

## CHAPTER 2

# An Introduction to Some Concepts and Definitions

### 1. Introduction

This chapter takes a step back and reviews in a nutshell the prerequisite for studying the methods of financial engineering. Readers with a good grasp of the conventions and mechanics of financial markets may skip it, although a quick reading would be preferable.

Financial engineering is a *practice* and can be used only when we define the related environment carefully. The organization of markets, and the way deals are concluded, confirmed, and carried out, are important factors in selecting the right solution for a particular financial engineering problem. This chapter examines the organization of financial markets and the way market practitioners interact. Issues related to settlement, to accounting methods, and especially to *conventions* used by market practitioners are important and need to be discussed carefully.

In fact, it is often overlooked that financial practices will depend on the conventions adopted by a particular market. This aspect, which is relegated to the background in most books, will be an important parameter of our approach. Conventions are not only important in their own right for proper pricing, but they also often reside behind the correct choice of theoretical models for analyzing pricing and risk management problems. The *way* information is provided by markets is a factor in determining the model choice. While doing this, the chapter introduces the mechanics of the markets, instruments, and who the players are. A brief discussion of the syndication process is also provided.

### 2. Markets

The first distinction is between *local* and *Euromarkets*. Local markets are also called *onshore markets*. These denote markets that are closely supervised by regulators such as central banks and financial regulatory agencies. There are basically two defining characteristics of onshore markets. The first is *reserve requirements* that are imposed on onshore deposits. The second is the formal *registration process* of newly issued securities. Both of these have important cost, liquidity, and taxation implications.

In money markets, reserve requirements imposed on banks increase the *cost* of holding onshore deposits and making loans. This is especially true of the large “wholesale” deposits that

banks and other corporations may use for short periods of time. If part of these funds are held in a noninterest-bearing form in central banks, the cost of local funds will increase.

The long and detailed registration process imposed on institutions that are issuing stocks, bonds, or other financial securities has two implications for financial engineering. First, issue costs will be higher in cases of registered securities when compared to simpler *bearer* form securities. Second, an issue that does not have to be registered with a public entity will disclose less information.

Thus, markets where reserve requirements do not exist, where the registration process is simpler, will have significant cost advantages. Such markets are called Euromarkets.

## 2.1. Euromarkets

We should set something clear at the outset. The term “Euro” as utilized in this section does not refer to Europe, nor does it refer to the Eurozone currency, the Euro. It simply means that, in terms of reserve requirements or registration process we are dealing with markets that are outside the formal control of regulators and central banks. The two most important Euromarkets are the Eurocurrency market and the Eurobond market.

### 2.1.1. Eurocurrency Markets

Start with an onshore market. In an *onshore* system, a 3-month retail deposit has the following life. A client will deposit USD100 cash on date  $T$ . This will be available the same day. That is to say, “days to deposit” will equal zero. The deposit-receiving bank takes the cash and deposits, say, 10 percent of this in the central bank. This will be the *required reserves* portion of the original 100.<sup>1</sup> The remaining 90 dollars are then used to make new loans or may be lent to other banks in the interbank overnight market.<sup>2</sup> Hence, the bank will be paying interest on the entire 100, but will be receiving interest on only 90 of the original deposit. In such an environment, assuming there is no other cost, the bank has to charge an interest rate around 10 percent higher for making loans. Such supplementary costs are enough to hinder a liquid *wholesale market* for money where large sums are moved. Eurocurrency markets eliminate these costs and increase the liquidity.

Let’s briefly review the life of a Eurocurrency (offshore) deposit and compare it with an onshore deposit. Suppose a U.S. bank deposits USD100 million in another U.S. bank in the New York Eurodollar (offshore) market. Thus, as is the case for Eurocurrency markets, we are dealing only with banks, since this is an interbank market. Also, in this example, all banks are located in the United States. The Eurodeposit is made in the United States and the “money” never leaves the United States. This deposit becomes usable (settles) in 2 days—that is to say, *days to deposit* is 2 days. The entire USD100 million can now be lent to another institution as a loan. If this chain of transactions was happening in, say, London, the steps would be similar.

### 2.1.2. Eurobond Markets

A bond sold publicly by going through the formal registration process will be an onshore instrument. If the same instrument is sold without a similar registration process, say, in London, and if it is a *bearer* security, then it becomes essentially an off-shore instrument. It is called a Eurobond.

<sup>1</sup> In reality the process is more complicated than this. Banks are supposed to satisfy reserve requirements over an average number of days and within, say, a one-month delay.

<sup>2</sup> In the United States this market is known as the federal funds market.

Again the prefix “Euro” does not refer to Europe, although in this case the center of Eurobond activity happens to be in London. But in principle, a Eurobond can be issued in Asia as well.

A Eurobond will be subject to less regulatory scrutiny, will be a *bearer* security, and will not be (as of now) subject to withholding taxes. The primary market will be in London. The secondary markets may be in Brussels, Luxembourg, or other places, where the Eurobonds will be *listed*. The settlement of Eurobonds will be done through Euroclear or Cedel.

### 2.1.3. Other Euromarkets

Euromarkets are by no means limited to bonds and currencies. Almost any instrument can be marketed offshore. There can be Euro-equity, Euro-commercial paper (ECP), Euro medium-term note (EMTN), and so on. In derivatives we have onshore forwards and swaps in contrast to off-shore nondeliverable forwards and swaps.

## 2.2. Onshore Markets

Onshore markets can be organized over the counter or as formal exchanges. *Over-the-counter* (OTC) markets have evolved as a result of spontaneous trading activity. An OTC market often has no formal organization, although it will be closely monitored by regulatory agencies and transactions may be carried out along some precise *documentation* drawn by professional organizations, such as ISDA, ICMA.<sup>3</sup> Some of the biggest markets in the world are OTC. A good example is the interest rate swap (IRS) market, which has the highest notional amount traded among all financial markets with very tight bid-ask spreads. OTC transactions are done over the phone or electronically and the instruments contain a great deal of flexibility, although, again, institutions such as ISDA draw standardized documents that make traded instruments homogeneous.

In contrast to OTC markets, organized *exchanges* are formal entities. They may be *electronic* or *open-outcry* exchanges. The distinguishing characteristic of an organized exchange is its formal organization. The traded products and trading practices are homogenous while, at the same time, the specifications of the traded contracts are less flexible.

A typical deal that goes through a traditional open-outcry exchange can be summarized as follows:

1. A *client* uses a standard telephone to call a *broker* to place an order. The broker will take the order down.
2. Next, the order is transmitted to exchange floors or, more precisely, to a *booth*.
3. Once there, the order is sent out to the *pit*, where the actual trading is done.
4. Once the order is executed in the pit, a verbal *confirmation* process needs to be implemented all the way back to the client.

*Stock markets* are organized exchanges that deal in equities. Futures and options markets process derivatives written on various underlying assets. In a *spot deal*, the trade will be done and confirmed, and within a few days, called the *settlement period*, money and securities change hands. In futures markets, on the other hand, the trade will consist of taking positions, and

<sup>3</sup> The International Securities Market Association is a professional organization that among other activities may, after lengthy negotiations between organizations, homogenize contracts for OTC transactions. ISDA is the International Swaps and Derivatives Association. NASD, the National Association of Securities Dealers in the United States, and IPMA, the International Primary Market Association, are two other examples of such associations.

settlement will be after a relatively longer period, once the derivatives *expire*. The trade is, however, followed by depositing a “small” guarantee, called an *initial margin*.

