Chapter 4
Option Contracts

Options are financial instruments that can be used to achieve a variety of investment objectives. For example, we shall see that ownership of a call (put) option allows an investor to profit from an increase (decrease) in the price of a security for a fraction of the price of the security. Furthermore, since losses are limited by the size of the initial investment, the holder of the call is protected against large losses that stock ownership may involve.

Options also allow shareholders to transfer unwanted risk associated with stock ownership to speculators willing to bear it. The necessity for transferring this risk generally reflects the shareholders' reluctance to sustain large losses. Option writers are investors who accept these risks. They are enticed into selling options by the size of the premium that compensates them for these risks. The size of the premium is related to the size of possible losses, the time of coverage, and other factors to be discussed. Option writers may be in a better situation to sustain such losses. For example they may be able to pool these risks with other risks in such a way that, in aggregate, the potential losses in their portfolios are more manageable.

In order to understand how options add another dimension to portfolio risk management, it is first necessary to understand how these contracts trade in an organized market. In this chapter we shall describe listed call and put stock options and present the basic terminology used in this market. The prices of these standardized contracts are determined in a competitive marketplace, and we shall discuss some of the factors that determine their prices. The appendix to this chapter describes the option exchanges and illustrates how option contracts are actually traded.

The primary objectives of this chapter are the following:

- To present the basic terminology used in the market for stock option contracts;
- To describe listed call and put stock options; and
- To discuss some of the factors that determine the prices of options.

Call Options

An American call option is a contract that gives the owner the right to purchase a given number of shares of a specific security at a specific price at any point in time prior to a predetermined date.[1] Usually the number of shares per contract is one hundred. To completely characterize a call contract, it is necessary to know the following:

- The name of the underlying security,
- The specified purchase price or strike price, and
- The duration of the contract or time to expiration.

Strike Prices

Strike prices are available at values surrounding the current stock price. Usually the prices are spaced at $\$2\frac{1}{2}$ intervals for stocks priced below \$25, \$5 intervals for stocks priced between \$25 and \$200, and \$10 intervals for stocks priced above \$200. As the stock price changes, new contracts are introduced in a systematic way, to be discussed later.

Call options with strike prices less than the stock price are termed in-the- money. Options with strike prices equal to the stock price are called at-the-money. Finally, calls which have strike prices exceeding the stock price are said to be out-the-money.

Expiration Dates

At any point in time, each underlying stock has option contracts available with several different expiration dates. The option with the closest expiration date is called the near series, the second one the middle series, and the option with the longest time to expiration is called the far series. Stock options usually expire on the Saturday following the third Friday in their stated month. When the near series expires, a new far series is introduced.

Until 1984 each underlying stock had option contracts available with 3 expiration dates. As an example a stock may have had January, April, and July options. When the January options expired, new nine-month October options were introduced. This contract belonged to the January/April/July/October series. Two other possible expiration cycles for an option existed. These were the February/May/August/November cycle and the March/June/September/December cycle. The three particular expiration month contracts that traded at any point in time depended, of course, on the actual time of the year.

The above expiration date rules applied until late 1984. In an effort to bring additional liquidity into the stock option market, the option exchanges instigated a program whereby stocks could trade an additional near-term contract. As a result, some stocks have four

[1] In this chapter all options we discuss are of the American variety. European options, discussed in Chapter 6, are similar to American contracts, with the exception that they cannot be exercised prior to the expiration date. The terminology of these contracts is unfortunate in that it has no geographic meaning. Most stock option contracts traded throughout the world are American. However, a few contracts traded in America and Europe are of the European variety.

expiration dates. Each has the nearest two months and the next two months of its normal $3-6-9$-month cycle trading at one time. Exhibit 1 illustrates the option contracts that are available at the end of each possible month for a January cycle option.

Exhibit 1
Option Contracts Available For January Cycle Series.

End of Current Month	**Option Contracts Available**
January	February, March, April, July
February	March, April, July, October
March	April, May, July, October
April	May, June, July, October
May	June, July, October, January
June	July, August, October, January
July	August, September,October, January
August	September, October,January, April
September	October, November, January, April
October	November, December, January, April
November	December, January, April, July
December	January, February, April, July

Example

Consider a stock that has an option contract expiring in January. After the expiration date, February and March contracts will trade as well as the usual April and July contracts.

Creation of Options with New Strike Prices

As already mentioned, when one option expires, a new series is introduced with strike prices surrounding the current stock price. As the stock price changes in value, new strike prices are added. In particular, if a stock price closes above (below) the highest (lowest) existing strike price for a certain number of days (usually two), a new strike price is created. Newly created contracts usually have a time to expiration exceeding thirty days. This often means that new near term contracts in the series are not introduced.

As a result of this method of introducing new strike prices, securities that have experienced significant price fluctuations over the past several months could have a large number of different strike prices available. The most actively traded option contracts, however, tend to be those contracts trading near-the-money and with the closest expiration date.

