Chapter 1

International Financial Markets: Basic Concepts

In daily life, we find ourselves in constant contact with internationally traded goods. If you enjoy music, you may play a U.S. manufactured CD of music by a Polish composer through a Japanese amplifier and British speakers. You may be wearing clothing made in China or eating fruit from Chile. As you drive to work, you will see cars manufactured in half a dozen different countries on the streets.

Less visible in daily life is the international trade in financial assets, but its dollar volume is much greater. This trade takes place in the international financial markets. When international trade in financial assets is easy and reliable—due to low transactions costs in liquid markets—we say international financial markets are characterized by *high capital mobility*.

Financial capital was highly mobile in the nineteenth century. The early twentieth century brought two world wars and the Great Depression. Many governments implemented controls on international capital flows, which fragmented the international financial markets and reduced capital mobility. Postwar efforts to increase the stability and integration of markets for goods and services included the creation of the General Agreement on Tariffs and Trade (the GATT, the precursor to the World Trade Organization, or WTO). Until recently, no equivalent efforts addressed international trade in securities. The low level of capital mobility is reflected in the economic models of the 1950s and 1960s: economists felt comfortable conducting international analyses under the assumption of capital immobility.

Financial innovations, such as the Eurocurrency markets, undermined the effectiveness of capital controls.[1] Technological innovations lowered the costs of international transactions. These factors, combined with the liberalizations of capital controls in the 1970s and 1980s, led to the development of highly integrated world financial markets. Economists have responded to this "globalization" of financial markets, and they now usually adopt perfect capital mobility as a reasonable approximation of conditions in the international financial markets.

International capital flows surged after the oil shock of 1973–74, which spurred financial intermediation on a global scale. Surpluses in the oil-exporting countries and corresponding deficits among oil importers led to a recycling of "petrodollars" in the growing Euromarkets. Many developing countries gained new access to international capital markets, where they financed mounting external imbalances. Most of this intermediation occurred in the form of bank lending, and large banks in the industrial countries accepted huge exposures to developing country debt. The debt crisis of the 1980s led to a significant slowdown in capital flows to emerging markets.[2] The waning of the debt crisis led to new large-scale private capital inflows to emerging markets in the 1990s.[3] Private capital responded to the efforts of many Latin American countries to liberalize, privatize, open markets, and enhance macroeconomic stability. Countries in Central and Eastern Europe began a transition toward market economies, and rapid growth in a group of economies in East Asia had caught the attention of investors worldwide. Net long-term private flows to developing countries increased from \$42 billion in 1990 to \$256 billion in 1997. This time the largest share of

[1] The term 'Eurocurrency' refers to deposits denominated in a currency that is not the currency of the financial center where the deposit is held, such as dollar deposits in London or dollar deposits in Japan. The second example makes it clear that the terms is misleading, as Europe need not be involved.

[2] Loose monetary and fiscal policies in the borrowing countries, sharp declines in their terms of trade, and high international interest rates, triggered the debt crisis of the 1980s. Starting in Mexico in 1982, that crisis rapidly engulfed a large number of developing countries in Latin America and elsewhere.

[3] Debts were rescheduled, restructured, and finally reduced with the inception of the Brady Plan in 1989.

these flows took the form of foreign direct investment (investment by multinational corporations in overseas operations under their own control). These flows totaled $120 billion in 1997 (Council of Economic Advisors, 1999, p.221). Bond and portfolio equity flows were 34 percent of the total in that year, while commercial bank loans represented only 16 percent, compared with about two-thirds in the 1970s Council of Economic Advisors (1999, p.222). Net flows have been large and growing, but gross cross-border inflows and outflows have grown even faster. The Mexican peso crisis of December 1994 led to a modest slowdown in capital flows to emerging markets in 1995, they surged again thereafter until the Asian crisis erupted in the summer of 1997.

1.1 Foreign Exchange Market

Foreign exchange is highly liquid assets denominated in a foreign currency. In principle these assets include foreign currency and foreign money orders. However most foreign exchange transactions are purchases and sales of bank deposits. A ***foreign exchange rate*** is the price of one nation's currency in terms of another's.

> You can find exchange rate time series on FRED:
> `http://research.stlouisfed.org/fred2/categories/15`

When goods, services, or securities are traded internationally, the currency denomination of the payment may be an issue. The most obvious role of the foreign exchange market is to resolve this issue. Suppose for example that a US exporter of calculators to Mexico wishes to receive payment in dollars while the importer possesses pesos with which to make payment. Transforming the pesos into dollars will generally take place in the foreign exchange market.

When we speak of the foreign exchange market, we are usually referring to the trading of foreign exchange by large commercial banks located in a few financial centers—especially London, New York, Tokyo, and Singapore. Foreign exchange transactions topped $250B/day by 1986. By 1995 the foreign exchange market had a *daily* transactions volume of over a trillion dollars in the major financial centers (BIS, 2002, Table B.1).[4] By 1998 volume had risen to more than USD 1.5 trillion per day (after making corrections to avoid double counting). This is about 60 times the global volume of exports of goods and services.[5] However 1998 marked a temporary peak of trading volume in the traditional foreign exchange markets: although the forward market continued to grow, trading volume fell sharply in the spot foreign exchange markets. By 2001 volume had fallen to about $1.2 trillion per day. However, as seen in Figure 1.1, by 2007 volume reached USD 3.2T per day. As seen in Table 1.1, the dollar was still involved in about 90% of transactions, with the USD/EUR volume being more than a quarter of the total.

About 31% of these transactions take place in London and 16% in New York, similar to the situation in the previous decade. In the 1980s Tokyo established itself as a major center, but it has lost ground to Singapore. In 1992 Tokyo had about 13% of the foreign exchange volume; the most recent survey pegs it at 9% and gives Singapore around 6%. About half the trading volume was the USD vs. the EUR and the JPY (BIS, 2002, Table B.7). With the adoption of the euro, trading shares were little changed, but there was some decline in volume associated with the elimination of intra-EMS trading. The share of trading in the euro against the dollar in 1999 roughly matched that of the German mark, French franc and Italian lira against the dollar in April 1998. Moreover, the euro/yen market appeared to be as small as the mark/yen market in 1998 (BIS, 2000, p.98).

Between 1995 and 1998, the share of electronic broking in spot foreign exchange market activity increased from about 10% to about 15%. The share doubled in the following two years, and in certain market segments, such as those involving the major currencies, electronic brokers reportedly covered between 50 and 80% of the market. The advance of electronic broking owes much to its lower costs, higher efficiency and, most importantly, greater transparency compared to traditional means of dealing. Spot foreign exchange mar-

[4]The Bank for International Settlements (BIS) is an international institution in Basle, Switzerland, that acts as a kind of central bankers' bank.

[5]In 1997 global exports were about $6.6 trillion, or about $25 billion per trading day (Council of Economic Advisors, 1999, p.224).