Different exchanges have different structures and use different approaches in *market making*. For example, at the New York Stock Exchange (NYSE), market making is based on the *specialist* system. Specialists run *books* on stocks that they specialize in. As market makers, specialists are committed to buying and selling at all times at the quoted prices and have the primary responsibility of guaranteeing a smooth market.

### 2.2.1. Futures Exchanges

EUREX, CBOT, CME, and TIFFE are some of the major futures and options exchanges in the world. The exchange provides three important services:

1. A physical location (i.e., the *trading floor* and the accompanying pits) for such activity, if it is an open-outcry system. Otherwise the exchange will supply an electronic trading platform.
2. An exchange *clearinghouse* that becomes the real counterparty to each buyer and seller once the trade is done and the deal ticket is stamped.
3. The service of *creating* and *designing* financial contracts that the trading community needs and, finally, providing a transparent and reliable trading environment.

The mechanics of trading in futures (options) exchanges is as follows. Two *pit traders* trade directly with each other according to their client’s wishes. One sells, say, at 100; the other buys at 100. Then the *deal ticket* is signed and stamped. Until that moment, the two traders are each other’s counterparties. But once the deal ticket is stamped, the clearinghouse takes over as the counterparty. For example, if a client has bought a futures contract for the delivery of 100 bushels of wheat, then the entity eventually responsible (they have agents) for delivering the wheat is not the “other side” who physically sold the contract on the pit, but the exchange clearinghouse. By being the *only* counterparty to all short and long positions, the clearinghouse will lower the counterparty risk dramatically. The counterparty risk is actually reduced further, since the clearinghouse will deal with *clearing members*, rather than the traders directly.<sup>4</sup>

An important concept that needs to be reviewed concerning futures markets is the process of *marking to market*. When one “buys” a futures contract, a margin is put aside, but no cash payment is made. This leverage greatly increases the liquidity in futures markets, but it is also risky. To make sure that counterparties realize their gains and losses daily, the exchange will reevaluate positions every day using the settlement price observed at the end of the trading day.<sup>5</sup>

#### EXAMPLE:

*A 3-month Eurodollar futures contract has a price of 98.75 on day T. At the end of day T + 1, the settlement price is announced as 98.10. The price fell by 0.65, and this is a loss to the long position holder. The position will be marked to market, and the clearinghouse—or more correctly—the clearing firm, will lower the client’s balance by the corresponding amount.*

<sup>4</sup> In order to be able to trade, a pit trader needs to “open an account” with a clearing member, a private financial company that acts as clearing firm that deals with the clearinghouse directly on behalf of the trader.

<sup>5</sup> The settlement price is decided by the exchange and is not necessarily the last trading price.

The *open interest* in futures exchanges is the number of outstanding futures contracts. It is obtained by totaling the number of short and long positions that have not yet been closed out by *delivery*, *cash settlement*, or *offsetting* long/short positions.

### 3. Players

*Market makers* make markets by providing days to delivery, notice of delivery, warehouses, etc. Market makers must, as an obligation, buy and sell at their quoted prices. Thus for every security at which they are making the market, the market maker must quote a bid and an ask price. A market maker does not warehouse a large number of products, nor does the market maker hold them for a long period of time.

*Traders* buy and sell securities. They do not, in the pure sense of the word, “make” the markets. A trader’s role is to execute clients’ orders and trade for the company given his or her *position limits*. Position limits can be imposed on the total capital the trader is allowed to trade or on the risks that he or she wishes to take.

A trader or market maker may *run* a portfolio, called a *book*. There are “FX books,” “options books,” “swap books,” and “derivatives books,” among others. Books run by traders are called “trading books”; they are different from “investment portfolios,” which are held for the purpose of investment. Trading books exist because during the process of buying and selling for clients, the trader may have to warehouse these products for a short period of time. These books are hedged periodically.

*Brokers* do not hold inventories. Instead, they provide a platform where the buyers and sellers can get together. Buying and selling through brokers is often more *discreet* than going to bids and asks of traders. In the latter case, the trader would naturally learn the identity of the client. In options markets, a *floor-broker* is a trader who takes care of a client’s order but does not trade for himself or herself. (On the other hand, a market maker does.)

*Dealers* quote two-way prices and hold large *inventories* of a particular instrument, maybe for a longer period of time than a market maker. They are institutions that act in some sense as market makers.

*Risk managers* are relatively new players. Trades, and positions taken by traders, should be “approved” by risk managers. The risk manager assesses the trade and gives approvals if the trade remains within the preselected boundaries of various risk managers.

*Regulators* are important players in financial markets. Practitioners often take positions of “tax arbitrage” and “regulatory arbitrage.” A large portion of financial engineering practices are directed toward meeting the needs of the practitioners in terms of regulation and taxation.

*Researchers and analysts* are players who do not trade or make the market. They are information providers for the institutions and are helpful in sell-side activity. Analysts in general deal with stocks and analyze one or more companies. They can issue buy/sell/hold signals and provide forecasts. Researchers provide macrolevel forecasting and advice.

### 4. The Mechanics of Deals

What are the mechanisms by which the deals are made? How are trades done? It turns out that organized exchanges have their own clearinghouses and their own clearing agents. So it is relatively easy to see how accounts are opened, how payments are made, how contracts are purchased and positions are maintained. The clearing members and the clearinghouse do most of these. But how are these operations completed in the case of OTC deals? How does one buy a bond and pay for it? How does one buy a foreign currency?

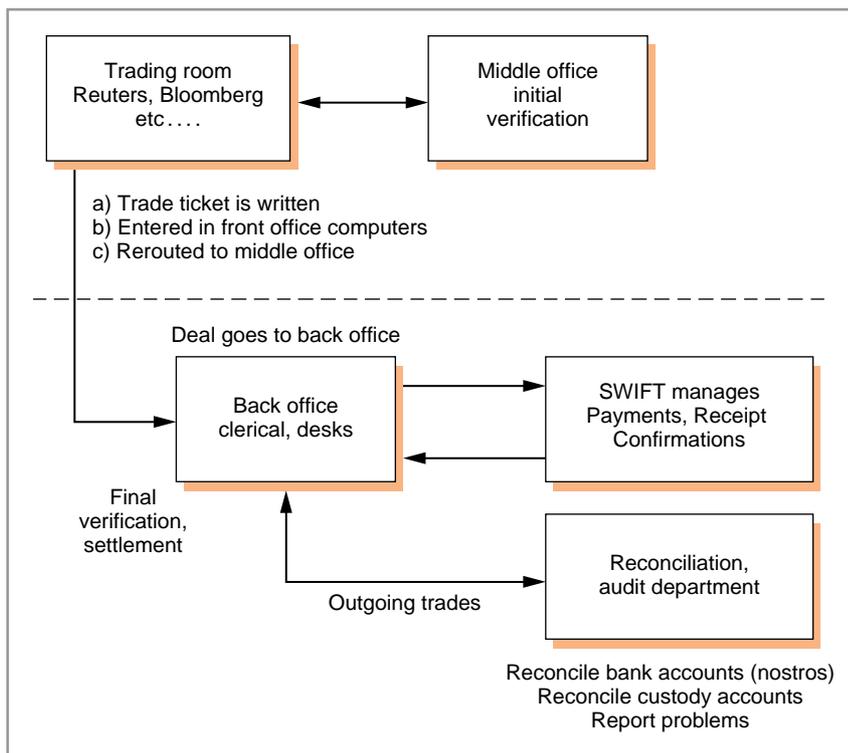


FIGURE 2-1. How trades are made and confirmed.

Turning to another detail, *where* are these assets to be kept? An organized exchange will keep positions for the members, but who will be the custodian for OTC operations and secondary market deals in bonds and other relevant assets?

