Lecture Notes for Chapter 3

International Financial Markets and Institutions

Chapter 3

The spot market for foreign exchange

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Road Map

3.1 Main Issues

- The organization of the market for trading spot exchange.
- The convention for quoting the spot exchange rate.

3.2 Motivating problems

Motivating Problem 3.1 (Cross rates)

You work for a large multinational firm that has its headquarters in Paris. The multinational firm has subsidiaries in 2 countries—Japan and Canada. All foreign sales are made through these subsidiaries. Each month, the subsidiaries remit to the Paris office their income over the month. This income is in the local currency of the country in which the subsidiary is located (JPY and CAD).

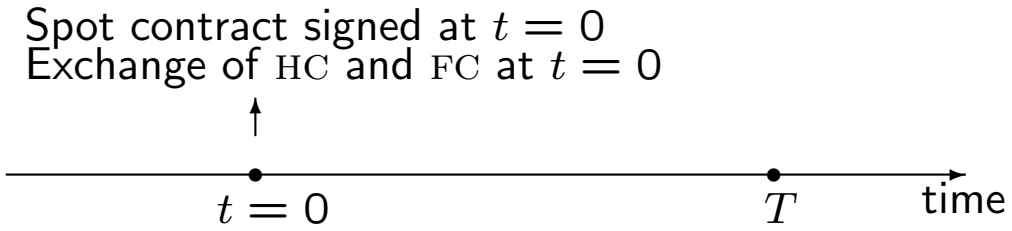
- The exchange rates that are quoted to you are in terms of the USD; that is, USD/JPY and USD/CAD. How do you find the rates in terms of FRF.

- If the inflows are JPY 100 M and CAD 10 M, what is their total value in terms of FRF.

3.3 Definition of the spot exchange rate

Definition 3.1 (Spot exchange rate)

The spot rate, S_t, is the amount of HC one pays or receives in exchange for one unit of the FC today ($t = 0$).



Example 3.1 (Spot exchange rate for goods)

- If one needs USD 100 to buy a copy of the textbook, then the exchange rate is USD 100/textbook.

- If one receives USD 2000 when selling a computer, then the exchange rate is USD 2000/computer.

Example 3.2 (Spot exchange rate for currencies)

From the second column of Table 3.1, where the USD/FC quotes are given, we see that:

- One needs USD 1.6173 to buy one GBP; thus, the exchange rate is USD 1.6173/GBP, often written as: USD/GBP 1.6173.

- One receives USD 0.664 when selling one CAD; thus, the exchange rate is USD 0.664/CAD or USD/CAD 0.664.

Table 3.1: Foreign exchange spot rates

For selected currencies, as reported by *The Wall Street Journal* on July 29, 1999

Country	US$ equiv	Currency per US$
column 1	column 2	column 3
Belgium (Franc)	0.0266	37.62
Britain (Pound)	1.6173	0.6183
Canada (Dollar)	0.664	1.506
China (Renminbi)	0.1208	8.2773
Denmark (Krone)	0.144	6.9425
France (Franc)	0.1635	6.1173
Germany (Mark)	0.5482	1.824
Hong Kong (Dollar)	0.1288	7.7618
Japan (Yen)	0.008662	115.45
Sweden (Krona)	0.1221	8.1868
Switzerland (Franc)	0.6721	1.4878
Euro	1.0723	0.9326

3.4 Market organization

3.4.1 Trading in the currency market

- Currency trading does not occur on an organized exchange
  - In contrast to stock markets and futures markets, trading is not limited to a particular time, there is no centralized clearing mechanism, and contracts are not standardized.

- The currency market consists of
  - a wholesale tier, (an informal network of about 500 banks and currency brokers that deal with each other and with large corporations), and
  - a retail tier.

- Most interbank dealing is done electronically.

- Many players in the wholesale market act as market makers.
  - Any interested party can ask a market maker for a two-way quote (that is, bid and ask quotes), without having to reveal whether she intends to buy or sell.
  - Such a quote is binding: a market maker undertakes to buy or sell at the price that was indicated.
  - Of course, there are limits to the market maker's commitment to this quote.
    - The potential customer should decide almost immediately whether to buy ('mine'), sell ('yours'), or not to deal; she cannot invoke a quote made, say, five minutes ago.
    - The quote is good for only a standard amount—typically USD 1 million.

