Futures Markets

A) Introduction

Futures and options contracts are a new breed of financial instrument. This part describes the futures contracts and show how they can be used to manage risk or take speculative positions. It also shows how to read the prices of these contracts as they appear in the financial press.

Before going further, it is important to remind students about forward contracts.

A forward contract is an agreement struck today that binds two counterparties to an exchange at a later date. For example, a currency forward contracts are a method for buying or selling a given amount of foreign currency at specified dates in the futures - often one, three, or six months ahead, but possibly one, three, or five years ahead. Forward contracts exist for other financial transactions such as equity shares (common in Europe), government securities, as well as for goods and services - forward contracts for college tuition or for an artist's services. In each case, the forward contract establishes an obligation for two counterparties to make an exchange at a specified future date.

Despite the use of forward contracts, the possibility of default poses a potentially serious problem for counterparties in a forward contract. How can counterparties separated by great distances and lacking complete information about one another overcome this inherent risk?. One method is to make forward contracts only with people of high character, reputation, and credit quality, so that the likelihood of a default is minimized.

Another method, associated with futures contracts, calls for both counterparties to post a "good-faith bond" that is held in escrow by a reputable and disinterested third party. In case of default, the bond is available to compensate the nondefaulting counterparty.

Futures contracts were associated with physical commodities such as agricultural commodities (like corn and wheat), primary commodities (like lumber or copper), or precious metals (like silver and gold). Indeed, prior to 1972, futures contracts were associated exclusively with these physical commodities. But with the rise of exchange rate volatility and interest rate volatility, the demand for financial hedging instruments multiplied.

The benefits of financial futures contracts were clear to market economists who view the huge increases in trading volume as a confirmation that access to the market improves economic welfare. Futures contracts offer a means for risk management and risk spreading that potentially improves welfare for everyone even though it creates no tangible output.

Now we start describing the institutional aspects of futures markets.

B) Futures Contracts and the Organized Exchange

When a future contract is first listed for trading, there has no volume. Assume that the first trade is for one contract, leaving one trader **long one** contract and one trader **short one** contract. In this example, there is a buyer and a seller. The **buyer** is said to have a **long position**, while the **seller** has a **short position**. The act of buying is called going long, and the act of selling is called going short. When one trader buys and another sells a forward contract, the transaction generates one contract of trading **volume**. At any moment in time, there is some number of futures contracts obligated for delivery; this number is called the **open interest** (will be discussed further later).

Futures contracts trade on an organized exchange (like the Chicago Board of Trade). The exchange is a voluntary, nonprofit association of its member. **Exchange memberships**, also called **seats,** may be held only by individuals, and the memberships are traded in an active market like any other assets. Members could serve also on committees to regulate the exchange's operations, rules, audit functions, public relations, and legal and ethical conduct of members.

Trading in futures contracts take may take place only during official trading hours in a designated trading area called a **pit**. This is a physical location on the floor of the exchange. Each commodity trades in a designated pit, and the system used for trading is of **open outcry**. In this system, a trader must make any offer to buy or sell to all other traders present in the pit. Traders also use an unofficial system of hand signals to express their wishes to buy or sell.

Traders in the pit fall into two groups: a trader can trade for his or her own account and bear the losses or enjoy the profits stemming from this trading. Second, a trader can be a broker acting on behalf of this or her own firm or on behalf of a client outside the exchange.

Members of the exchange who trade in the pits are typically speculators. A **speculator** is a trader who enters the futures market in pursuit of profit, accepting risk in the endeavor. Other traders can be **hedgers**, traders who trade futures to reduce some preexisting risk exposure. **Hedgers** are often producers or major users of a given commodity. For example, hedgers in wheat might include wheat farmers and large baking firms. A farmer might hedge by selling his anticipated harvest through the futures market. For most part, hedgers are not located on the floor of the exchange. Instead, they trade through a brokerage firm. The brokerage firm communicates the order to the pit and has it executed by a broker in the pit.

Trading futures contract in a centralized exchange has advantages with respect to **price discovery**, which refers to the ability of market participants to observe or "discover" the current market price. In a centralized market, traders observe all transactions prices as posted by the exchange. We say that the futures market exhibits "transparency". In the futures market, anonymous orders enjoy the democracy of the marketplace. By comparison, price discovery may be compromised in a geographically dispersed market. In the Interbank forward foreign exchange market, there is no centralized record of prices. At times, some dealers may have difficulty gauging the market price when some price quotations represent the transactions and others are for "indications only". So, the interbank market lacks transparency.

a) Standardized Contract Terms

Transactions in the interbank forward market are customized and flexible to meet customer preferences. While certain maturities (such as 1, 3, 6, and 12 months) are popular for currency forwards (or other instruments), a counterparty can request a quotation for **any** forward maturity and for **any** contract size.

By comparison, transactions in the futures markets are highly standardized. Futures contracts are highly uniform and well-specified commitments for a carefully designed good to be delivered at a certain time and in a certain manner. The exchange designs the contracts and sets their specifications in order to obtain regulatory permission to begin trading. Each futures contract specifies a contract size or quantity of the underlying asset. Contract expiration dates are also standardized - often maturing in March, June, September, and December as well as the two months nearest to the present date. In addition, the exchange will standardize delivery terms for futures contracts, daily price-limit movements, minimum price fluctuations, and the trading days and hours.

As an example, consider the wheat contract of the CBOT. One wheat contract consists of 5,000 bushels of wheat that must be of the following types: No.2 Soft Red, No.2 Hard Red Winter, No.2 Dark Northern Spring, or No.1 Northern Spring. The wheat contract trades for expiration in the following months of each year: July, September, December and May. To deliver wheat in completion of the contract, the wheat must be in a warehouse approved by the CBOT. These warehouses must be in the Chicago Switching District or the Toledo, Ohio, Switching District. The buyer transmits payment to the seller, and the seller delivers a warehouse receipt to the buyer. The holder of a warehouse receipt has title to the wheat in the warehouse. Delivery can occur on any business day in the delivery month.

The contract also stipulates the **minimum price fluctuation**, or **tick size**. For wheat, one tick is 1/4 cent per bushel. With 5000 bushels per contract, this gives a tick size of $12.50 per contract. The contract also specifies a daily price limit, which restricts the price movement in a single day. For wheat, the trading price on a given day cannot differ from the preceding day's closing price by more than 20 cents per bushel, or $1000 per contract. When the contract enters its delivery month, this price limit is not in effect. Also, when a commodity enters a particularly volatile period, price limits are generally expanded over successive days. Finally, the exchange also controls the trading times for each futures contract. Wheat trades from 9:30 A.M. to 1:15 P.M Chicago time on each trading day, except for the last day of trading when trading in the expiring contract ceases at noon. The last trading day for the wheat contract is seven business days before the last business day of the delivery month.

Standardization may be anathema in the fashion industry, but in the futures market it is an effective means to promote trading and liquidity. Since all futures contracts for a given asset and maturity (such as "March 1998 DM") are identical, in the sense as all common equity shares of IBM are identical, futures can be traded continuously, much as if they were equity shares.

To see why futures contracts are relatively more liquid than forwards, assume that today (June 15) I purchase a six-month DM forward contract from Bank XYZ for delivery on December 15. Suppose that after 10 weeks (on September 1), the DM has appreciated and I want to secure my profit. To begin, my contract now has a maturity of about 15 weeks (or 105 days). This is a nonstandard maturity. I could try to sell my contract to another party, but there is no active market for 15-week forward contracts with

Bank XYZ as a counterparty. I could go back to Bank XYZ and ask them to buy it back. But Bank XYZ probably would decline for similar reasons - the original forward contract has been rolled into their overall book, and it would be a nuisance to attempt to reverse the transaction. The solution (from Bank XYZ or another bank) would be to initiate a second forward contract on September 1, whereby I sell DM forward for delivery on December 15. This would be an expensive alternative because 15-week forward contracts are to actively quoted in the market (the 15-week contract might involve a three-month forward (from September 1 to December 1) and 14 one-day rollovers until final maturity on December 15).

Alternatively, suppose that on June 15 I purchase a DM **futures contract** expiring on December 15. If I decide to sell my December DM contract after any period of time - 10 minutes, 10 days, or 10 weeks - I will find that the December DM futures contract is still trading on the futures exchange. Selling the contract closes my position and secures my gain or loss on the contract.

b) Variable Counterparty Risks versus the Clearinghouse

Forward market transactions link banks with other banks (the interbank market) or banks with customers (the retail market). Each counterparty to a transaction assumes the credit risk and the risk of default of the other counterparty. That is why bank credit officers make a detailed appraisal of the credit and risk quality of any potential counterparty before trading particulars are discussed.

By comparison, every futures contract trades on an organized exchange, which has the **clearinghous**e as one of two counterparties. The clearinghouse may be a separately chartered corporation or a division of the futures exchange. [For example, the clearinghouse for the CBOT is the Board of Trade Clearing Corporation. The Clearinghouse for the New York Futures Exchange is the Intermarket Clearing Corporation, which is a wholly owned subsidiary of the Options Clearing Corporation (OCC). The OCC acts as the clearing organization for all exchange-traded option contracts in the United States.] In either case, the clearinghouse is the legal entity on side of every futures contract, and it stands ready to meet the obligations of the futures contract vis-a-vis every customer of the exchange. Thus, a broker-transmitted buy order for DM futures from Aunt Millie in Ohio may be matched in the futures pit against a sell order for DM futures from Mega Corporation of Liverpool. But each customer's legal contract is with the clearinghouse. The clearinghouse therefore standardizes the counterparty risk of all futures contracts, and facilitates trade between buyers and sellers who remain anonymous to on another.

As an example, we look at the following trading situation. We assume that all transactions occur on a single day, say, May 1. Party 1 trades on the futures exchange to buy on contract of 5,000 bushels for delivery in September. In order for Party 1 to buy the contract, some other participant must sell. Say Party 2 is willing to sell and has complementary positions in the futures market. Without a perfect match in all respects, there could not have been a transaction. In all probability, the two trading parties will not even know each other. It is perfectly possible that each will have traded through a broker from different parts of the country. In such situation, problems of trust may arise. How can either party be sure that the other will fulfill the agreement.

As the table indicates, the clearinghouse guarantees fulfillment of the contract to each of the trading parties. After the initial sale is made, the clearinghouse steps in and acts as the seller to the buyer and acts as the buyer to the seller.

Futures Market Obligations
The oat contract is traded by the CBOT. Each contract is for 5,000 bushels, and prices are quoted in cents per bushel.