Several alternative mechanisms are in place to settle trades and keep the assets in custody. A typical mechanism is shown in Figure 2-1. The mechanics of a deal in Figure 2-1 are from the point of view of a market practitioner. The deal is initiated at the *trading* or dealing room. The trader writes the *deal ticket* and enters this information in the computer's front office system. The *middle office* is the part of the institution that initially verifies the deal. It is normally situated on the same floor as the trading room. Next, the deal goes to the *back office*, which is located either in a different building or on a different floor. Back-office activity is as important for the bank as the trading room. The back office does the final verification of the deal, handles settlement instructions, releases payments, and checks the incoming cash flows, among other things. The back office will also handle the messaging activity using the SWIFT system, to be discussed later.

#### 4.1. Orders

There are two general types of orders investors or traders can place. The first is a *market order*, where the client gets the price the market is quoting at that instant.

Alternatively parties can place a *limit order*. Here a derived price will be specified along the order, and the trade will go through only if this or a better price is obtained. A limit order is valid only during a certain period, which needs to be specified also. A *stop loss* order is similar. It specifies a target price at which a position gets liquidated automatically.

Processing orders is by no means error-free. For example, one disadvantage of traditional open-outcry exchanges is that in such an environment, mistakes are easily made. Buyer and seller may record different prices. This is called a “price out.” Or there may be a “quantity out,” where the buyer has “bought 100” while the seller thinks that he has “sold 50.” In the case of options exchanges, the recorded expiration dates may not match, which is called a “time out.” *Out-trades* need to be corrected after the market close. There can also be *missing trades*. These trades need to be negotiated in order to recover positions from counterparties and clients.<sup>6</sup>

## 4.2. Confirmation and Settlement

*Order confirmation* and *settlement* are two integral parts of financial markets. Order confirmation involves sending messages between counterparties, to confirm trades verbally agreed upon between market practitioners. Settlement is exchanging the cash and the related security, or just exchanging securities.

The *SWIFT system* is a communication network that has been created for “paperless” communication between market participants to this end. It stands for the Society for Worldwide Financial Telecommunications and is owned by a group of international banks. The advantage of SWIFT is the *standardization* of messages concerning various transactions such as customer transfers, bank transfers, Foreign Exchange (FX), loans, deposits. Thousands of financial institutions in more than 100 countries use this messaging system.

Another interesting issue is the relationship between settlement, clearing, and custody. *Settlement* means receiving the security and making the payment. The institutions can settle, but in order for the deal to be complete, it must be *cleared*. The orders of the two counterparties need to be matched and the deal terminated. *Custody* is the safekeeping of securities by depositing them with carefully selected depositories around the world. A *custodian* is an institution that provides custody services. Clearing and custody are both rather complicated tasks. *FedWire*, *Euroclear*, and *Cedel* are three international *securities clearing firms* that also provide some custody services. Some of the most important custodians are banks.

Countries also have their own clearing systems. The best known bank clearing systems are CHIPS and CHAPS. CHAPS is the clearing system for the United Kingdom, CHIPS is the clearing system for payments in the United States. Payments in these systems are cleared multilaterally and are netted. This greatly simplifies settling large numbers of individual trades.

Spot trades settle according to the principle of DVP—that is to say, *delivery versus payment*—which means that first the security is delivered (to securities clearing firms) and *then* the cash is paid.

Issues related to settlement have another dimension. There are important conventions involving normal ways of settling deals in various markets. When a settlement is done according to the convention in that particular market, we say that the trade settles in a *regular way*. Of course, a trade can settle in a special way. But special methods would be costly and impractical.

### EXAMPLE:

*Market practitioners denote the trade date by  $T$ , and settlement is expressed relative to this date.*

*U.S. Treasury securities settle regularly on the first business day after the trade—that is to say, on  $T + 1$ . But it is also common for efficient clearing firms to have cash settlement—that is to say, settlement is done on the trade date  $T$ .*

<sup>6</sup> As an example, in the case of a “quantity out,” the two counterparties may decide to split the difference.

*Corporate bonds and international bonds settle on  $T + 3$ .*

*Commercial paper settles the same day.*

*Spot transactions in stocks settle regularly on  $T + 3$  in the United States.*

*Euromarket deposits are subject to  $T + 2$  settlement. In the case of overnight borrowing and lending, counterparties may choose cash settlement.*

*Foreign exchange markets settle regularly on  $T + 2$ . This means that a spot sale (purchase) of a foreign currency will lead to two-way flows two days after the trade date, regularly.  $T + 2$  is usually called the spot date.*

It is important to expect that the number of days to settlement in general refers to business days. This means that in order to be able to interpret  $T + 2$  correctly, the market professional would need to pin down the corresponding *holiday convention*.

Before discussing other market conventions, we can mention two additional terms that are related to the preceding dates. The settlement date is sometimes called the *value date* in contracts. Cash changes hands at the value date. Finally, in swap-type contracts, there will be the *deal date* (i.e., when the contract is signed), but the swap may not begin until the *effective date*. The latter is the actual start date for the swap contract and will be at an agreed-upon later date.

## 5. Market Conventions

Market conventions often cause confusion in the study of financial engineering. Yet, it is *very* important to be aware of the conventions underlying the trades and the instruments. In this section, we briefly review some of these conventions.

Conventions vary according to the location and the type of instrument one is concerned with. Two instruments that are quite similar may be quoted in very different ways. *What* is quoted and *the way* it is quoted are important.

As mentioned, in Chapter 1 in financial markets there are always *two* prices. There is the price at which a market maker is willing to *buy* the underlying asset and the price at which he or she is willing to *sell* it. The price at which the market maker is willing to buy is called the *bid* price. The *ask* price is the price at which the market maker is willing to sell. In London financial markets, the ask price is called an *offer*. Thus, the bid-ask spread becomes the bid-offer spread.

As an example consider the case of deposits in London *money and foreign exchange markets*, where the convention is to quote the *asking* interest rate first. For example, a typical quote on interest rates would be as follows:

Ask (Offer)	Bid
$5\frac{1}{4}$	$5\frac{1}{8}$

In other money centers, interest rates are quoted the other way around. The first rate is the bid, the second is the ask rate. Hence, the same rates will look as such:

Bid	Ask (Offer)
$5\frac{1}{8}$	$5\frac{1}{4}$

A second characteristic of the quotes is decimalization. The Eurodollar interest rates in London are quoted to the nearest  $\frac{1}{16}$  or sometimes  $\frac{1}{32}$ . But many money centers quote interest

rates to *two* decimal points. Decimalization is not a completely straightforward issue from the point of view of brokers/dealers. Note that with decimalization, the bid-ask spreads may narrow all the way down to zero, and there will be no *minimum* bid-ask spread. This may mean lower trading profits, everything else being the same.

### 5.1. What to Quote

Another set of conventions concerns *what* to quote. For example, when a trader receives a call, he or she might say, “I sell a bond at a price of 95,” or instead, he or she might say, “I sell a bond at yield 5%.” Markets prefer to work with conventions to avoid potential misunderstandings and to economize time. Equity markets quote individual stock prices. On the New York Stock Exchange the quotes are to decimal points.

Most *bond markets* quote prices rather than yields, with the exception of short-term T-bills. For example, the price of a bond may be quoted as follows:

Bid price	Ask (Offer) price
90.45	90.57

The first quote is the price a market maker is willing to pay for a bond. The second is the price at which the market maker dealer is willing to sell the same bond. Note that according to this, bond prices are quoted to *two* decimal points, out of a par value of 100, regardless of the true denomination of the bond.

