

Chapter II

FUNDAMENTALS OF EXCHANGE TRADED OPTIONS

A. CHARACTERISTICS OF OPTIONS

1. Conventional OTC Options Compared to Listed Options

For many years options on stocks were sold only in the over-the-counter ("OTC") market. The terms of these options contracts — often called conventional or OTC options — were negotiated and entered into between the individual buyer and seller through broker-dealers with performance guaranteed by a NYSE member broker-dealer. Generally, the conventional OTC option remained outstanding until expiration because the individualized nature of the conventional OTC options contract made trading these options costly and difficult. Conventional OTC options are still being written but the activity in these options has substantially declined with the introduction of listed options trading.

Listed options differ from conventional OTC options in several important ways including: 1) a liquid secondary market exists for the trading of listed options; 2) transaction costs associated with listed options are lower than those for conventional OTC options; and 3) up-to-date quotations and transaction prices on listed options are obtainable, during the trading day, through quotation and price reporting services found in brokerage firms; and closing prices are available through newspapers.

The exercise rights of holders of conventional OTC options are against the particular seller of the options. To close a position in a conventional OTC option requires that either the original parties cancel the contract or that a buyer be found for the previously negotiated contract, a cumbersome and costly process generally transacted through brokers over the telephone. Closing transactions in listed options are effected on an options exchange.

The secondary market in listed options is made possible because all listed options contracts have standardized terms and are issued and guaranteed by one organization, the Options Clearing Corporation ("OCC"), which stands as intermediary between options buyers and sellers. Because options contracts with standardized terms are readily interchangeable, these contracts usually can be traded with ease.

Although the OCC issues each listed option contract which is bought and sold by options participants, it does not act as a dealer. A listed option is created when a person makes a sale of an option contract in an opening transaction. The obligation of the seller of a call option to deliver stock upon payment of the exercise price runs to the OCC, and the OCC is obligated to pay him the exercise price if the option is exercised. The buyer of a call option is obligated to pay the OCC the exercise price if he chooses to exercise, and the OCC is then obligated to deliver the underlying stock.

The seller of any option is commonly referred to as the writer of the option contract and is said to be "short" the option. The buyer is the holder of the option and is said to be "long" the option. The original purchase or sale of a contract is an "opening" transaction, because it opens up a new long or short position. The subsequent buying back of an identical option, or the sale of an option being held, is referred to as a "closing" transaction.

For every opening sale transaction in listed options there is a purchase transaction. If a writer of an option wishes to close out his position without awaiting exercise or expiration, he may do so by buying, in a closing purchase transaction, an option identical to the one he sold. Similarly, a holder of a listed option may close out his long position by entering a closing sale transaction. Because the OCC stands between writers and holders of options, there is no need for an opening writer to sell to an opening buyer. Instead, an opening writer may sell to a buyer closing out a short position. At any given time, however, the total obligations of writers of listed options owed to OCC are equal to the total obligations of the OCC to holders of the listed options. Data from the CBOE shows that on a cumulative basis from the inception of options trading on that exchange in 1973 through the expiration of CBOE's November 1977 series, 68.1 percent of opening purchase transactions in calls by holders other than marketmakers were closed in the course of

trading on CBOE, 5.1 percent 1/ were exercised and 27.1 percent were allowed to expire (see Figure 1).

2. The Options Contract

A stock option gives the holder either the right to buy or the right to sell a specified number of shares at a specified price ("strike price") of a designated underlying stock during the life of the option. An option giving the holder the right to buy the underlying stock is known as a "call option," because it gives the holder the right to call upon the person who sold the option to deliver the designated underlying stock upon payment of the exercise price. An option giving the holder the right to sell the underlying stock is known as a "put option," because it gives the holder the right to put the underlying stock to the seller of the option, and the writer is then obligated to pay the stated exercise price for the stock. The most significant terms of an option include the number of shares receivable or deliverable on exercise of the option, which is usually 100 shares, the expiration date, the underlying security and the exercise price. An option "premium" is the amount of money that an option buyer pays and an option seller receives for an option contract.

Listed option contract prices are quoted based on 1) the underlying security, 2) the expiration month and 3) exercise price. For example, an IBM Jan 280 call option refers to an option to buy 100

1/ OCC data show that most exercises are for the account of member firms.