- (a) **Party 1 Buys** 1 SEP contract for oats at 171 cents per bushel, and **Party 2 sells** 1 SEP contract oats at 171 cents per bushel.
- (b) **Party 1 Buys** 1 SEP contract for oats at 171 cents per bushel, and the **Clearinghouse** agrees to **deliver to Party 1** a SEP contract for oats at a price of 171 cents per bushel.
- (c) **Party 2 Sells** 1 SEP contract for oats at 171 cents per bushel, and the **Clearinghouse** agrees to **receive from Party 2** a SEP contract for oats and to pay 171 cents per bushel.

c) Cash Settlement and Delivery versus the Marking-to-Market

Another distinction between forwards and futures contracts concerns the obligations of a buyer or seller between the point of entering into the contract and the point of closing out and settling or selling the contract. Chief among these are the requirements for margin and daily settlement. Before trading a futures contract, the prospective trader must deposit funds with a broker. These are referred to as **margin**. Their purpose is to provide a safeguard to ensure that traders will perform on their contract obligations. The amount of this margin varies from contract to contract and may vary by broker as well.

There are three types of margin. The initial deposit just described is the **initial margin** - the amount a trader must deposit before trading any futures. The initial margin approximately equals the maximum daily price fluctuations permitted for the contract being traded.

For most futures contracts, the initial margin may be 5 percent or less of the underlying commodity's value. The smallness of this amount is reasonable, however, because there is another safeguard built into the system in the form of **daily settlement** or **marking-to-market.**

To understand the process of daily settlement, consider gain Party 1, who bought one contract for 171 cents per bushel. Assume that the contract closes on May 2 at 168 cents per bushel. This means that Party 1 has sustained a loss of 3 cents per bushel. Since there are 5000 bushels in the contract, this represents a loss of $150, which is deducted from the margin deposited with the broker. When the value of the funds on deposit with the broker reaches a certain level, called the **maintenance margin**, the trader is required to replenish the margin, bringing it back to its initial level. This demand for more margin is known as a **margin call**. The additional amount the trader must deposit is called the **variation margin**. The maintenance margin is about 75% of the amount of the initial margin. For example, assume that the initial margin was $1400 that Party 1 had deposited only this minimum initial margin, and that the maintenance margin is $1100. Party 1 has already sustained a loss of $150, so the equity in the margin account is $1250. The next day, assume that the price of oats drops 4 cents per bushel, generating an additional loss for Party 1 of $200. This brings the value of the margin account to $1050, which is below the level of the required maintenance margin. This means that the broker will require Party 1 to replenish the margin account to $1400, the level of the initial margin. To restore the margin account, the trader must pay $350 variation margin. Variation margin must always be paid in cash.(note, a trader could have withdrawn cash whenever the value of the equity exceeded $1400. However, a trader cannot withdraw funds that would leave the account's equity value below the level of the initial margin).

Another example

a) Tracking a Forward contract

Suppose that on June 15 I wish to purchase DM 1 million for forward delivery on September 15 at a price of $0.50/DM. Suppose I have a good credit line with a commercial bank. I execute my forward purchase on June 15, **but no funds change hands at this time**. I am now **"long forward DM"** for delivery on September 15. For the next three months, the value of the DM gyrates, but still no money changes hands.

On September 15, the forward contract matures and it is time to settle up and/ or take delivery. There are two possibilities. First, I may take delivery of the DM 1 million on September 15. In that case, I pay the bank $500,000 in exchange for DM 1 million delivered to my account. Second, I may not take delivery of the DM and instead settle up with the bank for the gain or loss on the forward contract. If DM is valued in the spot market on September at $0.52/DM, then the bank pays me $20,000. If the DM is valued in the spot market on September at only $0.47/DM, then I pay the back $30,000.

The essential point here, is that, no cash flows take place until the final maturity of the contract.

b) Tracking a futures contract

Now suppose, instead, on June 15, I purchase September DM futures contracts traded on the CME, and for convenience, assume that the price is $0.50/DM. To establish a DM 1 million "long futures" position, I will need to purchase eight contracts because each contract represents DM 125000. To enter this transaction, the broker requires that I post (in advance of any trades) a good-faith deposit (known as **margin**) either in the form of cash, a bank letter of credit, or short-term U.S. Treasury securities. (If I choose to use U.S. securities, I continue to accrue the interest earnings).

Let us assume that the **initial margin** in this case is 4 percent, which corresponds to $20,000.

Now suppose that on June 16, the September DM future falls in value and ends the day trading at $0.498. Taking $0.498 as the **settlement price** (the price used for settling up the value of the margin account), my broker calculates that I would incur a $2,000 loss if the futures contract were sold at this price. Thus, remaining value of my margin account has been reduced to $18,000. Now suppose that on June 17 the

September DM futures falls further to \$0.495. The value of my eight futures contracts is now \$495,000. Thus, the remaining value of my margin account has been reduced to \$15,000. We will define this value as before, equal to 75% percent of the initial margin, as the **maintenance margin.**

If my margin account falls below the maintenance margin value, my broker will issue a **margin call** and demand that I restore my margin account to the level of the initial margin before the end of the day. (In some cases, a long as 24 hours may be granted to fulfil a margin call). If not, the broker may elect to sell my futures contract and return any remaining proceeds of the margin account to me.

Assume that the September DM futures falls to a settlement price of \$0.489/DM. My margin account has been reduced to only \$9,000 - below the maintenance margin level . The broker will issue a margin call for \$11,000 (the so-called **variation margin**) to restore an initial margin of \$20,000.

Now consider the happier case where the DM appreciates in value to \$0.51/DM. In this case, the broker would credit my margin account for \$10,000 - equal to the \$0.01 gain on DM 1 million - bringing the total to \$30,000. These excess margin funds could be withdrawn and put to some other use.

The process of updating a margin account on a daily basis to reflect the market value of the underlying position is known as **marking to market**. To some economists, **marking to market is the defining feature of a futures market.**

Another example of daily settlement and margins

Consider an individual A, who on February 4 enters into a futures contract to buy 100 troy ounces of gold at the futures price of $365 per troy ounce. The initial margin for the contract is set at $2000 and the maintenance margin is set at 75% of the initial margin, or $1500. The table below follows A's margin account over a six day period. On February 4, A establishes the initial margin by paying $2000. On February 5, the futures price drops to $3 per troy ounce to $362, implying that A's margin account is reduced to $1700 = $2000 - ($3×100). On February 6, there is a further drop of $3, implying A's margin account at the beginning of the day, $1400, is below the required maintenance margin of $1500. There is a margin call of $600 made to individual A to reestablish the initial margin of $2000. If A refuses to forward the required funds, the broker will close A's futures position. Excess margin can be withdrawn from the margin account. For example, on February 7, the futures price rises to $364, implying that a gain of $500 is deposited into the margin account. Individual A can withdraw $500 at this time if he or she so wishes. The table shows that individual A withdrawing all gains on the futures contract. This completes the example.

Date	Futures prices in $	Cash flow in $	Begining margin in $	Cash withdrawal in $	Ending margin in $
2/4	365	0	0	-2000	2000
2/5	362	-300	1700	0	1700
2/6	359	-300	1400	-600	2000
2/7	364	500	2500	500	2000
2/8	365	100	2100	100	2000
2/9	367	200	2200	200	2000

d) Closing a Futures Position

There are three ways to close a futures position: delivery, offset, and an exchange-for-physical (EFP).

1) Delivery: Futures contracts are written to call for completion through the physical delivery of a particular good. The delivery takes place at certain locations and at certain times under rules specified by a futures exchange. In recent years, however, exchange have introduced futures contracts that allow completion through **cash settlement**. In cash settlement, traders make payments at the expiration of the contract to settle any gains or losses, instead of making physical delivery. In general, few futures contracts are actually closed through either physical delivery or cash settlement.

2) Offset: Futures contracts are completed through offset or via a **reversing trade.** In this case, the trader transacts in the futures market to bring his or her net position in a particular futures contract back to zero. Consider the previous example, where Party 1 has an obligation to accept 5,000 bushels of oats in September and to pay 171 cents per bushel for them at that time. Say, on May 10, the trader wishes to reverse the trade, so he can fulfill the commitment by entering the futures market again and making the reversing trade.

The Reverse Trade

- May 1, **Party 1's** Initial Position: **Bought** 1 Sept. contract for oats at 171 cents per bushel, and **Party 2 Sold 1** Sept. contract for oats at 171 cents per bushel.
- May 10, Party 1's reversing trade : **Sells 1** Sept. contract for oats at 180 cents per bushel, and **Party 3 Buys** 1 Sept. oats contract at 180 cents per bushel.

The price of September oats rose 9 cents per bushel during this period, happily yielding Party 1 a profit of $450. Party 2, the original seller, is not affected by Party 1's reversing trade. Party 2 still has the same commitment.

If the reversing trade can not be matched in terms of the good traded, the number of contracts, and the maturity, then the trader undertakes a new obligation instead of canceling the old. If Party 1 sold on

Dec contract on May 10 instead of selling the Sep contract, he or she would be obligated to receive oats in September and to delivery oats in December. Such a transaction result in holding two positions instead of a reversing trade.

3) Exchange-for-Physicals (EFP): A trader can complete a futures contract by engaging in an exchange for physicals. Two traders agree to a simultaneous exchange of a cash commodity and futures contract based on that cash commodity.

As an example:

An Exchange-for-Physicals Transactions

Before the EFP

- **Trader A : Long 1** wheat futures and Wants to acquire actual wheat. **Trader B is short 1** wheat futures, and owns wheat and wishes to sell.

EFP Transaction

- **Trader A** agrees with **Trader B** to **purchase wheat** and cancel futures, receives wheat and pays Trader B. **Reports EFP** to exchange; exchange adjusts books to show that **Trader A is out of the market.**
- At the same time, **Trader B agrees with Trader A to sell** wheat and cancel futures. **Delivers wheat**; receives payment from Trader A. **Reports EFP** to exchange; exchange adjusts books to show that **Trader B is out of the market.**

e) Exchanges and Types of Futures

The major U.S. and world futures exchanges will be presented in a graph. The graph will show the date they began trading, and the principal types of contracts they trade. This section is only intended for illustrative purposes, nothing else.

f) Around the clock trading and Globex

With the emergence of foreign futures exchanges, futures trading on some goods continues almost 24 hours a day. In this respect, the three most popular contracts are Treasury bills, Eurodollars, and Treasury bonds. For Treasury bills and Eurodollars, futures contracts trade in Singapore, London, Chicago, and Tokyo. These futures exchanges offer trading for more than 20 hours of each 24-hour period.

Compared to pit trading with open outcry, electronic trading is becoming popular, and cheaper to launch. Some foreign exchanges have different commitment to electronic trading than others. The four largest systems are: GLOBEX, sponsored by CME and the French Exchange MATIF; Project A, sponsored by the CBOT; Access, sponsored by NYMEX; and APT sponsored by the LIFFE of London.

GLOBEX began trading in June 1992. It was created to augment the open outcry system. Currently, trading on GLOBEX is restricted to hours when the CMOT is not open.