It is also possible that a market quotes neither a price nor a yield. For example, caps, floors, and swaptions often quote “volatility” directly. Swap markets prefer to quote the “spread” (in the case of USD swaps) or the swap rate itself (Euro-denominated swaps). The choice of what to quote is not a trivial matter. It affects pricing as well as risk management.

### 5.2. How to Quote Yields

Markets use three different ways to quote yields. These are, respectively, the money market yield, the bond equivalent yield, and the discount rate.<sup>7</sup> We will discuss these using *default-free pure discount bonds* with maturity  $T$  as an example. Let the time- $t$  price of this bond be denoted by  $B(t, T)$ . The bond is default free and pays 100 at time  $T$ . Now, suppose  $R$  represents the time- $t$  yield of this bond.

It is clear that  $B(t, T)$  will be equal to the present value of 100, discounted using  $R$ , but how should this present value be *expressed*? For example, assuming that  $(T - t)$  is measured in days and that this period is less than 1 year, we can use the following definition:

$$B(t, T) = \frac{100}{(1 + R)^{\left(\frac{T-t}{365}\right)}} \quad (1)$$

where the  $\left(\frac{T-t}{365}\right)$  is the remaining life of the bond as a fraction of year, which here is “defined” as 365 days.

<sup>7</sup> This latter term is different from the special interest rate used by the U.S. Federal Reserve System, which carries the same name. Here the discount rate is used as a general category of yields.

But we can also think of discounting using the alternative formula:

$$B(t, T) = \frac{100}{\left(1 + R\left(\frac{T-t}{365}\right)\right)} \quad (2)$$

Again, suppose we use neither formula but instead set

$$B(t, T) = 100 - R\left(\frac{T-t}{365}\right) 100 \quad (3)$$

Some readers may think that given these formulas, (1) is the right one to use. But this is not correct! In fact, they may *all* be correct, given the proper *convention*.

The best way to see this is to consider a simple example. Suppose a market quotes prices  $B(t, T)$  instead of the yields  $R$ .<sup>8</sup> Also suppose the observed market price is

$$B(t, T) = 95.00 \quad (4)$$

with  $(T - t) = 180$  days and the year defined as 365 days. We can then ask the following question: Which one of the formulas in (1) through (3) will be more correct to use? It turns out that these formulas can *all* yield the same price, 95.00, *if* we allow for the use of different  $R$ s.

In fact, with  $R_1 = 10.9613\%$  the first formula is “correct,” since

$$B(t, T) = \frac{100}{\left(1 + .109613\right)^{\left(\frac{180}{365}\right)}} \quad (5)$$

$$= 95.00 \quad (6)$$

On the other hand, with  $R_2 = 10.6725\%$  the second formula is “correct,” since

$$B(t, T) = \frac{100}{\left(1 + .106725\right)^{\left(\frac{180}{365}\right)}} \quad (7)$$

$$= 95.00 \quad (8)$$

Finally, if we let  $R_3 = 10.1389\%$ , the third formula will be “correct”:

$$B(t, T) = 100 - .101389\left(\frac{180}{365}\right) 100 \quad (9)$$

$$= 95.00 \quad (10)$$

Thus, for (slightly) different values of  $R_i$ , all formulas give the *same* price. But which one of these is the “right” formula to use?

That is exactly where the notion of *convention* comes in. A market can adopt a convention to quote yields in terms of formula (1), (2) or (3). Suppose formula (1) is adopted. Then, once traders see a quoted yield in this market, they would “know” that the yield is defined in terms of formula (1) and *not* by (2) or (3). This convention, which is only an implicit understanding during the execution of trades, will be expressed precisely in the actual contract and will be

<sup>8</sup> Emerging market bonds are in general quotes in terms of yields. In treasury markets, the quotes are in terms of prices. This may make some difference from the point of view of both market psychology, pricing and risk management decisions.

known by all traders. A newcomer to a market can make serious errors if he or she does not pay enough attention to such market conventions.

**EXAMPLE:**

*In the United States, bond markets quote the yields in terms of formula (1). Such values of  $R$  are called bond equivalent yields.*

*Money markets that deal with interbank deposits and loans use the money-market yield convention and utilize formula (2) in pricing and risk management.*

*Finally, the Commercial Paper and Treasury Bills yields are quoted in terms of formula (3). Such yields are called discount rates.*

Finally, the continuous discounting and the *continuously compounded* yield  $r$  is defined by the formula

$$B(t, T) = 100e^{-r(T-t)} \quad (11)$$

where the  $e^x$  is the exponential function. It turns out that markets do not like to quote continuously compounded yields. One exception is toward retail customers. Some retail bank accounts quote the continuously compounded savings rate. On the other hand, the continuously compounded rate is often used in some theoretical models and was, until lately, the preferred concept for academics.

One final convention needs to be added at this point. Markets have an *interest payments convention* as well. For example, the offer side interest rate on major Euroloans, the Libor, is paid at the conclusion of the term of the loan as a *single* payment. We say that Libor is paid *in-arrears*. On the other hand, many bonds make periodic *coupon payments* that occur on dates earlier than the maturity of the relevant instrument.

### 5.3. Day-Count Conventions

The previous discussion suggests that ignoring quotation conventions can lead to costly numerical errors in pricing and risk management. A similar comment can be made about *day-count* conventions. A financial engineer will always check the relevant day count rules in the products that he or she is working on. The reason is simple. The definition of a “year” or of a “month” may change from one market to another and the quotes that one observes will depend on this convention. The major day-count conventions are as follows:

1. *The 30/360 basis.* Every month has 30 days regardless of the actual number of days in that particular month, and a year always has 360 days. For example, an instrument following this convention and purchased on May 1 and sold on July 13 would earn interest on

$$30 + 30 + 12 = 72 \quad (12)$$

days, while the actual calendar would give 73 days.

More interestingly, this instrument purchased on February 28, 2003, and sold the next day, on March 1, 2003, would earn interest for 3 days. Yet, a money market instrument such as an interbank deposit would have earned interest on only 1 day (using the actual/360 basis mentioned below).

2. *The 30E/360 basis.* This is similar to 30/360 except for a small difference at the end of the month, and it is used mainly in the Eurobond markets. The difference between 30/360

and 30E/360 is illustrated by the following table, which shows the number of days interest is earned starting from March 1 according to the two conventions:

Convention	March 1–March 30	March 1–March 31	March 1–April 1
30E/360	29 days	29 days	30 days
30/360	29 days	30 days	30 days

According to this, a Eurobond purchased on March 1 and sold on March 31 gives an extra day of interest in the case of 30/360, whereas in the case of 30E/360, one needs to hold it until the beginning of the next month to get that extra interest.

3. *The actual/360 basis.* If an instrument is purchased on May 1 and sold on July 13, then it is held 73 days under this convention. This convention is used by most money markets.
4. *The actual/365 basis.* This is the case for Eurosterling money markets, for example.
5. *Actual/actual.* Many bond markets use this convention.

An example will show why these day-count conventions are relevant for pricing and risk management. Suppose you are involved in an interest rate swap. You pay Libor and receive fixed. The market quotes the Libor at 5.01, and quotes the swap rate at 6.23/6.27. Since you are receiving fixed, the relevant cash flows will come from paying 5.01 and receiving 6.23 at regular intervals. But these numbers are somewhat misleading. It turns out that Libor is quoted on an ACT/360 basis. That is to say, the number 5.01 assumes that there are 360 days in a year. However, the swap rates may be quoted on an ACT/365 basis, and all calculations may be based on a 365-day year.<sup>9</sup> Also the swap rate may be *annual* or *semiannual*. Thus, the two interest rates where one pays 5.01 and receives 6.23 are *not* directly comparable.