FIGURE 1
MODE OF LIQUIDATIONS OF LONG POSITIONS*
IN CBOE LISTED OPTIONS

1973-1977

| Maturity Group | Percent of Opening Purchases | | | | | |
|-----------------------------|------------------------------|---------------|----------------|---------------|----------------|---------------|
| | Closing Sales | | Exercises | | Expiration | |
| | Call Series | Put Series | Call Series | Put Series | Call Series | Put Series |
| 1973 | | | | | | |
| July | 73.3 | -- | 7.9 | -- | 16.2 | -- |
| Oct. | 77.4 | -- | 6.3 | -- | 13.7 | -- |
| 1974 | | | | | | |
| Jan. | 58.2 | -- | 3.9 | -- | 36.0 | -- |
| Apr. | 59.6 | -- | 3.7 | -- | 33.7 | -- |
| July | 49.9 | -- | 0.6 | -- | 48.2 | -- |
| Oct. | 52.9 | -- | 1.0 | -- | 45.2 | -- |
| 1975 | | | | | | |
| Jan. | 70.0 | -- | 3.7 | -- | 25.6 | -- |
| Apr. | 84.8 | -- | 7.5 | -- | 6.7 | -- |
| July | 71.4 | -- | 4.2 | -- | 23.3 | -- |
| Aug. | 41.8 | -- | 1.1 | -- | 58.5 | -- |
| Oct. | 73.1 | -- | 4.8 | -- | 23.6 | -- |
| Nov. | 60.4 | -- | 5.3 | -- | 34.6 | -- |
| 1976 | | | | | | |
| Jan. | 75.9 | -- | 8.3 | -- | 16.9 | -- |
| Feb. | 80.1 | -- | 7.2 | -- | 11.2 | -- |
| Apr. | 76.4 | -- | 4.0 | -- | 17.5 | -- |
| May | 66.8 | -- | 4.1 | -- | 30.4 | -- |
| July | 79.9 | -- | 6.5 | -- | 15.1 | -- |
| Aug. | 61.1 | -- | 4.9 | -- | 35.2 | -- |
| Oct. | 67.8 | -- | 5.1 | -- | 28.4 | -- |
| Nov. | 55.7 | -- | 6.4 | -- | 39.2 | -- |
| 1977 | | | | | | |
| Jan. | 68.8 | -- | 5.6 | -- | 26.3 | -- |
| Feb. | 60.1 | -- | 6.1 | -- | 34.0 | -- |
| Apr. | 55.0 | -- | 3.8 | -- | 41.8 | -- |
| May | 61.3 | -- | 8.1 | -- | 31.0 | -- |
| July | 66.4 | -- | 5.8 | -- | 28.3 | -- |
| Aug. | 60.9 | 72.3 | 5.9 | 5.5 | 33.1 | 23.6 |
| Oct. | 58.5 | 82.1 | 3.1 | 4.4 | 38.4 | 10.9 |
| Nov. | 61.7 | 75.8 | 6.3 | 5.8 | 32.9 | 18.3 |
| Expired Series 1973-1977 | 68.1 | 80.7 | 5.1 | 4.7 | 27.1 | 12.6 |

* Data are for public customer and firm proprietary accounts. Marketmaker opening and closing transactions are not distinguished for reporting purposes and are therefore excluded from the table. Because of occasional coding errors, total liquidations (closing transactions, exercises and expirations) do not necessarily equal opening purchases.

SOURCE: CBOE Market Statistics, various issues.

shares of IBM common stock at 280 per share (or an aggregate of \$28,000 plus transaction costs) until the following January. An IBM April 280 call option would refer to the same rights until the following April.

The rights and obligations under an option contract end on its expiration date. The expiration time for listed options has been standardized by the options exchanges and is 11:59 p.m. eastern time on the Saturday following the third Friday in the month in which the option expires. Options, however, cannot be purchased or sold after the conclusion of trading rotations, which commence at 3:00 p.m. eastern time on the business day before expiration in order to permit the OCC to handle the exercise of expiring options. 2/ All listed options of the same type -- that is, either puts or calls -- covering the same underlying security are called a "class of options," and all options of the same class having the same exercise price and expiration date are called a "series of options."