Project A is an electronic order-entry and matching system operated by CBOT for off-hours trading of CBOT contracts. The system operates from 2:30 to 4:30 PM and from 10:30 PM to 6:00 AM Chicago time.

Futures Prices

Having explored the basic institutional features of the futures market, we now consider futures prices. The study of the prices in a market provides the essential key to understanding all features of the market. Prices and the factors that determine those prices will ultimately influence every use of the market.

Our discussion of the futures prices begins with reading the price quotations that are available every day in the *Wall Street Journal*.

A) Newspaper Quotes

A graph will be presented to give an example of quoted futures prices, as reported in the Wall Street Journal, on 12 August 1994. The figures refer to the trading that took place the day before (in this case, 11 August 1994). The contract is identified as the Gold, 100 troy ounce contract traded on the Chicago Mercantile Exchange (CMX). The information about the contracts shown with the prices is useful, but incomplete. For a commodity, the type of it that is traded is not mentioned, nor is the delivery procedure. Further, the WSJ does not give information about daily price limits and it does not report the tick size. With so much information omitted, a trader should not trade based just on what the WSJ shows.

1) Expiry Cycle

Every contract is given an expiry cycle by the Exchange on which the contract is traded. These are listed in the first column on the left side of the page. The first date is August (1994). The second date is October (1994), the third date is December (1994), and so forth. When the delivery date is reached (the last four business days of the delivery month), the contract is dropped from the table.

2) Open

The open column refers to the price at which the first contract of the day was transacted. For the August (1994) contract, the open price was $377.00. This open price will in general be different from the previous day's settlement price. The previous day's settlement price can be determined by using the change column.

3) Settle

The settle column refers to the settlement price. This is the futures price to adjust all investors'margin accounts for the daily change in futures prices.

4) Change

The change column refers to the change in the settlement price from the previous day. For the August 1994 contract, the change is $1.50. This means that the previous day's settlement price was $377.20. For an investor with a long position in one contract, his or her margin account would be credited $150 ($=100\times\$1.50$).

5) Lifetime High and Low

The lifetime high/low column refers to the highest and the lowest futures price ever observed in the trading for a particular contract. For the August 1994 contract, the highest recorded futures price for this contract was $415.00 per ounce and the lowest price recorded was $341.50.

6) Open Interest

The open interest refers to the total number of contracts outstanding. In other words, it is the number of futures contracts for which delivery is currently obligated. To understand open interest, assume that the December 1997 contract has just been listed for trading, but that the contract has not been traded yet. At this point, the open interest in the contract is zero. Trading begins the first contract is bought. This creates one contract of open interest, because there is one contract now in existence for which delivery is obligated.

Subsequent trading can increase or decrease the open interest. To illustrate, follow the following

Time..Action.....................................Open Interest

t = 0 Trading opens for the popular contract.......................................0

t = 1 Trader A buys and Trader B sells 1 contract................................1

t = 2 Trader C buys and Trader D sells 3 contracts...............................4

t = 3 Trader A sells and Trader D buys 1 contract................................3

(Trader A has offset 1 contract and is out of the market. Trader D has offset 1 contract and is now short 2 contracts).

t = 4 Trader C sells and Trader E buys 1 contract...............................3

7) Est. Volume

The "Est. Vol" or estimated volume, refers to the estimated volume of trading in all futures for this contract. Also given is the estimated volume for the pervious day and the total open interest.

B) The Basis and Spreads

Futures prices bear economically important relationships to other observable prices. The futures price for delivery of a commodity in three months, must be related to the spot price, or the current cash price of the commodity at a particular physical location. The **spot price** is the price of a good for immediate delivery. It is called sometimes the **cash price** or the **current price**. The difference between the cash price and the futures price is called the **basis**. The difference in price for two futures contract expirations on the same commodity is an **intracommodity spread**. If the two futures prices that form a spread are futures prices for two underlying goods, such as wheat futures and a corn futures, then the spread is an **intercommodity spread.**

1) The Basis

The basis is defined as:

Basis = Current Cash Price - Futures Prices

First, this definition depends on the geographical location where the commodity is grown. The Basis calculated in considering futures prices for a commodity that has two different cash prices in two different locations will be different.

Second, The basis is calculated based on the futures price of the nearby contract. There is, however, a basis for each outstanding futures contract, and this basis will differ depending on the maturities of the contracts. In a **normal market**, prices for more distant futures are higher than for nearby futures. In an **inverted market**, distant futures prices are lower than the prices for contracts nearer to expiration.

At delivery the futures prices and the cash price must be equal, except for minor discrepancies due to transportation and other transactions costs. The basis must be zero. This behavior of the basis over time is known as **convergence.**

2) Spreads

The interacommodity spread indicates the relative price differentials for a commodity to be delivered at two points in time. Spread relationships are important for speculators; it is the holding of two or more related futures contracts.

Futures Markets: Trading and Hedging

The members of the exchange where contracts traded are individuals who physically go on the exchange floor and trade futures contracts. There are several ways to characterize these futures traders.

The first classification would be related to the strategies they employ

1) **A hedger** holds a position in the spot market. This might involve owning a commodity, or it may simply mean that the individual plans or is committed to the future purchase or sale of the commodity. Taking a futures contract that is opposite to the position in the spot market reduces the risk. For example, if you hold a portfolio of stocks, you can hedge that portfolio's value by selling a stock index futures contract. If the stocks' prices fall, the portfolio will lose value, but the price of the futures contract is also likely to fall. Since you are short the futures contract, you can repurchase it at a lower price, thus making a profit. The gain from the futures position will be at least partially offset the loss on the portfolio.

2) **Speculators** attempt to profit from guessing the direction of the market. Speculators include locals as well as the thousands of individuals and institutions off the exchange floor. They play an important role in the market by providing liquidity that makes hedging possible and assuming the risk that hedgers are trying to eliminate.

3) **Spreaders** use futures to speculate at a low level of risk. A futures spread involves a long position in one contract and a short position in another. Spreads may be intracommodity or intercommodity. An intracommodity spread is like a time spread in options. The spreader buys a contract with one expiration month and sells an otherwise identical contract with a different expiration month. An intercommodity spread, which normally is not used in options, consists of a long position in a futures contract on one commodity and a short position in a contract on another. In some cases, the two commodities trade on different exchanges. The rationale for this type of spread rests on a perceived "normal" difference between the prices of the two futures contracts. When the prices move out of line, traders employ intercommodity spreads to take advantage of the expected price realignments.

4) **Arbitraguers** attempt to profit from differences in the prices of otherwise identical spot and futures positions.

Another classification is by **Trading Style.** There are three distinct trading styles: scalping, day trading, and position trading.

Scalpers attempt to profit from small changes in the contract price. Scalpers seldom hold theirr positions for more than a few minutes. They trade by using their skill at sensing the market's short-term direction and by buying from the public at the bid price and selling to the public at the ask price. They are constantly alert to large inflows of orders and short-term trends. Because they operate with very low transaction costs, they can profit from small moves in contract prices.

Day Traders hold their positions for no longer than the duration of the trading day. Like scalpers, they attempt to profit from short-term market movements; however, they hold their positions much longer than do scalpers. Nonetheless, they are unwilling to assume the risk of adverse news that might occur overnight or on weekends.

Position traders hold their positions open for much longer periods than do scalpers and day traders. Position traders believer they can make profits by waiting for a major market movement. This may take as much as several weeks or may not come at all.

The futures markets also include thousands of individuals and institutions. Institutions include banks and financial intermediaries, investment banking firms, mutual funds, pension funds, and other corporations.

A) Hedging

Hedging is a transaction designed to reduce or, in some case, eliminate risk. Before we being with the technical aspects of hedging, it is worthwhile to ask two questions: (1) why do firms hedge, and (2) should they hedge.

Hedging is done to reduce risk, but is this desirable. If everyone hedged, would we not simply end up with an economy in which no one takes risk. This would surely lead to economic stagnancy. Moreover, we must wonder whether hedging can actually increase shareholder wealth.

If the famous Modigliani-Miller propositions are correct, then the value of the firm is independent for any financial institutions, which include hedging. Hedging, however, may be desired by the shareholders simply to find a more acceptable combination of return and risk. It can be argued, however, that firm need not hedge since shareholders, if they wanted hedging, could do it themselves. But this ignores several important points. It assumes that shareholders can correctly assess all the firm's hedgeable risk. If a company is exposed to the risk associated with volatile raw materials prices, can the shareholders properly determine the degree of risk. Can they determine the periods over which that risk is greater. Can they determine the correct number of futures contracts necessary to hedge their share of the total risk. Do they even qualify to open a futures brokerage accounts. Will their transaction costs be equal to or less than their proportional share of the transaction costs incurred if the firm did the hedging. The answer to each of these questions is **"maybe not"**. If should be obvious that hedging is not something that shareholders can always do as effectively as firms.

Hedging also reduces the probability of bankruptcy. There is not necessarily valuable to the shareholders except that it can reduce the expected costs that are incurred if the firm does go bankrupt. Finally, a firm may choose to hedge because its managers'livelihoods may be heavily tied to the performance of the firm. The managers may then benefit from reducing the firm's risk. This may not be in the shareholders's best interests, but it can at least explain why some firms hedge. Finally, hedging may send a signal to potential creditors that the firm is making a concerted effort to protect the value of the underlying assets. This can result in more favorable credit terms and less costly, restrictive covenants.

So we see that there are many reasons why firms hedge. Now let us look at some important hedging concepts.

Short Hedge and Long Hedge

The terms **short hedge** and **long hedge** distinguish hedgers that involve short and long positions in the futures contract, respectively. A hedger who holds the commodity and is concerned about a decrease in its price might consider hedging it with a short position in futures. If the spot price and futures price move together, the hedge will reduce some of the risk. For example, if the spot price decreases, the futures price also will decrease, Since the hedger is short the futures contract, the futures transaction produces a profit that at least partially offsets the loss on the spot position. This is called a **short hedge** because the **hedger is short futures**.

Another type of short hedge can be used in anticipation of the future sale of an asset. An example of this occurs when a firm decides that it will need to borrow money at a later date. Borrowing money is equivalent to issuing or selling a bond or promissory note. If interest rate increase before the money is borrowed, the loan will be more expensive. A similar risk exists if a firm has issued a floating rate liability. Since the rate is periodically reset, the firm has contracted for a series of futures loans at unknown rates. To hedge this risk, the firm might short an interest rate futures contract. If rates increase, the futures transaction will generate a profit that will at least partially offset the higher interest rate on the loan. Because it is taken out in anticipation of a future transaction in the spot market, this type of hedge is known as an **anticipatory hedge**.