**EXAMPLE:**

*Swap markets are the largest among all financial markets, and the swap curve has become the central pricing and risk management tool in finance. Hence, it is worth discussing swap market conventions briefly.*

- *USD swaps are liquid against 3m-Libor and 6m-Libor. The day-count basis is annual, ACT/360.*
- *Japanese yen (JPY) swaps are liquid against 6m-Libor. The day-count basis is semiannual, ACT/365.*
- *British pound (GBP) swaps are semiannual, ACT/365 versus 6m-Libor.*
- *Finally, Euro (EUR) swaps are liquid against 6m-Libor and against 6m-Euribor. The day-count basis is annual 30/360.*

Table 2-1 summarizes the day count and yield/discount conventions for some important markets around the world. A few comments are in order. First note that the table is a summary of

<sup>9</sup> Swaps are sometimes quoted on a 30/360 basis and at other times on an ACT/365 basis. One needs to check the confirmation ticket.

TABLE 2-1. Day-count and Yield/Discount Conventions

	Day-count	Yield Cash
<b>United States</b>		
Depo/CD	ACT/360	Yield
T-Bill/CP/BA	ACT/360	Discount
Treasuries	ACT/ACT, semiannual	B-E yield
Repo	ACT/360	Yield
<b>Euromarket</b>		
Depo/CD/ECP	ACT/360 (ACT/365 for sterling)	Yield
Eurobond	30E/360	Yield
<b>United Kingdom</b>		
Depo/CD/Sterling CP	ACT/365	Yield
BA/Tbill	ACT/365	Discount
Gilt	ACT/365 (semiannual)	B-E yield
Repo	ACT/365	Yield
<b>Germany</b>		
Depo/CD/Sterling CP	ACT/360	Yield
Bund	30E/360 (annual)	B-E yield
Repo	ACT/360	Yield
<b>Japan</b>		
Depo/CD	ACT/365	Yield
Repo domestic	ACT/365	Yield
Repo international	ACT/360	Yield

three types of conventions. The first is the day-count, and this is often ACT/360. However, when the 30/360 convention is used, the 30E/360 version is more common. Second, the table tells us about the yield quotation convention. Third, we also have a list of coupon payment conventions concerning long-term bonds. Often, these involve semiannual coupon payments.<sup>10</sup>

Finally, note that the table also provides a list of the major instruments used in financial markets. The exact definitions of these will be given gradually in the following chapters.

### 5.3.1. Holiday Conventions

Financial trading occurs across borders. But holidays adopted by various countries are always somewhat different. There are special independence days, special religious holidays. Often during Christmas time, different countries adopt different holiday schedules. In writing financial contracts, this simple point should also be taken into account, since we may not receive the cash we were counting on if our counterparty's markets were closed due to a special holiday in that country.

Hence, all financial contracts stipulate the particular holiday schedule to be used (London, New York, and so on), and then specify the date of the cash settlement if it falls on a holiday. This could be *the next business day* or *the previous business day*, or other arrangements could be made.

<sup>10</sup> To be more precise, day-count is a convention in measuring time. Properties like semiannual, quarterly, and so on are compounding frequency and would be part of yield quote convention.

### 5.4. Two Examples

We consider how day-count conventions are used in two important cases. The first example summarizes the confirmation of short-term money market instruments, namely a Eurodollar deposit. The second example discusses the confirmation summary of a Eurobond.

**EXAMPLE:** *A Eurodollar Deposit*

---

<i>Amount</i>	\$ 100,000
<i>Trade date</i>	Tuesday, June 5, 2002
<i>Settlement date</i>	Thursday, June 7, 2002
<i>Maturity</i>	Friday, July 5, 2002
<i>Days</i>	30
<i>Offer rate</i>	4.789%
<i>Interest earned</i>	$(100,000) \times 0.04789 \times 30/360$

---

Note three important points. First, the depositor earns interest on the settlement date, but does not earn interest for the day the contract matures. This gives 30 days until maturity. Second, we are looking at the deal from the bank's side, where the bank sells a deposit, since the interest rate is the offer rate. Third, note that interest is calculated using the formula

$$(1 + r\delta)100,000 - 100,000 \quad (13)$$

and not according to

$$(1 + r)^\delta 100,000 - 100,000 \quad (14)$$

where

$$\delta = 30/360 \quad (15)$$

is the day-count adjustment.

The second example involves a Eurobond trade.

**EXAMPLE:** *A Eurobond*

*European Investment Bank, 5.0% (Annual Coupon)*

---

<i>Trade date</i>	Tuesday, June 5, 2002
<i>Settlement date</i>	Monday, June 11, 2002
<i>Maturity</i>	December 28, 2006
<i>Previous coupon</i>	April 25, 2001
<i>Next coupon</i>	April 25, 2002
<i>Days in coupon period</i>	360
<i>Accrued coupon</i>	Calculate using money market yield

---

We have two comments concerning this example. The instrument is a Eurobond, and Eurobonds make coupon payments annually, rather than semiannually (as is the case of Treasuries, for example). Second, the Eurobond year is 360 days. Finally, accrued interest is calculated the same way as in money markets.

## 6. Instruments

This section provides a list of the major instrument classes from the perspective of financial engineering. A course on markets and instruments along the lines of Hull (2008) is needed for a reasonable understanding.

The convention in financial markets is to divide these instruments according to the following sectors:

1. *Fixed income instruments*. These are interbank certificates of deposit (CDs), or deposits (depos), commercial paper (CP), banker's acceptances, and Treasury bill (T-Bills). These are considered to be *money market* instruments.  
Bonds, notes, and Floating Rate Notes (FRNs) are bond market instruments.
2. *Equities*. These are various types of stock issued by public companies.
3. *Currencies and commodities*.
4. *Derivatives*, the major classes of which are interest rate, equity, currency, and commodity derivatives.
5. *Credit instruments*, which are mainly high-yield bonds, corporate bonds, credit derivatives, CDSs, and various guarantees that are early versions of the former.
6. Structured products MBS, CDO, ABS.

We discuss these major classes of instruments from many angles in the chapters that follow.

## 7. Positions

By buying or short-selling assets, one takes *positions*, and once a position is taken, one has *exposure* to various risks.

### 7.1. Short and Long Positions

A *long* position is easier to understand because it conforms to the instincts of a newcomer to financial engineering. In our daily lives, we often “buy” things, we rarely “short” them. Hence, when we buy an item for cash and hold it in inventory, or when we sign a contract that obliges us to buy something at a future date, we will have a long position. We are long the “underlying instrument,” and this means that we benefit when the value of the underlying asset increases.

A *short* position, on the other hand, is one where the market practitioner has sold an item without really owning it. For example, a client calls a bank and buys a particular bond. The bank may not have this particular bond on its books, but can still *sell* it. In the meantime, however, the bank has a short position.

A short (long) position can be on an *instrument*, such as selling a “borrowed” bond, a stock, a future commitment, a swap, or an option. But the short (long) position can also be on a particular *risk*. For example, one can be short (long) volatility—a position such that if volatility goes up, we lose (gain). Or one can be short (long) a spread—again, a position where if the spread goes up, we lose (gain).

