2. DERIVATIVE SECURITIES

Objectives: After reading this chapter, you will
1. Understand the reason for trading options.
2. Know the basic terminology of options.

2.1 Derivative Securities

A derivative security is a financial instrument whose value depends upon the value of another asset. The main types of derivatives are futures, forwards, options, and swaps.

An example of a derivative security is a convertible bond. Such a bond, at the discretion of the bondholder, may be converted into a fixed number of shares of the stock of the issuing corporation. The value of a convertible bond depends upon the value of the underlying stock, and thus, it is a derivative security. An investor would like to buy such a bond because he can make money if the stock market rises. The stock price, and hence the bond value, will rise. If the stock market falls, he can still make money by earning interest on the convertible bond.

Another derivative security is a forward contract. Suppose you have decided to buy an ounce of gold for investment purposes. The price of gold for immediate delivery is, say, $345 an ounce. You would like to hold this gold for a year and then sell it at the prevailing rates. One possibility is to pay $345 to a seller and get immediate physical possession of the gold, hold it for a year, and then sell it. If the price of gold a year from now is $370 an ounce, you have clearly made a profit of $25. That is not the only way to invest in gold.

Another possibility is to enter into a forward contract with another party. The contract states that you will buy an ounce of gold for, say, $360 a year from now. The contract specifies that you must buy the gold and the seller must deliver it. There is no exchange of money at the beginning of the contract. A year later, you settle your contract by paying $360 to the seller and getting the ounce of gold. Suppose that the market price of gold at that time is $370; then by selling it you will have an immediate profit of $10. The value of this contract on that day is $10 because by using it you gain $10 right away. The value of the forward contract varies daily with the fluctuation in the price of gold, and hence it is a derivative security.

A forward contract is executed between two interested parties, such as a silver mining company and the manufacturer of sterling-silver flatware. A futures contract is a standardized contract that trades on a regulated exchange. A futures contract is marked to the market every day, meaning that the losses and gains are settled on a daily basis. This prevents accumulation of large profits or losses.

Derivative securities have been in the news frequently in recent years. In 1995, the collapse of Barings Bank was entirely due to the unauthorized trading of derivatives by a

British bank official in Singapore. The subsequent billion-dollar loss was too much for the bank to bear, ultimately leading to its collapse. Many US corporations routinely invest in derivative securities primarily for hedging purposes. They make news only if they suffer losses in speculative use of the derivatives.

A swap involves the exchange, or swap, of two cash flows by two counterparties. An example is the contract between two banks, whereas the first bank pays to the second bank the interest on a certain principal at a fixed rate. The second bank pays to the first bank the interest on the same principal but at a floating rate. The swap contract may require the first bank to pay interest on $10 million at the fixed rate of 5% in monthly installments for the next three years. The second bank will pay the first bank the interest on $10 million in monthly installments for the next three years but at the LIBOR rate. The LIBOR rate is a floating rate that is adjusted monthly.

Why do the firms enter into such agreements? The reason is that of comparative advantage. The first bank is perhaps able to loan $10 million to a steady customer at 6% for the next three years. It will pay 5% to the second bank. Likewise, the second bank has loaned $10 million to another customer at LIBOR, which is expected to average over 6% over the next three years. Both banks come out ahead in this transaction.

Perhaps the most fundamental form of a derivative security is a call option. To understand the valuation of other derivative securities one should start by looking at call options first.

2.2 Call Options

On a Sunday afternoon, driving by the edge of town, you see a piece of land with a "FOR SALE" sign. You immediately realize that you could develop this land for use as a site for an apartment complex. Your creative juices are really flowing. It is a perfect opportunity to make a substantial amount of money provided you owned the land and had enough capital to build the apartments.

You know that you may be able to get a low interest loan from The Department of Housing and Urban Development (HUD) in Washington to construct the apartments. Their funding for such projects is limited, however. It is also possible that your loan application will be turned down. You think that borrowing money at the local bank at a much higher rate will definitely make the project unprofitable. Further, HUD takes at least six months to reach a final decision on such loan applications.

Even though you have enough money to purchase the land, you do not want to buy it outright because of several reasons. First, you do not want to tie up your money for six months while HUD is considering your loan application. Second, if you buy the land and there is a drop in the market value of the land, you may have to sell it at a loss if the loan application at HUD is unsuccessful. Third, there are transaction costs, such as transfer taxes and Realtor's commissions, which you want to avoid if your application at HUD is unsuccessful.