Example

Exhibit 2 shows the class of selected call options on XYZ that were available on February $1st$, when the stock price was 40. The 40 strike price options are at-the- money, the $45s$ are out-the-money, the $30s$ and $35s$ are in-the-money, and the $20s$ and $25s$ are said to be deep in-the-money.

Exhibit 2: Selected Calls on XYZ

Strike	April	July	October
25	$\surd$	$\times$	$\times$
30	$\surd$	$\surd$	$\times$
35	$\surd$	$\surd$	$\surd$
50	$\surd$	$\surd$	$\surd$

The April $35, 40$, and 45 options will probably be the most liquid options at this point in time.

Prices of Options

The price of a call option is determined in a competitive marketplace. The largest exchange is the Chicago Board Options Exchange. Other exchanges in the United States include the American, Philadelphia, Pacific, and New York Stock Exchanges. Exhibit 3 illustrates the typical option price information as reported in the Wall Street Journal. In particular, the exhibit shows the reported prices of options on IBM. The newspaper only reports information on the 1400 most active stock options. First, the name of the underlying security is presented with the closing stock price underneath. The next two columns indicate the strike price and the expiration month. The next two columns give the call volume and the last price. The final two columns give daily volume and last price for the put option. Option prices are reported on a per share basis, so the actual price is obtained by multiplying the quoted price by the number of shares per contract (usually 100). Option prices under \$3 trade in sixteenths of a point, while those over \$3 trade in eighths of a point. The 40 most active stock option contracts are highlighted at the top of the page, and volume and open interest summaries by option exchange are also reported.

Exhibit 3:
Reported Option Prices on IBM
Closing Stock Price = 122 3/4

Strike	IBM Expiration	Call Vol	Contracts Last	Put Vol	Contracts Last
110	Sept	62	13 1/2	1248	1 5/16
115	Aug	55	7 3/4	524	1/16
115	Sept	76	9 1/2	535	2 3/16
120	Aug	884	2 7/8	2360	1/4
120	Sept	536	7	582	3 1/2
125	Aug	3361	5/16	3829	21/2
125	Sept	858	4 1/2	251	6 1/4
130	Aug	914	1/16	1928	7 1/4
130	Sept	1327	2 5/16	2230	9 1/4
130	Oct	1191	4 3/8	5	9 1/2
135	Sept	512	1 7/16	2	13 3/4
140	Oct	307	1 3/4	–	–

Long-term Equity Anticipation Securities

On the listed option quotation page of the Wall Street Journal a section is devoted to long term equity anticipation securities, usually referred to as LEAPS. These contracts were initially created by the CBOE in October 1990, and now exist on all option exchanges. Essentially, LEAPS are long term options with maturities as long as two or three years. The Wall Street Journal publishes information on the most active LEAPS. Since they were introduced, volume has steadily increased. In 1992 more than 1.5 million LEAPS contracts were sold and in 1993 volume expanded by about 50%. Currently, such contracts account for about 6% of CBOE equity option volume. While this market only accounts for a fraction of the total options market, their growth has been rapid and significant, especially since the volume of short term equity options has not increased since 1990, *a* year in which over 48 million contracts were traded.

Exhibit 4 shows the closing prices, in dollars, of selected call options on XYZ. The prices are recorded on a per share basis. Thus, the actual prices per contract are obtained by multiplying the price by the number of shares per contract, which in this case is 100. The actual price of an April 35 call contract, for example, is \$700. The stock price is \$40, and the time to expiration of the near series is 12 weeks.

Exhibit 4: Call Option Prices on XYZ

Strike	April	July	October
25	15.06	-	-
30	10.88	12.12	-
35	7.00	8.62	-
40	4.00	5.75	7.38
45	2.00	3.69	5.39
50	0.88	2.38	3.75

The Intrinsic Value and Time Premiums of Call Options

The value of an American option depends on many factors including the price of the underlying security, S, the strike price, X, and the time remaining to expiration, T. Let C be the call option price. Oftentimes, to make matters specific we shall write the call price as a function of these parameters. That is, $C = C(S, X, T)$.

The intrinsic value of a call option is defined as the difference between the stock price and strike price or zero, whichever is greatest.

$$\text{Intrinsic Value} = \text{Max}(S - X, O)$$

All in-the-money call options have positive intrinsic value. Options trading at their intrinsic value are said to be trading at parity. Theoretically, an option should never trade below parity. If it did, an investor wanting to purchase the stock would find it cheaper to buy the stock by purchasing the option and exercising it immediately. For example, with XYZ trading at \$40, the value of all 35 options should exceed the intrinsic value of \$5.

