S. bank account or in a British bank account for the next year. She must evaluate the expected rate of return from these two investment strategies. (The numbers used in this example approximate the actual values of the variables as of October 12, 2010; the data tables at <http://www.wsj.com> were our source. Also, the calculations and data are included in the Excel workbook for this chapter, making it easy for instructors to update the table to current values.)

The return on the U.S. deposits is equal to one plus the U.S. interest rate ($1 + i_s$). This

is the gross dollar return Katya receives from her investment at the end of one year.

For the purposes of our example, suppose $i_{\$}$ is 0.252%.

The return on the British deposits includes two components. Katya receives one plus the British interest rate $(1 + i_{\pounds})$ as gross pound return after one year. Suppose i_{\pounds} is 0.490%. But pounds are not money in the United States. Katya must convert her British pounds back into U.S. dollars. Therefore, any gain or loss she earns when she converts her pounds back into U.S. dollars affects her rate of return.

This gain or loss will be determined by the spot exchange rate one year from now.

We call this the **expected exchange rate**, $E_{\$/\pounds}^e$. Given the current spot rate, $E_{\$/\pounds}$

(1.6114) and the interest rates on the two accounts, we can calculate the market's forecast of the exchange rate one year from now, 1.6076\$/£. Converting one U.S. dollar into British pounds would cost 1/E\$/£ today. One year from today, converting the British pounds back into U.S. dollars at the forward rate would yield $F_{\$/\pounds}$ dollars.

Therefore, the return on British deposits, in U.S. dollars, is

$$(1 + i_{\pounds}) \frac{E_{\$/\pounds}^e}{E_{\$/\pounds}}$$

But, unlike covered interest parity, the forward exchange rate is not known. The unknown variable in the uncovered interest parity equation is the expected exchange rate one year from now, $E_{\$/\pounds}^e$. As seen earlier, for our example, the expected exchange rate one year from now is 1.6076\$/£.

Thus, we have derived the uncovered interest parity condition (UIP).

APPLICATION

Evidence on Uncovered Interest Parity

If the UIP and CIP hold, this implies the forward exchange rate is equal to the expected future exchange rate. If we divide the CIP condition by the UIP condition, we get

$$(1+i_{\$}) = (1+i_{\text{€}}) \frac{F_{\$/\text{€}}}{E_{\$/\text{€}}}$$
$$(1+i_{\$}) = (1+i_{\text{€}}) \frac{E_{\$/\text{€}}^e}{E_{\$/\text{€}}}$$

Canceling terms yields

$$1 = \frac{F_{\$/\text{€}}}{E_{\$/\text{€}}^e}$$

This implies $F_{\$/\text{€}} = E_{\$/\text{€}}^e$.

The earlier empirical evidence on CIP was favorable, so we will assume CIP holds. We can test whether UIP holds by comparing the forward premium ($[F_{\$/\text{€}}/E_{\$/\text{€}}] - 1$) with the expected rate of depreciation over the next year or ($[E_{\$/\text{€}}^e/E_{\$/\text{€}}] - 1$), or

$$\frac{F_{\$/\text{€}}}{E_{\$/\text{€}}} - 1 = \frac{E_{\$/\text{€}}^e}{E_{\$/\text{€}}} - 1$$

The expression on the left-hand side is the **forward premium**. To estimate the right-hand side, we rely on surveys of foreign exchange traders. The slope of the estimated line is slightly greater than the 45-degree line, meaning UIP is weakly supported. The differences could be caused by transaction costs and risk aversion. Or the errors could simply be the result of foreign exchange traders' errors in forming their expectations.

Uncovered Interest Parity: A Useful Approximation

It will be convenient to use the following approximation:

$$i_s = i_\pounds + \frac{\Delta E_{\$/\pounds}^e}{E_{\$/\pounds}}$$

The left side of the equation is simply the interest earned from U.S. dollar deposits. This approximately equals the interest earned from British pound deposits, plus the expected depreciation of the dollar vis-à-vis the British pound during the next year.