Each class of options fits within one of three expiration cycles which establish the month in which the option contract will expire. The three expiration cycles are as follows:

2/ For procedures regarding tender of exercise notices, see OCC Prospectus (October 16, 1978) at 28-29.

| <u>Expiration Cycle</u> | <u>Expiration Cycle</u> | <u>Expiration Cycle</u> |
|-------------------------|-------------------------|-------------------------|
| January | February | March |
| April | May | June |
| July | August | September |
| October | November | December |

New series are generally created with a new expiration month for a nine-month life when an old series expires. Consequently, options for only three expiration months are outstanding at any one time. The exercise price for a new series of options is fixed in relation to the price of the underlying security at the time the trading in the new series begins. Exercise prices are generally, but not always, fixed at five-point intervals if the underlying security is trading below \$50 a share, at ten-point intervals if the underlying stock is trading between \$50 and \$200 a share, and 20-point intervals if the underlying stock trades above \$200 a share. Generally, when trading is to be introduced in a new expiration month an options exchange selects two exercise prices surrounding the then current market price. For example, if the underlying security trades at 27, new series would be opened at 25 and 30. Additional new series are also usually introduced whenever the price of the stock moves up or down to the midpoint of the next appropriate 5, 10, or 20-point interval from the exercise prices of existing contracts.

For example, the price of Bally Manufacturing Corporation stock, which is listed on the NYSE, had traded between January and September 20,

1978, at highly fluctuating prices ranging from a low of 15 per share to a high of 71-3/4 per share and closed, on September 20, 1978, at 40-3/8. On September 21, 1978, the Wall Street Journal reported the following prices of Bally options on the CBOE. Due to the stock's great price volatility during the year, new options series were frequently added. Such fluctuations in the prices of stocks underlying options, however, are rare occurrences.

Bally Option Prices on CBOE on September 20, 1978

| <u>Option</u> | <u>Price</u> | <u>- Nov. -</u> | | <u>- Dec. -</u> | | <u>- May -</u> | | <u>Close</u> |
|---------------|--------------|-----------------|-------------|-----------------|-------------|----------------|-------------|--------------|
| | | <u>Vol.</u> | <u>Cost</u> | <u>Vol.</u> | <u>Cost</u> | <u>Vol.</u> | <u>Cost</u> | |
| Bally | ...15 | 1 | 38-1/4 | b | b | b | b | 47-3/8 |
| Bally | ...20 | 3 | 33-1/4 | b | b | b | b | 47-3/8 |
| Bally | ...25 | 21 | 28-3/4 | a | a | b | b | 47-3/8 |
| Bally | ...30 | a | a | 9 | 19 | b | b | 47-3/8 |
| Bally | ...35 | 116 | 15 | 1 | 14 | b | b | 47-3/8 |
| Bally | ...40 | 193 | 11-1/8 | 82 | 14 | 52 | 20-1/4 | 47-3/8 |
| Bally | ...45 | 283 | 9-1/4 | 60 | 9-1/2 | 122 | 13 | 47-3/8 |
| Bally | ...50 | 1411 | 6-1/2 | 131 | 6-1/2 | 156 | 11-1/2 | 47-3/8 |
| Bally | ...60 | 2113 | 3-7/8 | 241 | 6-1/2 | 207 | 8-1/4 | 47-3/8 |
| Bally | ...65 | 3021 | 1-5/8 | 490 | 4-1/8 | 225 | 5-3/4 | 47-3/8 |

Price refers to the exercise price of the option.

Volume refers to the number of contracts traded on September 20, 1978 in the particular option.

Cost refers to the premium or purchase price at which an option traded on the CBOE on September 20, 1978 divided by the number of shares the option represented.

Close refers to the closing price for Bally Manufacturing stock on the NYSE on September 20, 1978.

a. - indicates the option was not traded on September 20, 1978

b. - indicates no option was offered.

3. Stock Price Considerations in Listed Options

Options can be used as a substitute for short-term stock trading and as a means of transferring certain of the risks and potential rewards of short-term stock price movements from the options seller to the options buyer. Various strategies can be used to accomplish this:

An investor who believes a stock will increase in price can (1) buy the stock; (2) buy a call; or (3) sell a put. An investor who believes a stock will decrease in price can (1) sell stock short; (2) sell a call; or (3) buy a put.