Another type of anticipator hedge involves an individual who plans to purchase a commodity at a later date. Fearing an increase in the commodity's price, the investor might buy a futures contract. Then, if the price of the commodity increases, the futures price also will increase and produce a profit on the futures position. That profit will at least partially offset the higher cost of purchasing the commodity. This is a **long hedge**, because the **hedger is long in the futures market**.

Another type of long hedge might be placed when on is short an asset. Although this hedge is less common, it would be appropriate for someone who has sold short a stock and is concerned that the market will go up. Rather than close out the short position, one might buy a futures and earn a profit on the long position in futures that will at least partially offset the loss on the short position in the stock.

In each of these cases, the hedger held a position in the spot market that was subject to risk. The futures transaction served as a temporary substitute for a spot transaction. Thus, when one holds the spot commodity and is concerned about a price decrease but does not want to sell it, one can execute a short futures trade. Selling the futures contract would substitute for selling the commodity. The following table summarizes these various hedging situations:

Condition Today	Risk	Appropriate Hedge
Hold asset	Asset price may fall	Short Hedge
Plan to buy asset	Asset price may rise	Long Hedge
Sold short asset	Asset price may rise	Long Hedge
Issued floating-rate liability	Interest rates may rise	Short Hedge
Plan to issue liability	Interest rates may rise	Short Hedge

Examples of Long and Short Hedges

1) A long Hedge

Consider the following example (discussed in the book). Silver is an essential input for the production of most types of photographic films and papers, and the price of silver is quite volatile. For a film manufacturer, there is considerable risk that profits could be dramatically affected by fluctuations in the price of silver. If production schedules are to be maintained, it is essential that silver be acquired on a regular basis in large quantities. Assume that the film manufacturer needs 50,000 troy ounces of silver in two months (in July) and confronts the silver prices on May 10 shown in the following table:

Silver Futures prices on May 10
The COMEX trades a silver contract for 5,000 troy ounces

Contract	Price (cents per troy ounce)
Spot	1052.5
Jul	1068.0
Sep	1084.0

Fearing that silver prices may rise unexpectedly, the film manufacturer decides that the price of 1068.0 is acceptable for the silver that he will need in July. He realizes that it is hopeless to buy the silver on the spot market at 1052.5 and to store the silver for two months. The price differential of 15.5 cents per ounce would not cover his storage cost. Also, the manufacturer will receive an acceptable level of profits even if he pays 1068.0 for the silver to be delivered in July. With these reasons in mind, he decides to enter the futures market to hedge against the possibility of future unexpected price increases, and accordingly, he enters the trades show in the following:

A long hedge in Silver

Cash Market

- **May 10:** Anticipates the need for 50,000 troy ounces in two months and expects to pay 1068 cents per ounce, or a total of $534,000.
- **July 10:** The spot price of silver is now 1071 cents per ounce. The manufacturer buys 50,000 ounces, paying $535,500.
- **Result:** Opportunity loss: **- $1,500**

Futures Market

- **May 10:** Buys ten 5,000 troy ounce July futures contracts at 1068 cents per ounce.
- **July 10:** Since the futures contract is at maturity, the futures and spot prices are equal, and the ten contracts are sold at 1071 cents per ounce.
- **Result:** Futures profit: **$1,500**

The Overall **Net Wealth Change =0**

Taking the futures price as the best estimate of the future spot price, the manufacturer expects to pay 1068.0 cents per ounce for silver in the spot market two months from now in July. At the same time, he buys ten 5,000 ounce July Futures contracts at 1068.0 cents per ounce. Since he buys a futures contract in order to hedge, this transaction is known as a **long hedge**. Time passes, and by July the spot price of silver has risen to 1071.0 cents per ounce, three cents higher than expected. Needing the silver, the manufacturer purchases the silver on the spot market, paying a total of $535,500. This is $1500 more than expected. Since the futures contract is about to mature, the futures price must equal to the spot price, so the film manufacturer is able to sell his ten futures contracts at the same price of 1071.0 cents per ounce, making a three cent profit on each ounce, and a total profit of $1,500 on the futures position. The cash and futures results net to zero. In the cash market, the price was $1,500 more than expected, but there was an offsetting futures profit of $1,500, which generated a net wealth change of zero.

2) A short hedge

As an example, we assume the same silver prices and a date of May 10, as shown in the previous table. A Nevada silver mine owner is concerned about the price of silver, since she wants to be able to plan for the profitability of her firm. If silver prices fall, she may be forced to suspend production. Given the current level of production, she expects to have about 50,000 ounces of silver ready for shipping in two months. Considering the silver prices shown previously, she decides that she would be satisfied to receive 1068.0 cents per ounce for her silver.

To establish this price, she decides to enter the silver futures market. By hedging, she can avoid the risk that silver prices might fall in the next two months. Here are the miner's transactions:

A short hedge in Silver

Cash Market

- **May 10:** Anticipates the sale of 50,000 troy ounces in two months and expects to receive1068 cents per ounce, or a total of $534,000.
- **July 10:** The spot price of silver is now 1071 cents per ounce. The miner sells 50,000 ounces, receiving $535,500.
- **Result:** Profits: **$1,500**

Futures Market

- **May 10:** Sells ten 5,000 troy ounce July futures contracts at 1068 cents per ounce.
- **July 10:** Buys 10 contracts at 1071.
- **Result:** Futures loss:-**$1,500**

The Overall **Net Wealth Change =0**

Anticipating the need to sell 50,000 ounces of silver in two months, the mine operator sells ten 5,000 ounce futures contracts for July delivery at 1068.0 cents per ounce. On July 10, with silver prices at 1071.0 cents per ounce, the miner sells the silver and receives $535,000. This is $1,500 more than she originally expected. In the futures market, however, the miner suffers an offsetting loss. The futures contracts she sold at 1068, she offsets in July at 1071.0 cents per ounce. Once again, the profits and losses in the two markets offset each other, and produce a net wealth change of zero.

Viewing the results from the vantage point of July, it is clear that the miner would have been $1,500 richer if she had not hedged. She would have received $1,500 more than originally expected in the physicals market, and she would have incurred no loss in the futures market. However, it does not follow that she was unwise to hedge. In hedging, the miner and the film manufacturer both decided that the futures price was an acceptable price at which to complete the transaction in July.

A) Interest Rates Futures

The most actively traded futures contracts in the world are the interest rate futures such as Eurodollar or U.S. Treasury bonds contracts. Commercial banks and money managers use these futures to hedge their interest rate exposure, i.e., to protect their portfolios of loans, investments, or borrowing against adverse movements in interest rates. They are also used by speculators as leveraged investments, based on their forecasts of movements in interest rates.

Organized markets for interest rate futures exist for instruments in several currencies. Following the United States and the United Kingdom, most countries with a major bond market have either already developed, or are in the process of developing, a futures market for long-term bonds and sometimes short-term paper.

Active U.S. dollar markets exist in three-month U.S. Treasury bills and Eurodollar deposits for short-term interest rates and in 20-year 8% Treasury bonds for long-term rates. Other futures contracts have been introduced for certificates of deposit (CDs), commercial paper, 5- and 10-year Treasury bonds, and the mortgage bons known as Ginnie Maes, or GNMA. Similarly, the London International Financial Futures Exchange offers a 3-month sterling deposit contract, a 3-to $4\frac{1}{2}$-year 12% U.K. gilt contract, and a 20-year 12% U.K. gilt contract. The Paris Bourse (MATIF) proposes a 15-year 10% government bond contract and 3-month Treasury bill and PIBOR contracts. The Tokyo Stock Exchange offers contracts on 10-year bonds with a 6% yield. The Sydney Futures Exchange proposes contracts for 3-month Australian bills and 10-year Australian bonds. Eurodollar contracts are traded on several exchanges in the United States, Canada, London, and Singapore. These interest rate futures markets are growing rapidly throughout the world, and new contracts are continually created to fit the needs of banks and investors. Major bond contracts will be given in a figure.

The quotation method used for these contracts is difficult to understand but tends to be similar among countries. Contracts on short-term instruments are quoted at a discount from 100. At delivery, the contract price equals 100 minus the interest rate of the underlying instrument. For example, three-month Eurodollar contracts are denominated in units of $1 million; the price is quoted in points of 100%. For this reason the September contract in one of the figures that will be presented is quoted at 93.61% on the CME. The price of 93.61% is linked to an interest rate on three-month Eurodollar deposits of 6.39% (100 minus 93.61). If the three-month interest rate at delivery is less than 6.39%, the buyer of the contract at 93.61 will make profit.

This quotation method is drawn from the Treasury bill market. However, further calculations are required to drive the profit or loss on such a futures position, since the interest rates for the three-month instruments are quoted on an annual basis. The true interest paid on a three-month instrument is equal to the annual yield divided by four. Therefore the profit or loss on one unit of a Eurodollar contract (or any other three-month financial contract) equals the futures price variation divided by four. The total gain or loss on one contract is therefore equal to

$$\text{Gain (loss)} = (\text{Futures price variation}/4)\ \text{Size of the contract} \tag{1}$$

Assume that in September the Eurodollar interest rate drops to 6% on the delivery date. The futures price will be 94% on that date. The profit to the buyer of one contract is :

$$\text{Gain} = ((94\%\text{-}93.61\%)/4)\ \$\ 1\ \text{million} = \$975 \tag{2}$$

The same quotation technique is used for Treasury bills and other short-term interest contracts.

B) Stock Index Futures

Stock index futures are linked to a published stock index. The contract size is a multiple of the index. For example, the dollar size of the Standard and Poor's 500 contracts traded on the CME is 500 times the S&P 500 index. As with all futures contracts, the futures price depends on the expected final settlement price, since the futures price converges at expiration toward the spot price of a good or financial instrument. A unique characteristics of stock index futures is that the underling good, the stock index, does not exist physically as a financial asset. As a result, all final settlements take place in cash rather than by delivery of a good or security. On the delivery date, the buyer of a stock index contract receives the difference between the value of the index and the previous futures price. The procedure works as if the contract were marked to market on the last day, with the final futures price replaced by the stock index value. The cash delivery procedure avoids most of the transaction costs involved in buying and selling a large number of stocks. That is why cash settlement is sometimes used for other financial futures contracts. Eurodollar futures contracts have a cash settlement, and many new contracts are being created with cash settlement rather than physical delivery.

Numerous stock index contracts are available in the United States and all major countries. Futures or forward markets for individual stocks also exist in some stock markets, such as Rio de Janeiro and Paris. The most active contracts will be presented in class. These indexes are usually broadly based to allow for broad participation in the market. One exception is the Chicago Maxi Market Index, which consists of only 20 stocks. It is favored because it is closely tracks the Dow Jones index and is easier to arbitrage, given the small number of stocks involved.