#### 7.1.1. Payoff Diagrams

One can represent short and long positions using *payoff diagrams*. Figure 2-2a illustrates the long position from the point of view of an investor. The investor has savings of 100. The upward-sloping vertical line  $OA$  represents the value of the investor's position given the price of the

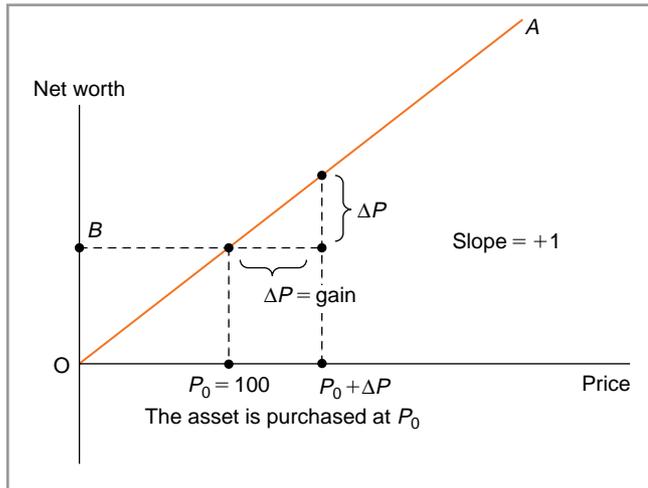


FIGURE 2-2a. Long position of a market.

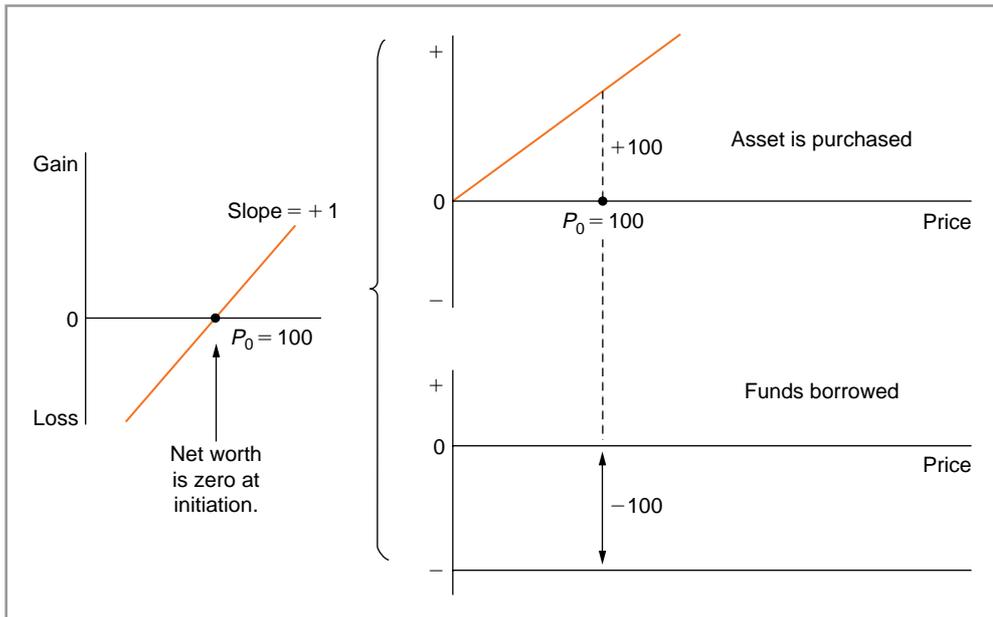


FIGURE 2-2b. Long position of a market professional.

security. Since its slope is  $+1$ , the price of the security  $P_0$  will also be the value of the initial position. Starting from  $P_0$  the price increases by  $\Delta P$ ; the gain will be equal to this change as well.

In particular, if the investor “buys” the asset when the price is 100 using his or her *own* savings, the net worth at that instant is represented by the vertical distance  $OB$ , which equals 100. A market professional, on the other hand, has no “money.” So he or she has to *borrow* the  $OB$  (or the  $P_0$ ) first and then buy the asset. This is called *funding* the long position.

This situation is shown in Figure 2-2b. Note that the market professional’s total *net* position amounts to zero at the time of the purchase, when  $P_0 = 100$ . In a sense, by first borrowing and then buying the asset, one “owns” not the asset but some *exposure*. If the asset price goes up,

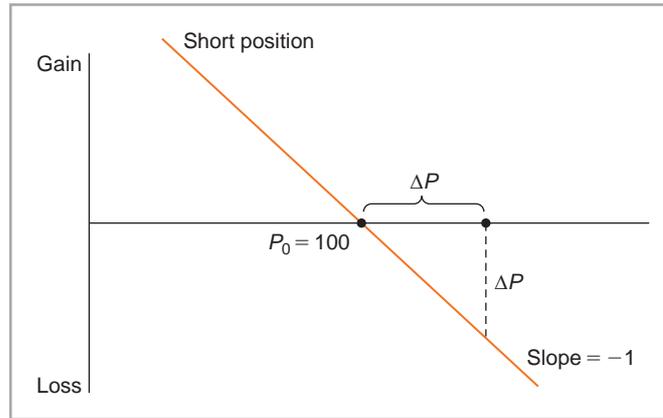


FIGURE 2-3

the position becomes profitable. If, on the other hand, the price declines, the position will show a loss.

Figure 2-3 shows a short position from a market practitioner's point of view. Here the situation is simpler. The asset in the short position is borrowed anyway at  $P_0 = 100$ . Hence, when the price is 100 at the time of the sale, the net worth is automatically zero. What was sold was an asset that was worth 100. The cash generated by the sale just equals the value of the asset that was borrowed. Therefore, at the price  $P_0 = 100$ , the position has zero value. The position will gain when the price *falls* and will lose when the price goes *up*. This is the case since what is borrowed is a security and not "money." The asset is sold at 100; and, when  $P$  increases, one would have to return to the original owner a security that is worth *more* than 100.

Similarly, when  $P$  falls, one *covers* the short position by buying a new security at a price lower than 100 and then returning this (less valuable) asset to the original owner. Overall, the short position is described by a downward sloping straight line with slope  $-1$ .

It is interesting to note some technical aspects of these graphs. First, the payoff diagrams that indicate the value of the positions taken are *linear* in the price of the asset. As the price  $P$  changes, the payoff changes by a constant amount. The sensitivity of the position to price changes is called *delta*. In fact, given that the change in price will determine the gains or losses on a one-to-one basis, the *delta* of a long position will be 1. In the case of a short position, the *delta* will equal  $-1$ .

One can define many other sensitivity factors by taking other partial derivatives. Such sensitivities are called *Greeks* and are extensively used in option markets.<sup>11</sup>

## 7.2. Types of Positions

Positions can be taken for the purposes of *hedging*, *arbitrage*, and *speculation*. We briefly review these activities.

Let us begin with *hedging*. Hedging is the act of eliminating the exposures of existing positions without unwinding the position itself. Suppose we are *short* a bond (i.e., we borrowed somebody's bond and sold it in the market for cash). We have cash at hand, but at the same time,

<sup>11</sup> Note that bid-ask spreads are not factored in the previous diagrams. The selling and buying prices cannot be the same at 100. The selling price  $P^{\text{ask}}$  will be larger than the buying price  $P^{\text{bid}}$ . The  $P^{\text{ask}} - P^{\text{bid}}$  will be the corresponding *bid-ask spread*. The original point is not zero but bid-ask.

