

Module 4

Derivatives and hybrids

Introduction

Upon completion of this module you will be able to:



Outcomes

- *describe* financing options beyond the regular or stocks and bonds.
- *identify* situations where call and put options would be attractive to investors.
- *explain* the value of options to an organisation.
- *identify* situations where convertible securities and warrants can be profitably used to meet a financing requirement.
- *estimate* the value of warrants and explain why organisations and investors seek these products.
- *describe* the differences between the various instruments.



Terminology

Hybrids	A security that combined the features of two different types of financial assets.
Derivatives :	A security whose price is dependent upon or derived from one or more underlying assets.
Options:	An agreement between a buyer and a seller that provides the purchaser of an option the chance to purchase or sell underlying security (shares) at a specified price for a predetermined period.
Call options:	The right to buy an underlying asset at a fixed price during a particular period..
Put options:	The right to sell an underlying asset at a fixed predetermined price on or before the exercise date.
Futures contract:	A contractual agreement, generally made on the trading floor of a futures exchange, to buy or sell a particular commodity or financial instrument at a

pre determined price in the future.

Forward contract:	A contract obligating one party to buy and another other party to sell a financial instrument, equity, commodity or currency at a specific future date is known as forward contract.
Convertible securities:	A bond or preferred stock that is convertible into a specific number of common stock at the choice of the holder.
Warrants:	A derivative security that gives the holder the right to purchase securities (usually equity) from the issuer at a specific price within a certain time frame.

Derivatives and hybrids

In MS-4 Accounting and Finance you learned about the risk return relationship and assessing the cost of capital of an organisation. That course focused on the issue of debt mainly in the form of bonds and equity in the form of preferred and common shares. Due to the complex nature of the investment world today new instruments are developed to allow the investing public alternative means of investing in organisations and to allow organisations a variety of products to lure investors to their organisation for investment purposes. Hybrids and derivatives are such products. Hybrids are securities that combine the features of two different types of financial assets. A preferred share is a common example of a hybrid security as it combines some of the features of a debt instrument, that is, fixed payments of dividends is similar to fixed interest payments and those of common shares, such as an ownership position in the organisation. In this module we will look at convertible securities and warrants as two popular hybrid securities.

Unlike hybrids, derivatives securities have value based on an underlying asset or security, but they are neither a debt nor an equity instrument. Derivatives are instruments linked to other existing securities and whose value depends on the value of the linked security it can also be defined as a financial contract whose value derives in part from the value and characteristics of one or more underlying assets (such as securities commodities), interest rates, exchange rates, or indices.

Derivative securities do not provide an organisation with funds, as would a primary bond issue or a primary share issue. Rather they are used by organisations to help manage their financial risk. In the next module we will focus on how these instruments are used by financial managers. This module will focus on valuing the instruments and identifying their value to an investor.



We will focus our attention here on the types of derivative securities that are of interest of most investors. Option and futures contracts are derivative securities, so named because their value is derived from connected underlying security. Numerous types of options and futures are traded in world financial markets. Furthermore, there are different types of options other than put and call discussed here. For example, a warrant is a corporate-created long-term option on the underlying common stock of the company. It gives the holder the right to buy the stock from the company at a stated price within a stated period of time, typically several years.

Features of derivatives and hybrids

Options and futures contracts share some common characteristics. Both have standardised features that allow them to be traded quickly and cheaply on organised exchanges. In addition to facilitating the trading of these securities, the exchange guarantees the performance of these contracts, and its clearinghouse allows an investor to reverse his or her original position before maturity. For example, a seller of a futures contract can buy the contract and cancel the obligation that the contract carries. The exchanges and associated clearing houses for both options and futures contracts have worked extremely well.

Options and futures contracts have important differences in their trading, the assets they can affect, their riskiness and so forth. Perhaps the biggest difference to note now is right to do so, as opposed to an obligation. The buyer of an option has limited liability, but the buyer of a futures contract does not.

Options and futures contracts are important to investors because they provide a way for investors to manage portfolio risk. For example, investors may incur the risk of adverse currency fluctuations if they invest in foreign securities, or they may incur the risk that interest rates will adversely affect their fixed-income securities. Options and futures contracts can be used to limit some, or all, of these risks, thereby providing risk-control possibilities. Thus, options and futures are useful to hedgers who wish to limit price fluctuations. On the other hand, speculators can use options and futures to try to profit from price fluctuations.

Options

An option is an agreement between a buyer and a seller that provides the purchaser of an option the chance to purchase or sell underlying security (shares) at a specified price for a predetermined period.

Call option

The right to buy an underlying asset at a fixed price during a particular period.

Put option

The right to sell an underlying asset at a fixed predetermined price on or before the exercise date.

American option

An option that can be exercised at any time till the expiration date.

European option

An option that can only be exercised on expiration date is known as a European Option.

Exercising the option

The act of buying or selling the underlying asset via the option is called exercising the option.

Expiration date

The last day on which the option can be exercised is called expiration date.

Striking price

The fixed price in the option contract at which the holder can buy or sell the underlying asset is known as strike price or exercise price.

Call options allow the holder of an option to buy a specified number of shares at a specified price either at a point in time or for a set period. Put options allow the holder of an option to sell a specified number of shares at a specified price at a set time or for a period. The price at which the shares can be purchased is referred to as the exercise price of the option. Typically, one option gives you the right to purchase 100 shares. European options differ from American options in that European options can only be exercised on the expiration date. American options can be exercised any time up to the expiration date.

One important item to note about options is that they are not used to raise capital for an organisation, as the company whose stock is being contracted for does not participate in the option contract nor does it receive any funds as a result of the option contract.

Options are attractive to investors as a means of protecting their investment positions. If investors purchase a call option, they are anticipating that the price of the underlying stock will increase. Through the purchase of an option they ensure that they can purchase shares at a price that will be below their forecasted market prices at the date they exercise the option. If the price of the underlying shares is below the option strike price the purchaser will let the option expire without exercising it.



If investors purchase a put option, they are anticipating that the price of the underlying stock will decline. If the market price falls below the strike price, the option holder will exercise his option and sell his/her shares at the strike price. If the share price rises above the strike price, the option holder will sell his/her shares on the open market and let the option expire without exercising it.

Buyers of calls are betting that the price of the underlying common stock will rise, making the call option more valuable. Put buyers are betting that the price of the underlying common stock will decline, making the put option more valuable. Both put and call options are written (created) by other investors who are betting the opposite of their respective purchasers. The sellers (writers) receive an option premium for selling each new contract while the buyer pays this option premium.