- Another way of dealing is via currency brokers.

  - The broker, who at any given moment may have open telephone lines with one hundred banks, will then shop around and see if there are any takers at this price.
  - Roughly half of the transaction volume occurs via brokers.

- At any point in time, exchange markets on at least one continent are active, so that the world-wide exchange market is open 24 hours a day.

3.4.2 Statistics about the currency market

- Size
  The daily volume of trading on the exchange market (including the currency futures, options, and swaps markets) is more than USD 1800 billion.
  - It is about five to ten times the daily volume of international trade in goods and services.

- Location
  The major markets are, in order of importance, London, and New York, with less important markets being Singapore, Zurich, Hong Kong, and Frankfurt.

- Currencies
  The most important markets, per currency, have been USD/DEM and the

USD/JPY markets; together they represent over half of the world trading volume.

3.4.3 Currency markets by delivery date

The exchange market consists of two core segments:

- *Spot:* the exchange market for payment (of home currency) and delivery (of foreign currency) "today".
  - In practice, "today" means the same day only when you buy or sell notes or coins (and this part of the market is very small).
  - For 'electronic' deposits, delivery is within two working days for most currencies, and one day between Canada and the US or between Mexico and the US.

- *Forward:* the exchange market for contracts signed today but payment and delivery take place at some future date.
  - The forward market consists of many sub-segments corresponding to different delivery dates, with each sub-segment having its own price.
  - The most active forward markets are for 30, 90, 180, 270, and 360 days, but bankers nowadays quote rates up to ten years forward.
    * Note that months are indicated as 30 days.
    * A 30-day contract is settled one month later than a spot contract, and a 180-day forward contract is settled six months later than a spot contract—each time including the two-day delay convention.
    * You can always obtain a price for non-standard maturities, too, for instance 64 days (two months and four days), or for a specific date.

- *Volume*

  In London,

  - spot transactions represent about 50% of the total foreign exchange market volume.
  - The forward market, together with the closely related swap market makes up another 47% of the volume.
  - The remaining 3% of total trade consists of currency futures and currency options.

3.5 Conventions for quoting the spot exchange rate

We first look at the simple (but unrealistic) case where there are no transactions costs; then, we consider the case with bid-ask spreads.

3.5.1 Spot rate without transactions costs

- Our convention: quote exchange rates in terms of HC/FC.
  - This quote tells us the price of the FC.
  - Thus, statements about buying or selling will always refer to the currency in the denominator (the "foreign" currency).
  - This convention, standard in continental Europe, is called the *direct quote*.

Example 3.3 (Direct spot exchange quotes)

From the second column of Table 3.1 (on page 8), we see that:

– One needs USD 0.65 to buy one AUD; thus, the exchange rate is USD/AUD 0.65.

– The exchange rate with the Belgian Franc is USD/BEF 0.0266.

- The second column in Table 3.1 treats the USD as the HC and the other currency as the FC.

- The third column treats the USD as the FC and the other currency as the HC. Thus, the numbers in the last column are the *inverse* of the numbers in the second column.

Example 3.4 (Inverting exchange rates)

From the second column of Table 3.1, we can compute the quotes given in the third column as follows:

- The USD/AUD rate is 0.65, implying that the AUD/USD rate is $\frac{1}{0.65} = 1.5385$.

- The USD/EUR rate is 1.0723, implying that the EUR/USD rate is $\frac{1}{1.0723} = 0.9326$.

Given an exchange rate HC/FC (which is a quote for FC since it is in the denominator), we can get the quote for the HC by inverting this exchange rate.

3.5.2 Cross exchange rates

All the quotes in Table 3.1 are in terms of the USD. But one may also wish to make spot transactions between other currencies *without* going through the USD.

The rate at which one can exchange two non-USD currencies directly is called the *cross rate*.

The cross rate for different currencies is given in Table 3.2.