So, what should you do? One possibility is to approach the owner of the land and buy an option on the land. You tell him that you would like to buy the land for $100,000 at some time during the next nine months. You will pay the owner $5,000 for this *call option*. The owner of the land may sell the call option to you possibly because the best offer he has received recently was only $85,000. Of course, he will keep the $5,000 paid for the option even if you do not buy the land. He may be quite happy with the $100,000 selling price.

You are willing to buy a call option because you are risking only $5,000, which you can afford to lose if you do not get a favorable response from HUD. There is also the possibility that you have lined up another buyer after nine months who is willing to pay $120,000 for the same piece of land. Then you can *exercise* the option, buy the land for $100,000 and at the same time sell it for $120,000. Your total cost is $105,000 and your profit $15,000, all on an initial $5,000 investment.

To summarize, an option is a contract between a buyer and a seller. The contract has essentially three elements:

1. The buyer agrees to buy the underlying asset at a certain *fixed* price, but he does not have to. On the other hand, the seller must sell the asset if the buyer decides to *exercise* the option. The fixed selling price of the asset is called the exercise price.

2. The seller receives a call *premium* that he keeps whether the option is exercised or not. This is his compensation for keeping the asset off the market during the life of the option, and reserving it for the option holder.

3. The option has a certain *life*, or *term*. Once the term of the option has expired, it becomes invalid. The value of an option that has expired is zero.

For instance in the previous example, the term of the option is nine months, exercise price is $100,000 and the call premium is $5,000.

If you own a call option, you may take any one of these actions:

1. *Exercise* your option and buy the asset,
2. *Sell* the option to another investor before it expires, or,
3. *Do nothing*, and let the option expire.

Another example of an option is the ticket to a sports event. If you buy a basketball ticket for $5 from University of Scranton, you can do any of the three things: You can exercise the option by watching the game, or, you can sell the ticket to a friend, or, you may let the option expire by not attending the game. The University keeps the $5 in any case.

In financial markets, call options are available on the stock of various corporations, on foreign currencies, on commodities such as gold, or heating oil. Why should an investor buy a call on, say, Boeing stock? This is because he believes that the price of a share of

Boeing stock will rise above the exercise price and that he will be able to buy the stock at a cheaper price near the expiration of the option. In general, people buy call options in the anticipation of future price appreciation of the underlying asset.

We may classify the call options as being in-the-money if the price of the asset is higher than the exercise price. Similarly, if the value of the asset is below the exercise price, the call option is out-of-the money. For an at-the-money call, the price of the underlying asset is the same at the exercise price.

2.3 Put Options

Put options are opposite to call options. The holder of a put option has the right, but not the obligation, to *sell* the underlying asset at a fixed price. The seller of the put, who is also called the *writer* of the put, must buy the asset at the exercise price. Put options have a certain life, and they become worthless after expiration.

Why should one buy a put option? This is because the investor is worried about a possible decline in the value of the assets that he is holding. If you are holding Boeing stock that is currently selling at $45 a share, and you believe that it may drop to $40 a share in the near future, then you may want to buy a put with exercise price $45. If the stock does drop in value, you will simply exercise the put option and sell it at $45 anyway. If the price of the stock rises, you will lose the premium of the put, but you do not have a loss on the stock.

A put option is essentially an insurance policy. People buy home insurance, automobile insurance, or health insurance. They are perfectly happy if their house does not burn down, or they do not have a car accident, or if they do not break a leg. However, in case of a calamity, they are protected from financial loss.

Why should one sell a put? For the same reason that the insurance companies sell insurance policies – to make money. A person selling Boeing puts believes that Boeing stock will not decline in price and he will simply pocket the put premium. During the past several years when the stock market has been rising steadily, many investors have made money just by selling puts.

2.4 Development of the Options Markets

People have traded the options on various commodities for centuries. Before 1973, the investors bought stock options through option dealers who would advertise their buying and selling prices for different options on different stocks. They would avoid risk by buying and selling the same option simultaneously, with a price spread that would represent their profit. In 1973 the first options exchange, CBOE was set up under adequate regulatory supervision. The Options Clearing Corporation also came into being to serve as a go between buyers and sellers and to have an orderly market.

2.5 Organized Options Trading

The option trading is carried out in a very organized fashion. To begin with, the standard contract size is 100 shares of stock. For example, when you buy one call option on Ford, it entitles you to buy 100 shares of the stock. Suppose you want to find the value of an option. You can see is easily on the Internet. If you see the value as 2.25, it is actually selling for $225.