Once the option is created and the writer receives the premium from the buyer, it can be traded repeatedly in the secondary market. The premium is simply the market price of the contract as determined by investors. The price will fluctuate constantly, just as the price of the underlying common stock changes.

This makes sense because the option value is affected by the time remaining to maturity, current interest rates, the volatility of the stock, and the price at which the option can be exercised.

Using puts and calls

Puts and calls allow both buyers and seller (writers) to speculate on the short-term movements of certain common stocks. Buyers have an option on the common stock for a small, known premium, which is the maximum that the buyer can lose. If the buyer is correct about the price movements on the common gains and magnified in relation to having bought (or sold short) the common because a smaller investment is required. However, the buyer has only a short time in which to be correct. Writers (sellers) earn the premium as income, based on their beliefs about a stock. They win or lose, depending on whether their beliefs are correct or incorrect.

Option can be used in a variety of strategies, giving investors opportunities to manage their portfolios in ways that would be unavailable in the absence of such instruments. For example, since the most a buyer of a put or call can lose is the cost of the option, the buyer is able to truncate the distribution of potential returns. That is, after a certain point, no matter how much the underlying stock price changes, the buyer's position does not change.

Option gains/losses

Option prices are negotiated between the buyer and the seller. The most that a purchaser will lose by purchasing an investment is the price paid for the option. To calculate the profit on options we will work through an example of different scenarios for both a call and a put option.

Gains/losses on call options

We will use the following facts in our calculations:

Option Price	\$100
Strike Price	\$45

Remember that an option gives the right to purchase 100 shares of the underlying stock.

If the market price of the shares increases to \$50, investors will have a profit at the time that they exercise their options. The gain is calculated as the difference between the market price of the shares when the option is exercised and the strike price multiplied by 100 shares less the cost of the option. In this case the gain would be \$400 (i.e., $[(\$50 - \$45) \times 100] - \$100$). If the market price of the shares was equal to or less than the strike price, the amount of loss incurred by the purchase of the option is simply the option price of \$100.

Profit or loss

$$= \text{Market price of stock} - (\text{Premium paid for option} + \text{Exercise Price})$$

To break-even, the value of stock must exceed the exercise price by an amount equal to premium paid for an option. For the writer or seller, of option, the opposite picture emerges.

Gains/losses on put options

Using the same facts, with respect to option price and strike price as the above call option example, we will show how gains and losses are calculated on put options. Basically you are just taking the opposite view on the market price of the shares. You gain as the purchaser of a put option when the market price declines.

We will assume that the market price of the underlying stock decreases to \$41. In the case of a put the gain is calculated as the strike price – the market price of the shares multiplied by the number of shares sold less the cost of the option. In this case the gain on exercising the option would be \$300 (i.e., $[(45-41) \times 100] - 100$). If the market price were to increase above the strike



price of \$45 then the purchaser would let his option expire and his/her loss would be the \$100 option cost.

Why are options purchased /sold?

What follows is a list of the most common reasons why options are purchased:

- Similar to warrants, the purchase of options allows an investor to gain a benefit from a change in the market price of shares with a smaller investment than would be required for the purchase of shares.
- The purchaser locks in what he/she feels is a good price today for shares to be purchased or sold in the future. Currently this investor may not have sufficient cash available to purchase the shares outright.
- If you have a set amount to invest, you may choose to purchase a call option and invest the balance of your funds in a more secure investment. This allows you to gain the benefit of any decrease in share value while earning a return in a less risky investment.
- An option is a protection of a current position. For example, you may purchase a put option when you feel that the price of the shares you own is likely to increase but there is a chance that the value will fall. You may purchase the put option to limit any potential loss and still participate in any gain if the market price increases.
- Options also have the effect of exaggerating swings in an investor's wealth since the value of the option will change more than the value of the underlying stock. Indeed the option can (and often does) become worthless even when share prices are positive.

Value of an option

The value of a call option at its expiration date can be calculated as follows:

$$V_o = \text{Max} (V_s - E, 0)$$

V_o = Value of option

V_s = Value of stock

E = Exercise price or Zero

Value of an option can never be negative because when the exercise price of stock will be greater than the market price of stock no investor will be ready to exercise his option, therefore, the value of option can never be negative but zero.

Theoretical value of option

Theoretical value of an option can be calculated by multiplying all the expected stock prices with their respective probabilities and taking the sum of all the resulting values. Here is an example of calculation of theoretical value of an option, suppose current market price a share of stock of XYZ company is \$10 which is equal to the exercise price of option, the option has no theoretical value, however, if there is probability that the price of stock will increase before expiration the option has positive value, suppose further that the option has 60 days to expiration and following probabilities:

0.3 That the price will be \$7

0.4 That of \$8

0.3 That of \$17

The expected value of option at the end of period will be:

$$0(.3) + 0(.4) + ($17 - $10) (.3) = $2.10$$

Hedging by using option

Here is an example of hedging, suppose the price of stock \$ 50 (equals to the exercise price of option) there is 2/3 probability that the price of stock will increase by 20 per cent and 1/3 probability that the price will decrease by 10 per cent.

$$\text{Expected value of stock} = 2/3(1.20 \times 50) + 1/3(.90 \times 50) = \$55$$

Value of the option at the end of period

Stock Price	Probability	Option Value
\$60	2/3	(\$60-\$50) = \$10
\$45	1/3	\$0

Expected Value of option at the end of period

$$= 2/3(\$10) + (1/3) (\$0) = \$6.667$$

Option Delta

In this situation, a hedged position can be established buying the stock (holding it long) and by writing options. In our example, the idea is to



establish a riskless hedged position. The appropriate hedge ratio of stock to option is known as the option delta. It can be determined by

For our example,

$$\begin{aligned} \text{The option delta} &= \frac{\text{Spread of possible option prices}}{\text{Spread of possible stock prices}} \\ &= \frac{-dV_o}{-dV_s} \\ &= \frac{\$10}{\$15} \\ &= \frac{2}{3} \end{aligned}$$

Where uV_o is the end-of-period value of the option when the stock price, uV_s , is \$60 at the end of the period, and dV_o is the value of the option when the stock price dV_s is \$45 at the end of the period. This hedge ratio means that the person who wishes to hedge should purchase two shares of stock (the long position) and write three options (the short position).