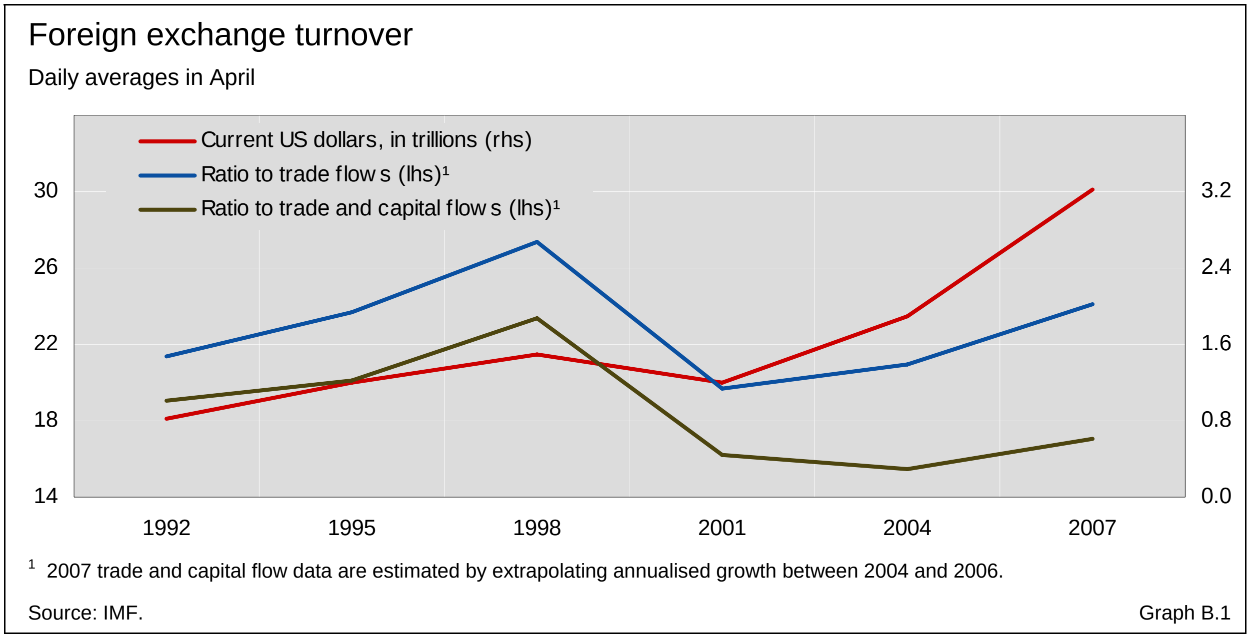

Figure 1.1:
Source: BIS 2007

kets have traditionally been opaque, given the difficulty of disseminating price information in the absence of centralised exchanges. Before the advent of electronic broking, dealers had typically to enter into a number of transactions to get information market prices. The role of such price discovery activities has been drastically reduced as traders turn to electronic brokers, which are able to instantly determine the "best" price available in the market. As a result, foreign exchange dealers now require fewer transactions than needed in traditional trading. Bid-ask spreads on the major exchange rates have fallen dramatically.

You can get foreign-exchange market data from the BIS:

`http://www.bis.org/publ/rpfxf07t.htm`

The foreign exchange market is constituted by a geographically dispersed web of brokers, traders, businesses, and individuals. There is always at least one active center, so the foreign exchange market is open twenty-four hours a day. The main participants in this market are retail customers, commercial banks, foreign exchange brokers, and central banks.

Retail customers generally transact with commercial banks. Commercial banks hold in-

Table 1.1:

Reported foreign exchange market turnover by currency pair[1]

Daily averages in April, in billions of US dollars and per cent

	2001		2004[2]		2007	
	Amount	% share	Amount	% share	Amount	% share
US dollar/euro	354	30	503	28	840	27
US dollar/yen	231	20	298	17	397	13
US dollar/sterling	125	11	248	14	361	12
US dollar/Australian dollar	47	4	98	5	175	6
US dollar/Swiss franc	57	5	78	4	143	5
US dollar/Canadian dollar	50	4	71	4	115	4
US dollar/Swedish krona[3]	…	…	…	…	56	2
US dollar/other	195	17	295	16	572	19
Euro/yen	30	3	51	3	70	2
Euro/sterling	24	2	43	2	64	2
Euro/Swiss franc	12	1	26	1	54	2
Euro/other	21	2	39	2	112	4
Other currency pairs	26	2	42	2	122	4
All currency pairs	1,173	100	1,794	100	3,081	100

[1] Adjusted for local and cross-border double-counting. [2] Data for 2004 have been revised. [3] The US dollar/Swedish krona pair could not be separately identified before 2007 and is included in "other". Table B.5

Source: BIS 2007

ventories of foreign exchange to satisfy the needs of their retail customers. When a retail customer purchases foreign exchange from a commercial bank, the bank's inventories of foreign exchange are depleted. When the customer sells foreign exchange, the bank's inventories increase. If the many retail sales and purchases were perfectly matched, there would be no net effect on the banks inventories of foreign exchange. But since sales and purchases are imperfectly offsetting, the bank's inventories move above or below their desired level. This is the basis of an active market in foreign exchange among commercial banks.

Commercial banks in the U.S. may trade foreign exchange directly with each other. More often, they rely on interbank intermediaries called foreign exchange ***brokers***. A broker is someone who "brings together" a buyer and a seller, without taking a position in foreign exchange. That is, the broker simply arranges the transaction for a fee. This fee is a ***spread*** between what a purchaser of foreign exchange pays (the ***ask price***) and what the seller of foreign exchange receives (the ***bid price***).

Use of a foreign exchange broker allows anonymous pricing, which is a reason central banks also rely on brokers for their foreign exchange transactions. Major brokerage houses are global and thereby able to service the interbank market around the clock.

1.2 Exchange Rates

We have been talking about the purchase and sale of foreign exchange. Of course, these transactions must take place at some price. We call that price the ***exchange rate***. That is, an exchange rate is the rate at which two different monies trade for each other. In this book, an exchange rate is the number of units of the domestic money required to purchase one unit of a foreign money. This type of exchange rate is called a ***direct quote***.[6] With this convention, an exchange rate is like any other price: the domestic currency cost of a purchase.

[6]The ***reverse quote***—the number of units of foreign money required to purchase one unit of the domestic money—is also often reported and referred to as an exchange rate. In fact US traders generally use the reverse quote convention, but we use the direct quote—a price like any other—because it is conceptually simpler.

For example, if an American must spend USD 0.95 to buy a Canadian dollar, the exchange rate is CAD-USD=0.95. The first currency in the pair is called the ***base currency***. The second currency in the pair is called the ***quote currency*** (or counter currency). So in this example, the base currency is the Canadian dollar and the quote currency is the U.S. dollar. An exchange rate states how much of the quote currency you need to buy one unit of the base currency.

From the perspective of a Canadian facing the same relative price, it takes CAD 1.05 to buy a American dollar, so the exchange rate is USD-CAD=1.05. Note that we have the three letter ***ISO codes*** to describe the relationship between the Canadian dollar (CAD) and the U.S. dollar (USD).[7] In this book, we shall also use the codes for the Euro (EUR), the British pound (GBP), and the Japanese yen (JPY).

1.2.1 Spatial Arbitrage

As discussed above, the foreign exchange market is geographically dispersed but highly integrated. The primary reason for this is the extremely low transactions costs, both in the actual transfer of foreign exchange and in communication between different centers. Transfer costs are low because of the perfect homogeneity and minimal costs of geographical transport of the traded commodities (e.g., dollar bank deposits). Communication takes place continuously by telephone and computer network. As a result, exchange rates in different centers are closely aligned. This ***spatial arbitrage*** quickly eliminates differences in exchange rates between centers.