Property 1

The price of a call option should equal or exceed its intrinsic value:

$$C(S, X, T) \geq Max[S - X, 0]$$

At expiration, the option holder has the choice of buying the stock for the strike price or allowing the option to expire. The option should be exercised if it is in-the-money. If it is out-the-money, the option is worthless.

Property 2

At the expiration date, the value of a call option equals its intrinsic value

$$C(S, X, 0) = Max[S - X, 0].$$

The difference between the observed call price and its intrinsic value is called the time premium. If the time premium is zero, the call is trading at parity.

Exhibit 5 illustrates the time premiums of the XYZ call options. Note that all options are trading above parity.

Exhibit 5
Time Premiums of XYZ Call Options

Strike	April	July	October
25	0.06	-	-
30	0.88	2.12	-
35	2.00	3.62	-
40	4.00	5.75	7.38
45	2.00	3.69	5.39
50	0.88	2.38	3.75

Since an option with a longer time to expiration has all the characteristics of an option with a shorter expiration but lasts longer, it should carry a higher price. The time premium reflects this value.

Property 3

The value of a call options with the same strike increases as the time to expiration increases.

$$C(S, X, T_1) \leq C(S, X, T_2) \qquad if \quad T_1 \leq T_2$$

The call value can be represented as the sum of two components:

$$\text{Call Premium} = \text{Intrinsic Value} + \text{Time Premium}$$

As the expiration date nears, the time premium shrinks to zero. Prior to expiration, the size of the time premium depends on the time remaining to expiration and on the intrinsic

value. From Exhibit 5 it can be seen that the time premiums of at-the- money options are relatively larger than time premiums of in-the-money or out-the- money options. This phenomenon will be discussed in more detail in later chapters.

Call Option Transactions

A call buyer's opening transaction consists of the initial call purchase. Since the time premium shrinks as the expiration date approaches, call buyers hope that this decay is more than offset by an increase in the intrinsic value. At any time, the call holder can do one of three things:

- Exercise the call by paying the strike price in return for shares.
- Cancel the position by selling the call option at the current market price.
- Hold onto the call and take no immediate action.

Exercising Call Options

If an option is exercised and the acquired stock is immediately sold at market price, then ignoring commission costs, the option holder will profit only from the intrinsic value.

Example

Suppose an investor owns an April 40 call option on a stock that is priced at $42. By exercising the call option, the investor pays $40 for a stock whose market value is $42. If the stock is sold at its market value of $42, then ignoring commission costs, the net profit to the option holder will be $2 less the initial cost of the option.

Property 4

By exercising a call option the investor forfeits the time premium

Rather than exercising the call option, the investor could have cancelled the position by selling the option at its current market price. In this way, the time premium would not be forfeited.

Although it appears that early exercise of a call option is not a sound strategy, there are circumstances in which it is appropriate. These include the following situations:

(i) If the investor wants to own the stock and the option is trading at parity, exercising

the call rather than selling the option and buying the stock may be advantageous, once transaction costs are considered.

(ii) Immediately before an ex-dividend date, the holder of a deep in-the-money call option may find it profitable to exercise the call early, especially if the dividend paid on the stock is sufficiently large.

Property 5

For a stock that pays no dividends, no incentive exists to exercise the call option early. The option holder will either sell the call or hold onto it

The optimal timing of exercising options and the impact of dividends on the exercise policy is discussed more fully in Chapter 6.

Selling Call Options

For every opening transaction involving an option purchase, there is an opening transaction involving an option sale. The seller (or writer) of an option is obliged to deliver 100 shares of the underlying stock for the agreed strike price in the event that the option is exercised. The writer of the call receives the call premium for this obligation. The writer anticipates that the stock price will decline in value or increase at a rate slower than the decrease of the time value of the option.

Unlike the call purchaser, who has a voluntary right to exercise the call, the writer has a legal obligation to deliver 100 shares at the strike price in the event that the option is exercised.

Example

An XYZ April 45 call option initially sold for a premium of $2. In March, with the stock price at 52, the option is exercised. The writer, in this case, is obligated to deliver 100 shares of the security for $45 per share.

At any point in time the writer of a call option can do one of two things:

- Close out the position by buying the call back at the current market price, or
- Do nothing.

The call writer should be particularly aware of conditions that will encourage the buyer

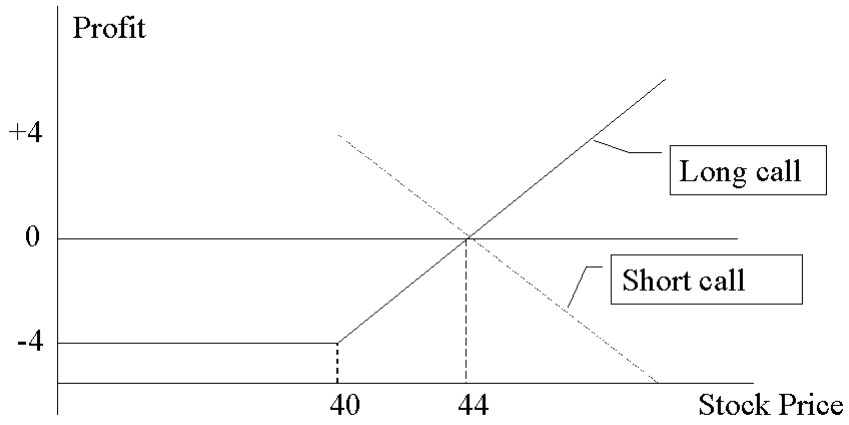
to exercise the call. As discussed, exercise can occur if the call trades at parity and an ex-dividend date is near.