All stock index futures prices are expressed as the value of the underlying index. As an illustration, let's assume that the December contract of the Sydney All Ordinary index contract is 1150. The next day this contract quotes at 1170. The gain in Australian dollars for the holder of one contract is equal to:

$$\text{Gain} = (1170\text{-}1150)\ \text{A\\$}\ 100 = \text{A\\$}2000 \tag{3}$$

In general:

$$\text{Gain (Loss)} = \text{Futures price variation} \times \text{Contract value multiplier} \tag{4}$$

Stock index futures become so popular because, like any other futures contracts, they offer an investor leverage. One can speculate on or hedge stocks with only a small cash investment equal to the margin. The specific advantage of a stock index contract is that an investor can directly invest in the stock market in a broad sense, without having to bear the specific risk of individual securities. Let's consider an investor who is bullish on an economy but has no knowledge or expectations about individual firms in that economy. What the investor wants is a diversified portfolio that will appreciate with the market rather than a few individual issues, which are vulnerable to specific factors. The investor has two alternatives: to buy an index funds with the associated costs or to buy stock index futures. Stock index futures are a convenient, highly liquid, and relatively inexpensive way to get a position similar to that of a well diversified portfolio. They can even be used to short the market.

There are numerous situations in which stock index futures are useful:

- Because of their leverage and liquidity, they allow for active up-and-down speculation.
- Large institutional investors may hedge their portfolios by selling stock index contracts when they anticipate a decline in the market. Hedging avoids the large transaction costs involved in rapidly liquidating a large portfolio. Moreover, the hedge can be undone instantly should expectations be revised.
- An investor may be very bullish on specific companies and expect their stock price performance to outperform the market. However, the market as a whole may decline, pushing all stock prices down. The investor can hedge the associated market risk of the selected securities by taking a short position in stock index futures.
- Institutions that move large sums of money in the stock market use these contracts to immediately take a position in the market, while slowly lining up sellers of shares at the best price. Even if the stock market goes up before the purchase program is completed, the institution benefits from the rise thanks to its long position in stock index futures. An alternative strategy is to ask brokers and dealers for a firm price immediately; because brokers require a certain amount of time to line up sellers, they charge a marked-up asking price. This compensates them for the risk of the market's going up while they are lining sellers. With stock index futures, the need for this procedure, and the risk premium required, is eliminated. The same applies to institutions wanting to sell large portfolios.
- Foreign investors are interested in stock index futures to reduce cash movements between countries and manage their risk exposure better.

Option Payoffs and Option Strategies

A) Introduction

One of the most interesting characteristics of an option is that it can be combined with stock or other options to produce a wide variety of alternative strategies. The profit possibilities are so diverse that virtually any investor can find an option strategy that suit his or her risk preference and market forecast.

In a world without options, the available strategies would be quite limited. If the market were expected to go up, one would buy stock; if it were expected to go down, one would sell short stock. However, selling short stock requires an investor to meet certain requirements, such as having a minimum amount of capital to risk, selling short on an uptick or zero-plus tick, and maintaining minimum margins. Options make it simple to convert a forecast into a plan of action that will pay off if correct. Of course, any strategy will penalize if the forecast is wrong. With the judicious use of options, however, the penalties can be relatively small and known in advance.

This part examine some of the more popular option strategies. The ones we examine should provide a basic understanding of the process of analyzing option strategies. Further study and analysis of the more advanced and complex strategies can be done using the framework presented here. Specifically, we should cover the strategies of calls, puts, and stock and combining calls with stock and puts with stock. We should see how calls and stock can be combined to form puts and how puts and stock can be combined to form calls. Further strategies will look at spreads, which involve one short and one long option, and combination strategies, which entail both puts and calls. The approach used to analyze option strategies is to determine the profit a strategy will produce for a broad range of stock prices when the position is closed. This methodology is simply yet powerful enough to demonstrate its strengths. One attractive feature is that there are actually three ways to present the strategy. Because reinforcement enhances learning, we shall utilize all three presentations.

The first method is to determine an equation that gives the profit from the strategy as a function of the stock price when the position is closed. You will find that the equations are quite simple and build on the notations that will be presented. The second method is a graphical analysis that uses the equations to construct graphs of the profit as a function of that stock price when the position is closed. The third approach is to use a specific numerical example to illustrate how the equations and graphs apply to real-world options.

B) Option Notation

We now introduce some notation for referring to options. In analyzing options we are interested in the option price as a function of the stock price, the time until expiration, and the exercise price. The options may either calls or puts, and the options may be either European or American. Therefore, we adopt the following notation:

S_t = price of the underlying stock at time t
X = the exercise price for the option
T = the expiration date of the option
c_t = the price of a European call at time t
C_t = the price of an American call at time t
p_t = the price of a European put at time t
P_t = the price of an American put at time t

We will write the value of an option in the following form:

$$c_t(S_t, X, T-t) \tag{5}$$

which means the price of a European call at time t given a stock price at t of S_t, for a call with an exercise price of X, that expires at time T, which is an amount of time T-t from now (time t). For convenience, we could sometimes omit the "t" subscript, as in:

$$p(S, X, T) \tag{6}$$

In that case, you may assume that the current time is time t = 0, and the option expires T periods from now. In this part, however, we focus on the value of options at expiration, so will mainly be concerned with values such as:

$$C_T(S_T, X, T) \tag{7}$$

indicating the price of an American call option at expiration, when the stock price is S_T, the exercise price is X, and the option expires at time T, which happens to be immediately.

Regarding European and American options, the difference is related to the exercise privileges associated with the option. An **American option** can be exercised at any time, while a **European option** can be exercised only at expiration. At expiration, both European and American options have exactly the same exercise rights. Therefore, European and American options at expiration have identical values, assuming the same underlying good and the same exercise price:

$$C_T(S_T, X, T) = c_T(S_T, X, T) \text{ and } P_T(S_T, X, T) = p_T(S_T, X, T) \tag{8}$$

We focus on option values and profits at expiration. Therefore, we use the notation for an American option throughout, but the results holds perfectly well for European options as well.

a) Buy Or Sell A Call Option

We consider the value of call options at expiration, along with the profits and losses that come from trading call options. At expiration, the owner of an option has an immediate choice: exercise the option or allow it to expire worthless. Therefore, the value of the option will either be zero or it will be the **exercise value** or the **intrinsic value** - the value of the option if it is exercised immediately. The value of a call at expiration equals zero, or the stock price minus the **exercise price**. For our discussion of option values and profits at expiration, we use the notation for American options (C_T or P_T), but the principles apply equally to European options as well.

$$C_T = Max\{0, S_T - X\} \tag{9}$$

For any stock price less than the exercise price, the call will be worthless. If the stock price equals the exercise price, the value of $S_T - X$ equals zero, so the call will still be worthless. Thus, for any stock price equal to or less than the exercise price at expiration, the call is worth zero.

If the stock price exceeds the exercise price, the call is worth the difference between the stock price and the exercise price.

A graph will be presented to show the characteristic shape for a **long** and **short positions** in a **call option**. We will note that the short position has a zero value for all stock prices equal to or less than the exercise price. If the stock prices exceeds the exercise price, the short position is costly. Using our notation, the value of a **short call position** at expiration is:

$$-C_T = -Max\{0, S_T - X\} \tag{10}$$

The short position never has a value greater than zero, and when the stock price exceeds the exercise price, the short position is worse than worthless. From this consideration, it appears that no one would ever willingly take a short position in a call option. However, this leaves out the payments made from the buyer to the seller when the option first trades.

Now, continuing with the same notations, say that the call option was purchased for C_t. To profit the holder of a long position in the call needs a stock price that will cover the exercise price and the cost of acquiring the option. For a long position in a call acquired at time $t < T$, the cost of the call is C_t . The **profit or loss** on the **long call position** held until expiration is:

$$C_T - C_t = Max\{0, S_T - X\} - C_t \tag{11}$$

The seller of a call receives payment when the option first trades. The seller continues to hope for a stock price at expiration that does not exceed the exercise price. However, even if the stock price exceeds the exercise price, there may still be some profit left for the seller. The **profit or loss** on the **sale of a call**, with the position held until expiration is:

$$C_t - C_T = C_t - Max\{0, S_T - X\} \quad (12)$$

A graph will be presented to illustrate the profits and losses of both long and short positions in a call option.

The figure will show some important points. For the call buyer, the worst that can happen is losing the entire purchase price of the option. Second, potential profits from a long position in a call option are theoretically unlimited. The profits depend only on the price of the stock at expiration. Third, the holder of a call option will exercise any time the stock price at expiration exceeds the exercise price. The call holder will exercise to reduce a loss or to capture a profit.

Regarding selling a call: first, the best thing that can happen to the seller of a call is never to hear any more about the transaction after collecting the initial purchase price. Second, potential losses from selling a call are theoretically unlimited. As the stock price rise, the losses for the seller of a call continue to mount.

A final observation about option trading, is that, the profits from the buyer and seller of the call together are always zero. The buyer's gains are the seller's losses, and vice versa:

$$\text{Long call profits} + \text{Short call profits}= \quad (13)$$

$$(C_T - C_t) + (C_t - C_T) = (Max\{0, S_T - X\} - C_t) + (C_t - Max\{0, S_T - X\}) = 0 \quad (14)$$

Therefore, the options market is a **zero-sum game**; there are no net profits or losses in the market. The trader who hopes to speculate successfully must be planning for someone else's losses to provide his profits.

Question: *What happens if option values stray from the relationship we analyzed.*

If prices stray from these relationships, arbitrage opportunities arise. Consider for example a call option with an exercise price of \$100. At expiration, with the stock trading at \$103, the price of a call option must be \$3. If the price is too high, say \$4, there is one arbitrage opportunity. If the call is too cheap, say \$2, there is another arbitrage opportunity. Say the call is only \$2. In this case, the money hungry arbitrager would transact as follows:

Buy 1 Call.........................-2
Exercise the Call................-100
Sell the share.......................+103
Net Cash flow......................+\$1

These transactions meet the conditions for arbitrage. First, there is no investment because all the transactions occur simultaneously. The only cash flow is a \$1 cash inflow. Second, the profit is certain once the trader enters the transaction. Therefore, these transactions meet the conditions for arbitrage: they offer a riskless profit without investment. If the call were priced at \$2, traders would buy options, exercise, and sell the share. These transactions would cause tremendous demand for the call and a tremendous supply of the share. These supply and demand forces would subside only after the call and share price adjusted to prevent arbitrage.

b) Buy Or Sell A Put Option

Again, we use the notation for an American put (P_T), but all of the conclusions hold identically for European puts. At expiration, the holder of a put has two choices - exercise or allow the option to expire worthless. If the holder exercises, he surrenders the stock and receives the exercise price. Therefore, the holder of a put will exercise only if the exercise price exceeds the stock price. The value of a put option at expiration equals zero, or the exercise price minus the stock price, whichever is higher:

$$P_T = Max\{0, X - S_T\} \quad (15)$$

If the stock price equals or exceeds the exercise price at expiration, the put is worthless. When the stock price at expiration falls below the exercise price, the put has value. In this situation, the value of the put equals the exercise price minus the stock price.