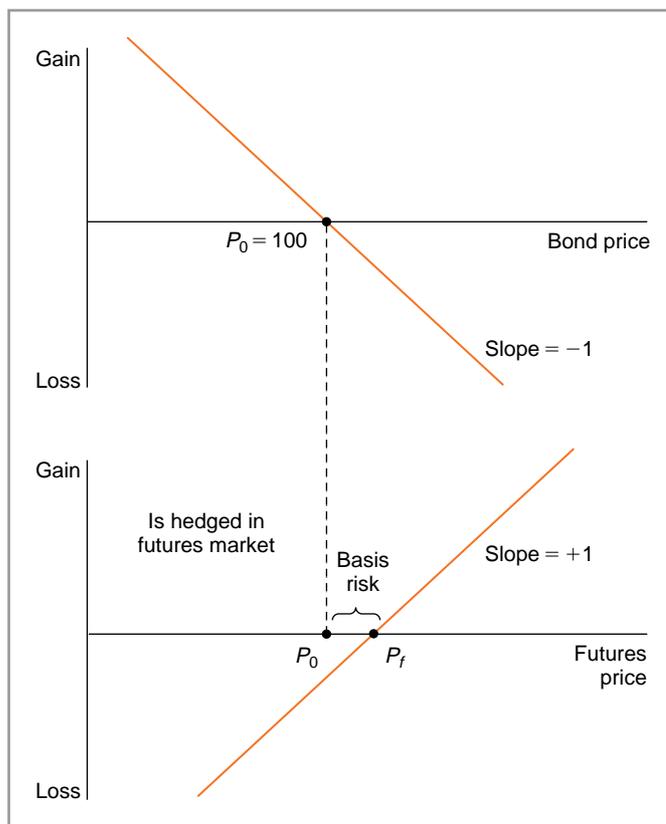


FIGURE 2-4. A hedge.

we owe somebody a bond. This means that if the bond price goes *up*, our position will have a *mark-to-market* loss.

In order to eliminate the risk we can buy a “similar” bond. Our final position is shown in Figure 2-4. The long and short positions “cancel” each other except for some remaining basis risk. At the end, we will have little exposure to movements in the underlying price  $P$ . To hedge the same risk we can also take the long position not in the *cash* or *spot* bond markets, but in a *futures* or *forward* market. That is to say, instead of buying another bond, we may write a contract at time  $t$  promising that we *will* buy the bond at a prespecified price  $P^f$  after  $\delta$  days. This will not require any cash disbursement until the settlement time  $t + \delta$  arrives, while yielding a gain or loss given the way the market prices move until that time. Here, the forward price  $P^f$  and the spot price  $P$  will not be identical. The underlying asset being the same, we can still anticipate quite *similar* profits and losses from the two positions.

This illustrates one of the basic premises of financial engineering. Namely that as much as possible, one should operate by taking positions that do not require new funding.

### 7.2.1. Arbitrage

The notion of arbitrage is central to financial engineering. It means two different things, depending on whether we look at it from the point of view of market *practice* or from the *theory* of financial engineering.

We begin with the definition used in the theory of financial engineering. In that context, we say that given a set of financial instruments and their prices,  $\{P_1, P_2, \dots, P_k\}$ , there is no arbitrage opportunity if a portfolio that costs nothing to assemble now, with a nonnegative return in the future is ruled out. A portfolio with negative price and zero future return should not exist either.

If prices  $P_i$  have this characteristic, we say that they are *arbitrage-free*. In a sense, arbitrage-free prices represent the *fair* market value of the underlying instruments. One should not realize gains without taking some risk and without some initial investment. Many arguments in later chapters will be based on the no-arbitrage principle.

In market practice, the term “arbitrage,” or “arb,” has a different meaning. In fact, “arb” represents a position that *has* risks, a position that *may* lose money but is still highly likely to yield a “high” profit.

### 7.2.2. Comparing Performance

There are two terms that need to be defined carefully in order to understand the appendix to Chapter 11 and several examples. An asset  $A$  is set to **outperform** another asset  $B$ , if a long position in  $A$  and a simultaneous short position in  $B$  makes money. Otherwise  $A$  is said to **underperform**  $B$ . According to this, outperform indicates relative performance and is an important notion for spread trading.

## 8. The Syndication Process

A discussion of the syndication process will be useful. Several contract design and pricing issues faced by a financial engineer may relate to the dynamics of the syndication process. Stocks, bonds, and other instruments are not sold to investors in the primary market the way, say, cars or food are sold. The selling process may take a few days or weeks and has its own wrinkles. The following gives an indicative time table for a syndication process.

### 8.1. Selling Securities in the Primary Market

Time tables show variations from one instrument to another. Even in the same sector, the timing may be very different from one issuer to another, depending on the market psychology at that time. The process described gives an example. The example deals with a Eurobond issue. For *syndicated loans*, for facilities, and especially for IPOs, the process may be significantly different, although the basic ideas will be similar.

1. The week of D-14: Manager is chosen, *mandate* is given. Issue strategy is determined. Documentation begins.
2. The week of D-7: *Documentation* completed. Co-managers are determined.
3. D-Day: “Launch” date. Sending “faxes” in to *underwriter* and *selling group* members. Issue is published in the press.
4. D + 8: Preliminary allotment done by lead manager.
5. D + 9: Pricing day.
6. D + 10: Offering day. Allotment faxes are sent to group members.
7. D + 24: Payment day. Syndicate members make payments.

In other markets, important deviations in terms of both timing and procedure may occur during actual syndication processes. But overall, the important steps of the process are as shown in this simple example.

### 8.1.1. Syndication of a Bond versus a Syndicated Loan

We can compare a bond issue with processing a syndicated loan. There are some differences. Syndicated loans are instruments that are in *banking books* or *credit departments* of banks. The follow-up and risk management is done by the banking credit departments with methodologies similar to standard loans. For example, information in the offering circular is not as important.

Bonds, on the other hand, are handled by investment or in *trading books*, and the analysis and information in the circular are taken seriously. Documentation differences are major.

The syndicated loan tries to maintain a relationship between the bank and its client through the agent. But in the bond issue, the relationship between the lender and the borrower is much more distant. Hence, this type of borrowing is available only to good names with good credit standing. (Banks have to continuously follow lesser names to stay aware of any deterioration of credit conditions.) The maturities can also be very different.

## 9. Conclusions

This chapter reviewed some basic information the reader is assumed to have been exposed to. The discussion provided here is sketchy and cannot be a substitute for a thorough course on conventions, markets, and players. Also, market conventions, market structure, and the instrument characteristics may change over time.

### Suggested Reading

*It is important for a financial engineering student to know the underlying instruments, markets, and conventions well. This chapter provided only a very brief review of these issues. Fortunately, several excellent texts cover these further. Hull (2008) and Wilmott (2000) are first to come to mind. Market-oriented approaches to instruments, pricing, and some elementary financial market strategies can be found in Steiner (1997) and Roth (1996). These two sources are recommended as background material.*

## Appendix 2-1: The Hedge Fund Industry

The term *hedge fund* has recently become a household word. Originally only high net worth individuals could buy into them and regulators saw no urgency in regulating or registering them. This is the first characteristic of hedge funds. The second characteristic has to do with their investment practices. Most registered mutual funds have essentially two choices: They could either go long in the stated asset class or stay in cash. Often there is a limit on the latter. Thus, mutual funds have no room for maneuver during bear markets. Hedge funds on the other hand were unregulated and could *short* the markets. This was perceived at that time to be the “hedge” for a down market, hence the term “hedge fund” emerged.

The third difference is less well known. While traditional mutual funds normally only offer *relative* returns, hedge funds aim to offer *absolute* returns on an investment. For example traditional funds set for themselves stock or bond market *benchmarks* and then measure their performance relative to these benchmarks. The fund may be down, but if the benchmark is down even more, the fund is said to *outperform*.<sup>12</sup> This is because a typical mutual fund has

<sup>12</sup> For example a manager is said to have outperformed his or her benchmark even if the fund loses 2 percent but the benchmark is down 5 percent.

to be long the underlying securities. When the price of the security goes down they have few means to make positive returns.