UIP provides a theory of how expectations are linked to the current spot exchange rate and to interest rates across countries. Rewriting the UIP condition yields

$$E_{\$/\pounds}^e = E_{\$/\pounds} \frac{(1+i_s)}{(1+i_\pounds)}$$

For example, suppose that the current spot rate is $E_{\$/\pounds} = \1.50 , the interest rate on U.S. dollar deposits is 5%, and the interest rate on English deposits is 4%. Using the data, we

know that investors expect that the U.S. dollar will depreciate:

$$E_{\$/\text{€}}^e = \$1.50 \frac{(1.05)}{(1.03)} = \$1.53$$

6 Conclusions

This chapter provides an overview of exchange rates, the forex market, and the conditions defining equilibrium in the market, and discusses the ways in which private actors and the government participate in the forex market. Although there are mainly two types of exchange rate regimes, fixed and floating, some countries have adopted other systems, such as currency unions and dollarization.

Arbitrage and expectations are important in driving exchange rate movements, especially in the short run. The conditions developed here will be used to develop a more complete theory of exchange rate determination.

S I D E B A R

Assets and Their Attributes

Investors have many options in holding their wealth. There are many available assets: cash, stocks, bonds, bank deposits, real estate, and so on. Investors make choices about how to hold their wealth based on three criteria:

- *Rate of return*: the net increase in wealth generated from holding the asset.
- *Risk*: volatility of an asset's rate of return. For a given expected rate of return, investors prefer the one with less volatility.
- *Liquidity*: the ease with which an asset can be converted into cash to buy goods

and services (e.g., the ease with which it can be liquidated or sold). Investors prefer more liquid assets.

These observations lead to two conclusions. First, investors are willing to trade off more of one attribute for less of the other(s). That implies that all assets are substitutes for each other (although they may not be very close substitutes). Second, expectations matter.

Most assets do not have guaranteed rates of return (especially if we look at the real rates of return). Investors' forecast of the rate of return is called the *expected rate of return*.

Teaching Tips

Teaching Tip 1: Uncovered interest parity says the difference between the U.S. interest rate and the foreign interest rate should equal the expected rate of depreciation of the U.S. dollar.

The Excel workbook for this chapter includes a worksheet that shows comparable 2009 interest rates for a number of countries as well as for the United States. The United States – foreign difference is also included. Show this table to your students and ask them to discuss the results. For example, Iceland's currency is expected to appreciate by

11.24%. Do you believe that result? (Data are from the IMF's International Financial Statistics database, accessed December 2010.)

Teaching Tip 2: In this chapter, we assumed frictionless trading in the forex market. This assumption is relaxed in the last chapter of the textbook. For now, explore the bid-ask spread with your students. The bid price is the price at which a dealer is willing to sell a security or currency. The ask price is the willingness-to-buy price. Dealers make a living on the bid-ask spread. In foreign currency markets, this spread is quoted in pips. For most currencies, a pip is equal to 0.0001 on the exchange rate. For the yen, however,

one pip is 0.01 of the exchange rate. Exchange rates are conventionally quoted as foreign currency per U.S. dollar. For example, in the euro–U. S. dollar market, suppose the bid price is 1.4745 and the ask price is 1.4746. The spread is 1 pip. OANDA’s website offers a complete list of bid-ask spreads for its trades

(<http://fxtrade.oanda.com/why/spreads/recent>). You can assign this as an individual or group project. Either way, have each person or team calculate the round-trip cost of a trade in which \$1,000 (U.S. dollars) are used to buy a foreign currency at the bid price. The foreign currency is then used to purchase U.S. dollars at the ask price. The difference between the ending dollar amount and \$1,000 is the round-trip cost. (Tell your students to avoid trades on Saturdays and Sundays because the spreads are larger, reflecting the fact that forex markets are closed on those days.)

(There are three examples for this chapter in the Excel workbook. OANDA’s website is loaded with educational material. Begin with <http://fxtrade.oanda.com/learn/intro-to-currency-trading/conventions/> and work through the links on that page. Pay special attention to <http://fxtrade.oanda.com/learn/intro-to-currency-trading/conventions/currency-pairs> and <http://fxtrade.oanda.com/learn/intro-to-currency-trading/conventions/currency-pairs>.)