Some graphs will be presented to illustrate the value of a **long and short** position in a **put option**. profits and losses also will be illustrated. (Students are assumed one way or another, that, they have done similar analysis in other courses, so there is no need for repetition).

C) Option Combinations

This part discusses some of the most important ways that traders can combine options. By trading option combinations, traders can shape the risk and return characteristics of their option positions, which allows more precise speculative strategies.

a) The straddle

A **straddle** consists of a call and a put with the same exercise price and the same expiration. The buyer of a straddle buys the call and put, while the seller of a straddle sells the same two options. Consider a call and put, both with $100 exercise prices. We assume the call costs $5 and the put trades for $4. The profit and losses for the straddles are just the combined profits and losses from buying both options. If we let T as the expiration date of the option and let t be the present, then C_t is the current price of the option and C_T is the price of the option at expiration. Similarly, P_t is the present price of the put and P_T is the price of the option at expiration. So, the cost of the **long straddle** is:

$$C_t + P_t \tag{16}$$

and the value of the straddle at expiration will be:

$$C_T + P_T = Max\{0, S_T - X\} + Max\{0, X - S_T\} \tag{17}$$

Similarly, the **short straddle position** costs :

$$-(C_t + P_t) \tag{18}$$

so the short trader receives a payment for accepting the short straddle. The value of the short straddle at expiration will be:

$$-(C_T + P_T) = -Max\{0, S_T - X\} - Max\{0, X - S_T\} \tag{19}$$

A graph will show the profits and losses from buying and selling the straddle. The maximum loss for the straddle buyer is the cost of the two options. Potential profits are almost unlimited for the buyer if the stock price rises or falls enough. The figure will show also, the maximum profit for the short straddle trader occurs when the stock price at expiration equals the exercise price. If the stock price equals the exercise price, the straddle owner cannot exercise either the call or the put profitably. Therefore, both options expire worthless and the short straddle trader keeps both option premiums. However, if the stock price diverges from the exercise price, the long straddle holder will exercise either the call or the put. Any exercise decreases the short trader's profits and may even generate a loss. If the stock price exceeds the exercise price, the call owner will exercise, while if the stock price is less than the exercise price, the straddle owner will exercise the put.

The short trader bets that the stock price will not diverge too far from the exercise price, so the seller is betting that the stock price will not be too volatile. In making this bet, the straddle seller risks theoretically unlimited losses if the stock price goes too high. Likewise, the short trader's losses are almost unlimited if the stock price goes too low. The short trader's cash inflows equal the sum of the two option prices. At expiration, the short trader's cash outflows equals the exercise result for the call and for the put. If the call is exercise against him at expiration, the short trader loses the difference between the stock price and the exercise price. If the put is exercise against him, the short trader loses the difference between the exercise price and the stock price.

b) The Strangle

A strangle consists of a put and a call with the same expiration date and the same underlying good. In a strangle the call has an exercise price above the stock price and the put has an exercise price below the stock price. Let X_1 and X_2 be the two exercise prices, such that $X_1 > X_2$. Therefore, a strangle is similar to a straddle, but the put and call have different exercise price. Let $C_{t,1}$denote the cost of the call with an exercise price X_1 at time t, and let $P_{t,1}$ indicate the cost of the put with exercise price X_2.

The **long strangle** trader **buys the put and call**, while the **short trader sells** the two **options**. The **cost** of the **long strangle** is:

$$C_t(S_t, X_1, T) + P_t(S_t, X_2, T) \tag{20}$$

Then the value of the strangle at expiration will be:

$$C_T(S_T, X_1, T) + P_T(S_T, X_2, T) = Max\{0, S_T - X_1\} + Max\{0, X_2 - S_T\} \tag{21}$$

The cost of the **short strangle** is:

$$-C_t(S_t, X_1, T) - P_t(S_t, X_2, T) \tag{22}$$

and the value of the short strangle at expiration will be:

$$-C_T(S_T, X_1, T) - P_T(S_T, X_2, T) = -Max\{0, S_T - X_1\} - Max\{0, X_2 - S_T\} \tag{23}$$

The long trader of a strangle is betting that the stock price will move significantly below the exercise price on the put or above the exercise price on the call. The buyer has the chance for very large profits if the stock price moves dramatically away from the exercise price. Theoretically, the profit on a strangle is boundless. The profits on the short position are just the negative values of the profits for the long position. For very low stock prices, the short strangle position gives large losses, as it does for very high stock prices. Therefore, the short strangle trader is betting that stock prices stay within a fairly wide band. In essence, the short strangle trader has a high probability of a small profit, but accepts the risk of a very large loss.

A) Combining Options with Bonds and Stocks

Now, we show how to combine options with stocks and bonds to adjust the payoff patterns to fit any taste for risk and return combinations. These combinations show us the relationships among the different classes of securities. By combining two types of securities, we can imitate the payoff patterns of a third.

In this section we consider some combinations of options with bonds or stocks. An example, is the covered call - a long position in the underlying stock and a short position in a call option.

a) The Covered Call: Stock plus a Short Call

In a covered call transaction, a trader is assumed to already own a stock and writes a call option on the underlying stock. This strategy is undertaken as an income enhancement technique. Assume a trader owns a share currently priced at $100. She might write call option on this share with an exercise price of $110 and an assumed price of $4. The option premium will be hers to keep. In exchange for accepting the $4 premium, the trader realizes that the underlying stock might be called away from her if the stock price exceeds $110. If the stock fails to increase by $10, the option she has written will expire worthless. The example illustrates the fact that this strategy involves selling an option with a striking price far removed from the current value of the stock, because the intention is to keep the premium without surrendering the stock through exercise.

However, there is no free lunch in the options market. If the stock price were to rise to $120, the trader would not receive this benefit, because the stock would be called away from her.

b) A portfolio Insurance: Stock Plus a Long Put

Portfolio insurance is an investment technique designed to protect a stock portfolio from severe drops in value. We analyze a simple strategy for implementing portfolio insurance with options. Portfolio insurance applies only to portfolios, not individual stocks. Thus, we should assume that the underlying good is a well-diversified portfolio of common stocks. Therefore, the portfolio insurance is protecting the value of this stock portfolio from large drops in value.

In essence, portfolio insurance with options involves holding a stock portfolio and buying a put option on the portfolio. If we have a long position in the stock portfolio, the profits and losses from holding the portfolio consist of the profits and losses from the individual stocks. Therefore, the profits and losses for the portfolio resemble the typical stock's profits and losses.

Let S_t be the cost of the stock portfolio at time t, and let P_t be a put option on the portfolio. The close of an insured portfolio is, therefore:

$$S_t + P_t \tag{24}$$

Because the price of a put is always positive, it shows that an insured portfolio costs more than the uninsured stock portfolio alone. At expiration, the value of the insured portfolio is:

$$S_T + P_T = S_T + Max\{0, X - S_T\} \tag{25}$$

As the profit on an uninsured portfolio is $S_T - S_t$, the insured portfolio has a superior performance when $Max\{0, X - S_T\} - S_t - P_t > 0$

As an example, consider an investment in the stock index at a value of 100.00. We assume that the put has a striking price of 100.00 and costs 4.00 (expressed in terms of the index). A graph will be presented to show the effects of combining an investment in the index stocks and buying a put on the index.

The insured portfolio, the index plus a long put, offers protection against large drops in value. If the stock index suddenly falls to 90.00, the insured portfolio loses only 4.00. No matter how low the index goes, the insured portfolio can lose only 4.00 points. However, this insurance has a cost. Investment in the index itself shows a profit for any index value over 100.00. By contrast, the insured portfolio has a profit only if the index climbs above 104.00. In the insured portfolio, the index must climb high enough to offset the price of buying the insuring put option. Because the put option will expire, keeping the portfolio insured requires that the investor buy a series of put options to keep the insurance in force. The figure illustrates that the combined position of a long index and a long put gives a payoff shape that matches a long position in a call. Like a call, the insured portfolio protects against extremely unfavorable outcomes as the stock price falls.

This similarity between the insured portfolio and a call position suggests that a trader might buy a call and invest the extra proceeds in a bond in order to replicate a position in an insured portfolio.

Bounds on Option Prices

In this part we formulate rules that enable use to better understand how call options are priced. It is important to keep in mind that our objective is to determine the price of a call option prior to its expiration day.

A) Principles of Call Option Pricing

The Minimum value of a call

A call option is an instrument with limited liability. If the call holder sees that it is advantageous to exercise it, the call will be exercised. If exercising it will decrease the call holder's wealth, the holder will not exercise it. The option cannot have negative value, because the holder cannot be forced to exercise it. Therefore,

$$C(S,T,E) \geq 0 \tag{26}$$

For an American call, the statement that a call option has a minimum value of zero is denominated by a much stronger statement:

$$C_a(S,T,E) \geq Max(0, S - E) \tag{27}$$

The minimum value of an option is called its **intrinsic value**, sometimes referred to as **parity value**, **parity**, or **exercise value**. Intrinsic value, which is positive for in-the-money calls and zero for out-of-the money calls, is the value the call holder receives from exercising the option and the value the call writer gives up when the option is exercised.

To prove the intrinsic value rule, consider one 160 call option. The stock price is \$164, and the exercise price is 160. Evaluating the expression gives Max (0,164 - 160) = 4. Now consider what would happen if the call were priced at less than \$4 - say, \$3. An option trader could buy the call for \$3, exercise it - which would entail purchasing the stock for \$160 - and then sell the stock for \$164. This arbitrage transaction would net an immediate riskless profit of \$1 on each share. All investors would do this, which would drive up the option's price. When the price of the option reached \$4, the transaction would no longer be profitable. Thus, \$4 is the minimum price of the call.

The intrinsic value concept applies only to an American call, because a European call can be exercised only on the expiration day. If the price of a European call were less than Max (0, S - E), the inability to exercise it would prevent traders from engaging in the aforementioned arbitrage that would drive up the call's price.

The price of an American call normally exceeds its intrinsic value. The difference between the price and the intrinsic value is called the **time value** or **speculative value** of the call, which is defined a:

$$C_a(S,T,E) - Max(0, S - E) \tag{28}$$

The time value reflects what traders are willing to pay for the uncertainty of the underlying stock.

The Maximum Value of a Call

A call option also has a maximum value:

$$C(S,T,E) \leq S \tag{29}$$

The call is a conduit through which an investor can obtain the stock. The most one can expect to gain from the call is the stock's value less the exercise price. Even if the exercise price were zero, no one would pay more for the call than for the stock. However, one call that is worth the stock price is one with an infinite maturity.