We will work with a stark definition of ***arbitrage***: buying an item where it is cheap and *simultaneously* selling it where it is dear. Naturally this raises demand and therefore price

[7] The codes were created by the International Organization for Standardization and are maintained as ISO Number 4217:1995, "Codes for the representation of currencies and funds." The ISO 4217 currency code is usually composed of the country's two-character ISO 3166 country code plus an extra character to denote the currency unit. For example, the code for United States Dollars is simply the US's two-character ISO 3166 code ("US") plus a one-character currency designator ("D"). For more discussion see http://www.xe.com/iso4217.htm. For the ISO 3166 codes see http://www.din.de/gremien/nas/nabd/iso3166ma/.

in the cheap location, whereas in the dear location supply rises and price falls. The price for the arbitraged item thereby moves toward a single value in all locations.

The limiting case of zero transactions costs captures the key intuition behind arbitrage. For example, suppose you received a quote of CAD-USD=0.81 in New York and CAD-USD=0.82 in London. You could simultaneously buy Canadian dollars in New York for USD 0.81 and sell them in London for USD 0.82, making a risk free profit. Such a transaction is arbitrage, a risk free profit with essentially no capital investment. Of course arbitrage opportunities are extremely attractive, so we expect quick, large responses to them. The demand for CAD rises in New York and the supply rises in London, quickly eliminating any differences in exchange rates between centers.

1.2.2 Triangular Arbitrage

Let us ignore transaction costs for a moment, and consider a situation where the law of one price prevails for each exchange rate. That is, there is a single price at which each currency can be bought or sold in terms of each other currency. For example, imagine that you had the extreme good fortune to be quoted the following exchange rates.

	↓ buys →	USD	CAD	JPY
USA	USD	1	1.25	100
Canada	CAD	0.8	1	100
Japan	JPY	0.01	0.01	1

Table 1.2: Imaginary Opportunity for Triangular Arbitrage

You can buy JPY 100 with USD 1; and you can then sell JPY 100 back for USD 1. Since we are ignoring transactions costs, you just end up back where you started. And this is true for every pair of currencies in table 1.2. But this does not mean that there are no arbitrage opportunities left. Suppose you bought CAD 1.25 for USD 1, but then bought JPY 125 for your CAD 1.25. The same initial dollar purchase has netted you more yen. (We call the indirectly achieved exchange rate of USD-JPY=125 a ***synthetic*** cross rate.) Note that you could now sell your JPY 125 for USD 1.25, completing a ***triangular arbitrage*** that nets you a profit.

As before, we expect that the activity of arbitrageurs will lead to an adjustment of the exchange rates and an elimination of this profit opportunity. That is, we expect triangular arbitrage to align exchange rates so that there are no profits from sequentially buying and selling three currencies. As a result, it is not cheaper to acquire desired foreign currency indirectly (via a third currency) than directly.

In the absence of triangular arbitrage opportunities, should we consider the profitability of sequentially buying and selling larger numbers of currencies? The answer is no: the elimination of triangular arbitrage opportunities also eliminates the profits from longer sequences of buying and selling.

1.3 Forward Exchange

Up to now, our discussion of the foreign exchange market has focused on the ***spot*** rate: the price for immediate delivery of foreign exchange.[8] However it is also possible to use a *forward contract* to contract for future sale or purchase of foreign exchange. Like a spot contract, a forward contract specifies quantity of foreign exchange to be purchased or sold and a price at which the transaction is to take place. However it also specifies a future date on which the transaction is to take place. There are active *forward markets* in major currencies for one month, two months, three months, 6 months, 9 months, and a year out. Total volume on the forward exchange markets exceeds that on the spot markets, with most of it occurring in the one month and three month forward contracts. Spot market purchases have declined to 40 percent of foreign exchange transactions in 1998, and forward instruments continued to grow in importance relative to spot sales (Council of Economic Advisors, 1999, p.224).[9]

[8] Although small spot transaction may take place with no delay, large spot transactions may allow up to two working days for delivery (depending on the currencies involved).

[9] Over-the-counter derivatives remain a small fraction of total transactions, but they have been the fastest-growing segment of the market.

It is not unusual for banks to quote rates up to ten years forward. The price specified in a forward contract is referred to as the *forward exchange rate*.[10]

Two primary functions of the forward market are hedging and speculation. Hedging is the purchase or sale of an asset in order to offset the risk involved in one's current financial position. For example, someone who expects a future payment in foreign exchange can offset the implied exchange risk (the risk of an unforeseen change in the spot rate) by selling that foreign exchange forward. Speculation is the purchase or sale of an asset in order to profit from the difference between the current value of the asset and its expected future value. For example, speculators can try to profit from any difference between the current forward rate and their expectations of the future spot rate. Only about 20% of foreign exchange directly trades involve nonfinancial customers (Council of Economic Advisors, 1999, p.224).

1.3.1 FX Swaps

You could combine a spot transaction with a forward transaction in the reverse direction. This locks in a rate of return based on the difference between the two rates. Foreign exchange swaps allow you to arrange this as a single transaction. For example, foreign exchange may be purchased spot and sold forward. The combined transaction is detailed in a single contract, the foreign exchange swap contract, which specifies the term of the swap and the swap rate. There are two settlement dates: the start date (or "near" date), when the currencies are first exchanged, and the end date (or "far" date), when they are exchanged back. The difference between the two exchange rates is called the swap rate (or swap *points*, if only the final digits are quoted). For reporting purposes, a swap is considered a single transaction. As seen in Table 1.3, foreign exchange swaps constitute the bulk of trading in the foreign exchange market.

[10] The forward exchange rate is sometimes called the *outright rate*. Rather than quote the outright rate, market makers may quote the much less volatile *swap rate*. The swap rate is the difference between the outright rate and the spot rate. For example, suppose the spot rate is CAD-USD=0.80 spot and you are quoted a swap rate of +0.01. (The CAD is trading at a forward premium.) This implies a forward rate of CAD-USD=0.81. The swap rate is less volatile than the forward rate because forward and spot rates tend to move together.

Table 1.3:

Global foreign exchange market turnover[1]

Daily averages in April, in billions of US dollars

	1992	1995	1998	2001	2004[2]	2007
Spot transactions	394	494	568	387	631	1,005
Outright forwards	58	97	128	131	209	362
Up to 7 days	…	50	65	51	92	154
Over 7 days	…	46	62	80	116	208
Foreign exchange swaps	324	546	734	656	954	1,714
Up to 7 days	…	382	528	451	700	1,329
Over 7 days	…	162	202	204	252	382
Estimated gaps in reporting	44	53	60	26	106	129
Total "traditional" turnover	820	1,190	1,490	1,200	1,900	3,210
Memo: Turnover at April 2007 exchange rates[3]	*880*	*1,150*	*1,650*	*1,420*	*1,970*	*3,210*

[1] Adjusted for local and cross-border double-counting. Due to incomplete maturity breakdown, components do not always sum to totals. [2] Data for 2004 have been revised. [3] Non-US dollar legs of foreign currency transactions were converted from current US dollar amounts into original currency amounts at average exchange rates for April of each survey year and then reconverted into US dollar amounts at average April 2007 exchange rates. Table B.1

Source: BIS 2007

For example, a CA firm may need USD 100,000 for three months. Say the initial exchange rate is CAD 1.2000 per USD with 31 swap points, so that the re-exchange rate is CAD 1.2031 per dollar. At the start date, the firm will pay CAD 120,000 for USD 100,000. At the end date the firm "returns" the USD 100,000 and receives CAD 120,310.