By undertaking such transactions, the end-of-period values for the two futures states will be:

Stock Price at end of Period	Value of Long Position in Stock	Value of Short Position in Option	Value of Combined Hedged Position
\$60	$2(\$60) = \120	$-3(\$10) = -\30	\$90
\$45	$2(\$45) = \90	$-3(\$0) = \0	\$90

We see that when the stock price at the end of the period is \$60, the value of two shares of stock is \$120. However, we must subtract from this value of the negative value of our hedged position. When the stock price is \$45, two shares are worth \$90, and in this case there is no loss on the short position. Therefore, the overall position is perfectly hedged in the sense of providing the same value at the end of the period, regardless of the stock price outcome.

In summary, the hedge ratio, or option delta, is the ratio of the number of shares of stock to the number of options necessary to get offsetting price

movements. These movements are such that the net value of the hedged position remains unchanged.

The Black and Scholes option pricing model

Modern option pricing techniques are often considered among the most mathematically complex of all applied areas of finance. Financial analysts have reached the point where they are able to calculate, with alarming accuracy, the value of a stock option. Most of the models and techniques employed by today's analysts are rooted in a model developed by Fischer Black and Myron Scholes in 1973.

The Black and Scholes Option Pricing Model did not appear overnight, in fact, Fisher Black started out working to create a valuation model for stock warrants. This work involved calculating a derivative to measure how the discount rate of a warrant varies with time and stock price. The result of this calculation held a striking resemblance to a well-known heat transfer equation. Soon after this discovery, Myron Scholes joined Black and the result of their work is a startlingly accurate option pricing model. Black and Scholes cannot take all credit for their work; in fact their model is actually an improved version of a previous model developed by A. James Boness in his Ph.D. dissertation at the University of Chicago. Black and Scholes' improvements on the Boness model come in the form of a proof that the risk-free interest rate is the correct discount factor, and with the absence of assumptions regarding investor's risk preferences.

Assumptions of model:

Assumptions of the Black and Scholes model:

1. The stock pays no dividends during the option's life. No dividend is given on stock.
2. European Option. Only European option can be used for this model.
3. Markets are efficient. The assumption of efficient market is that no one can predict the movement of stock prices and there is no arbitrage in the market.
4. No commissions are charged. No transaction cost.
5. Interest rates remain constant and known. The Black and Scholes model uses the risk-free rate to represent this constant and known rate.
6. Returns are normally distributed. Return on all stocks in the financial market is normally distributed.

The specific model

In this context, the equilibrium value of an option, C that entitles the holder to buy one share of stock is shown by Black and Scholes to be:



$$C(S, t) = N(d_1) S - N(d_2) K e^{-r(T-t)}$$

Where,

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T - t)}{\sigma\sqrt{T - t}}$$

$$d_2 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - \frac{\sigma^2}{2}\right)(T - t)}{\sigma\sqrt{T - t}} = d_1 - \sigma\sqrt{T - t}.$$

For both, as above:

- $N(\cdot)$ is the cumulative distribution function of the standard normal distribution
- $T - t$ is the time to maturity
- S is the spot price of the underlying asset
- K is the strike price
- r is the risk free rate (annual rate, expressed in terms of continuous compounding)
- σ is the volatility of returns of the underlying asset

The formula

This formula may seem hopelessly complicated but it has a rather straightforward interpretation. In the equation $N(d_1)$ represents the delta, or hedge ratio of stock to option necessary to maintain a fully hedge position. In keeping with our earlier discussion, the option holder can be viewed as levered investor. He or she borrows an amount equal to the exercise price, E at an interest rate of r . therefore, the second term on the right of equation represents the loan and thus equation represents the following:

Option Value

$$\text{= (Option Delta X Share Price) – loan adjusted}$$

The important implication of Black-Scholes model is that the value of an option is the function of the short-term interest rate, of the time to expiration, and of the variance rate of return on the stock, but it is not a function of the expected return on the stock. The value of the option increases with the increase of either or all of terms: for duration to expiration of the option, t , for the variance rate s_2 and for the short term interest rate, with increases in t , r and s_2 the value of option approaches the value of a share of a stock as a limit.

Solution of formula

In solving the formula we consider four of the five variables;

- The current stock price
- The time to expiration of the option
- The exercise price and,
- The short-term interest rate.

The key unknown, then, is the standard deviation of the stock price, Black and Scholes assume that the stocks continuously compounded rate of return is normally distributed with constant variance. The usually approach to the problem is to use the recent past volatility of the stock as a proxy for its volatility during the life of option. We might use weekly observations of stock prices over the last year and derive the annualised standard deviation of the natural logarithm of price relative. There are other ways to estimate volatility, but we will not get into them as they are beyond the scope of this module..

Illustration

To illustrate the use of the Black-Scholes option pricing formula suppose that on the basis of an analysis of past volatility we found the standard deviation of the stock continuously compounded return to be .40. By referring to a financial newspaper we are able to look up the other four terms necessary to solve the option pricing formula. Suppose we find the following:

Stock price, $V_s = \$ 30$

Exercise Price $K = \$ 28$

Short term annual rate of interest continuously compounded $r = .10$

Time of Expiration $t = .50$ year (1/2 year)

Natural Log $\ln = (30/28) = .068993$

Solving first for d_1 and d_2

$$d_1 = \frac{\ln(30/28) + [.10 + 1/2(.40)^2](.50)}{.40 \sqrt{.50} \cdot 28.2843} = \frac{.158993}{.40 \sqrt{.50} \cdot 28.2843} = .562$$

$$d_2 = \frac{\ln(30/28) + [.10 - 1/2(.40)^2](.50)}{.40 \sqrt{.50} \cdot 28.2843} = \frac{.078993}{.40 \sqrt{.50} \cdot 28.2843} = .279$$



Cumulative probabilities

$N(d_1)$ and $N(d_2)$ are the probabilities that a random variable with a standardised normal distribution will take on values less than d_1 and less than d_2 . With the bell-shaped normal distribution, slightly over two-thirds of the distribution falls within one standard deviation on either side of the mean, 95 per cent within two standard deviations, and 99.7 per cent within three standard deviations

$$.2912 - \left(\frac{.12}{.50}\right)(.2912 - .2743) = .287$$

This presents the area of normal distribution that is .562 or more standard deviations greater than the mean. To determine the area of the normal distribution that is less than .562 standard deviation, we merely subtract .287 from 1. Therefore,

$$N(d_1) = N(.562) = 1 - .287 = .713$$

For the d_2 of .279, we see in Table C that it lies between the standard deviations of .25 and .30. Interpolating here, we obtain

$$.4013 - \left(\frac{.29}{.50}\right)(.4013 - .3812) = .390$$

$$N(d_2) = N(.279) = 1 - .390 = .610$$

Putting it together

Given $N(d_1)$ and $N(d_2)$ together with the information on the stock price, the exercise price, the interest rate, and the length of time to expiration of the option, we are able to compute the equilibrium value of the option. For our example problem:

$$V_o = \$30(.713) - \$28(.610)e^{-(0.1)(0.5)} = \$5.14$$

Thus, the Black-Scholes option pricing model suggests that an option to buy one share of stock having the characteristics specified is worth \$5.14.