IN-CLASS PROBLEMS

1. Use Table 13-1 in the textbook to answer the following questions:

	Exchange Rates on June 30, 2010	Exchange Rates on June 30, 2009 (one year previous)

Country (currency)	Currency Symbol	(1) Per \$	(2) Per £	(3) Per €	(4) Per \$	(5) Per £	(6) Per €
Canada (dollar)	C\$	1.063	1.59	1.302	1.161	1.913	1.629
Denmark (krone)	DKr	6.081	9.098	7.449	5.309	8.743	7.447
Euro (euro)	€	0.816	1.221	—	0.713	1.174	—
Japan (yen)	¥	88.49	132.39	108.39	96.49	158.9	135.34
Norway (krone)	NKr	6.503	9.729	7.966	6.437	10.6	9.028
Sweden (krona)	SKr	7.782	11.643	9.532	7.748	12.76	10.868
Switzerland (franc)	SFr	1.078	1.613	1.321	1.088	1.791	1.536
United Kingdom (pound)	£	0.668	—	0.819	0.607	—	0.852
United States (dollar)	\$	—	1.496	1.225	—	1.647	1.403

- a. Calculate the U.S. dollar–Swiss franc exchange rate, $E_{\$/\text{franc}}$, and the U.S. dollar–British pound exchange rate, $E_{\$/\text{£}}$ as of June 30, 2010. (Data and answers for this question are included in the Excel workbook for this chapter.)

Answer:

$$E_{\$/\text{franc}} = 1/(1.078) = \$0.928$$

$$E_{\$/\text{£}} = 1/(0.668) = \$1.497$$

- b. What happened to the value of the U.S. dollar relative to the Swiss franc and the British pound between 2009 and 2010? Calculate 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 calculated in (a).

Answer: Between those two years, the value of the U.S. dollar depreciated against the British pound and appreciated against the Swiss franc. The percentage of appreciation/depreciation in each currency relative to the dollar is given in the following:

$\% \Delta E_{\$/\text{franc}} = (\$0.928 - \$0.919)/\$0.9191 = 0.0093 = 0.93\%$ appreciation in the franc vis-à-vis the dollar

$\% \Delta E_{\text{C}\$/\$} = (\$1.497 - \$1.647)/\$1.647 = -0.0913 = 9.13\%$ appreciation in the pound vis-à-vis the dollar

- c. Using the information in the table for the most recent year, calculate the Japanese yen–Norwegian krone exchange rate.

Answer:

$$2010: E_{\text{¥}/\$} = (88.49\text{¥}/(6.503\text{krone}/\$)) = 13.61 \text{ krone}/\text{¥}$$

2. Suppose that the U.S. dollar has appreciated relative to the Chinese yuan and depreciated relative to the Mexican peso. What has happened to the value of the dollar based on the effective exchange rate? How is your answer based on the relative importance of U.S. trade with China and Mexico? Explain.

Answer: When the dollar depreciates against one currency (peso) and appreciates relative to another (yuan), the effective exchange rate weights the percentage change

in the exchange rates according to how much the U.S. trades with each country.

Because the United States trades more with Mexico than with China (Mexico is the United States' second-largest trading partner after Canada), the depreciation will receive greater weight. Therefore, looking at the effective exchange rate, the U.S. dollar has depreciated against a basket that includes the peso and the yuan.

3. Use the table below to answer the following questions.

Exchange Rate Quotations

Foreign Currency Units per U.S. dollar			
Country (currency)	Currency Symbol	June 30, 2010	June 30, 2005
Brazil (real)	BRL	1.7973	2.3555
China (yuan)	¥ (CNY)	6.8086	8.2865
Mexico (peso)	MXN	12.8355	10.7630

Data from: <http://www.oanda.com>.

You and a friend Yi are considering a summer vacation to one of two locales, Mexico or Brazil. Mexico's currency unit is the Mexican (new) peso and the real is used in Brazil. You live in the United States and Yi lives in China. The cost of the hotel is denominated in local currency units. You and Yi are trying to choose the locale with the lowest hotel expenses. The price of a hotel room is 200 reals per night in Brazil

and 800 pesos per night in Mexico. Assume these prices remain unchanged between 2005 and 2010.

- a. Calculate the U.S. dollar price of a hotel room in Brazil and in Mexico for June 2005. Calculate these prices for 2010. Based on your answers, where would you spend your vacation in June 2005? In June 2010?

Answer:

The U.S. dollar price of hotel rooms in June 2010:

Brazil: 200 reals per room/1.7973 reals per dollar = \$111.28

Mexico: 800 pesos per room/12.8355 pesos per dollar =

\$117.50 The U.S. dollar price of hotel rooms in June 2005:

Brazil: 200 reals per room/2.3555 reals per dollar = \$84.91

Mexico: 800 pesos per room/10.7630 pesos per dollar =

\$96.54 In both years, the Brazilian hotel has a lower dollar price.