Hedge funds, on the other hand can realize profits in the down markets as well. Unlike most traditional fund managers, hedge funds can (1) use derivatives, (2) leverage to make bigger investments and, more important, (3) sell short.

Often, hedge fund managers start as prop desk traders at major banks. They then leave the bank to set up their own businesses. Originally the clients were wealthy individuals, but later started including institutions and other banks. Hedge funds are now decisive players in financial markets. Below we introduce some basic facts about them.

### Some facts

*Assets* under management in hedge funds were around \$1.43 trillion in 2006, this is from \$500 billion in 2001.<sup>13</sup> But, because they *leverage* their capital in multiples of 10 or more, hedge funds are much more influential than their capital indicates. According to Reuters, hedge fund trading activity accounted for up to half the daily turnover on the New York Stock Exchange and the London Stock Exchange in 2005. More important, hedge funds make up almost 60 percent of U.S. credit derivatives trading, and about half of emerging market bond trading. According to the same sources, about one-third of equity market activity is due to hedge funds. It is estimated that they are responsible for more than 50 percent of trading in commodities.

Most hedge funds are located in lightly regulated, low-tax, offshore centers like the Cayman Islands or Bermuda. The Cayman Islands are the single most popular *location* for hedge funds, with almost one in two registered there. However, there are many hedge funds in the United States or Europe where they are registered with regulators.

Most institutional investors are not allowed by regulators to directly invest in hedge funds. However, they can invest in *funds of hedge funds*, which are regulated. Annual *fees* at traditional mutual funds are normally between 30 and 50 bp. Hedge funds charge an annual 1–2 percent management fee. However they also receive up to 20 percent of any outperformed amount. Funds of hedge funds charge an additional annual 1–1.5 percent *management fee* and an average 10 percent *performance fee*.

Many hedge funds have *high water marks*. If the value of the portfolio they are managing falls below, say, last year's value, the fund does not receive performance fees until this level is exceeded again. This means that after a sharp fall in the portfolio, such funds will be dissolved and reestablished under a different entity.

### Strategies

Hedge funds are classified according to the strategies they employ. The market a hedge fund uses is normally the basis for its strategy classification.

*Global macro* funds bet on trends in financial markets based on macroeconomic factors. Positions are in general levered using derivatives. Such derivatives cost a fraction of the outright purchase.

*Managed futures*. These strategies speculate on market trends using futures markets. Often computer programs that use technical analysis tools like relative strength and momentum indicators are used to make investment decisions.

*Long/short* strategists buy stocks they think are cheap and short those they think are expensive. The overall position can be net long or net short. This means that they are not necessarily

<sup>13</sup> Hedge Fund Research, Reuters.

market neutral. Within this category, the class of *short bias* funds can take long equity positions, but their overall position must be short.

*Emerging market* funds use equities or fixed-income. Managers using this strategy tend to buy securities and sell only those they own. Many emerging market countries do not allow short selling and derivatives markets there are normally not developed.

*Event driven*. There are two groups here. *Merger or risk arbitrage* trades the shares of firms in takeover battles, normally with a view that the bid will have to be raised to win over shareholders in the target company and will cost the bidder a lot more money. A higher buyout price will usually weigh on the bidding company's share price as it could deplete cash reserves or force it to issue bonds to pay the extra money.

*Distressed debt* funds trade the bonds of a company in financial distress, where prices have collapsed, but where the chances of repayment are seen as high or there is a possibility debt could be converted into equity. Distressed debt normally trades at a deep discount to its nominal value and could be bought against the company's investment grade bonds, which, because of collateral agreements, may not have crashed to the same extent.

*Relative value*. These strategies generally buy stocks or bonds managers think are cheap and sell those they think are expensive. They account for a significant portion of the capital under management.

*Equity neutral or hedged* strategies should be cash neutral, which means the dollar value of stocks bought should equal the dollar value of stocks they have shorted. They can also be market neutral, which means the correlation between a portfolio and the overall market should be zero.

*Fixed income* strategies look at interest rates, sovereign bonds, corporate bonds and mortgage and asset backed securities. Managers can trade corporate against government debt, cash versus futures or a yield curve—short maturity bonds against long maturity bonds. Bonds of different governments are often traded against each other where interest rate cycles are seen to be out of sync.

*Convertible arbitrage* funds trade convertible bonds. These are the implicit equity, bond, credit and derivatives such as options.

*Credit derivatives* are a key tool for hedge funds. Within this class *capital structure arbitrage*, put simply, involves a hedge fund manager trading corporate bonds against the company's stock on the basis that one is cheap and the other expensive.

## Prime Brokerage

Prime brokers offer settlement, custody and securities lending services to hedge funds. Prime brokers earn their money from commissions and by charging a premium over money market lending rates for loans.

Prime brokers provide trade execution, stock lending, leveraged finance and other essential services to hedge funds. In fact, without prime brokerages, hedge fund activity would be very different than where it is at the moment.

One factor is the level of leverage prime brokers are offering. Such leverage can multiply a hedge fund's activities by a factor of 10 more. The second major help provided by prime brokers is in execution of trades. For example, short selling an asset requires borrowing it. How would the hedge fund find a place to borrow such an asset? Prime brokers have better information on this.

Their major point is risk management and position keeping. Prime brokers keep the positions of the hedge funds<sup>14</sup> and have developed elaborate risk management systems that a small hedge fund may find too costly to own.

Industry sources estimate bank revenues from hedge funds are 20 percent and rising. Some of that comes from prime brokerage services, but a large part comes from other activities like trading.

<sup>14</sup> This also helps watching the health of the fund closely.

## Exercises

1. Suppose the quoted swap rate is 5.06/5.10. Calculate the amount of fixed payments for a fixed payer swap for the currencies below in a 100 million swap.

- USD.
- EUR.

Now calculate the amount of fixed payments for a fixed receiver swap for the currencies below in a 100 million swap.

- JPY.
- GBP.

2. Suppose the following stock prices for GE and Honeywell were observed before any talk of merger between the two institutions:

Honeywell (HON) 27.80

General Electric (GE) 53.98

Also, suppose you “know” somehow that GE will offer 1.055 GE shares for each Honeywell share during any merger talks.

- (a) What type of “arbitrage” position would you take to benefit from this news?
- (b) Do you need to deposit any of your funds to take this position?
- (c) Do you need to and can you borrow funds for this position?
- (d) Is this a true arbitrage in the academic sense of the word?
- (e) What (if any) risks are you taking?

3. Read the market example below and answer the following questions that relate to it.

*Proprietary dealers are betting that Euribor, the proposed continental European-based euro money market rate, will fix above the Euro BBA Libor alternative. . . The arbitrage itself is relatively straightforward. The proprietary dealer buys the Liffe September 1999 Euromark contract and sells the Matif September 1999 Pibor contract at roughly net zero cost. As the Liffe contract will be referenced to Euro BBA Libor and the Matif contract will be indexed to Euribor, the trader in effect receives Euribor and pays Euro BBA Libor.*

*The strategy is based on the view that Euribor will generally set higher than Euro BBA Libor. Proprietary dealers last week argued that Euribor would be based on quotes from 57 different banks, some of which, they claimed, would have lower credit ratings than the eight Libor banks. In contrast, Euro BBA Libor will be calculated from quotes from just 16 institutions. (From IFR, December 18, 1998)*

- (a) Show the positions of the proprietary dealers using position diagrams.
- (b) In particular, what is on the horizontal axis of these diagrams? What is on the vertical axis?
- (c) How would the profits of the “prop” dealers be affected at expiration, if in the meantime there was a dramatic lowering of all European interest rates due, say, to a sudden recession?