To elaborate the model practically some examples are incorporated. These Illustrations and examples are adapted from *Financial Management & Policy*, James C. Van Horne, Stanford University, Prehall, 12th Edition, pg, 109-110.

Other parameters of model

Delta:

$$\text{Delta} = N(d_1)$$

Delta is a measure of the sensitivity the calculated option value has to small changes in the share price.

Gamma:

$$\text{Gamma} = \frac{\phi(d_1)}{s\sigma\sqrt{t}}$$

Gamma is a measure of the calculated delta's sensitivity to small changes in share price.

Theta:

$$\text{Theta} = -\frac{s\phi(d_1)\sigma}{2\sqrt{t}} - rxe^{-rt}\Phi(d_2)$$

Theta measures the calculated option value's sensitivity to small changes in time till maturity.

Vega:

$$\text{Vega} = s\phi(d_1)\sqrt{t}$$

Vega measures the calculated option value's sensitivity to small changes in volatility.

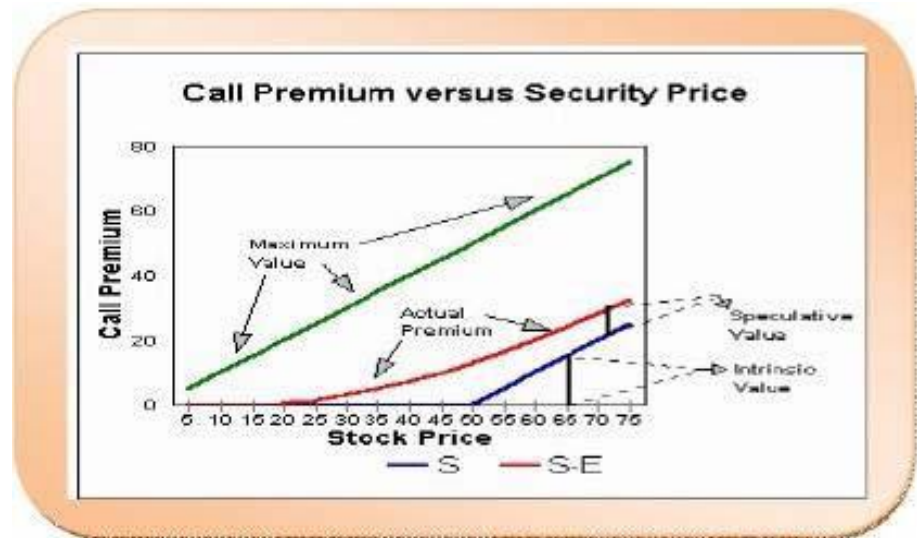
Rho:

$$\text{rho} = xte^{-rt}\Phi(d_2)$$

In order to understand the model itself, we divide it into two parts. The first part, $SN(d_1)$, derives the expected benefit from acquiring a stock outright. This is found by multiplying stock price [S] by the change in the call premium with respect to a change in the underlying stock price [$N(d_1)$]. The second part of the model, $Ke(-rt)N(d_2)$, gives the present value of paying the exercise price on the expiration day. The fair market value of the call option is then calculated by taking the difference between these two parts.

Graphical representation of the Black and Scholes model:

The following graph shows the relationship between a call's premium and the underlying stock's price. The first graph identifies the Intrinsic Value, Speculative Value, Maximum Value, and the Actual premium for a call.



Graph Adopted from Kevin Rubash, Bradley University, Foster College of Business Administration "A Study of Option Pricing Models", Finance Research.
<http://hilltop.bradley.edu/~arr/bsm/model.html/>. Date accessed /17/01/2010

What is options trading?

An option is simply granting someone the right to buy or sell something in the future. In the case of Dow index futures options, when someone buys a Dow call option they are buying the right to purchase that underlying Dow future at a specific price, known as the "strike price", at a future time, known as the "expiration date". When an investor buys a put, they are essentially selling the market; a call essentially buys the market. Likewise, selling a put essentially buys the market; selling a call essentially sells the market.

In order to receive the opportunity to buy an option on this future, investors pay a "premium". If the market does not reach the strike price of the option, then that option will expire worthless on the expiration date. If the market does reach the strike price of the option on the expiration date, then the investor will be assigned the underlying future at that strike price.

Advantages and disadvantages of using option

ADVANTAGES	DISADVANTAGES
<p>Following are the advantages of using options:</p> <p>FLEXIBILITY: Options can be used in a wide variety of strategies, from conservative to high-risk, and can be tailored to more expectations than simply “the stock will go up” or “the stock will go down”.</p> <p>LEVERAGE: An investor can gain leverage in a stock without committing to a trade.</p> <p>LIMITED RISK: Risk is limited to the option premium (except when writing options for a security that is not already owned).</p> <p>HEDGING: Options allow investors to protect their positions against price fluctuations when it is not desirable to alter the underlying position.</p>	<p>Following are the disadvantages of using option:</p> <p>COST: The costs of trading options (including both commissions and the bid/ask spread) is significantly higher on a percentage basis than trading the underlying stock, and these costs can drastically eat into any profits.</p> <p>LIQUIDITY: With the vast array of different strike prices available, some will suffer from very low liquidity making trading difficult.</p> <p>COMPLEXITY: Options are very complex and require a great deal of observation and maintenance.</p> <p>UNLIMITED RISK: Some option positions, such as writing uncovered options, are accompanied by unlimited risk.</p>

Overall Options present a good opportunity to formulate plans which can take advantage of volatility in underlying markets as well as price direction. However for most traders the disadvantages are significant and online futures trading is usually a better option.

Article Source: EzineArticles.com what is Options Trading? An option is simply granting someone the right to buy or sell something in the future. In the case of Dow index futures options, when someone buys a Dow call option they are buying. Article on options trading - advantages and disadvantages by timwreford by Tim Wreford.

<http://www.zeromillion.com/financial-services/options-trading-advantages-and-disadvantages-by-tim-wreford.html/>. Date accessed 17/01/2010.



Futures contracts

Futures contracts have been available on commodities such as corn and wheat for a long time. They are also available on several financial instruments, including stock market indexes, currencies, Treasury bills, Treasury bonds and bank certificates of deposit.