- b. For June 2005 and June 2010, calculate the following: Real–yuan exchange rate, $E_{\text{real/yuan}}$

Peso–yuan exchange rate, $E_{\text{peso/yuan}}$

Answer:

June 2005: $E_{\text{real/yuan}} = E_{\text{real/\$}}/E_{\text{yuan/\$}} = 1.7973/6.8086 = 0.2640$ reals per yuan

June 2010: $E_{\text{real/yuan}} = 2.3555/8.2865 = 0.2843$ reals per yuan

June 2005: $E_{\text{peso/yuan}} = E_{\text{peso/\$}}/E_{\text{yuan/\$}} = 12.8355/6.8086 = 1.8852$ pesos per yuan

June 2010: $E_{\text{peso/yuan}} = 10.7630/8.2865 = 1.2989$ pesos per yuan

- c. Using your answers from (b) and the information in the table, calculate the Chinese yuan price of a hotel room in Brazil and in Mexico for June 2005.

Calculate these prices for 2010. Based on your answers, where would Yi prefer to spend her vacation in June 2005? In June 2010?

Answer:

June 2005 yuan price of hotel room:

Brazil: $200 \text{ reals per room} / 0.2843 \text{ reals per yuan} = 703.5873 \text{ yuan per room}$
Mexico: $800 \text{ pesos per room} / 1.2989 \text{ pesos per yuan} = 615.9249 \text{ yuan per room}$

June 2010 yuan price of hotel room:

Brazil: $200 \text{ reals per room} / 0.2640 \text{ reals per yuan} = 757.6476 \text{ yuan per room}$
Mexico: $800 \text{ pesos per room} / 1.8852 \text{ pesos per yuan} = 424.3606 \text{ yuan per room}$

In both years, Mexico has a lower hotel price. Looks like you and Yi will be taking separate vacations.

4. Go to the Federal Reserve Bank of St. Louis Economics Database (FRED) and look up exchange rate data for the following currencies (relative to the U.S. dollar) for the past four years: Chinese yuan, euro, Brazilian real, and Hong Kong dollar. Are these exchange rates fixed or floating relative to the U.S. dollar? If the currency is floating against the U.S. dollar, does the exchange rate change by more than 15% in a given year?

Answer: The euro and the Brazilian real are floating against the U.S. dollar. The Hong Kong dollar is fixed against the U.S. dollar. Both the euro and the real have changed in value relative to the U.S. dollar by more than 10% over the last four years.

While the Chinese yuan is pegged to the dollar, there has been a gradual appreciation since 2004, totaling 17.47%. (The data for this problem are contained in the Excel workbook for this chapter, as are graphs of the four exchange rates.)

5. As the volume of transactions in the foreign exchange market grows, how do you expect this to affect the government's ability to effectively intervene in the market? Consider the different tools the government has and their effectiveness in influencing exchange rates.

Answer: As the volume of transactions increases, the government's ability to intervene in the foreign exchange market will be limited. First, the effectiveness of interventions will be weaker because the government's interventions will have less of an effect in a high-volume market. Second, it will be more difficult to enforce and maintain capital controls on a higher volume of transactions. In this case, there will be substantial profits associated with the establishment of a black market.

6. Explain how triangular arbitrage works. Why is this important for vehicle currencies in global markets?

Answer: A triangular trade occurs in the following way. First, the arbitrageur buys one currency, A. Then, she sells A for another currency, B. Finally, she sells B for a third currency, C. The vast majority of currency pairs are exchanged through a third currency. This is because some foreign exchange transactions are relatively rare, which makes it more difficult to exchange currency directly. When a third currency is used in these types of transactions, it is known as a vehicle currency.

7. In June 2006, a Korean investor is considering investing in bank deposits in Korea and Japan. The annual interest rate on Korean deposits is 6.25%, versus 3.75% on deposits in Japan. Suppose that the forward rate in June 2006 is equal to $F_{\text{won/¥}} = 8.2$. In June 2006, the expected exchange rate is 8.2 won/¥. For the remainder of this question, please use the linear approximations for uncovered and covered interest rate parity. The spot exchange rate in June 2006 is $E_{\text{won/¥}} = 8$.

a. Does *covered* interest parity hold in this example? If so, how do you know?

Calculate the expected return in Japanese deposits (denominated in Korean won) in this case.