Options have standardized exercise prices for various stocks. For low priced stocks, selling at less than $5, the exercise prices increase by $.50, for medium priced stocks, the exercise price rises by $5 jumps, and so on. This creates an orderly change in the exercise price.

The trading of options ends on the third Friday of a given month. The owner of an option has until noon on the following Saturday to notify the broker his intention to exercise the option. Many brokerage houses will automatically exercise an option for a buyer if it is .375 in the money, or assign it to a seller if it is .75 in the money.

2.6 Options Exchanges

In USA, five principal exchanges conduct option trading. The following table shows the names of the exchanges, their location, and their commonly used symbols. The oldest and the biggest exchange is the Chicago Board of Options Exchange. There are many other options exchanges around the world.

Name of Exchange	Location	Symbol
Chicago Board of Options Exchange	Chicago	CBOE
American Stock Exchange	New York	AMEX
Philadelphia Stock Exchange	Philadelphia	PHLX
Pacific Stock Exchange	San Francisco	PSE
New York Stock Exchange	New York	NYSE

2.7 The Mechanics of Trading Options

Suppose that Boeing stock is selling at $63 a share and you believe that it will rise to $70 a share within a month. In anticipation of the price increase, you may buy a call option with exercise price 65 with one month to maturity for 2. A month later, this option will be worth 5 and thus you will get a profit of 3. To put this in practice you will call your stockbroker and place an order to buy 3 calls. The calls will be selling for $200 each and you will have to pay $600, plus the commissions. If the commissions are $25, then the total cost will be $625. On the last trading day, you may sell the calls for $3*500 - 25 = $1475. Your net profit should be $1475 - 625 = $850.

The broker relays the buy order to the floor of the exchange where it is met with a sell order at the same price. The trade takes place and the orders are executed. In order to

maintain an orderly flow of buy and sell orders, and in order to make sure that the buyers and sellers will make good on their promises when the options are exercised, a new entity, called The Options Clearing Corporation (OCC) has been created. The OCC acts as a go between the buyers and the sellers, buying each option from a seller, and simultaneously selling it to some other buyer.

The seller of a call option has the following three choices at the expiration of the option:

1. If the option is out-of-money, do nothing because the option will *not be exercised*,
2. If the option is in the money, *deliver* the stock and receive cash payment for it, because the option *will be exercised*.
3. If the option is in the money, buy it back so that it *cannot be exercised*.

Generally, the seller of a call already owns the stock and he can deliver it. If he does not own the stock, he may have to buy it in the market and then deliver it.

2.8 Option Price Quotations

The option contracts are on 100 shares of stock each. That is, if you buy 3 call options, then you have the right to buy 300 shares of the underlying stock. Further, if an option is trading at $2 per share, the option contract will be worth $200, because it covers 100 shares of stock.

Option prices for Google, Inc. (NASDAQ), June 10, 2005
Closing price 282.50, Net change –3.81, Volume 12,721,400

July 2005 Calls							July 2005 Puts					
Last	Net	Volume	Bid	Ask	Open interest	Exercise price	Last	Net	Volume	Bid	Ask	Open interest
51.10	-4.20	29	56.70	52.70	12,494	230	0.05	-0.05	172	0.05	0.10	13,811
41.10	-3.50	161	46.70	42.70	16,069	240	0.05	-0.05	274	0.05	0.10	16,711
32.60	-4.10	1,177	36.80	32.80	14,219	250	0.15	-0.10	1,870	0.10	0.20	25,778
23.00	-3.70	568	27.00	23.10	10,415	260	0.40	-0.10	1,990	0.40	0.45	17,592
13.50	-4.20	1,475	13.50	13.80	11,783	270	1.20	-0.10	8,791	1.10	1.20	23,607
6.50	-3.50	13,549	6.50	6.60	13,191	280	3.90	+0.50	15,836	3.90	4.10	28,044
2.65	-2.35	15,140	2.65	2.75	23,076	290	10.00	+1.50	4,077	10.00	8.10	11,742
1.10	-1.30	12,431	1.00	1.10	27,525	300	18.30	+2.40	1,011	18.40	15.50	3,259
0.40	-0.70	3,924	0.90	0.45	13,182	310	27.70	+2.90	241	27.70	24.40	1,102
0.20	-0.35	2,659	0.15	0.20	11,160	320	37.20	+2.20	16	37.50	33.80	929
0.10	-0.15	705	0.05	0.10	9,115	330	46.10		156	47.40	43.60	412
0.05	-0.05	363	0.05	0.05	6,912	340	54.20		56	57.40	53.50	637