The maximum loss an option buyer can experience is limited to the initial investment. However, the maximum loss in selling call options is unlimited. To guarantee that the writer can meet obligations, brokerage firms require certain margin requirements to be met. These requirements may be stricter than the minimum set of requirements set by law. In addition, the initial call premiums taken in are held by the brokerage firm as collateral.

The profit obtained by holding a call option to expiration depends on the stock price at expiration. The solid line in Exhibit 6 illustrates the potential profit of an April 40 call option initially purchased for $4 and held to expiration.

The profit from selling the call is the mirror image of the profit from buying the call and is represented by the dashed line. The profit functions clearly illustrate that the profit (loss) of the buyer equals the loss (profit) of the writer. Notwithstanding commission costs, options are zero sum games.

Exhibit 6
Profit on a Call Option



Put Options

A put option is a contract that gives the owner the right to sell a given number of shares of a specified security at a specified strike price at any point in time prior to a specified

date. The writer of a put is legally obliged to accept delivery of the shares for the strike price in the event that the put holder exercises the option.

Prices of Put Options

Exhibit 4 illustrated the prices of all call options available on XYZ when the stock price was \$40. Exhibit 7 shows the prices of all put options on a per share basis. Note that the available strike prices and times to expiration are the same as for the call options. A holder of an April 45 put option has the right to sell 100 shares of XYZ at \$45 per share, regardless of the market value of the security. The ability to do this extends to the third Friday in April.

A buyer may purchase a put in anticipation of a stock price decline. The buyer need not own the underlying security. If it is owned, then the put provides insurance against stock price declines below the strike. This is more fully explained in the next chapter.

The put options with strike 40 are trading at-the-money. Since their strike price equals the stock price, their full premium is a time premium. Put options have intrinsic value if the strike price is higher than the stock price. For example, the 45 put options have intrinsic value, since the put holder could buy 100 shares of XYZ at the market price of \$40 per share, and then "put" the shares onto the option seller for the strike price of \$45 per share.

Exhibit 7: Selected Put Option Prices

Strike	April	July	October
25	0.06	-	-
30	0.25	0.75	-
35	1.00	1.95	-
40	3.00	3.88	4.50
45	5.88	6.62	7.12
50	10.00	10.06	10.25

Stock price = \$40
Time to Expration of April Series = 12 weeks

For put options, the intrinsic value is given by the following equation:

$$\text{Intrinsic Value} = \text{Max}(X - S, O).$$

Options with positive intrinsic value are called in-the-money options. Thus, the 45 and 50 strike priced options are in-the-money. Exhibit 8 illustrates the dollar time premiums of the put prices in Exhibit 7. Note that the April 50 put option is trading at parity.

Exhibit 8: Time Premium of Put Options

Strike	April	July	October
25	0.06	-	-
30	0.25	0.75	-
35	1.00	1.95	-
40	3.00	3.88	4.50
45	0.88	1.62	2.12
50	0.00	0.06	0.25

As with call options, if put options traded below parity, arbitrage opportunities would exist. For example, if the 45 put was priced below the parity value of \$5, say at \$3, then an arbitrager would buy the put and the stock for an initial investment, excluding transaction costs, of \$43. By exercising the put immediately, the investor would obtain a \$2 profit.

Put Option Transactions

At any point in time a put holder, like a call holder, can either exercise or cancel the position, or do nothing. If the put holder exercises the contract, then any positive time premium is lost. However, the holder of an in-the-money put option may decide to exercise even though several months may remain to expiration. By not exercising the option, the investor is foregoing receipt of the high strike price on which interest could be earned. The following example illustrates that put holders may correctly exercise their right prior to expiration.

Example

The owner of the three-month XYZ 50 put option and 100 shares of XYZ may exercise early. The stock is at \$1, and the put option is at its parity value of \$49. No further dividends are due prior to expiration. The interest rate is 8 percent.

By exercising early, the investor receives \$5,000 immediately. This money will generate \$100 in interest over the three-month period. By delaying exercising, the investor is delaying receipt of these funds, and hence sacrificing potential interest income.