Answer:

$$\text{CIP: } i_{\text{won}} = i_{\text{¥}} + (F_{\text{won/¥}} - E_{\text{won/¥}})/E_{\text{won/¥}}$$

$$\text{Return on Korean deposits: } i_{\text{won}} = 6.25\%$$

$$\text{Return on Japanese deposit (in won, covered by forward contract): } i_{\text{¥}} +$$

$$(F_{\text{won/¥}} - E_{\text{won/¥}})/E_{\text{won/¥}} = 3.75\% + (8.2 - 8)/8 = 3.75\% + 3.13\% = 6.88\%$$

Yes, CIP does hold because the return on a Korean deposit is equal to the return on the Japanese yen deposit (covered by a forward contract).

b. Does *uncovered* interest parity hold in this example? If so, how do you know? If not, what is the implied risk premium? Which deposits pay a higher expected return? Calculate the return on Japanese deposits (denominated in Korean won) in this case.

Answer:

$$\text{UIP: } i_{\text{won}} + i_{\text{¥}} + (E_{\text{won/¥}}^E - E_{\text{won/¥}})/E_{\text{won/¥}}$$

$$i_{\text{won}} = 6.25\%$$

Expected return on Japanese deposit (in won, *not* covered by forward contract):

$$i_{\text{¥}} + (E_{\text{won/¥}}^{\text{2006}} - E_{\text{won/¥}}) / E_{\text{won/¥}} = 3.75\% + (8.25 - 8) / 8 = 3.75\% + 3.125\%$$

$$= 6.875\%$$

UIP does not hold in this case because the expected returns are not equal.

- c. Suppose the exchange rate in June 2007 is equal to 8.528 won per yen. Calculate the Korean investor's actual return, assuming that he invests in Japanese deposits in June 2006. How do these answers compare with those from (b)?

Answer: We know what happened to the won. It appreciated by 6.6% against the yen.

$$\text{Actual return on Japanese deposit: } i_{\text{¥}} + (E_{\text{won/¥}}^{2007} - E_{\text{won/¥}}^{2006}) / E_{\text{won/¥}}^{2006} = 3.75\%$$

$$+ (-6.6\%) = -2.85\%$$

If an investor left his deposits in the Japanese bank for the whole year, he would have earned a loss.

- d. Consider two Korean investors: one uses speculation and the other uses hedging. Based on your previous answers, which one earned a higher return (or smaller loss) on Japanese assets between June 2006 and 2007? Explain briefly why.

Answer: Although investors expected a depreciation back in June 2006, the won actually appreciated against the yen between June 2006 and June 2007. Therefore, speculators who bet on the won depreciation will lose. The investors who hedged against the depreciation in the won will earn higher returns (or earn relatively smaller losses).

8. Consider an investor seeking to invest in France. Using the UIP condition (allowing for risk), explain how each of the following would affect the value of the euro and U.S. dollar.

a. A decrease in U.S. interest rates

Answer: $i_{\$}$ decreases \rightarrow return on \$ deposits decreases \rightarrow \$ depreciates, € appreciates, $E_{\$/\epsilon}$ increases

b. An increase in France's interest rates

Answer: i_{ϵ} increases \rightarrow return on € deposits increases \rightarrow \$ depreciates, € appreciates, $E_{\$/\epsilon}$ decreases

c. A decrease in the expected future exchange rate, $E^e_{\$/\epsilon}$

Answer: $E_{\$/\epsilon}$ decreases \rightarrow return on € deposits increases \rightarrow \$ appreciates, € depreciates, $E_{\$/\epsilon}$ decreases

9. Consider the different interest rate parity conditions studied in the chapter. Why might the exchange rate used in forward contracts differ from the current spot rate? Why might the forward rate differ from the future spot rate expected by investors? Explain.

Answer: According to CIP, the difference between the forward rate and the current spot rate reflects differences in interest rates over time. Because investors can easily arbitrage away these differences without risk, the CIP holds, but this does not imply that forward rates and spot rates are equal.

If UIP and CIP hold, then $F_{\$/\epsilon} = E^e_{\$/\epsilon}$. Therefore, we would expect that the forward rate and expected future spot rate are equal. If they differ, this would reflect errors in

investors' forecasts. It is worth noting, however, that UIP involves risky arbitrage—investors are trading on their forecasts expected exchange rates, without the cover of a forward contract.