The buyer of stock benefits from any increase in price in excess of his transactions costs and bears the full risk of loss in the event of a market decline. Transaction costs include commission charges and any interest that must be paid if stock is purchased on margin. While a call option buyer and a put option seller benefit from a stock price increase, their risk and reward positions are different.

The call option buyer:

- . Has the right to buy the underlying stock;
- . Does not profit until the price of the underlying stock increases sufficiently to cover the premium for the call option plus transaction costs;
- . Limits his risk of loss to premiums paid plus transaction costs.

The put option seller:

- . Has the obligation to buy the underlying security on exercise of the option

- . Limits his profit to the premium received on the sale of the option, less transactions costs;
- . Limits his risk of loss only to the extent of the market price decline of the underlying security during the life of the option, a portion of which would be offset by the premiums received less transaction costs ("net premiums").

Similarly, the risk-reward positions of a call option seller and a put option buyer are different in the event of a stock price decline.

The call option seller:

- . Has the obligation to deliver the underlying stock on exercise of the option;
- . Limits his profit to the premium received on sale of the options, less transaction costs;
- . Limits his risk of loss only to the extent that the market price increase of the underlying security during the life of the option is offset by the net premium received.

The put option buyer:

- . Has the right to deliver the underlying stock;
- . Has profits only to the extent the price of the underlying stock declines in an amount greater than the premium for the put option plus transaction costs;
- . Limits his risk of loss to the premium paid plus transaction costs.

4. Short-Term Character of Options Trading

Although listed options may have a maximum term of nine months, most options are written for shorter terms. Indeed, the very short-term horizon of option traders is evident from the distribution of outstanding options — called open interest — and contract volume by

expiration month. Statistics for 1977 indicate that 50 to 60 percent of open positions are in options with less than 3 months to expiration; over 70 percent with less than 4 months and 90 percent with less than 6 months (see Figure 2). Similarly, over 60 percent of contract volume usually appears to be in options with less than 4 months to expiration (see Figure 3). Even greater concentration of interest and volume exists for some individual classes of options. For example, data for Eastman Kodak show that nearly 70 percent of May, 1978 volume in Eastman Kodak options was in contracts expiring in June, 1978.

FIGURE 2
 PERCENTAGE OF OPEN INTEREST IN EXCHANGE TRADED CALL OPTIONS
 BY MONTHS TO EXPIRATION

| 1977 | <u>Months to Expiration</u> | | | | | | |
|------|-----------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|-----------------|
| | <u>3 Months</u> | <u>4 Months</u> | <u>5 Months</u> | <u>Less Than 6 Months</u> | <u>7 Months</u> | <u>8 Months</u> | <u>9 Months</u> |
| | (Cumulative Percent) | | | | | | |
| Jan. | 60.0 | 75.3 | 75.6 | 92.2 | 98.2 | 98.3 | 100.0 |
| Feb. | 62.0 | 62.4 | 83.6 | 92.6 | 92.8 | 99.1 | 100.0 |
| Mar. | 53.7 | 76.1 | 86.1 | 86.3 | 96.6 | 99.9 | 100.0 |
| Apr. | 56.7 | 71.0 | 71.4 | 90.0 | 96.9 | 97.1 | 100.0 |
| May | 56.9 | 57.6 | 80.8 | 91.1 | 91.5 | 99.1 | 100.0 |
| Jun. | 49.2 | 73.9 | 85.3 | 85.8 | 96.8 | 98.9 | 100.0 |
| Jul. | 57.0 | 72.7 | 73.5 | 91.0 | 97.1 | 97.5 | 100.0 |
| Aug. | 60.5 | 61.6 | 83.1 | 92.2 | 92.8 | 99.0 | 100.0 |
| Sep. | 54.3 | 77.5 | 87.6 | 88.3 | 97.3 | 100.0 | 100.0 |
| Oct. | 60.0 | 74.5 | 75.5 | 91.9 | 97.7 | 98.0 | 100.0 |
| Nov. | 61.7 | 63.0 | 84.2 | 92.8 | 93.2 | 99.3 | 100.0 |
| Dec. | 56.5 | 79.6 | 88.8 | 89.5 | 97.8 | 99.9 | 100.0 |