1.3.2 Hedging

Fluctuations in the spot exchange rate cause fluctuations in the value of assets denominated in a foreign currency. That is, holding such assets involves *currency risk*. The forward market can be used to *hedge* this risk. To see how, imagine that you are a U.S. exporter who expects to receive payment of JPY 1M in one month. Since the USD-JPY exchange rate may move during the month, you do not know what the dollar value of your receipts will be. You are exposed to currency risk. However, you could sell the JPY 1M forward today, which would eliminate the currency risk and lock in the dollar value of the receipts.[11]

[11] Of course, you do not need the forward market to hedge your future receipt. Instead you could borrow JPY 1M/$(1+i^*)$ which you will pay back with your JPY 1M receipt when it arrives. In the meantime, you

Exchange rate variability creates an incentive to hedge, to reduce the variance of profits. The extent of hedging will depend on its cost, of course. If you can sell forward your anticipated foreign exchange receipts at a price close to what you expect will prevail in the spot market, then hedging will look attractive. If the forward sale yields much less revenue than expected from a future spot sale, you are less likely to hedge. You may also be less likely to engage in international trade. To what extent is concern about the negative effects of exchange rate variability on international trade offset by the availability of hedging through the forward market?

1.3.3 Speculation

The forward market can also be used for pure speculation. Suppose for example that you expected that in one month a spot rate of CAD-USD=0.81 while the current one month forward rate was CAD-USD=0.8. You might choose to bet on your expected future spot rate by buying Canadian dollars forward for U.S. dollars, in anticipation of selling them for a profit. Of course this is risky: if the future spot rate turns out to be CAD-USD=0.79 you will lose from your speculative activity. Nevertheless, the further the forward rate deviates from your expected future spot rate, the greater your incentive to place a bet on your expectation. This suggests that speculative activity will keep forward rates from wandering too far from the expected future spot rates of major participants in the foreign exchange markets.

Empirically, however, forward rates appear to be more closely linked to current than to future spot rates. This raises some puzzling questions that are explored in chapter 11. One possibility is that volatile new information is constantly shifting the spot rate and the

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can put the money to work for you without exchange risk by selling it spot and lending it, so that you end up with

$$\text{JPY 1M}\, S\,(1+i)/(1+i^*)$$

So choose the method of hedging that leaves you with the most dollars at the end of the transactions. When

$$F = S\frac{1+i}{1+i^*}$$

you will be indifferent between the two methods.

expected spot rate together, and the correlation between the spot rate and the forward rate reflects this. In this case, the forward rate might be the best possible predictor of the future spot rate, even though it is a poor predictor by absolute standards. In fact, **?** and **?** find that the forward rate outperforms professional forecasters. Another possibility is that the forward rate is not closely linked to the expected future spot rate. Note that as a matter of proximate causality, commercial banks set the forward rate to insure that covered interest parity holds (**?**). This places emphasis on the current spot rate and interest rates as determinants of the forward rate, rather than on the expected future spot rate. (See **?** for a discussion.)

Speculation in the spot market may exceed that in the forward market. Goodhart (1988) found that London bankers speculate on exchange rate movements by issuing debt in one currency in order to buy another currency spot.

1.3.4 Covered Interest Parity

The forward rate allows you to lock in an effective return from holding foreign currency. That is, you can spend S_t to buy a unit of foreign exchange today (time t) and then immediately sell it forward $T - t$ days in the future for $F_{t,T}$.[12] Your effective return is then

$$fd_{t,T} \stackrel{\text{def}}{=} \frac{F_{t,T} - S_t}{S_t} \tag{1.1}$$

We call fd the forward discount on the domestic currency or, equivalently, the forward premium on foreign exchange. For example, if the EUR-USD is 1.20 spot but is 1.23 forward 180 days, then the 180-day forward discount on the dollar is (1.23-1.20)/1.20=0.025. Using this computation, figure 1.2 illustrates variations in the forward discount for a given forward rate and various spot rates.

The forward discount on the domestic currency is positive if the forward rate is greater

[12] In practice you would undertake these two transactions in a single contract to reduce the transactions cost. The forward discount gives the effective return over the period $[t, T]$: a percentage return that has not been annualized.