If the underlying security pays a dividend, then there may be incentives to wait until after the ex-dividend date before exercising the put option. For example, consider a trader who owns a put on a stock. The ex-dividend day is one day away. On the ed-dividend day, the stock price is expected to decline, pushing the put deeper into the money. As a result, the trader may decide to delay exercising in order to capture the benefits of the depreciation.

Property 6

(i) For stocks paying no dividends, early exercise of calls is not optimal, but early exercise of puts may be optimal.

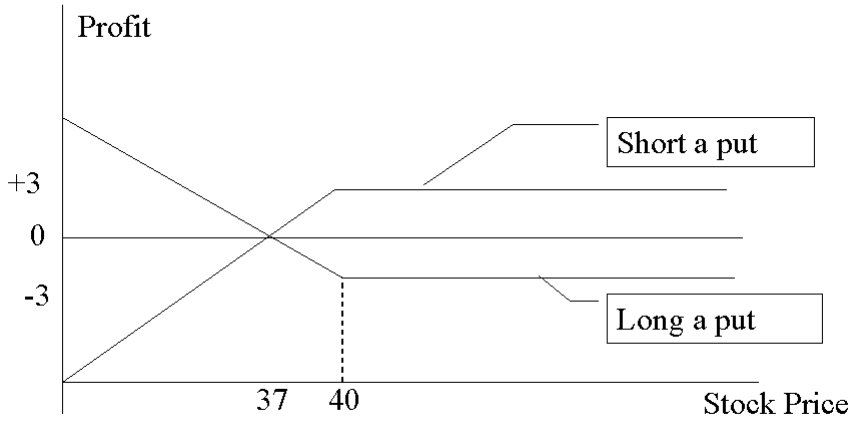
(ii) For stocks paying dividends, early exercise of calls and puts may be optimal. As dividend size increases, early exercise of call options becomes more likely and early exercise of put options before the last ex-dividend date becomes less likely

The decision to exercise a call or put option early depends on trade-offs between dividend and interest income and is discussed in more detail in Chapter 6.

The profit from holding a put option to expiration is represented graphically by the solid line in Exhibit 9. The initial cost is \$3 and it is assumed that the put is held to maturity. The profit from the sale of a put option is the mirror image and is indicated by the dashed line.

The relationship between put and call prices together with the effects of dividends and interest rates will be explored in the next chapter.

Exhibit 9
Profit on a Put Option



Adjustment of Option Contracts for Stock Splits and Stock Dividends

Listed call options are not adjusted for cash dividends. However, strike price adjustments are made if the stock splits or if stock dividends occur.

Example

(i) Suppose a stock declares a two-for-one split. If the stock was trading at \$60, then after the split the price would be \$30. A call option with strike 50 would, in this case, split into two call options with strike 25 each. A 55 call option would split into two 27.5 strike-priced calls.

If the split ratio was not an integer, the adjustment would be more complex. For example, consider a three-for-two split. In this case, not only would the strike price be adjusted, but also the number of shares per contract.

(ii) When a three-for-two split occurs, new strike prices are established by dividing the old strike price by 1.5 and rounding off to the nearest $1/8^{th}$ of a point. If the strike price was 85, then the new strike price would be near 85/1.5, or 56 2/3. The investor would now hold one option contract with strike 56 5/8. If the option was exercised, 150 shares (rather than 100 shares) would be delivered.

(iii) XYZ Corporation "spins off" its subsidiary, ABC Inc., by distributing to its stockholders 1.5 shares of ABC for every share of XYZ stock. In this case, outstanding XYZ options might be adjusted to require delivery of 100 shares of XYZ plus 150 shares of ABC stock. Alternatively, the strike prices of XYZ might be reduced by the value, on a per share basis, of the distributed property.

(iv) XYZ is acquired by a corporation in a cash merger. Each holder of XYZ stock receives \$50 per share. In this case, XYZ options might be adjusted to call for the delivery of \$5000 in cash, rather than 100 shares of XYZ.

The Determinants of Option Value

We have seen that the stock price, strike price, time to expiration, and dividend policy are factors that influence option prices. There are only two other primary determinants of option prices, namely the volatility of the underlying stock price and interest rates. In future chapters the exact relationship of option prices to each of these variables will be analyzed. Nonetheless, we have already seen that American option prices increase as time to expiration increases and as the stock price moves deeper into the money. Moreover, we have seen that as dividend size increases, early exercise of call options becomes more likely and early exercise of puts before the ex-dividend date becomes less likely. In this section we shall provide intuitive explanations of the impact volatility and interest rates have on

option prices.

The Role of Volatility

The volatility of a stock is a measure of its potential dispersion over future possible stock prices. A stock with high volatility would have a high degree of dispersion in future values and could thus increase or decrease by significant amounts. In contrast, a stock with no volatility would be riskless since future prices would be certain.