SOURCE: Options Clearing Corporation

FIGURE 3
 PERCENTAGE OF CONTRACT VOLUME IN EXCHANGE TRADED CALL OPTIONS
 BY MONTHS TO EXPIRATION

| 1977 | <u>Months to Expiration</u> | | | | | | |
|------|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | <u>3 Months</u> | <u>4 Months</u> | <u>5 Months</u> | <u>6 Months</u> | <u>7 Months</u> | <u>8 Months</u> | <u>9 Months</u> |
| | Less Than | | | | | | |
| | (Cumulative Percent) | | | | | | |
| Jan. | 37.0 | 70.4 | 80.3 | 80.6 | 93.6 | 98.1 | 98.3 |
| Feb. | 49.2 | 63.5 | 64.0 | 81.8 | 89.5 | 89.7 | 98.8 |
| Mar. | 51.0 | 51.6 | 73.7 | 82.2 | 82.4 | 94.9 | 99.9 |
| Apr. | 31.1 | 64.1 | 73.0 | 73.3 | 90.1 | 96.1 | 96.3 |
| May | 50.6 | 64.4 | 64.9 | 82.6 | 90.3 | 90.6 | 98.9 |
| Jun. | 53.4 | 54.6 | 76.2 | 84.5 | 85.1 | 95.8 | 99.7 |
| Jul. | 32.5 | 67.8 | 77.5 | 78.2 | 92.1 | 96.6 | 97.1 |
| Aug. | 52.3 | 66.4 | 67.2 | 83.7 | 91.0 | 91.5 | 98.7 |
| Sep. | 53.0 | 53.9 | 76.8 | 84.6 | 85.2 | 95.8 | 99.9 |
| Oct. | 33.4 | 67.8 | 76.3 | 77.0 | 92.1 | 97.2 | 97.5 |
| Nov. | 55.5 | 68.4 | 69.3 | 86.1 | 92.3 | 92.7 | 99.2 |
| Dec. | 57.8 | 59.7 | 80.9 | 87.2 | 88.1 | 97.0 | 99.9 |

SOURCE: Options Clearing Corporation

5. Transaction Costs

The short-term nature of most options contracts means that transactions costs can have a significant effect on the profitability of options transactions. The listed options markets have substantially reduced the transactions costs of trading options. A study by Black and Scholes of conventional OTC options transactions for the period 1966-1969 concluded that transactions costs effectively reduced the rate of return of call buyers from 33.3 percent to 8.3 percent. In contrast, the rate of return of call writers was reduced only from 8.6 percent to 6.6 percent. On the basis of this research they anticipated that if the options markets could be made more efficient, and less costly for call buyers, the demand for options would probably increase. 3/

Transaction costs are now substantially less in listed options than they had been in conventional OTC options. In addition, listed option transaction costs, if considered without regard to transaction costs that may be incurred as a result of stock trading that is related to options trading, are less than the charges for trading stock in shares equivalent to that covered by an option contract. Although competitive commission rates mean that transactions can be entered into at different charges at different firms, the published commission charges of ten large retail brokers and one representative discount broker illustrate the current costs of options trading as compared with trading directly in the stock (see Figure 4).

3/ Black, Fischer, and Scholes, Myron, "The Valuation of Options Contracts and A Test of Market Efficiency," The Journal of Finance, May, 1972, pp. 414, 416.

Figure 4

SAMPLE COMMISSION CHARGES FOR TEN LARGE
FULL-SERVICE BROKERS AND ONE DISCOUNT BROKER
 (amounts in dollars)