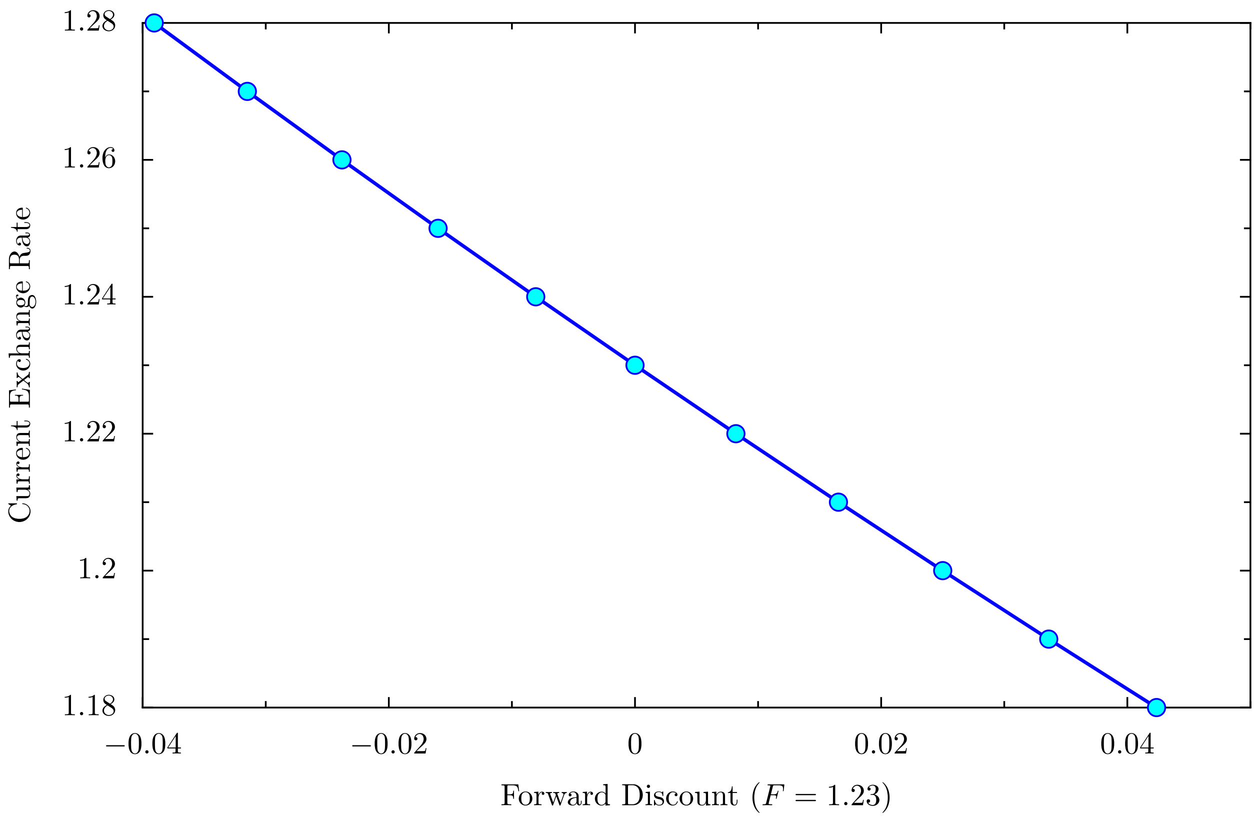

Figure 1.2: Computing the Forward Discount on the Domestic Currency

than the spot rate—that is, if the domestic currency price of foreign exchange is higher in the forward market than in the spot market. In this case, we say that the domestic currency trades at a forward discount. The forward discount on the domestic currency is negative if the forward rate is less than the spot rate. In this case, we say that the domestic currency trades at a forward premium. Note that, ignoring the unlikely event of your forward contract going unfulfilled, the return defined by the forward discount is essentially risk free.

Of course, if effective return is your concern you can do better than this. Instead of holding foreign currency from t to T, you can invest in a foreign currency denominated interest bearing asset. Let $i^*_{t,T}$ be the risk free return available on foreign currency denominated assets. Then without incurring additional risk, you can raise your effective return to $i^*_{t,T} + fd_{t,T}$.[13] This is the basis of the concept of covered interest parity.

Let $i_{t,T}$ denote the risk free effective return on domestic currency denominated assets. We have seen that $i^*_{t,T} + fd_{t,T}$ is the risk free effective return available on foreign currency denominated assets. Since each of these is a risk free rate of return measured in the domestic currency, they must be equal.

$$i_{t,T} = i^*_{t,T} + fd_{t,T} \tag{1.2}$$

Equation (1.2) is known as the covered interest parity condition. When no confusion can arise as to the periods involved, we express (1.2) more simply as (1.3).

$$fd = i - i^* \tag{1.3}$$

[13] This development of the covered interest parity condition neglects the forward sale of the interest payment on the foreign currency denominated asset. That is, to eliminate all currency risk we need to sell forward $1 + i^*_{t,T}$ units of foreign exchange (not just one unit). If we take this into account, we get

$$i_{t,T} = i^*_{t,T} + fd_{t,T}(1 + i^*_{t,T})$$

as our covered interest parity condition. Since the product $fd_{t,T} i^*_{t,T}$ will often be very small, we will keep things simple by ignoring it.

Alternatively, if we interpret i as the log of one plus the domestic interest rate, i^* similarly, and fd as the log of one plus the forward discount, the original statement holds exactly.

Note that we have assumed the availability of risk free interest bearing assets. Country risk may be important for some assets, leading to deviations from covered interest parity. These deviations, known as the country premia, are small for the major industrial nations (Isard, 1988).

We say portfolio capital is "mobile" to the extent that international financial markets are frictionlessly integrated. (Frictions include transactions costs or government controls.) In such circumstance, domestic and foreign residents are on equal footing in the purchase and sale of domestic and foreign assets. We then expect opportunities for risk-free profit making—arbitrage opportunities—to be quickly and completely exploited. Thus the most basic measure of international capital mobility is the disappearance of arbitrage opportunities in international financial markets. Of particular interest for our current purposes is that different ways of obtaining a riskless interest yield in any one currency should yield identical rates of return. That is, covered interest parity should obtain. Covered interest parity is thus a basic condition of perfect capital mobility, and deviations from covered interest parity are a primary indicator of imperfections or frictions in international capital markets.

Deviations from covered interest parity can be due to transactions costs, capital controls, political risk (e.g., fear of capital controls), or limitations on the supply of arbitrage funds. The last of these may help explain why CIP does not appear to hold well over long horizons (e.g., several years). Political-risk is sometimes discussed under the rubric of 'safe-haven effects,' where an increase in perceived political risk leads to an increased demand for assets from countries with low political risk.

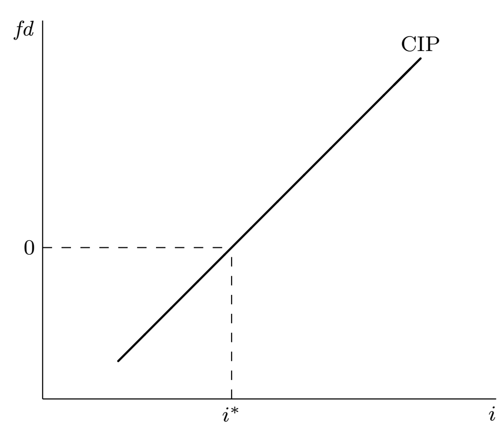

Figure 1.3: Covered Interest Parity

1.4 Capital Mobility

When financial assets are freely tradable across international borders at negligeable transactions costs, we speak of *perfect capital mobility*. For many countries, especially developed economies, perfect capital mobility seems to be a reasonable approximation of actual market conditions. Yet in a world with highly integrated financial markets, we might expect returns on similar domestic and foreign assets (Harberger, 1978). Returns on domestic and foreign assets often differ, even when the assets appear comparable in risk and liquidity characteristics.[14] In this section, we briefly explore three reasons for this divergence: risk premia, transactions costs, and capital controls.

1.4.1 Risk Premium

Even economies with perfect capital mobility may not have *perfect capital substitutability*. An individual treats two assets as perfect substitutes when the decision between them is based solely on their expected rate of return. An immediate implication is that when market participants consider two assets to be perfect substitutes, these will offer a common expected rate of return. Most assets, however, are not perfectly substitutable in an individual's portfolio. For example, an individual will usually care about the risk characteristics of assets, which generally differ among assets. (See chapter 11 for a more complete discussion.)

Compare the *ex post* real return from holding the domestic asset, with the uncovered real return from holding the foreign asset,

$$r_t \stackrel{\text{def}}{=} i_t - \pi_{t+1} \tag{1.4}$$

$$r_t^{df} \stackrel{\text{def}}{=} i_t^* + \Delta s_{t+1} - \pi_{t+1} \tag{1.5}$$

[14] Furthermore, domestic savings and investment are highly correlated, which is something of a puzzle in highly integrated financial markets (Feldstein and Horioka, 1980; Frankel, 1991). However, Montiel (1994) notes that Feldstein-Horioka tests indicate a relatively high degree of capital mobility for most Latin American countries, despite the extensive legal barriers.

Define the ***excess return*** on the domestic asset as difference between these two *ex post* real rates of return.

$$
\begin{aligned}
er_{t+1} &\stackrel{\text{def}}{=} r_t - r_t^{df} \\
&\stackrel{\text{def}}{=} (i_t - \pi_{t+1}) - (i_t^* + \Delta s_{t+1} - \pi_{t+1}) \\
&= i_t - (i_t^* + \Delta s_{t+1})
\end{aligned} \tag{1.6}
$$

This is the *ex post* difference in the uncovered returns.