A futures contract is an agreement that provides for the future exchange of a particular asset between a buyer and a seller. The seller contracts to deliver the asset at a specified delivery date in exchange for a specified amount of cash from the buyer. Although the cash is not required until the delivery date, a “good faith deposit,” called the margin, is required to reduce the chance of default by either party. The margin is small compared to the value of the contract.

A long position represents a commitment to purchase the asset on the delivery date, while a short position represents a commitment to deliver the asset at contract maturity. Although the words “buy” and “sell” are used in conjunction with futures contracts, these words are figurative only because a futures contract is not actually bought or sold. Instead, each party enters into the contract by mutual agreement, and no money changes hands at this time.

Most futures contracts are not exercised. Instead, they are “offset” by taking a position opposite to the one initially undertaken. For example, a purchaser of a May Treasury bill futures contract can close out the position by selling an identical May contract before the delivery date, while a seller can close out the same position by purchasing that contract.

The person holding a long position will profit from an increase in the price of the asset, while a person holding a short position will profit from a decrease. Every long position is offset by a short position; therefore, when all futures participants are taken into account, the aggregate profits must also be zero. This is what is meant when we say the futures contract is a zero-sum game.

Using futures contracts

Most participants in futures are either hedgers or speculators. Hedgers seek to reduce price uncertainty over some future period. For example, by purchasing a future contract, a hedger can lock in a specific price for the asset and be protected from adverse price movements. Similarly, sellers can protect themselves from downward price movements. Speculators, on the other hand, seek to profit from the uncertainty that will occur in the future. If prices are expected to rise (fall), contracts will be purchased (sold). Correct anticipations can result in very large profits because only a small cash margin is required to initiate a transaction.

Forward contracts

A contract obligating one party to buy and another other party to sell a financial instrument, equity, commodity or currency at a specific future date is known as forward contract. Fundamentally, forward and futures contracts have the same function: both types of contracts allow people to buy or sell a specific type of asset at a specific time at a given price. However, it is in the specific details that these contracts differ. First of all, futures contracts are exchange-traded and, therefore, are standardised contracts. Forward contracts, on the other hand, are private agreements between two parties and are not as rigid in their stated terms and conditions. Because forward contracts are private agreements, there is always a chance that a party may default on its side of the agreement. Futures contracts have clearing houses that guarantee the transactions, which drastically lowers the probability of default to almost never.

Secondly, the specific details concerning settlement and delivery are quite distinct. For forward contracts, settlement of the contract occurs at the end of the contract. Futures contracts are marked-to-market daily, which means that daily changes are settled day by day until the end of the contract. Furthermore, settlement for futures contracts can occur over a range of dates. Forward contracts, on the other hand, only possess one settlement date. And lastly, because futures contracts are quite frequently employed by speculators, who bet on the direction in which an asset's price will move, they are usually closed out prior to maturity and delivery usually never happens. On the other hand, forward contracts are mostly used by hedgers that want to eliminate the volatility of an asset's price and delivery of the asset or cash settlement will usually take place.

Convertible securities

Convertible securities are either bonds or preferred shares that have a feature that allows the investor to exchange these instruments for a predefined number of common shares. Convertible bonds have all the characteristics of a regular bond but in addition they offer an opportunity for capital appreciation due to the fact they can be converted into common shares at a stated price and for a stated period. Due to these convertible features these bonds often carry a lower interest rate than a regular bond (we will refer to a regular bond as a straight bond, that is, a bond with no convertible feature).

Convertible security: A bond or preferred stock that is convertible into a specific number of common stock at the choice of the holder.

A convertible preferred share operates the same way. It has the same features and rights as a regular preferred share with the added feature that it may be converted to common shares at a stated price for a stated period. As with bonds, these generally command a lower dividend rate from investors as they



have the opportunity to participate more fully in the growth of the organisation. We will focus on convertible bonds in this module.

Convertible security features

A convertible security is a bond or share of preferred stock that can be converted at the option of the holder into common stock of the same corporation.

Conversion price: The price per share at which common stock will be exchanged for the security.

The convertible security gives the investor a fixed return from a bond or a specified dividend from preferred stock. In addition, the investor receives an option on the common stock. Because of this option, the company can sell the convertible security at a lower yield than it would have to pay on a straight bond or preferred stock issue.

Conversion premium, conversion value and conversion ratio

Conversion ratio: The number of shares of common stock into which a convertible security can be converted.

Conversion value: The value of convertible security in terms of common stock into which the security can be converted.

Conversion premium: The market price of a convertible security minus its conversion value.

The ratio of exchange between the convertible security and the common stock can be stated in terms of either a conversion price or a conversion ratio. Suppose Aqeel Corporation's 9.75 per cent convertible subordinated debentures (\$1,000 face value) have a conversion price of \$43.75, meaning that each debenture is convertible into 22.86 shares of common stock. We simply divide the face value of the security (\$1,000) by the conversion price (\$43.75) to obtain the conversion ratio, 22.86 shares. This is the number of shares of common stock an investor will receive upon converting each convertible debenture.

The conversion terms are not necessarily constant over time. Some convertible issues provide for increases or step-ups in the conversion price at periodic intervals. For example, a \$1,000- face-value bond might have a conversion price of \$40 a share for the first five years, \$45 a share for the second five years, \$50 for the third five years, and so on. In this way, the bond converts into fewer shares of common stock as time goes by.

Usually, the conversion price is adjusted for any stock splits or stock dividends that occur after the securities are sold. If the common stock were split two for one, the conversion price would be halved. This provision protects the convertible bondholder and is known as an anti-dilution clause.

Other features

Almost all convertible bond issues are subordinated to other creditors. That fact permits the lender to treat convertible subordinated debt or convertible preferred stock as a part of the equity base when evaluating the financial condition of the issuer. In the event of liquidation, it makes no difference to the creditor if the issue is actually converted. In either case, the lender has a prior claim. The situation is different with a convertible bond that is not subordinate. As long as the bond is not converted, its holder would be a general creditor in the event of liquidation. For this reason, there is a strong incentive from other creditors for the company to make the issue subordinated.

Dilution: A decrease in the proportional claim on earning and assets of a share of common stock because of issuance of additional shares.

Investors in a company's common stock tend to recognise the potential dilution in their position before actual conversion takes place. For accounting reporting purposes, a company with convertible securities or warrants outstanding is required to report earnings per share in such a way that the reader of the financial statement can visualise the potential dilution. More specifically, it must report earnings per share on two bases.