| <u>FULL SERVICE BROKERS</u> | <u>100 SHARES @\$40/SHARE (Amount)</u> | <u>PERCENT OF VALUE</u> | <u>500 SHARES @\$40/SHARE (Amount)</u> | <u>PERCENT OF VALUE</u> | <u>1 CONTRACT* @\$4/CONTRACT (Amount)</u> | <u>PERCENT OF VALUE</u> | <u>5 CONTRACTS @\$4/CONTRACT (Amount)</u> | <u>PERCENT OF VALUE</u> |
|-----------------------------|--|---------------------------------|--|---------------------------------|---|---------------------------------|---|---------------------------------|
| 1 | 75.30 | 1.88 | 300.00 | 1.50 | 25.00 | 6.25 | 74.80 | 3.74 |
| 2 | 74.24 | 1.86 | 306.56 | 1.53 | 27.50 | 6.88 | 80.78 | 4.04 |
| 3 | 74.90 | 1.87 | 307.75 | 1.54 | 25.00 | 6.25 | 78.54 | 3.93 |
| 4 | 74.00 | 1.85 | 303.00 | 1.52 | 25.00 | 6.25 | 74.80 | 3.74 |
| 5 | 75.86 | 1.90 | 314.73 | 1.57 | 26.75 | 6.69 | 81.11 | 4.06 |
| 6 | 74.90 | 1.87 | 265.36 | 1.33 | 26.75 | 6.69 | 80.03 | 4.01 |
| 7 | 68.00 | 1.70 | 292.00 | 1.46 | 25.00 | 6.25 | 77.00 | 3.85 |
| 8 | 70.18 | 1.76 | 316.95 | 1.58 | 15.84 | 3.96 | 74.80 | 3.74 |
| 9 | 75.03 | 1.88 | 306.78 | 1.54 | 25.00 | 6.25 | 75.80 | 3.79 |
| 10 | 74.00 | 1.85 | 310.00 | 1.55 | 25.00 | 6.25 | 87.69 | 4.38 |
| <u>DISCOUNT BROKER</u> | | | | | | | | |
| 11 | 44.79 | 1.20 | 189.29 | .95 | 30.00 | 7.50 | 56.55 | 2.83 |

* IN MOST CASES, THE COMMISSION CHARGE FOR ONE CONTRACT IS THE MINIMUM COMMISSION CHARGE FOR A TRANSACTION. BROKER'S FIGURES FOR THE DISCOUNT BROKER ASSUME A LIMIT ORDER RATE.

SOURCE: OPTIONS STUDY QUESTIONNAIRE AND BROKER PUBLISHED RATE SCHEDULES.

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Although the commissions on options transactions, as a proportion of the amount of money involved in a transaction, are higher than for stock, the dollar amount of commissions on an option contract for 1 call to buy 100 shares of stock is about one-third as large as the commission on a 100 share transaction in the underlying stock. Because most brokers have a minimum commission charge, however, a better comparison might be 5 contracts for which the options commission charges are roughly one-fourth the commission on a 500-share stock transaction. 4/ Commissions, of course, would be different on options and stock trades at different prices than those used in Figure 4, but the dollar amount of commissions on an option will be less than on a stock trade in an equivalent number of shares underlying the option. Some discount brokers have advertised rates as low as \$12.50 per option contract for fewer than five options, and \$2.50 - \$8.50 per contract for orders of five options or more; but such rates may be set purposely low to attract customers with a large volume of orders.

4/ Moreover, if the options expire worthless, the loss is automatic and there is no sale commission involved, whereas a stock commission is incurred on the sale of a stock at a loss or profit.

Commissions and commission equivalents (retail mark up) affect both the profitability of a transaction and the incentives of broker-dealers and their registered representatives in recommending investments to their customers, as is described in more detail below in chapter V.

6. Options Pricing Models

As indicated above, the options contract serves to unbundle the risks and potential rewards associated with short-term stock price movements. The options price is the market valuation of the bundle of rights that are being transferred. Chief among these is the right to benefit from or limit losses from short-term stock price fluctuations. The perceived probability of significant stock price changes will often reflect the past short-term price movements of the stock.

Some stocks trade within relatively narrow short-term price ranges, whereas other stocks are more volatile. For example, the Wall Street Journal reported on December 12, 1978, that for the 52 prior weeks American Telephone and Telegraph traded between 56-7/8 and 64-5/8 a share and closed on December 11, 1978 at 61 per share. However, Minnesota Mining and Manufacturing Company ("3M") had traded during this period between 43 and 66 a share and closed on December 11, 1978, at 61. If all other factors could be held constant, the premium for an option usually would be greater for a stock which is expected to

have volatile short-term price movements than the premium for an option for a stock which is expected to trade within a narrow range during the life of the option. Accordingly, the volatilities of AT&T and 3M may help to explain why AT&T July 60 options closed on December 11, 1978, at $3\frac{3}{4}$ whereas the 3M July 60 options closed at $7\frac{3}{8}$. Likewise, if all other factors could be held constant, the price of an option would decline as the contract approaches maturity. Thus, on December 11, 1978, the 3M Jan 60 options closed at $3\frac{3}{8}$ while the 3M July 60s closed at $7\frac{3}{8}$. Similarly, if all other factors could be held constant, the price of an option would increase or decrease as the price of the underlying stock fluctuates around the option exercise price. The amount of the increase or decrease, if any, would of course depend upon the perceived probability that the stock would trade at an advantageous price in relation to the exercise price at expiration. For example, if a call option had an exercise price of \$50 with one week left to expiration, a movement in the price of the stock from 40 to 41 would probably have no effect on the price of the option.