As volatility increases, call prices also increase. To see this, note that buying a call option provides an alternative to purchasing stock in anticipation of capturing gains from the stock price advance. As volatility increases, the future dispersion of possible stock prices expands. While this increases the likelihood of large profits from the stock, it also increases the chances of large losses. However, the call holders will obtain all the benefits from expanded dispersion without the drawbacks. Specifically, by owning in-the-money call options, call holders can participate dollar for dollar in favorable outcomes. If unfavorable outcomes occur, however, call holders merely do not exercise their contracts. Consequently, call holders will prefer more volatility to less. As a result, the higher the volatility of the stock over the lifetime of the call option, the higher its value relative to the stock.

Note that the same argument holds true for put options. The greater the dispersion of future potential stock prices, the greater the chance the stock price will end up in the money (below the strike). Since it is not necessary for put holders to exercise their option, their losses are limited, should the stock price appreciate. Thus, put premiums should expand as volatility increases.

Property 7

Call and Put option prices increase as volatility increases.

The Role of Interest Rates

As interest rates increase, call prices also increase. To see this, recall that buying a call option provides an alternative to purchasing stock in anticipation of capturing gains from an increasing stock price. As interest rates rise, the cost of carrying the underlying security rises and the call option will appear more attractive vis-a-vis the stock.

An alternative way of illustrating the impact of interest rates on option prices is provided by considering an investor who buys the call option and invests sufficient funds (at the riskless rate) to ensure that, at expiration, the account will have grown to the strike price. The effective strike price at expiration is really the present value of the strike. As interest rates increase, this effective strike price decreases. Hence, an increasing interest rate has the same impact on option prices as a decreasing strike price.

This simple analysis has assumed that interest rates do not affect the stock price. Clearly, if interest rate increases reduced the volatility or the price of the stock, for example, then the analysis would be more complex. Note, too, that with rising interest rates, the effective strike prices are reduced, and hence put premiums fall. Thus, put prices will move in an opposite direction to call prices when interest rates change.

Property 8

As interest rates increase, all things being equal, call option prices increase and put option prices decrease.

Exhibit 10 illustrates the direction option premiums will move as each variable increases.

Exhibit 10:
Effects of Increase in Variables on Option Premiums

Variable	Call Premium	Put Premium
Stock Price	Increases	Decreases
Strike Price	Decreases	Increases
Time-to-Expiration	Increases	Increases
Dividend	Decreases	Increases
Stock Volatility	Increases	Increases
Interest Rates	Increases	Decreases

Conclusion

Standardized exchange traded stock option contracts are introduced into the marketplace in a well-defined way. At any point in time, a variety of option contracts that differ in strike price and time to maturity can trade. Option prices are set so that in-the-money contracts are more valuable than out-of-the-money contracts, and the far series are more valuable than the near series. Although the strike price and expiration date are key ingredients in determining the price of an option, we have seen that volatility, interest rates and dividends are factors that also must be considered.

Options are highly leveraged financial instruments that allow speculators to participate in the stock market without owning stock and allow shareholders to hedge against unwanted risk. Options can be bought or sold. The maximum loss associated with the purchase of an option is the initial investment. On the other hand, the sale of an option can expose the writer to unlimited losses. The purchase of an option provides the investor with a right. In contrast, an option writer is obligated to fulfill the terms of the option contract if it is exercised.

The terms of a stock option are not adjusted for cash dividends, but are adjusted for stock dividends and stock splits. Any adjustment is designed to be as fair as possible to both the buyer and the seller.

The role of the Option Clearing Corporation (OCC) is to act as the buyer for every seller and the seller for every buyer. As a result, all traders look to the OCC for performance. Since buyers pay the full premium up front, they cannot default on their side of the bargain. Sellers, however, have potential obligations to fulfill, and could easily default. As a result, in order to sell options, brokers require that their clients maintain margin accounts.

Options are zero sum games. That is, ignoring transaction costs, the profit (loss) obtained by the buyer of an option is equal to the loss (profit) incurred by the seller. In the next few chapters we shall see that the primary economic role of options is to provide a financial mechanism of transferring risk among investors.

References

There are numerous books and brochures that define put and call stock options and describe the institutional structure of the option markets. The Options Clearing Corporation and the option exchanges publish many booklets that describe the risks and rewards of trading options. These pamphlets can be obtained directly from the exchanges or through a stock broker.

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Exercises

1. Below are selected option prices for GM taken from the Wall Street Journal on September 16th 1993. The stock closed at 47 1/4.

Strike	Expiration Date	Calls (Vol)	Calls (Price)	Puts (Vol)	Puts (Price)
35	Sept.	35	12 1/4	-	-
40	Sept.	735	7 3/8	-	-
40	Oct.	34	6 1/8	-	-
40	Dec.	545	8	108	9/16
45	Sept.	686	2 1/4	379	1/16
50	Sept.	-	-	58	3 3/4
50	Oct.	180	5/8	16	31/8
50	Dec.	548	1 5/8	10	4 1/4

(a) Which call options are in the money, and which contracts are out of the money?