The Value of a Call at Expiration

The price of a call at expiration is given as:

$$C_T(S_T,T,E) = Max(0, S_T - E) \tag{30}$$

because no time remains in the option's life, the call price contains no time value. The prospect of future stock price increases is irrelevant to the price of the expiring option, which will be simply its intrinsic value.

At expiration, an American option and a European option are identical instruments. Therefore, this rule holds for both types of options.

B) Principles of Put Option Pricing

The Minimum Value of a Put

A put is an option to sell a stock. A put holder is not obligated to exercise it and will not do so if exercising will decrease wealth. Thus, a put can never have a negative value:

$$P(S,T,E) \geq 0 \tag{31}$$

An American put can be exercised early, therefore:

$$P_a(S,T,E) \geq Max(0, E-S) \tag{32}$$

Suppose that there is a 170 put on a stock, and sells for less than E - S. Let the put sell for \$5. Then it would be worthwhile to buy the stock for \$164, buy the put for \$5, and exercise the put. This would net an immediate risk-free profit of \$1. The combined actions of all investors conducting this arbitrage would force the put price up at least \$6, the difference between the exercise price and the stock price.

The value, Max (0, E-S), is called the put's **intrinsic value**. An in-the-money put has a positive intrinsic value, while an out-of-the money put has an intrinsic value of zero. The difference between the put price and the intrinsic value is the **time value** or **speculative value**. The time value is defined as $P_a(S,T,E) - Max(0, E-S)$. As with calls, the time value reflects what an investor is willing to pay for the uncertainty of the final outcome.

The intrinsic value specification, Max (0, E - S), does not hold for European puts. That is because the option must be exercisable for an investor to execute the arbitrage transaction previously described. European puts indeed can sell for less than the intrinsic value.

The Maximum Value of a Put

At expiration, the payoff from European put is Max (0, E - S). The best outcome that a put holder can expect is for the company to go bankrupt. In that case, the stock will be worthless (S = 0) and the put holder will be able to sell the shares to the put writer for E dollars.

Thus, the present value of the exercise price is the European put's maximum possible value. Since an American put can be exercised at any time, its maximum value is the exercise price.

$$P_e(S,T,E) \leq E(1+r)^{-T} \tag{33}$$

$$P_a(S,T,E) \leq E \tag{34}$$

The Value of a Put at Expiration

On the put's expiration date, no time value will remain. Expiring American puts therefore are the same as European puts. The value of either type of put must be the intrinsic value. Thus,

$$P_T(S_T,T,E) = Max(0, E-S_T) \tag{35}$$

If $E > S_T$ and the put price is less than E - S_T, investors can buy the put and the stock and exercise the put for an immediate risk-free profit. If the put expires out-of-the-money ($E < S_T$), it will be worthless.

The option prices considered in this part depend on five factors: the price of the underlying stock, the exercise price of the option, the time remaining until expiration, the risk-free rate of interest, and the possible price movements on the underlying stock. For stocks with dividends, the potential dividend payments during an option's life can also influence the value of the option. For the moment, I postpone the discussion of these factors until we discuss the Black-Scholes model.

A) The Black-Scholes Analysis

The Black-Scholes analysis is analogous to the no-arbitrage analysis we used to value options when stock price changes are binomial. A riskless portfolio consisting of a position in the option and a position in the underlying stock is set up. In the absence of arbitrage opportunities, the return from the portfolio must be the risk-free interest rate r.

The reason why a riskless portfolio can be set up is because the stock price and the option price are both affected by the same underlying source of uncertainty: stock price movements. In any short period of time, the price of a call option is perfectly positively correlated with the price of the underlying stock; the price of a put option is perfectly negatively correlated with the price of the underlying stock. In both cases, when an appropriate portfolio of the stock and the option is set up, the gain or loss from the stock position always offsets the gain or loss from the option position so that the overall value of the portfolio at the end of the short period of time is known with certainty.

Although the Black-Scholes model did not evolve directly from the binomial model, it is a mathematical extension of it. Recall that the binomial model can be extended to any number of time period. Suppose we let n equal infinity so that each time period is very small. The interest rate, r, is the risk-free rate over each time period. As you can imagine, the number of stock prices at expiration will very large - in fact, infinite. Although the algebra is somewhat complex, the equation for the binomial model becomes the equation for the Black-Scholes model. I will illustrate later how the binomial price converges to the Black-Scholes price.

We shall omit the math here, but it is important to review the model's assumptions:

1. The rate of return on the stock follows a **lognormal distribution.** This means that the logarithm of 1 plus the rate of return follows the normal, or bell-shaped curve. The lognormal distribution is a convenient and realistic characterization of stock returns because it reflects stockholders'limited liability.

2. The risk-free rate and variance of the return on the stock are constant throughout the option's life.

3. There are no taxes or transaction costs.

4. The stock pays no dividends.

5. The calls are European.

The Black-Scholes formulas for the prices of European calls and puts on nondividend-paying stocks are:

$c = SN(d_1) - Xe^{-rT}N(d_2)$

$p = Xe^{-rT}N(-d_2) - SN(-d_1)$

where:

$d_1 = (\ln(S/X) + (r + \sigma^2/2)T)/(\sigma\sqrt{T})$

$d_2 = (\ln(S/X) + (r - \sigma^2/2)T)/(\sigma\sqrt{T}) = d_1 - \sigma\sqrt{T}$

The function N(x) is the cumulative probability function for a standardized normal variable. In other words, it is the probability that a variable with a standard normal distribution, $\Phi(0,1)$, will be less than x. The variables c and p are the European call and put prices, S is the stock price, X is the strike price, r is the risk-free interest rate, T is the time to expiration, and σ is the volatility of the stock price. Since the American call, C, equals the European call price, c, for a nondividend-paying stock, the above equation also gives the price of an American call. Unfortunately no exact analytic formula for the value of an American put on nondividend-paying stock has been produced. Note that r is the continuously compounded risk-free rate.

The only problem in applying the above equations is the computation of the cumulative normal distribution function, N. Tables of N are usually provided in all statistical books. The function can also be evaluated using a polynomial approximation. On such approximation that can be easily be obtained using a hand calculator is given by the equations:

$N(x) = 1 - (a_1k + a_2k^2 + a_3k^3)N^{'}(x)$ when x$\geq$ 0

$N(x) = 1 - N(-x)$ when x<0

where:

k $= 1/(1 + \alpha x)$

$\alpha = 0.33267$

$a_1 = 0.4361836$
$a_2 = -0.1201676$
$a_3 = 0.9372980$
and
$N'(x) = \left(1/\sqrt{2\pi}\right) e^{-x^2/2}$
This provides values for N(x) that are always accurate to 0.0002.

Example: Consider the situation where the stock price six months from the expiration of an option is $42, the exercise price of the option is $40, the risk free interest rate is 10% per annum, and the volatility is 20% per annum. This means that S = 42, X = 40, r =0.1, T = 0.5, and $\sigma = 0.2$.

$d_1 = (\ln(S/X) + (r + \sigma^2/2)T)/(\sigma\sqrt{T}) = 0.7693.$
$d_2 = (\ln(S/X) + (r - \sigma^2/2)T)/(\sigma\sqrt{T}) = d_1 - \sigma\sqrt{T} = 0.6278$
and $Xe^{-rT} = 40e^{-0.05} = 38.049$

Hence, if the option is a European call, its value, c, is given by:
c = 42N(0.7693)-38.049N(0.6278).
If the option is a European put, its value p, is given by: p = 38.049N(-0.6278) - 42N(-0.7693).
using the approximation, we have: N(0.7693)=0.7791. N(-0.7693)=0.2209. N(0.6278)=0.7349 and N(-0.6278)=0.2651.
so that: c = 4.76 and p = 0.81.

The stock price has to rise by $2.76 for the purchaser of the call to break even. Similarly, the stock price has to fall by $2.81 for the purchaser of the put to break even.

Another Numerical Example

Let us use the Black-Scholes model to price an option of July 165 call. The inputs are the stock price of $164, an exercise price of $165, and a time to expiration of say 0.0959. We have also the risk-free rate of 5.35 percent as the Treasury bill yield that corresponds to the option's expiration. In the model of Black-Scholes model, the risk-free rate must be expressed as a continuously compounded yield. The continuously compounded equivalent of 5.35% is Ln(1.0535) = 0.0521. Let us also use 0.29 as the standard deviation, which corresponds to a variance of 0.0841.

The computation of the Black-Scholes price is a five step process that is presented below. You can first calculate the values of d_1 and d_2, then you look up N(d_1) and N(d_2) in the normal probability table. Then you plug the values into the formula for C.

S = 164, X = 165, r = 0.0521, T = 0.0959

- Compute $d_1 = (\ln(S/X)+(r+\sigma^2/2)T)/(\sigma\sqrt{T}) = [\ln(164/165) + (0.0521 + 0.0841/2)0.0959] / \left(0.29\sqrt{0.0959}\right) = 0.0328$
- Compute $d_2 = d_1 - \sigma\sqrt{T} = 0.0328 - 0.29\sqrt{0.0959} = -0.0570$
- Look up N(d_1), that N(0.03)=0.5120
- Look up N(d_2) $= N(-0.06) = 0.4761$
- Plug into formula C $= SN(d_1) - Xe^{-rT}N(d_2) = 164(0.5120) - 165e^{-(0.0521)(0.0959)}(0.4761) = 5.803$

So the theoretical fair value for the July 165 call is $5.803. Say the call's actual market price is $5.75. This suggests that the call is slightly underpriced. Assuming no transaction costs, an investor should buy the call.

Factors that influence the option price

There are six factors that influence the option price:
1. Current price of the underlying asset
2. Strike price
3. Time to expiration of the option
4. Expected price volatility of the underlying asset over the life of the option.
5. Short-term risk-free interest rate over the life of the option.
6. Anticipated cash payments on the underlying asset over the life of the option.

The impact of each of these factors may depend on whether the option is a call or put, and whether the option is an American option or a European option.

A summary could be presented:

Effect of an increase of factor on

Factor	Call Price	Put Price
Current price of underlying asset	increase	decrease
Strike price	decrease	increase
Time to expiration of option	increase	increase
Expected price volatility	increase	increase
Short-term interest rate	increase	decrease
Anticipated cash payments	decrease	increase

The above variables enter into the Black-Scholes model. With this model, we can see these effects more directly.

The Swaps Market

A **swap** is an agreement between two or more parties to exchange sets of cash flows over a period in the future. For example, Party A might agree to pay a fixed rate of interest on $1 million each year for five years to Party B. In return, Party B might pay a floating rate of interest on $1 million each year for five years. The parties that agree to the swap are known as **counterparties**. The cash flows that the counterparties make are generally tied to the value of debt instruments or to the value of foreign currencies. Therefore, the two basic kinds of swaps are **interest rate swaps** and **currency swaps**.