Of course, all factors cannot be held constant, and the prices of options reflect the complex interrelation of all of the above factors as well as additional factors that apply in a free market which reflects the judgments of the various participants. Nevertheless, many professional traders and arbitrageurs with low or no transactions costs have developed options pricing models based upon these basic

principles and upon other factors which they deemed relevant. This is done in an attempt to identify options which appear to be under or over-valued in relation to other options and to the stocks, in anticipation that they will profit if these pricing discrepancies disappear and to prevent paying prices that are too high or accepting prices that are too low. Computers are normally used because of the multiplicity of relevant factors, many of them generated by constantly changing conditions in the securities markets.

The most widely known options pricing model is the theoretical valuation formula developed by Fischer Black and Myron Scholes from which most current options pricing models have been derived. The Black-Scholes formula was developed from the principle that options can be used to eliminate market risk from a stock portfolio. This theory assumes that efficient option pricing would result in returns on options portfolios equal to the risk-free interest rate available on investments in U.S. government securities. Their pricing model was developed using European options which are exercisable only at maturity and has been revised, in part, because it assumed factors which are not characteristic of listed options, including (1) no transactions costs; (2) no dividends; (3) the option would be exercised on only the final day before its expiration; (4) there were no restrictions on short selling; and (5) various assumptions about the characteristics of stock

price movements. 5/ Nonetheless the Black-Scholes options pricing model serves to illustrate how options pricing models work.

The Black-Scholes mathematical options pricing model requires five items of information to compute an estimate of an option's theoretical value at any point in time: (1) stock price; (2) time to maturity; (3) exercise price; (4) risk free interest rate; and (5) probable volatility of the stock. 6/ All these factors, except volatility, are readily determinable as of a particular point in time. In most computer pricing models the future volatility of the stock is estimated based on its past volatility.

The Black-Scholes or similar options pricing models are also used to estimate the dollar-for-dollar sensitivity of an option's price to movements of the price in the underlying security at any point in time. Pricing models hold constant the factors other than stock price that affect the value of an option while estimating the relationship of changes in the price of the option relative to changes in the price of the stock. This estimate of the ratio relationship between the dollar change in the price of the option and the dollar change in the price of the stock is called the "delta factor." The delta factor of a call option can range

5/ Black, Fischer and Scholes, Myron, "The Pricing of Options and Corporate Liabilities" The Journal of Political Economy, May/June 1973, p. 640.

6/ Black, Fischer, "Fact and Fantasy In the Use of Options," Financial Analyst Journal, July-August, 1975, p. 36.

from 0 to plus 1.00. The delta factor of a put option ranges from 0 to minus 1.00. If for every one point rise in the price of the equity security the call option price rises 1/4 point, the call option has a delta of .25 (and the put option a delta of $-.75$). If, for every point rise in the stock the call option price rises 1/2, the call option has a delta of .50 (and the put option a delta of $-.50$). ^{7/}

A long call position and a short put position increase and decrease in value with the stock. Therefore, these positions have positive delta factors. The value of a short call position and long put position moves in the opposite direction of the stock price. Therefore, these positions have negative delta factors. A long stock position has a delta value of 1.00 while a short stock position has a negative delta value of 1.00.