(b) Which put options are in the money, and which are out of the money?

(c) Compute the time premiums of all contracts.

(d) Ignoring transaction costs, what would be the dollar cost of purchasing 3 call options with strike 45 and expiration, September.

(e) Look at the Sept. \$40 call and the Oct. 40 call. If you could trade at these prices, what strategy would you put into place?

(f) Can you explain why the prices in (e) appear distorted? That is, explain why implementing the above strategy will not likely work.

2. A three-month call option with strike price \$50 is currently trading at \$5. The stock price is \$50. An investor has \$5000 to invest and is considering buying 100 shares or 10 options.

(a) For both strategies, compute the three-month return on investment if at the expiration date the stock price is \$40, \$50, or \$60.

(b) Repeat (a) if the option is a put option.

(c) Based on (a) and (b), can you conclude that options are highly leveraged financial instruments?

3. Mr. Vestor knows that his certificate of deposit matures in two months, at which time cash will be released, which he will invest in the stock market. However, he would like

to buy stock now, for he feels a rally is imminent. Would you recommend that Mr. Vestor buy call or put options in the interim? What type of contracts (strike price and maturity) would you recommend?

4. XYZ trades at \$50. The \$45 put option trades at 1 1/2, and the \$50 put option trades at \$3.

(a) Compute the profit (and return) from buying the \$45 put if the stock price at expiration is \$40 and \$45. Repeat the analysis if the \$50 put is purchased.

(b) Does the out-of-the-money put option offer a higher reward (and higher risk) potential?

5. XYZ is trading at \$50 . Ms. Vestor feels it would be a good buy at \$45. Rather than place a limit order to buy at \$45, she decides to sell a \$50 put option that is currently trading at \$5. Discuss the benefits of this strategy by considering what happens if at the expiration date the stock trades above \$50 and below \$50.

6. Consider the following information: Price of XYZ = \$50. Price of ABC = \$50. XYZ April 50 Call = \$3. ABC April 50 Call = \$5. Based on this information alone, can an investor determine which option contract is overpriced? If not, what other factors should be considered?

7. XYZ is selling at \$50 and a four-month call option with strike 45 is selling at \$9.

(a) What is the maximum profit obtained if the call option is sold? Under what conditions would this profit be obtained?

(b) Mr. Vestor sold the call option. What loss is incurred if the stock is trading at \$62 at the expiration date?

(c) What is the minimum loss that will be incurred if after two months, with the stock trading at \$63 , Mr. Vestor decides to cut his losses by buying back the call?

8. A call option with strike 30 and time to expiration of two months trades at \$6. Another call on the same stock has strike 30 and time to expiration of three months, and trades at \$4. Construct a strategy that guarantees profit.

9. A put option with strike 30 and time to expiration of two months trades at \$6. Another put on the same stock has strike 30, time to expiration 3 months, and trades at \$4. Can one construct a strategy that guarantees profit? If so, what is this strategy?

10. A dont option is an option that you pay for at expiration, only if you do not exercise the option by expiration. Do you think the premium of a dont call option would be

higher or lower than the premium for a regular American call option? Justify your answer.

11. A trading range call option can be exercised only for the strike price, if the underlying stock price stays within a given range of prices. Would such an option be more or less valuable than an American call option? Explain your answer.

12. An investor with \$5500 is bullish on XYZ. XYZ trades at \$55. One possible investment is to buy 100 shares. An alternative is to buy one call option with a strike of 55 (assume the premium is \$5) and invest the remaining \$5000 in bonds for six months at 10 percent. Compare the two investments, assuming that the stock pays no dividends.

14. An XYZ April 50 call option is bought for \$5. At expiration the stock is selling at \$60. If the call is sold, the commission will be \$25. If the call is exercised and the stock is then sold, there will be a commission when the stock is bought and again when it is sold. Assuming a commission for each transaction of \$65, compare the two strategies of selling versus exercising. Based on this analysis, how do commission costs affect option strategies?

15. A European option is identical to an American option except that it can be exercised only at the expiration date.

(a) Would you suspect a European call option to be worth more or less than its American counterpart? Explain.

(b) Would you expect a European put option to be worth more or less than its American counterpart? Explain.

16. Provide an intuitive explanation for the fact that put premiums drop when interest rates rise.

Appendix

Executing Option Orders

The option exchanges attempt to provide a continuous, competitive, and fair market environment for the purchase and sale of options. They determine the underlying securities on which options are traded, and they enforce rules applicable to the handling of accounts and execution of buy and sell orders. Specific information about exchange functions is readily available in rule books of the various exchanges and in publications put out by brokerage firms.