Swap transactions are facilitated by s**wap facilitators** (could include **brokers or dealers)** - economic agents who help counterparties identify each other and help the counterparties consummate swap transactions. By taking part in swap transactions, swap dealers expose themselves to financial risk. This risk can be serious, because it is exactly the risk that the counterparties are trying to avoid. In this respect, the dealer must price the swap to provide the reward for his services in bearing risk, and as a result of his transactions in the swap market, he has to manage a swap portfolio.

The origins of the swap market can be traced to the late 1970s, when currency traders developed currency swap as a technique to evade British controls on the movement of foreign currency. The first interest rate swap occurred in 1981 in an agreement between IBM and the World Bank. Since that time, the market has grown rapidly. By 1995, interest rate swaps with $10.6 trillion in underlying value were outstanding, and currency swaps totaled another $993 billion. The total swaps market exceeded a principal amount of $11.5 trillion, with about 90 percent of the swaps being interest rate swaps and the remaining 10 percent being currency swaps.

In the swaps market, only the counterparties know that the swap take place, as opposed to transactions in the futures or options market. Also, the swaps market is virtually not a regulated market. It is free from federal regulation. So, participants in the swaps market are thankful to avoid regulation.

Other characteristics that should be discussed are related to the following:

- To consummate a swap transaction, one potential counterparty must find a counterparty that is willing to take the opposite side of a transaction. If one party needs a specific maturity, or a certain pattern of cash flows, it can be very difficult to find a wiling counterparty.
- Because a swap transaction is a contract between two counterparties, the swap cannot be altered or terminated early without the agreement of both parties.
- By its very nature, the swaps market has not such guarantor. As a consequence, parties to the swap must be certain of the creditworthiness of their counterparties.

A) Plain Vanilla Swaps

In this section we analyze the different kinds of swaps, and show how they can help corporations in managing various types of risk exposure. We discuss the **plain vanilla swaps** that include the **interest rate swap** or a **currency swap**.

1) Interest Rate Swaps

In a plain vanilla interest rate swap, one counterparty has an initial position in a **fixed rate debt instrument**, while the other counterparty has an initial position in a **floating rate obligation**. In this initial position, the party with the floating rate obligation is exposed to changes in interest rates. By swapping this floating rate obligation, this counterparty eliminates exposure to changes interest rates.

To see the nature of the plain vanilla interest rate swap, we use an example. We assume that the swap covers a five-year period and involves annual payments on a $1 million principal amount. Let us assume that Party A agrees to pay a fixed rate of 12 percent to Party B. In return, Party B agrees to pay a floating rate of LIBOR + 3 percent to Party A. (LIBOR stands for London Interbank Offered Rate, and it is a based rate at which large international banks lend funds to each other). Floating rates in the swaps market are most often set as equaling LIBOR plus some additional amount. A figure will be presented to show the transactions between Party A and Party B. Party A pays 12 percent of $1 million, or $120,000 each year to Party B. Party B makes a payment to Party A in return, but the actual amount of the payments depends on movements in LIBOR.

As a practical matter, the principal amounts are not exchanged since there is no point of exchanging the same amount. Instead, the principal plays a conceptual role in determining the amount of interest payments. Because the principal is not exchanged, it is called **notional principal**, an amount used as a base for computations, but not an amount that is actually transferred from one party to another. In the above example, the notional principal is $1 million. Knowing that amount, we compute the actual dollar amount of the cash flows that the two parties make to each other each year.

If we assume that the LIBOR is 10 percent at the time of the first payment. This means that Party A will be obligated to pay $120,000 to Party B. Party B will owe $130,000 to Party A. Offsetting the two mutual obligations, Party B owes $10,000 to Party A. Generally,only the **net payment**, the difference between the two obligations, actually take place.

2) Foreign Currency Swaps

In a currency swap, one party holds one currency and desires a different currency. The swap arises when one party provides a certain principal in one currency to its counterparty in exchange for an equivalent amount of a different currency. For example, Party C may have German marks and be anxious to swap those marks for U.S. dollars. Similarly, Party D may hold U.S. dollars and be willing to exchange those dollars for German marks. With these needs, Parties C and D may be able to engage in a currency swap.

A plain vanilla currency swap involves the three different sets of cash flows:

- At the initiation of the swap, the two parties actually do exchange cash. The entire motivation for the currency swap is the actual need for funds denominated in a different currency. This differs from the interest rate swap in which both parties deal with dollars and can pay only the net amount.
- The parties make periodic interest payments to each other during the life of the swap agreement.
- At the termination of the swap, the parties again exchange the principal.

As an example:

- let us assume that the current spot exchange rate between German marks and U.S. dollars is 2.5 marks per dollar. Thus, the mark is worth $0.40.
- We assume that the U.S. interest rate is 10 percent and the German interest rate is 8 percent.
- Party C holds 25 million marks and wishes to exchange those marks for dollars.
- In return for the marks, Party D would pay $10 million to Party C at the initiation of the swap.
- Assume also that the term of the swap is seven years and the parties will make annual interest payments.
- With the interest rate in the example, Party D will pay 8 percent interest on the 25 million marks it received, so the annual payment from Party D to Party C will be 2 million marks.
- Party C received $10 million dollars and will pay interest at 10 percent, so Party C will pay $1 million each year to Party D.
- It was assumed also that the two parties pay a fixed rate of interest on their respective currencies (in other we could consider a plain vanilla swap to be an arrangement in which one party pays a fixed rate while the other pays a floating rate, thus creating a fixed-for-floating currency swap. Our example is a fixed-for-fixed currency swap).

In actual practice, the parties will make only net payments. For example, assume that at year 1 the spot exchange rate between the dollar and mark is 2.222 marks per dollar, or $0.45 per mark. Valuing the obligations in dollars at this exchange rate, Party C owes $1 million and Party D owes $900,000 (2 million marks at $0.45 per mark). Thus, Party C would pay the $100,000 difference. At other times, the exchange rate could be different, and the net payment would reflect that different exchange rate.

At the end of seven years, the two parties again exchange principal. In our example, Party C would pay $10 million and Party D would pay 25 million marks. This final payment terminates the currency swap. A figure will show the transactions of the currency swap.

B) Motivation For Swaps

We saw in the context of plain vanilla swaps that one party begins with a fixed rate obligation and seeks a floating rate obligation. The second party exchanges a floating rate obligation for a fixed rate obligation. For this swap to occur, the two parties have to be seeking exactly the opposite goals.

There are two basic motivations that we consider in this part.

1) Commercial Needs

Consider a savings and loan association. Savings and loan associations accept deposits and lend those funds for long-term mortgages. Because depositors can withdraw their funds on short notice, deposit rates must adjust to changing interest rate conditions. Most mortgagors wish to borrow at a fixed rate for a long time. As a result, the savings and loan association can be left with floating rate liabilities and fixed rate assets. This means the association is vulnerable to rising rates. If rates rise, the saving and loan will be forced to increase the rate it pays on deposits, but it cannot increase the interest rate it charges on the mortgages that have already been issued.

To escape this interest rate risk, the association might use the swaps market to transform its fixed rate assets into floating rate assets or transform its floating rate liabilities into a fixed rate liabilities. Let us assume that the loan and saving association wishes to transform a fixed rate mortgage into an asset that pays a floating rate of interest. The association is like Party A - in exchange for the fixed rate mortgage that it holds, it wants to pay a fixed rate of interest and receive a floating rate of interest. Engaging in a swap will help the association.

We extend the plain vanilla interest rate swap. Assume that the savings and loan association has just loaned $1 million for five years at 12 percent with annual payments, and pays a deposit rate that equals to LIBOR plus 1 percent. With these rates,the association will lose money if LIBOR exceeds 11 percent.

We present a figure to illustrate the swap transaction under which the loan association enters to. Party A is the savings and loan association, and it receives payments at a fixed rate of 12 percent on the mortgage. After it enters the swap, the association also pays 12 percent on a notional principal of $1 million. In effect, it receives mortgage payments and passes them through to Party B under the swap agreement. Under the agreement, Party A receives a floating rate of LIBOR plus 3 percent. From this cash inflow, the association pays its depositors LIBOR plus 1 percent. This leaves a periodic inflow to the association of 2 percent, which is the spread that it makes on the loan. The association now has a fixed rate inflow of 2 percent, and it has succeeded in avoiding its exposure to interest rate risk. No matter what happens to the level of the interest rates, the association will enjoy a net cash inflow of 2 percent on $1 million.

2) Comparative Advantage

In many situations, one firm may have better access to the capital market than another firm. For example, a U.S. firm may be able to borrow easily in the United States, but it might not have favorable access to the capital market in Germany. (we could make the same argument for a German firm).

The table shows a borrowing rates for Parties C and D, the firms of our plain vanilla currency swap example. Previously, we assumed that for each currency, both parties faced the same rate. However, we

- assume that Party C is a German firm with access to marks at a rate of 7 percent, while the US firm, Party D, must pay 8 percent to borrow marks. On the other hand
- Party D can borrow dollars at 9 percent, while the German Party C must pay 10 percent for its dollar borrowings.

As a result, Party C enjoys a comparative advantage in borrowing marks and Party D has a comparative advantage in borrowing dollars. That means that each firm can exploit its comparative advantage and share the gains by reducing the overall costs.

Borrowing rates for two firms in two currencies

Firm	U.S. dollar Rate	German Mark Rate
Party C	10%	7%
Party D	9%	8%

A figure will be presented to provide more information. In the first one, Party C borrows 25 million marks from a third party lender at its borrowing rate of 7 percent, while Party D borrows $10 million from a fourth party at 9 %. After that, the two parties will engage in a plain vanilla currency swap. Party C forwards the 25 million marks it has just borrowed to Party D, which reciprocates with the $10 million it has borrowed.

In the following figure we see the interest payments between Party C and Party D and the lenders. Party C pays interest payment at a rate of 10% on the $10 million it received from Party D, and Party D pays 2 million marks interest per year on the 25 million marks it received from Party C. Party C pays 1.75 million marks interest annually, but it receives 2 million marks from Party D, while Party D receives $1 million from Party C, from which it pays interest of $900,000.

In this case, Party C gets the use of $10 million and pays out 1.75 million marks. Had it borrowed dollars on its own, it would have paid a full 10 percent, or $1 million per year. At current exchange rate of 2.5 marks per dollar, Party C is effectively paying $700,000 annual interest on the use of $10 million. This is an effective rate of 7%. Party D pays $900,000 interest each year and receives the use of 25 million marks. This is equivalent to paying 2,250,000 marks annual interest ($900,000 times 2.5 marks per dollar) for the use of 25 million marks, or a rate of 9 percent. By engaging in the swap, both parties achieve an effective borrowing rate that is much lower than they could have obtained by borrowing the currency they needed directly.