The first is basic earnings per share, where earnings per share are based on only outstanding common stock. The second is diluted earnings per share, where earnings per share are calculated "as if" all potentially dilutive securities were converted or exercised. For companies with sizeable financing involving potentially dilutive securities, the difference between the two earnings per share figures can be substantial.

Use of convertibles

In many cases, convertible securities are employed as "deferred" common stock financing. Technically, these securities represent debt or preferred stock, but in essence they are delayed common stock. Companies that issue convertibles expect them to be converted in the future. By selling a convertible security instead of common stock, companies create less dilution in earnings per share, both now and in the future. The reason is that the conversion price on a convertible security is higher than the issuing price on a new issue of common stock. The current market price of the common stock of the Mohsin Corporation is \$40 per share. If the company raises capital with an issue of common stock, it will have to under price the issue in order to sell it in the market. The company can sell the stock through underwriters and thus realise net proceeds of \$32 per share. If the company wishes to raise \$16 million, the issue will involve 500,000 shares of additional stock. On the other hand, if Mohsin Corporation sells a convertible issue, it is able to set the conversion price above the current market price per share. If the conversion premium is 20 per cent, the conversion price will be \$48 per



share. Assuming a \$16 million issue of convertibles, the number of shares of additional common stock after conversion will be

$$\frac{\$16\text{Million}}{\$48} = 333,333$$

We see that potential dilution with a convertible issue is less than that with a common stock issue because 500,000 minus 333,333 leaves 166,667 fewer shares to be added. Another advantage to the company in using convertible securities is that the interest rate or preferred dividend rate is lower than the rate the company would have to pay on a straight bond or a straight preferred stock issue. The conversion feature makes the issue more attractive to investors. The greater the value of the conversion feature to investors, the lower the yield the company will need to pay in order to sell the issue. The lower interest payments may be particularly useful to a company in a growth phase, because lower payments allow the firm to keep more cash for growth. Moreover, new companies or ones with relatively low credit ratings may find it extremely difficult to sell a straight issue of bonds or preferred stock. The market may respond favourably to convertible issues of these companies, not because of the quality of the convertible bonds or the convertible preferred stock but because of the quality of the underlying common stock.

Why issue convertible securities?

- The conversion right is a selling feature of a bond or preferred share issue.
- Can attract investors who may otherwise not want to invest equity capital in your organisation but are willing to lend money to the organisation.
- These securities combine the security of being a debt holder with the benefits of participating in the increase in value of the company.
- Can be issued at a lower interest rate than a straight bond, but a low conversion price would then imply expensive equity and providing the conversion price is reasonable, they may result in a lower cost than issuing common shares.
- Convertible securities do not provide any new capital to the organisation but they transfer debt to equity which could reduce the overall risk assessment of a company.

Determining the value of a convertible bond

There are different values that can be used to assess the value of a convertible bond. The first is what is referred to as the straight bond value. This is the value of that would be attributed to the bond if it did not carry a convertible feature. We calculate this value the same way we calculate the present value

of a straight bond. We therefore need to know the coupon rate of the convertible bond, the market interest rate for a bond with the same risk assessment, the term of the bond, and the par value of the bond. We will use an example of a convertible bond with the following features and market assumptions:

Par Value	\$1,000
Coupon Rate	8%
Annual Interest	\$80
Market Rate of Return	10%
Term	15 years
Conversion Ratio	20 shares
Market Price per Share	\$30

Based on this information we can calculate the straight bond value as:

Present value of \$80 annual interest, remembering that bond coupons are actually paid half yearly at \$40 in our example for 15 years discounted at 10 per cent = \$608, Plus the present value of the principal of \$1,000 due in 15 years discounted at 10 per cent = \$239

Total straight bond value is \$847. The conversion value is the conversion ratio times the market price per share, which in this example equals 20 shares times \$30 = \$600. The straight bond price is the minimum value a bond would trade at. Therefore in the above example the bond would trade at the \$847 amount and not the conversion value of \$600.

What would the bond actually sell for in the market? As long as the conversion value is less than the straight bond value, the bond would likely sell at the straight bond value plus a market premium. The amount of the market premium depends on the value attributed to the shares and the probability the share prices will increase to the point that conversion is profitable. In other words, what is the outlook for the price of the shares? If the market believes that the share price will rise above the conversion price, investors will be willing to pay more than the straight bond value. When the conversion value is greater than the straight bond value then the convertible bond would trade at the conversion value as a minimum and there may be a market premium. Again the amount of the market premium is dependent on the outlook for the share price.



Agency costs

Convertible securities may serve a useful role for the company when agency problems exist. Here straight debt holders are concerned about company actions that might result in wealth expropriation in favour of the equity holders. The convertible bond mitigates this problem by giving lenders a potential equity stake.

Stock purchase warrants

A stock purchase warrant is a type of security that is typically issued with a bond or preferred share issue. It entitles the holder to buy a specified number of common shares at a specified price for a specified period of time. While warrants are issued with bonds or preferred shares they are detachable from these securities, which means that they can be traded on their own with no impact to the bond or preferred share with which they were originally issued. Warrants are traded on stock exchanges. Why are warrants issued? Much like convertible debt they are issued to enhance the marketability of a debt issue or a preferred share issue. The stated price at which shares can be purchased is referred to as the exercise price. The exercise price of a warrant is normally set at a value above the stock price of common shares at the time the warrant is issued.

Determining the value of a warrant

We will examine the value of a warrant assuming it is issued with a bond. We will work through the calculations for the implied value of a warrant, the theoretical value, and the warrant premium.

Implied value of a warrant

Simply stated, the implied value of all warrants is the difference between a straight bond value and the price of a bond with warrants. Let us return to the example we used for convertible bonds in section 2.3. In that example, the straight bond value was \$847. If we assume that we purchase a bond issue with the same risk level but to which warrants were attached for \$950, the implied value of the attached warrants would be \$103 ($950 - 847$). A bond would normally have more than one warrant attached to it; therefore, to get the implied value of a warrant you would calculate the total implied value divided by the number of warrants attached to the bond. If we assume that this bond had 10 warrants attached to it, the value of each warrant would be \$10.30 ($\103 divided by 10). What does this value mean? It really means very little on its own. As the value of a warrant is dependent on the value of the shares it can be converted to, we must examine the market value of each warrant compared to the implied value. As an investor what we want is a situation where the implied value of the warrant is less than the current market value of the warrant. How do we determine market value? As with convertible bonds, market value is not something that we can calculate with

any degree of certainty as it will depend on market forces and views of the underlying common shares. We can, however, calculate a theoretical value.