In this appendix, the process of executing option orders through the option exchange is discussed. In addition, the central role of the Options Clearing Corporation is investigated, and the process of assigning exercise notices to investors with short positions is discussed.

Placing Option Orders

To place an order with a broker, the investor must specify the name of the underlying security, the type of option (put or call), the number of contracts to buy or sell, the strike price, the expiration month, and the type of order. The type of order provides the broker with instructions on the price the customer is prepared to pay and the time for which the order is in effect. As with futures contracts the types of orders that can be placed include market orders, limit orders and stop orders among others.

Example

The current price of XYZ is \$50.*A* limit order to buy one April call option with strike 50 for \$4 is placed with the broker. The order is a day order. If the option price is still above \$4 by the end of the day, the order is cancelled.

Execution of Orders

After receiving an order from a customer, the broker will direct it to the appropriate exchange. A broker who represents the firm on the floor of the exchange will attempt to execute the order in a fashion consistent with the rules of the exchange. At the Chicago Board Options Exchange, for example, trading is done by a system of "open outcry." In this system, offers to buy and sell options on a particular stock are made to all traders present in a specified area. The broker may trade with three types of traders:

1. *Market makers* trade for their own accounts. Their activity on the floor of the exchange enhances liquidity and tightens the spread that may exist between bid and ask quotes. Market makers are required to maintain bid and ask prices for each contract. The exchange sets limits for the spread between the bid and ask prices that market makers quote. For options priced less than \$0.50, the spread must be less than \$0.25. For options priced less than \$10, the spread must be less than \$0.50. For options priced less than \$20, the spread must be less than \$0.75. Finally, for all other cases, the spread must be less than \$1.0.

2. *Order book officials* are exchange employees who can accept only public orders. They cannot trade for their own accounts. Their job is to see that public limit orders are executed as soon as their threshold prices have been attained. Limit orders are all entered into a computer, and executed as soon as the limit price is reached. The information on all outstanding limit orders is available to all traders.

3. *Other brokers* trade on behalf of their clients and their firm's accounts. They trade on the floor with other floor brokers or with market makers.

Once an oral agreement is reached between two floor traders, the transaction is reported to the Options Clearing Corporation and back to the original broker. Within a few minutes of placing an order, the customer will learn of the trade.

The Options Clearing Corporation

Once a price is negotiated between two brokers on the floor of the exchange, the two cease to deal with each other. Instead, they deal with the Options Clearing Corporation (OCC). The OCC guarantees that all option obligations are met by breaking up every trade and becoming the seller for every buyer and buyer for every seller. Thus, all traders look to the OCC to maintain its side of the bargain, rather than to other traders.

Since the number of contracts purchased by the OCC equals the number sold, its net position is always zero. However, its position is not completely free of risk. To illustrate this, assume a particular investor exercises a call option. In this case the OCC is obliged to deliver 100 shares of the stock for the strike price. To accomplish this the OCC will, in effect, exercise one of its call options. If the investor to whom the exercise notice is assigned delivers the shares, the OCC covers its obligation. However, if the assigned writer fails to deliver the securities, the OCC must still fulfill its obligation.

To protect itself against the risk of default by sellers of options, the OCC requires that its member firms guarantee the obligations of all their particular customers. Toward this goal, the OCC requires that all member firms whose clients have short positions provide the OCC with collateral. These accounts are

balanced daily. The clearing members, in turn, must ensure that their customers have sufficient funds to meet their potential obligations. They achieve this by requiring that their clients provide collateral for all their written positions. The exact amount of collateral required depends on the transaction and is discussed in the next chapter.

The breaking up of all trades by the OCC provides option traders with additional benefits. Since all members are, in essence, trading against the OCC, they can easily cancel their positions. For example, a writer who sold a call option (to the OCC) can cancel the position by buying an option (at market-determined prices). In essence, this action results in a cancellation of the original transaction. Without the OCC, individual sellers would have to negotiate with individual buyers to establish a price at which both parties would settle.

Exercising Option Contracts

Although most buyers and sellers of options close out their positions by an offsetting sale or purchase, there are occasions when a contract will be exercised. To exercise an option, the owner must instruct his or her broker to give exercise instructions to OCC. To ensure that an option is exercised on a particular day, this notice must be tendered before a particular time (which may vary across brokerage firms). The broker passes the exercise instructions to the OCC.

On the next business day, the OCC randomly assigns the exercise notice to a clearing member who has an account that contains a written option in the relevant security. The brokerage firm to which the notice is assigned then randomly allocates the assignment to a customer who has a written position. Once an exercise notice has been assigned to a writer, the writer can no longer effect an offsetting closing transaction, but must instead purchase (if the exercise notice is a put) or sell (if the notice is a call) the underlying securities for the strike price. Settlement between brokers on exercised options occurs on the fifth business day after exercise. Each broker involved in an exercise settles with his or her own customer.