Table 3.2: Currency cross spot rates

For selected currencies, as reported by *Dow Jones* on July 29, 1999

	Dollar	Euro	Pound	Yen	D-Mark	FFranc	CdnDlr
Canada	1.506	1.6149	2.4357	0.01304	0.82566	0.24619	....
France	6.1173	6.5596	9.8935	0.05299	3.3538	....	4.062
Germany	1.824	1.9559	2.95	0.0158	....	0.29817	1.2112
Japan	115.45	123.8	186.72	....	63.295	18.873	76.66
U.K.	0.6183	0.663	....	0.00536	0.33899	0.10108	0.41057
Euro	0.9326	....	1.5083	0.00808	0.51128	0.15245	0.61924
U.S.	....	1.0723	1.6173	0.00866	0.54825	0.16347	0.66401

Example 3.5 (Reading cross rates)

– The cross exchange rate for CAD/EUR is 1.6149.

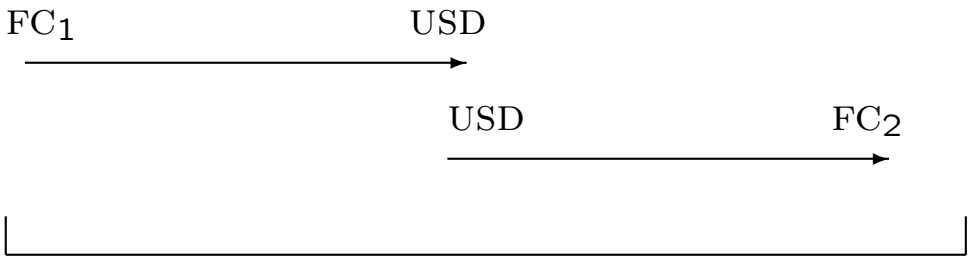
– The cross exchange rate for DEM/JPY is 0.0158.

Calculating cross exchange rates To calculate the cross rate between two non-USD currencies, say $\mathrm{FC}_1/\mathrm{FC}_2$, one needs to assume that one is first exchanging FC_1 for USD and then exchanging USD for FC_2; that is, implicitly we are going through the USD.

To find out how many units of FC_1 we need to buy one unit of FC_2, we

- first find out how many units of USD we need to buy one unit of FC_2: $\mathrm{USD}/\mathrm{FC}_2$

- then, from the inverse quotes, find out how many units of FC_1 we need to buy this many units of USD: $\mathrm{FC}_1/\mathrm{USD}$.



First convert FC_1 to USD; then convert USD to FC_2
Both transactions take place at the same time: $t = 0$

Example 3.6 (Calculating cross rates)

– The cross exchange rate for CAD/EUR can be calculated (from Table 3.1) as follows:

$$[\text{USD/EUR } 1.0723] \times [\text{CAD/USD } 1.506] = \text{CAD/EUR}1.6149,$$

where we got the USD/EUR quote from the second column of Table 3.1 and the CAD/USD quote from the third column (because this is the inverse quote).

– Similarly, the cross exchange rate for DEM/JPY is:

$$[\text{USD/JPY } .008662] \times [\text{DEM/USD } 1.824] = \text{DEM/JPY}0.0158.$$

▶ Observe that we can take advantage of the currency units to check if we are doing the right calculations.

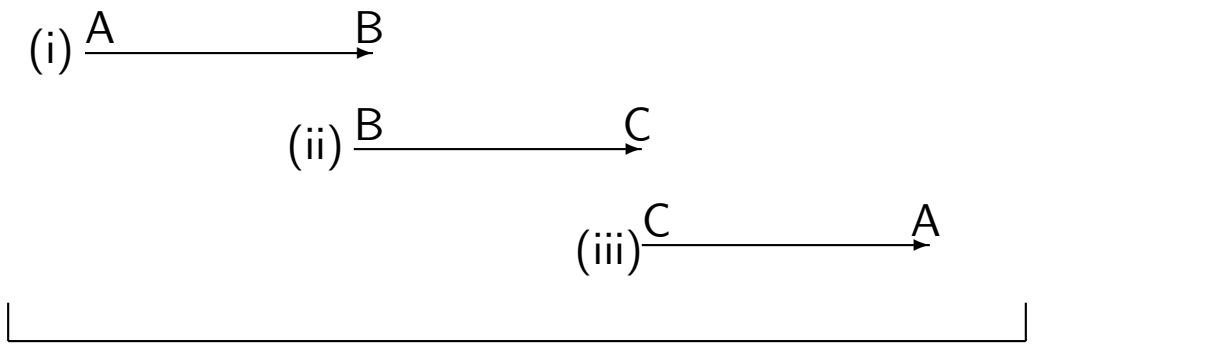
For example, in the last computation, if we write the exchange rate units as fractions:

$$\left[\frac{\text{USD}}{\text{JPY}}\ 0.008662\right] \times \left[\frac{\text{DEM}}{\text{USD}}\ 1.824\right] = \text{DEM/JPY}0.0158,$$

we see that the USD in the numerator of the first quote cancels out with the USD in the denominator of the second quote, leaving us with the quote we wish to determine: DEM/JPY

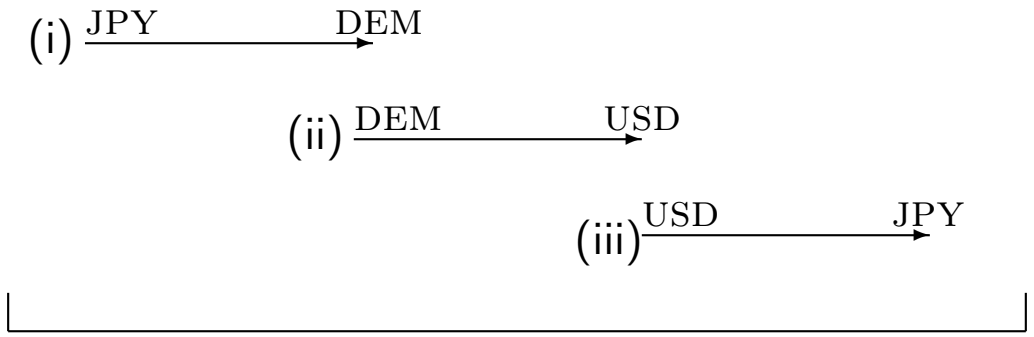
Cross rates and triangular arbitrage If the cross rate was different from the obtained from the calculations described above, then there would be an opportunity for triangular arbitrage.

Definition 3.2 (Triangular arbitrage)
Triangular arbitrage is the buying and selling of one currency for another, ending with the original currency, for the purpose of making a profit.



Example 3.7 (Cross rates and triangular arbitrage)

Suppose that the cross exchange rate for DEM/JPY is 0.0160 instead of 0.0158. Then, the following strategy could be used to make arbitrage profits:



– Sell one JPY and receive DEM 0.0160;

– To deliver (produce) these JPY,

  ⋆ Take DEM 0.0158 and buy USD at the rate USD/DEM 0.54825.

  ⋆ Take these USD and buy JPY at the rate JPY/USD 115.45.

⋆ This will give us:

$$\begin{aligned} &\text{DEM } 0.0158 \times \frac{\text{USD}}{\text{DEM}} 0.54825 \times \frac{\text{JPY}}{\text{USD}} 115.45 \\ = &\text{DEM } 0.0158 \times \frac{\text{JPY}}{\text{DEM}} \frac{1}{0.0158} = \text{JPY} 1. \end{aligned}$$

– Your profit per JPY is the difference:

$$\text{DEM } 0.0160 - \text{DEM } 0.0158 = \text{DEM } 0.0002.$$

▶ Triangular arbitrage ensures that spot rates are consistent across currencies—it determines the relation between different spot rates.

3.5.3 Spot rates with bid-ask spreads

- So far, we have ignored transactions costs.
- But when we buy an object we typically have to pay more for it than the price we would get for selling it.
  - Ask price: the price paid to buy the object (this is the seller's asking price).
  - Bid price: the price received when selling an object (this is the buyer's bid price).
- The difference between the ask price and the bid price is called the *bid-ask spread*.
- The spread is the "market-maker's" commission for executing the trade. This spread compensates the market-maker for taking a position that she may not desire.