Theoretical value of a warrant

The theoretical value of a warrant is an estimate of the market price of the warrant. In order to calculate the theoretical value of a warrant you need to know the current market price of the underlying common shares, the exercise price stated in the warrant, and the number of shares the warrant holder can purchase with each warrant. The theoretical value assuming immediate conversion is equal to:

It is the market price of a common share less the exercise price of the warrant multiplied by the number of shares that can be purchased with each warrant.

We will assume the following facts to demonstrate this calculation:

Stock price = \$100

Exercise price = \$75

Number of shares that can be purchased with each warrant = 5

Theoretical value = $(100 - 75) \times 5 = \$125$

If the implied value of these same warrants were below \$125, that would be positive for the investor, i.e., he/she would be paying less than the estimated value of the warrants. You would also expect the market value of the warrant to be above the \$125 theoretical value. Why?

Because they are a cheap way to maintain an option to buy the stocks until the warrant expires. Investors get the benefit of capital gains on the stock but only have the value of the warrants at risk.

Warrants and leverage

The value of a warrant is the increased leverage that a warrant can provide over the investment in the common shares themselves. A warrant will have a lower price than a common share, therefore requiring a lower initial investment. A warrant will increase in value as the underlying stock increases in value. On a percentage basis there will be a higher percentage return on a warrant than on the common stock itself. This may not sound logical, but here is an example to show what this means and why it is logical.



Information at the date of original investment:

Market price of a warrant	\$6
Exercise price	\$45
Market price of a share	\$50

Assume the market price increased to \$54 the following year. If you have purchased shares in the company you would have a gain of \$4 per share (\$54 - \$50), which is an 8 per cent return ($4/50$). If you had purchased a warrant (assuming one warrant can purchase one share) the theoretical value of the warrant the following year would be \$9 (which is calculated as the market price less the exercise price or $54 - 45$). If you sold your warrant at this price you would have a gain of \$3 ($9 - 6$). This would be a return of 50 per cent (i.e., $3/6$). Therefore you can see that the percentage return is much higher on a warrant. Of course if the share price declines there would be a higher loss as well.

Example of a warrant issue

This is an example of a Canadian issue of warrants just to add some real life to the theory you have just read. For our example we have chosen Biomira Inc., a biotech company listed on both the TSX and the NASDAQ. Biomira has yet to produce a clinically proven drug and must finance most of its research and clinical trial expenditures from capital raised from investors. Until this year, these funds had come almost entirely from the issue of common stock. The capital markets have been very tough on young companies such as Biomira over the past couple of years. In Biomira's case, the company has cut its costs to the bone to enable it to complete its Phase III clinical trial analysis for its leading product candidate Theratope.

To provide additional financing additional equity was raised in 2003 as detailed below. In May Biomira arranged two private placements of shares in the United States. The terms of an issue from early May 2003 were:

Shares offered: up to 3,245,615

Price per share: USD1.14

Warrants attached to shares: up to 548,148

Exercise price of warrants: USD1.66

Term for warrants: two years

Basically an investor received 169 warrants for every 1,000 shares purchased ($[548,148/3,245,615] \times 1,000$). Biomira did not opt to list these warrants as a separate security.

In this case, an investor subscribing to this issue has a two-year period during which time shares could be purchased for USD1.66. Clearly this could generate substantial gains for the investor over and above what was realised from the initial stock purchase. At the time this offer was made Biomira shares were trading at about USD1.18 – significantly below the warrant exercise price. This is fairly typical – therefore a significant rise in stock price is usually required for an investor to realise any financial benefit from the warrant.

Module summary



Summary

In this module you learned:

- Derivatives and hybrids are used by investors to allow them to participate in the growth of a company without actually taking an ownership position.
- Options are an agreement between investors to purchase or sell shares for a specified period at a specified (strike) price, either at a set point in time or for a set period of time.
- Call options allow the optionholder to buy shares; put options allow the optionholder to sell shares.
 - An American option can be exercised at any time till the expiration date.
 - A European option can only be exercised on expiration date is known as European Option.
- The Black-Scholes option pricing model provides an exact formula for determining the value of an option based on the volatility of the stock, the price of the stock, the exercise price of the option, the time to expiration of the option and the short term interest rate. The fixed price in the option contract at which the holder can buy or sell the underlying asset is known as strike price or exercise price.
- As call and put options are contracts between investors there is no new capital provided to the organisation whose shares are being optioned.
- Convertible securities are used to make company debt or preferred shares more attractive to potential investors.
- Convertible features give bondholders or preferred shareholders the right to convert their current holdings to common shares for a specified period of time at a specified conversion ratio.
- A futures contract is an agreement that provides for the future exchange of a particular asset between a buyer and a seller and available on commodities as well as on several financial instruments. Futures contracts are exchange-traded and, therefore, are standardised contracts.
- A contract obligating one party to buy and another other party to sell a financial instrument, equity, commodity or currency at a specific future date is known as forward contract. Forward contracts are private agreements between two parties and are not

as rigid in their stated terms and conditions.

- Convertible securities often carry lower interest or dividend rates than similar products with no conversion feature, but the value of the conversion needs to be accounted for in the overall cost of capital.
- While convertible bonds do not provide new capital to the organisation, they do provide a transfer of debt of the company into equity. This will improve their debt ratios and therefore their risk ratings.
- Warrants are issued with debt initially but they can be detached from the bond and traded separately.
- Warrants offer the warrant holder the option to purchase shares at a specified price for a specified period of time. As the shares will be purchased from the organisation there is new capital generated when the warrant is exercised. There will be an increase in the equity with no corresponding decrease in the debt level.



Assignment



Assignment

1. Define call option and put option. Under what circumstances might you want to buy each one of them? Which one has greater potential profit? Explain.
2. Compare and contrast option, warrants, futures and forwards.
3. Assuming that the current market stock price of XYZ Company is at \$50 per share. Call options with an exercise price of \$35 are selling for \$10. Discuss what's wrong here.
4. If the risk of a stock increases, what is likely to happen to the price of call options of the stock? To the price of put option? Explain.
5. Explain why convertible securities often carry lower interest or dividend rates than similar products with no conversion feature.