By assigning a delta value to all stock and option positions, a specialist/marketmaker on the floor of an options exchange can establish long and short positions in various series of options of the same class and in the underlying stock which, if his estimates of the various delta factors are correct, can result in a position in which any increase or decrease in value of the stock will be offset by increases or decreases in his combined options and stock positions. If his calculations are correct, and his positive deltas are equal to his negative deltas, his overall position will be free of risk of stock price movements and his

^{7/} See Black, F. and M. Scholes, "The Pricing of Options and Corporate Liabilities, Journal of Political Economy (May/June, 1973), pp. 642ff.

portfolio is said to be in a "neutral delta position." For example, a sale of a call option, which has a delta of .5, can be hedged by a purchase of two call options having a delta of .25. In this case, the value of the short option's position will decrease by \$.50 for each \$1 increase in the price of the underlying stock and the two long options will increase by \$.25 each, or a total of \$.50, offsetting the loss on the short option position.

The delta factor changes as the price of the underlying security and the other factors that determine the price of the option change. Usually the changes will be small on a day-to-day basis. The exception occurs during large stock price movements when, apparently, the statistical reliability of estimates of delta becomes suspect. However, through the use of options as hedges, portfolio managers have sought to reduce or eliminate virtually all of the market risk on their portfolios. However, as the market risk is reduced, the theoretical rate of return is also reduced until it approaches the risk free interest rate, a return which can be approximated by investing directly in U.S. government securities.

While the computer option pricing models illuminate certain of the factors affecting the pricing of options and can aid in options trading decisions, the chapter on Sales Practices shows how computer-generated data and certain mathematical relationships have formed the background for unethical sales practices by broker-dealers and investment advisers and have been used to add mysticism and unnecessary complexity to options transactions.

7. Examples of the Effect of Options Contracts

Assuming that there are no pricing biases or market inefficiencies which are disadvantageous to either options writers or buyers, 8/ then the value of the bundle of risks and potential rewards being transferred under an options contract should be approximately equal except for commissions and other transactions costs. An example of how an options buyer and options seller may fare during the life of a seven-month options contract can help demonstrate the effect of the options contract on both buyer and seller during a period of short term price movements in a hypothetical situation, assuming that both the buyer and seller hold the contract until expiration. As indicated above, however, nearly all options market participants close out their options positions in the secondary market prior to expiration.

8/ This assumption is useful for exposition purposes, but studies indicate that in the real world, pricing inefficiencies and biases do exist. For example, in a study of OTC options, Black and Scholes found that through pricing biases which favored the seller, buyers effectively paid all of the transactions costs necessary for maintenance of the market. See Black and Scholes, note 3, p. 12 above, at pp. 413-417.

Also, studies by Gould and Galai, and Klemkosky and Resnick suggest that theoretical put and call parity is violated by systematic divergence of put and call prices in the real world. Listed options have reduced these divergences and usually transactions costs in and out preclude profitable arbitrage by most public investors. While listed options have reduced transactions costs, there is no reason to assume that bias no longer exists, especially with restrictions on listed puts and the higher costs that are thereby imposed on arbitrage activities. See Gould, J. P. and Galai, D., "Transactions Costs and Put and Call Prices," Journal of Financial Economics, (July 1974), Galai, Dan, "Tests of Market Efficiency of the Chicago Board Options Exchange," Journal of Business, (April 1977) and Klemkosky, Robert C. and Resnick, Bruce G., "Put-Call Parity and Market Efficiency" presented to Southern Finance Association Annual Conference, November 1978, Washington, D.C.

a. Call Option

Assume, for example, that XYZ stock is selling at \$50 a share on October 20, and that a call option on XYZ expiring in May and exercisable at 50 trades at 6. The writer of this option will receive \$600 per contract paid by the buyer before any allowance for transaction costs. Of course, both sides in this transaction would have to pay commissions. If the writer owns the 100 shares of XYZ (a covered option), he will be in a better position than he would have been without the combined stock/option position anytime the stock trades at less than 56 but above 44 per share, after allowance for transaction costs (see Figure 5). The writer of the call option, however, may be called upon to deliver the shares anytime, although exercise is likely only when the stock price is above \$50. If the writer of the option does not own the underlying stock (an uncovered option) or an offsetting option, the writer assumes the risks of rises in the market price of the underlying stock and will be required to acquire and deliver the underlying stock, much like a short-seller, if the option is exercised against him. In exchange for the options premium, however, the writer of the option gives up to the option buyer the right to gains through exercise or resale of the contract. This would normally only occur if XYZ sells above \$50 a share. The covered writer retains the risks of ownership if XYZ declines in price. The uncovered writer is exposed to unlimited risks on the upside, but none on the downside.