A similar relationship must hold for the expected excess returns and the expected rate of depreciation of the spot rate. Consider an individual facing interest rates i and i^* who expects the spot rate depreciation to be Δs^e. If this individual understands (1.6) and has a minimal consistency in her expectations, then her expected excess return from holding the domestic asset with interest rate i instead of the foreign asset with interest rate i^* must be

$$er_{t+1}^e = i_t - (i_t^* + \Delta s_{t+1}^e) \tag{1.7}$$

A key determinant of an individual's asset allocation decisions will be the expected excess return from holding that asset. (We discuss this in detail in chapter 11.) We refer to the *equilibrium* expected excess return as the risk premium (rp) in the foreign exchange market. For convenience we will ignore any variation in the spot depreciation expected by different market participants, so we can just write the risk premium without ambiguity.

$$
\begin{aligned}
rp_t &\stackrel{\text{def}}{=} er_{t+1}^e \\
&= i_t - (i_t^* + \Delta s_{t+1}^e)
\end{aligned} \tag{1.8}
$$

In an ***efficient market***, the expectations of market participants are fully reflected in the equilibrium market price. That is, we call a market ***efficient*** when the market price is an equilibrium price that fully reflects the beliefs of market participants. When capital is highly mobile, we expect the foreign exchange markets to be very efficient in this sense.

In the example we are considering, interest rates will fully reflect the spot rate depreciation expected by market participants (since this determines their expected excess returns and thereby their asset demands). Capital mobility will also assure covered interest parity, so we can also express the risk premium as

$$rp_t = fd_t - \Delta s^e_{t+1} \tag{1.9}$$

1.4.2 CIP Again

Give our decomposition of the forward discount on the domestic currency into a risk premium on domestic assets and an expected rate of depreciation of the domestic currency, we can offer an alternative representation of covered interest parity.

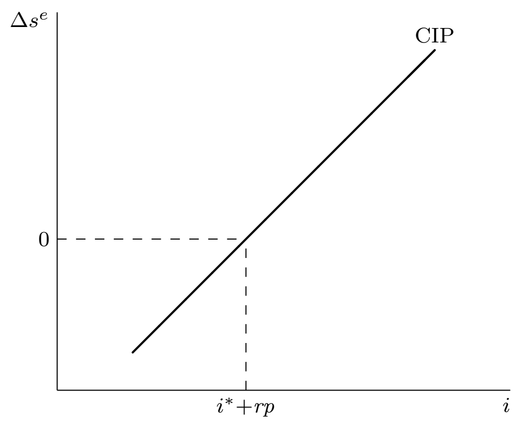

Figure 1.4: Covered Interest Parity

1.4.3 Transaction Costs

Although we will often work with the simplification of referring to a single exchange rate, the real world is a bit more complicated. First of all, there is a small difference between purchase and sale prices in the foreign exchange market. Foreign exchange is sold at the *ask rate*, while it is purchased at the lower *bid rate*. The *spread* between the selling and buying rates is a source of profits for the banks and brokers in the foreign exchange market.

$$
\begin{tikzcd}[row sep=huge, column sep=huge]
\boxed{\$_0} \arrow[r, shift right, "(1+t)/(1+i)"'] \arrow[d, shift right, "(1+t_S)S"'] & \boxed{\$_1} \arrow[l, shift right, "(1+t)(1+i)"'] \arrow[d, shift right, "(1+t_F)F"'] \\
\boxed{\pounds_0} \arrow[u, shift right, "(1+t_S)/S"'] \arrow[r, shift right, "(1+t^*)/(1+i^*)"'] & \boxed{\pounds_1} \arrow[l, shift right, "(1+t^*)(1+i^*)"'] \arrow[u, shift right, "(1+t_F)/F"']
\end{tikzcd}
$$

Source: Deardorff (1979).

Figure 1.5: Foreign Exchange and Securities Markets

In the late 1990s, the lower cost and greater transparency of electronic broking led to its domination of the spot foreign exchange market, driving the wholesale bid-ask spreads on most major currencies below three hundredths of a U.S. cent (BIS, 2000, p.99). Second, not everyone participates in the wholesale market. The modest foreign transactions of a small business or an individual will take place at much higher spreads. This is to be expected, for small transactions any fixed costs of foreign exchange transactions will have to be reflected in the spread (unless explicitly charged). The bid-ask spread varies by customer type. A tourist buying or selling foreign exchange at a bank may pay around 1%, creating a spread of 2%. The same tourist using a credit card may face a much lower spread, generally much closer to the wholesale spread.

In every case, the intuition behind arbitrage remains the same. For example, suppose you received a quote of CAD-USD=0.80-0.81 in New York and CAD-USD=0.82-0.83 in London. You could buy Canadian dollars in New York for USD 0.81 and simultaneously sell them in London for USD 0.82, making a risk free profit. Arbitrage opportunities exist as long as the bid price in one center is higher than the ask price in another. We therefore expect such occurrences to quickly disappear.

Competition and the Law of One Price

You may have noticed that in the presence of transaction costs the arbitrage argument does not assure that bid prices (or ask prices) are identical across centers. Arbitrage merely assures that bid and ask prices overlap. However we can expect identical bid and ask prices across centers due to the competition among traders in the foreign exchange markets. Any bank wishing to sell foreign exchange must offer it at a price as low as that of its competitors. Any bank wishing to buy foreign exchange must offer a price as high as its competitors. Thus all banks who wish to be involved in both buying and selling foreign exchange will have the same bid and ask prices.

Synthetic Cross Rates

Once we return to the consideration of transactions costs, synthetic cross rates may be preferable to direct rates despite triangular arbitrage. Essentially, a *synthetic* version of a contract relies on multiple transactions to achieve the goal of the contract. Clearly the transactions costs of multiple transactions will be an issue in the construction of synthetic contracts. Yet moving between two currencies can be cheapest using the U.S. dollar as an intermediary, despite the need to incur transactions costs twice. The reason is that the high trading volume in the U.S. dollar results in low spreads of the U.S. dollar against other currencies.

Although there are an increasing number of exceptions, most currencies simply are not traded against each other by professional traders. Even the most actively traded currencies tend to be traded against the dollar. Suppose we have twenty actively traded currencies; then each will have nineteen exchange rates. That is 380 prices to keep track of in the foreign exchange markets. But if all twenty currencies are always quoted against the dollar, there are only nineteen prices to keep track of. At the retail level, the background reliance on the dollar is invisible: the customer is simply quoted the cross-rate.

1.4.4 Capital Controls

Capital controls were common in the twentieth century. The use of capital controls surged during World War I and again during the Great Depression. After World War II, many countries continued to use capital controls in an effort to deal with balance-of-payments difficulties. The IMF explicitly permitted such controls.[15]

During the 1970s and 1980s, the developed countries removed most of their controls on the international trade in financial assets. The free flow of international capital was presumed to increase income and growth, and developing countries were encouraged to follow suit. In the 1990s, many developing countries nevertheless continued to rely on extensive capital controls, often as a way to insulate their macroeconomic policy from international considerations (Grilli and Milesi-Ferretti, 1995; Johnston and Tamirisa, 1998). Controls on capital outflows were the most prevalent. But countries also turned to controls on capital inflows, primarily to control direct foreign investment and real estate purchases (Johnston and Tamirisa, 1998). Latin American countries in particular, and especially Chile and Colombia, turned to controls on capital inflows in an attempt to slow large capital inflows (Edwards, 1998).