Assessment



Assessment

1. Marks-Write Pen Company has an outstanding issue of convertible bonds with a \$1,000 par value. These are convertible into 50 shares of common stock. They have a 10 per cent coupon and a 10-year maturity. The interest rate on a straight bond of similar risk is eight per cent.
 - a. Calculate the straight bond value of the bond.
 - b. Calculate the conversion value of the bond when the market price of the stock is \$30/share.
 - c. What is the least you would expect the bond to sell for at a market price of common stock of \$18/share?
2. Sun & Fun Sports Equipment must decide whether to obtain \$1,000,000 of financing by selling common stock at its current price of \$40 per share or selling convertible bonds. The firm currently has 250,000 shares of common stock outstanding. Convertible bonds can be sold for their \$1,000 par value and would be convertible at \$45. The firm expects its earnings available to common stockholders to be \$700,000 each year over the next several years.
 - a. Calculate the number of shares the firm would need to sell to raise the \$1,000,000.
 - b. Calculate the earnings per share resulting from the sale of common stock.
 - c. Calculate the number of shares outstanding once all bonds have been converted.
 - d. Calculate the earnings per share associated with the bond financing after conversion.
 - e. Which of the financing alternatives would you recommend the company adopt? Why?
3. State whether the following statements are TRUE or FALSE:
 - a. Derivatives are used by corporations as a useful tool for managing certain aspects of the firm's risk.
 - b. Leasing allows the lessee, in effect, to depreciate land, which is prohibited if the land were purchased.
 - c. Conversion ratio is the ratio at which a convertible security can be exchanged for a nonconvertible security.
 - d. Convertibles can be used as a form of deferred common stock financing.
 - e. A stock-purchase warrant gives the holder the right to



- purchase a certain number of shares of common stock at a specified price over a certain period.
- f. Contrary to convertibles, warrants provide for the injection of additional equity capital into the firm at some future date.
 - g. Both warrants and rights result in new capital equity. However, warrants are issued at an exercise price below the prevailing market price of the stock; rights are generally issued at a subscription price above the prevailing market price.
 - h. The strike price is the price at which the holder of a call option can buy a specified amount of stock at any time before its expiration date.
 - i. Call option is an option to sell a specified number of shares of a stock on or before some future date at a stated price.
4. At the time of issuance, the issuer of a convertible security normally establishes a conversion price _____ the current market price of the firm's stock.
 - a. below
 - b. equal to
 - c. above
 - d. unrelated to
 5. When the price of the firm's common stock _____ the conversion price, the market price of the convertible security will normally _____ to a level close to its conversion value.
 - a. falls below; rise
 - b. rises above; fall
 - c. rises above; rise
 - d. equals; fall
 6. The straight bond value is the _____ price at which a convertible bond would be traded.
 - a. minimum
 - b. optimum
 - c. maximum
 - d. average
 7. A firm has an outstanding bond with a \$1,000 par value that is convertible at \$40 per share of common stock. If the current market value of common stock per share is \$45, the conversion value of the bond is

- a. \$880.
 - b. \$1,000.
 - c. \$1,125.
 - d. \$1,200.
8. All of the following are true of stock-purchase warrants EXCEPT
- a. When a firm makes a large issue of debt, the attachment of stock-purchase warrants may add to the marketability of the issue.
 - b. Suppliers of debt are more likely to require warrants on an issue of debt from an existing corporation than from a new firm.
 - c. Warrants are similar to conversion features on debt.
 - d. The attachment of warrants may lower the required interest rate.
9. In the financial statement of the firm, puts and calls
- a. Determine cash management policy.
 - b. Influence the capital structure decision.
 - c. Affect bond quality.
 - d. Have no influence.
10. An investor is considering buying 500 shares of ABC Company at \$32 per share. Analysts agree that the firm's stock price may increase to \$45 per share in the next four months. As an alternative, the investor could purchase a 120-day call option for 500 shares at a strike price of \$30 for \$5,000. What profit would the investor realise if the stock price increased to \$42 per share?
- a. \$0
 - b. \$1,000
 - c. \$4,000
 - d. \$6,000

Problems:

11. Asad & Company's common stock has a present market price per share of \$28. A six-month call option has been written on the stock with an exercise price of \$30. Presently the option has a market value of \$3. At the end of six months, you estimate the market price of the stock to be \$24 per share with a probability of .1, \$28 with a probability of .2, \$32 with a probability of .4, \$37 with a probability of .2, and \$43 with a probability of .1.
- a. What is the expected value of share price six months hence? What is the expiration value of the option if that expected



- value of share price should prevail?
- b. What is the expected value of option price at expiration; assume that the option is held to this time? Why does it differ from the option value determined in part a?
 - c. Presently, what is the theoretical value of the option? Why does it have a positive value?
12. Wajahat and Awais Company's share price is now \$60. Six months from now, it will be either \$75 with probability .70 or \$50 with probability .30. A call option exists on the stock that can be exercised only at the end of six months at an exercise price of \$65.
- a. If you wished to establish a perfectly hedged position, what would you do on the basis of the facts just presented?
 - b. Under each of the two possibilities, what will be the value of your hedged position?
 - c. What is the expected value of option price at the end of the period?
13. A call option enables the holder to acquire one share of stock at \$45 a share for each option held. The option has six months until its expiration. The market price of the stock is currently \$40 a share, and the expected standard deviation of its continuously compounded return over the near future is .30. The short term annual interest rate is 10 per cent.
- a. On the basis of this information, what is the proper value of the option using the Black-Scholes option pricing model? (The calculation can be made with a reasonably sophisticated calculator or with an ordinary calculator and various tables.)
 - b. What is the appropriate hedge ratio, and how does it work?

Answer Key to Assessment Questions

1. Marks-Write Pen Company
 - a. $B = \$100(6.710) + \$1,000(.463) = \$1,134$
 - b. $50 \times \$30/\text{share} = \$1,500$
 - c. \$1,134, the straight value of the bond is the minimum value of the bond regardless of the price of the common stock.

2. Sun & Fun Sports Equipment
 - a. $1,000,000 / 40 = 25,000$ shares
 - b. $700,000 / (250,000 + 25,000) = \2.55 EPS
 - c. $1,000,000 / 1,000 = 1,000$ bonds
 $1,000 / 45 = 22.222$ shares
 $1,000 \text{ bonds} \times 22.222 \text{ shares} = 22,222$ shares
 $250,000 + 22,222 = 272,222$ shares outstanding
 - d. $700,000 / (250,000 + 22,222) = \2.57 EPS
 - e. Since the convertible bond issue results in less dilution and higher EPS (although the EPS are very close), it is therefore recommended. The risk of an overhanging issue should be considered since the marginal increase in EPS is slight.

3. State whether the following statements are TRUE or FALSE:
 - a. True
 - b. True
 - c. False
 - d. True
 - e. True
 - f. False
 - g. False
 - h. True
 - i. False



4. C
5. C
6. A
7. C
8. B
9. D
10. B

Answers to Problems 11-13 to be provided by your tutor.

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