September 2005 Calls							September 2005 Puts					
Last	Net	Volume	Bid	Ask	Open interest	Exercise price	Last	Net	Volume	Bid	Ask	Open interest
59.20	-4.90	33	59.70	60.20	2,806	230	5.70	+0.30	17	5.30	5.70	2,072
52.30	-1.20	11	51.80	52.30	2,416	240	7.50	+0.10	114	7.40	7.80	2,174
44.30	-3.90	27	44.50	45.00	5,092	250	10.60	+0.90	37	10.00	10.40	1,674
37.50	-3.10	70	37.80	38.30	2,576	260	14.10	+0.70	44	13.40	13.60	1,408
31.10	-4.40	103	31.80	32.30	4,084	270	17.50	+0.10	16	17.20	17.60	2,961
26.70	-3.10	343	26.40	26.80	2,601	280	21.90	+0.60	461	21.80	22.10	945
22.10	-2.40	332	21.80	22.20	2,486	290	27.60	+0.80	95	27.00	27.20	889
18.20	-2.30	613	17.90	18.10	6,924	300	34.50	+2.50	82	33.10	33.60	542
15.20	-1.60	323	14.50	14.90	2,463	310	40.30	+1.10	10	39.70	40.20	468
11.90	-2.00	278	11.80	12.10	2,135	320	45.90		21	46.90	47.40	266
9.60	-1.00	293	9.50	9.70	7,729	330	50.30		30	54.70	55.10	327

The previous tables show a sample of option prices, downloaded from an Internet site on June 10, 2005. The options are on Google, Inc., the well-known Internet search engine company. The left half of the table shows the prices for calls, and the right half for puts. The first table gives the options expiring in July 2005 and the second one for those that expire in September 2005. The option trading expires on the third Friday of a given month. The options will expire on July 15, 2005 and September 16, 2005. The volume represents the total number of option contracts traded. The total number of options outstanding at any time is represented by "open interest." The prices are the closing prices for various options.

The last trade in the stock market may take place at a different time compared to the last trade in the options market. This means that if the closing stock price is 51.00, the last option could have traded when the stock was at a different price. The smallest variation in stock price is 1¢, and for the option prices, the smallest change is 5¢.

2.9 Types of Options: Stock Options, Index Options, Bond Options, Option Funds

Besides options on stocks, investors may buy options on the entire market. These call options, called the index options will rise in value when the value of the underlying index, such as S&P100, rises. This allows the investors to take advantage of an upward, or even downward trend in the market. It is also possible to buy options on Treasury bonds. The value of the bonds, and hence the options, depends upon the interest rates.

2.10 Internet Sites

www.marketwatch.com	This is a very informative web site. It is updated throughout the day with breaking stories, stock prices, options, fundamentals, and a host of other topics.
www.cboe.com	This is primarily devoted to options. The section on education is quite useful. You can even sign up for a free online course.
www.etrade.com	The website of a typical online discount broker gives the pricing information.
www.yahoo.com	The finance section of yahoo has many more sites that you want to explore.

2.11 Transaction Costs

At one time, mainly in the 1970s and 1980s, the cost of trading options was quite high. The commission on a $5000 stock purchase could be $200, and the cost of buying options worth $1000 could easily be $150. This meant that the profit potential in option strategies was quite small. The things have changed dramatically after the wide use of Internet as a

trading vehicle. Because of increasing use of computers, lower cost of long-distance telecommunications, automated data entry systems, the transaction costs for option trading have become small.

Exercises

2.1. You have bought ten ounces of gold at $800 an ounce and put them in a bank security deposit box, which rents at $20 per year in advance. The bank also offers a one-year CD, which pays 3.5% interest.

(A) What is the minimum forward selling price per ounce for the one-year forward contracts that you plan to sell? $830.07 ♥

(B) Suppose you are able to sell 10 contracts at the forward price of $840. Find the profit in this transaction. The profit is calculated as the final (cash) payoff minus the initial (cash) investment. $380 ♥

(C) Find the NPV of the investment in (B). $95.94 ♥

2.2. The current price of a stock is $60 a share. The forward price of a six-month contract on the stock is $62. Find the implied interest rate. $6.778% ♥

Key Terms

at-the-money, 4
call option, 2
convertible bond, 1
derivative security, 1
exercise price, 3
forward contract, 1
insurance policy, 4
in-the-money, 4
option, 3
out-of-the money, 4
premium, 3
put option, 4
swap, 2
term, 3