- Markets where the trading volume is small will typically have larger spreads; this is because in these markets it is more difficult for the market-maker to get out of an undesirable position.

- Also, the commission is larger in the retail sector of the market as compared to the wholesale segment, and the commission usually increases as the size of the transaction decreases.

Definition 3.3 (Spot bid and ask exchange rates)

The spot ask exchange rate is the amount of HC one requires to buy one unit of the FC today, and the spot bid exchange rate is the amount of HC that one receives when selling one unit of the FC today.

Table 3.3: Foreign exchange spot bid and ask rates

Country	US$ bid	US$ ask
Britain (Pound)	1.6171	1.6175
Canada (Dollar)	0.6632	0.6648
Japan (Yen)	0.008652	0.008672
Euro	1.0721	1.0725

Example 3.8 (Spot bid and ask exchange rates)

– If you are planning a holiday to Britain and wish to buy Pounds, then the you have to pay USD/GBP 1.6175. This is the ask rate for GBP (the currency in the denominator)

– If you have some Pounds left over after your holiday, when you sell them you will received the bid rate, $\mathrm{USD}/\mathrm{GBP}$ 1.6171, which is less than what you paid to purchase Pounds.

3.5.4 Inverting spot rates with bid-ask spreads

- The spot bid-ask quotes in Table 3.3 are in terms of the USD.

  To get the inverse quotes, that is the quotes in terms of FC/USD, we need to invert the bid-ask quotes.

- To get the inverse bid quote we invert the USD/FC *ask* quote; to get the inverse ask quote, we invert the USD/FC *bid* quote.

- The reason why we invert the USD ask quote to get the inverse bid quote is that, to preclude arbitrage, the bid quote must always be smaller than the ask quote.

  Thus, to get the inverse bid quote to be the smaller number we need invert the (larger) direct ask quote; similarly, the inverse ask quote will be larger than the inverse bid quote only if it obtained by inverting the (smaller) direct bid quote.

$$\text{FC/USD bid quote: } = \frac{1}{\text{USD/FC ask quote}}$$

$$\text{FC/USD ask quote: } = \frac{1}{\text{USD/FC bid quote}}$$

Example 3.9 (Inverting bid-ask spot exchange rates)

In Table 3.4, the fourth column (bid per US$) is obtained by inverting the US$ ask quotes in the third column; the fifth column (ask per US$) is obtained by inverting the US$ bid quotes in the second column.

Consequently, the bid per US$ quotes in column 4 are smaller than the corresponding ask per US$ quotes in column 5.

Table 3.4: Foreign exchange spot bid and ask rates

Country	US$ bid	US$ ask	bid per US$	ask per US$
column 1	column 2	column 3	column 4 $= \frac{1}{\text{column 3}}$	column 5 $= \frac{1}{\text{column 2}}$
Britain (Pound)	1.6171	1.6175	0.6182	0.6184
Germany (Mark)	0.5480	0.5484	1.8235	1.8248
Japan (Yen)	0.008652	0.008672	115.3136	115.5802
Euro	1.0720	1.0726	0.9323	0.9328

3.6 Summary

- Currencies are not traded on an organized exchange; instead trading takes place via banks (market-makers) and brokers.

- The market for currencies is very deep—over USD 1.8 trillion is traded daily,
  - with most of the trade being in the spot and forward markets, and
  - a majority of this being unrelated to trade in goods and services.

- Quotes for spot exchange rate are typically against the USD (direct).
  - Indirect quotes can be obtained by inverting the appropriate direct quote.
  - Cross rates can be obtained by computing the effective rate if one transacted via the USD.

3.7 Recommended readings

- Chapters "0" and 1 of Sercu and Uppal, "International Financial Markets and the Firm."

3.8 Practice problems

Quiz questions

- Questions 1–9 on page 41 of SU Chapter 1.

Exercise questions

- Questions 2–5 on page 42 of SU Chapter 1.