Capital flows are one way to move consumption between the present and the future, and there can be many good reasons to do this. Demographic shifts are one reason: an aging population may find it prudent to save for retirement by investing abroad. This may explain why the more rapidly aging Japanese population buys more assets from the U.S. than they sell there (Neely, 1999). Real investment opportunities are another reason. It can pay to borrow abroad in order to make high yielding domestic investments. For example, from 1960–1980 South Korea borrowed heavily in international markets, financing its domestic investments during a period of strong growth (Neely, 1999). Finally, it may pay to borrow

[15] Consider the following section of the IMF's Articles of Agreement, signed in 1944. "Article VI. Section 3. Controls of capital transfers: members may exercise such controls as are necessary to regulate international capital movements ..."

in order to consume in the face of temporary negative real-income shocks, including declines in export prices, rises in import prices, recession, or natural disasters. For example, after a devastating earthquake in 1980, Italy borrowed abroad to help finance disaster relief and rebuilding (Neely, 1999). These examples highlight the benefits of international capital flows.

However in the 1990s, a series of financial crises diminished the reputation of capital flows. In 1992–3, the European Monetary System. In December 1994, after a decade of reforms had finally led to renewed confidence and large capital inflows, Mexico experienced a major currency crisis. In 1997–8, several East Asian economies experienced large capital outflows that forced abandonment of exchange rate pegs and precipitated banking crises and severe recessions. As policy makers searched for ways to prevent a recurrence of such crises, many focused on the benefits of limiting the mobility of financial capital. On September 1, 1998, Malaysia adopted capital controls. The Malaysian strategy was to discourage short-term capital flows while permitting long-term capital to flow freely. Early assessments of the results were largely favorable, although some observers worried that they were replacing rather than enabling reform of a fragile financial sector (Neely, 1999).

Speculative Attacks

In 1997, government policies in Thailand led to high nominal interest rates and a stock market decline. Currency traders began to question whether the central bank could sustain these policies and whether a devaluation of the baht was imminent. High capital mobility meant that these speculators could rapidly move huge sums in order to place their bets against the baht. George Soros, a famous currency speculator who had profited handsomely from the collapse of the British pound in 1992, began with others to bet heavily against the baht. In May, trading soared from the usual USD 1B/day to more than USD 10B/day. Other Asian central banks aided the Thai central bank in its defense of the baht, and initially Soros and other traders left the field with huge losses. Ultimately, however, the speculators proved correct in their anticipation that the baht parity could not be sustained.

Terms and Concepts

Problems for Review

1. What is foreign exchange? (Be precise.)

2. What are the ISO codes for the US dollar, the British pound, the Japanese yen, the Euro, and the Canandian dollar?

3. Turn to the table of cross rates in a recent issue of the Financial Times to update the first row of table 1.2. Complete the rest of the table by calculating cross rates.

4. What is a "synthetic" cross rate?

5. Get exchange rate data from the Financial Times at http://www.FT.com and update table 1.2. (Registration is free.)

6. Find a paper offering exchange rate quotes, and determine the EUR-USD spot exchange rate, 30 day forward rate, and 90 day forward rate. Do the same for the EUR-JPY and JPY-USD exchange rates. How closely does the triangular arbitrage condition hold?

7. You are a Canadian exporter expecting a payment of USD 1M in three months. You want to hedge your currency risk. After looking at prevailing interest rates and exchange rates, you decide to hedge forward. Ignoring transactions costs, must US exporters expecting payment in Canadian dollars wish to hedge forward or spot?

8. Suppose there are no profit opportunities in triangular arbitrage. Prove that arbitrage opportunities involving more than three currencies have also been eliminated.

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.1 Exponents and Logarithms

In order to test whether the available data are supportive of the core predictions of the monetary approach, we often need to specify the functional form of relationships that we have been describing only in the most general theoretical terms. Many empirical tests of the monetary approach require us to be specific about the functional form for money demand. The most widely used functional form is log-linear. This section offers a very brief review of logarithms. (The next section develops the log-linear specification of the monetary approach to the determination of flexible exchange rates.)

The discussion in this section is indebted to Maor (1994).

The simplest way to motivate logarithms is by thinking again about the geometric progression $2^0, 2^1, 2^2, \ldots$. The monotonicity of the exponential function means that it is an injection (one-to-one), so that the inverse mapping is also a function. We call the inverse mapping the *logarithmic* function. Continuing with our base 2 example, the exponential function maps $2 \mapsto 4$ and $3 \mapsto 8$, so the logarithmic function maps $4 \mapsto 2$ and $8 \mapsto 3$.

Consider any member of this geometric progression, x, so that

$$x = b^m \tag{10}$$

This states a relationship between the number x, the base b, and the exponent m. We have a second way of stating this relationship: we say that m is the logarithm with base b of the number x.

$$\log_b x = m \tag{11}$$

So $x = b^m$ and $\log_b x = m$ are just two different ways of saying exactly the same thing.

Looking again at our geometric progression, we see immediately that there is a simple rule for multiplying any two terms of the progression:

$$b^m \times b^n = b^{m+n} \tag{12}$$

For example,

$$b^2 \times b^3 = (b \times b) \times (b \times b \times b) = b \times b \times b \times b \times b = b^5 \tag{13}$$

In this sense, we have transformed the problem of multiplication into the simpler problem of addition: the addition of the exponents.

Here is another way of making the same observation.

$$\log_b(x \times y) = \log_b x + \log_b y \tag{14}$$

For example, suppose $x = b^m$ and $y = b^n$ (so that $\log_b x = m$ and $\log_b y = n$), then

$$\log_b(x \times y) = \log_b(b^m \times b^n) = \log_b b^{m+n} = m + n \tag{15}$$

With a little work, we can similarly transform division into the simpler problem of subtraction. We would like to use the rule

$$\frac{b^m}{b^n} = b^{m-n} \tag{16}$$

Here is another way of making the same observation. We would like to be able to say that

$$\log_b(x/y) = \log_b x - \log_b y \tag{17}$$

To see these are the same, recall the relationship between logarithms and exponents, and suppose $x = b^m$ and $y = b^n$ (so that $\log_b x = m$ and $\log_b y = n$). With the rule $b^m/b^n = b^{m-n}$ we can then write

$$\log_b(x/y) = \log_b(b^m/b^n) = \log_b b^{m-n} = m - n \tag{18}$$

For example

$$\frac{b^3}{b^2} = \frac{b \times b \times b}{b \times b} = b \times \frac{b \times b}{b \times b} = b = b^1 \tag{19}$$

But what about b^2/b^3? Applying our rule we get $b^2/b^3 = b^{-1}$, so we will need to know what is meant by a negative exponent. We will extend our exponential notation to define $b^{-m} = 1/b^m$. So $b^{-1} = 1/b^1$, $b^{-2} = 1/b^2$, etc. Then

$$\frac{b^2}{b^3} = \frac{b \times b}{b \times b \times b} = \frac{1}{b} \times \frac{b \times b}{b \times b} = \frac{1}{b^1} = b^{-1} \tag{20}$$

We just need to think of our geometric progression as extending in both directions:

$$\ldots, b^{-3}, b^{-2}, b^{-1}, b^0, b^1, b^2, b^3, \ldots \tag{21}$$

Our rule that multiplication can be characterized in terms of the addition of exponents produces a related rule:

$$(b^m)^n = b^{mn} \tag{22}$$

For example

$$\begin{aligned}(b^3)^2 &= b^3 \times b^3 \\ &= (b \times b \times b) \times (b \times b \times b) \\ &= (b \times b \times b \times b \times b \times b) \\ &= b^6\end{aligned} \tag{23}$$

Here is another way of making the same observation.

$$\log_b x^n = n \log_b x \tag{24}$$

For example, suppose $x = b^m$ (so that $\log_b x = m$) then

$$\log_b x^n = n \log_b x = n \log_b b^m = n \times m \tag{25}$$

In summary, we have developed three useful rules in our discussion of logarithms.

$$\log_b(xy) = \log_b x + \log_b y \tag{26}$$

$$\log_b(x/y) = \log_b x - \log_b y \tag{27}$$

$$\log_b x^k = k \log_b x \tag{28}$$

Let's take an example rooted in computers: base 2 arithmetic. Consider the case where $b = 2$:

n	...	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	...
2^n	...	1/8	1/4	1/2	1	2	4	8	16	32	64	128	256	512	...

We can multiply 16×32 as follows. Noting that $\log_2(16 \times 32) = \log_2 16 + \log_2 32 = 4 + 5 = 9$, we conclude $16 \times 32 = 2^9 = 512$.

.2 Expectations, Consistency, and Efficiency

By now it should be clear that we cannot go very far in our thinking about financial markets without thinking about expectations. Economists consider this a major problem, since expectations cannot be observed. Rather than simply treat expectations as an unobserved exogenous influence on financial markets, economists impose certain structure upon expectations. Two common structures are the expectations be self-consistent and informationally efficient.

.2.1 Law of Iterated Expectations

Linearity

For any two variables x and y, and any two constants a and b,

$$\mathcal{E}_t(ax + by) = a\mathcal{E}_t x + b\mathcal{E}_t y \tag{29}$$

Forecast Errors

The *forecast error* is the difference between the expected outcome and the realized outcome. Expectational consistency requires that the expected forecast error be zero.

$$\mathcal{E}_t\{s_{t+1} - \mathcal{E}_t s_{t+1}\} = 0 \tag{30}$$

When combined with linearity, this implies

$$\mathcal{E}_t s_{t+1} = \mathcal{E}_t\{\mathcal{E}_t s_{t+1}\} \tag{31}$$

which is quite natural, since today's expectation is known today. But it also implies the stronger relationship

$$\mathcal{E}_t s_{t+k} = \mathcal{E}_t\{\mathcal{E}_{t+k-1} s_{t+k}\} \tag{32}$$

We say that expectations satisfy the law of iterated expectations. It is easy to imagine exceptions to the law of iterated expectations. For example, today I might know that the spot rate will be pegged at a specific value at time $t+k$, but I might also be planning a hypnosis session tomorrow where I will be induced to believe it will take on a different value. Requiring expected forecast errors to be zero disallows such anticipated loss of knowledge over time.

An Application

When the forward exchange market is efficient, the forward rate fully reflects the beliefs of the market participants. This relates the interest differential to the expected value of the future spot rate and the risk premium on the domestic currency.

$$i_t - i_t^* = \Delta s_{t+1}^e + rp_{t+1} \tag{33}$$

For the moment, let us suppose the risk premium is zero. We can write the expected rate of depreciation as the expected change in the log of the spot rate

$$\Delta s_{t+1}^e = s_{t+1}^e - s_t \tag{34}$$

so we have

$$s_t = s_{t+1}^e - (i_t - i_t^*) \tag{35}$$

In the next period we will have

$$s_{t+1} = \mathcal{E}_{t+1} s_{t+2} - (i_{t+1} - i_{t+1}^*) \tag{36}$$

Applying the law of iterated expectations, we know that our expectation today of our next period's expectation is just our expectation today of the two period ahead spot rate.

$$\mathcal{E}_t \mathcal{E}_{t+1} s_{t+2} = \mathcal{E}_t s_{t+2} \tag{37}$$

Secondly, individuals should expect that (35) will hold in the future.

$$s_{t+1} = \mathcal{E}_{t+1} s_{t+2} - (i_{t+1} - i^*_{t+1}) \tag{38}$$

Together these give us

$$\mathcal{E}_t s_{t+1} = \mathcal{E}_t s_{t+2} - \mathcal{E}_t (i_{t+1} - i^*_{t+1}) \tag{39}$$

$$\mathcal{E}_t s_{t+2} = \mathcal{E}_t s_{t+3} - \mathcal{E}_t (i_{t+2} - i^*_{t+2}) \tag{40}$$

$$\vdots \tag{41}$$

Applying these relationships repeatedly to (35), we get

$$\begin{aligned} s &= \mathcal{E}_t s_{t+1} - (i_t - i^*_t) \\ &= \mathcal{E}_t s_{t+2} - \sum_{k=0} 1 (i_{t+} - i^*_{t+k}) \\ &= \lim_{T \to \infty} \{\mathcal{E}_t s_{t+T+1} - \sum_{k=0}^{T} (i_{t+} - i^*_{t+k})\} \end{aligned} \tag{42}$$

Informational Efficiency

Economists have meant a number of different things by the efficient markets hypothesis. Most often, the hypothesis is that markets are not only efficient, but are also informationally efficient. That is, not only do market prices fully reflect the beliefs of market participants, but the beliefs of market participants fully reflect the available information. When this is the case, economists like to say that expectations are "rational". What they mean is that market participants do not make systematic (i.e., predictable) forecasting errors.

Let the information available at time t be $\mathcal{I}_t$. Let $\mathcal{E}\{\cdot|\mathcal{I}_t\}$ denote the mathematical expectation conditional on this information. Then expectations are "rational" if

$$\Delta s^e_{t+1} = \mathcal{E}\{\Delta s_{t+1}|\mathcal{I}_t\} \tag{43}$$

When there is no danger of ambiguity about the information set, we will just write

$$\Delta s^e_{t+1} = \mathcal{E}_t \Delta s_{t+1} \tag{44}$$

Following Fama (1970), we can distinguish various degrees of market efficiency. A market is informationally efficient relative to $\mathcal{I}_t$ if "abnormal returns" cannot be obtained using only the information in $\mathcal{I}_t$. A market that is efficient relative to the past history of prices is called *weakly efficient*. A market that is efficient relative to all publically available information is called *semi-strong form efficient*. A market that is efficient relative to all publically and privately available information is called *strong form efficient*.

Consider the forecast error

$$\varepsilon_{t+1} = \Delta s - \mathcal{E}\{\Delta s_{t+1}|\mathcal{I}_t\} \tag{45}$$

Note that the expected value of the forecast error, given information $\mathcal{I}_t$, is zero.