19

OPTIONS

Introduction

Derivatives – options, futures, forwards, etc. – are the subject of this chapter and the next two. Derivative instruments have become increasingly important for companies over the last 20 years. Managers can exploit these powerful tools to either reduce risk or to go in search of high returns. Naturally, exceptionally high returns come with exceptionally high risk. So managers using derivatives for this purpose need to understand the risk they are exposing their company to. Many companies have lost fortunes by allowing managers to be mesmerized by the potential for riches while failing to take time to fully understand the instruments they were buying. They jumped in, unaware of, or ignoring, the potential for enormous loss. These three chapters describe the main types of derivative and show how they can be used for controlling risk (hedging) and for revving-up returns (speculation).

Exceptionally high returns come with exceptionally high risk.

What is a derivative?

A derivative instrument is an asset whose performance is based on (derived from) the behavior of the value of an underlying asset (usually referred to simply as the 'underlying'). The most common underlyings are commodities (for example tea or pork bellies), shares, bonds, share indices, currencies and interest rates. Derivatives are contracts that give the *right*, and sometimes the obligation, to buy or sell a quantity of the underlying, or benefit in another way from a rise or fall in the value of the underlying. It is the legal right that becomes an asset, with its own value, and it is the right that is purchased or sold.

The derivatives markets have received an enormous amount of attention from the press in recent years. This is hardly surprising as spectacular losses have been made and a number of companies have been brought to the point of collapse using derivatives. Some examples of the unfortunate use of derivatives include:

- Metallgesellschaft, the German metals and services group, which was nearly destroyed in 1994 after losing more than DM2.3bn on energy derivatives;
- Procter & Gamble, which lost $102m speculating on the movements of future interest rates in 1994;
- Orange County in California, which lost at least $1.7bn on leveraged interest rate products;
- Barings, Britain's oldest merchant bank, which lost over £800m on the Nikkei Index (the Japanese share index) contracts on the Singapore and Osaka derivatives exchanges, leading to the bank's demise in 1995;
- Sumitomo, which lost £1.17bn on copper and copper derivatives over the ten years to 1996;

- Long-Term Capital Management, which attempted to exploit the 'mispricing' of financial instruments, by making use of option pricing theory. In 1998 the firm collapsed and the Federal Reserve Bank of New York cajoled 14 banks and brokerage houses to put up $3.6bn to save it, thereby preventing a financial system breakdown.

In many of the financial scandals derivatives have been used (or misused) to speculate rather than to reduce risk. These chapters examine both of these applications of derivatives but places particular emphasis on the hedging (risk-mitigating) facility they provide. These are powerful tools and managers can abuse that power either through ignorance or through deliberate acceptance of greater risk in the anticipation of greater reward. However there is nothing inherently wrong with the tools themselves. If employed properly they can be remarkably effective at limiting risk.

A long history

Derivative instruments have been employed for more than two thousand years. Olive growers in ancient Greece unwilling to accept the risk of a low price for their crop when harvested months later would enter into forward agreements whereby a price was agreed for delivery at a specific time. This reduced uncertainty for both the grower and the purchaser of the olives. In the Middle Ages forward contracts were traded in a kind of secondary market, particularly for wheat in Europe. A futures market was established in Osaka's rice market in Japan in the seventeenth century. Tulip bulb options were traded in seventeenth-century Amsterdam.

Commodity futures trading really began to take off in the nineteenth century with the Chicago Board of Trade regulating the trading of grains and other futures and options, and the London Metal Exchange dominating metal trading.

So derivatives are not new. What is different today is the size and importance of the derivatives markets. The last quarter of the twentieth century witnessed an explosive growth of volumes of trade, variety of derivatives products, and the number and range of users and uses. In the 20 years to 2003 the face value of outstanding derivatives contracts rose dramatically to stand at about US$120 trillion (US$120,000,000,000,000). Compare that with the total production of all the goods and services in the UK in a year of around £1 trillion.

Derivatives are not new. What is different today is the size and importance of the markets.

What is an option?

An option is a contract giving one party the right, but not the obligation, to buy or sell a financial instrument, commodity or some other underlying asset at a given price, at or before a specified date. The purchaser of the option can either exercise the right or let it lapse – the choice is theirs.

A very simple option would be where a firm pays the owner of land a non-returnable *premium* (say £10,000) for an option to buy the land at an agreed price (say, £1m) because the firm is considering the development of a retail park within the next five years. The property developer may pay a number of option premiums to owners of land in different parts of the country. If planning permission is eventually granted on a particular plot the option to purchase may be *exercised*. In other words the developer pays the price agreed at the time that the option contract was arranged to purchase the land (say, £1m). Options on other plots will be *allowed to lapse* and will have no value. By using an option the property developer has 'kept the options open' with regard to which site to buy and develop and, indeed whether to enter the retail park business at all.

Options can also be *traded*. Perhaps the option to buy could be sold to another company keener to develop a particular site than the original option purchaser. It may be sold for much more than the original £10,000 option premium, even before planning permission has been granted.

Once planning permission has been granted the greenfield site may be worth £1.5m. If there is an option to buy at £1m the option right has an *intrinsic value* of £500,000, representing a 4,900 percent return on £10,000. From this we can see the gearing effect of options: very large sums can be gained in a short period of time for a small initial cash outlay.

Share options

Share options have been traded for centuries but their use expanded dramatically with the creation of traded option markets in Chicago, Amsterdam and, in 1978, the London Traded Options Market. In 1992 this became part of the London International Financial Futures and Options Exchange, LIFFE (pronounced 'life'). Euronext bought LIFFE in 2002 and it is now officially Euronext.liffe.

A share call option gives the purchaser a right, but not the obligation, to *buy* a fixed number of shares at a specified price at some time in the future. In the case of traded options on Euronext.liffe, one option contract relates to a quantity of 1,000 shares. The seller of the option, who receives the premium, is referred to as the *writer*. The writer of a call option is obligated to sell the agreed quantity of shares at the agreed price some time in the future. American-style options can be exercised by the buyer at any time up to the expiry date, whereas European-style options can only be exercised on a predetermined future date. Just to confuse everybody, the distinction has nothing to do with geography: most options traded in Europe are US-style options.

Call option holder (call option buyers)

Now let us examine the call options available on an underlying share – Cadbury Schweppes, on 4 February 2004. There are a number of different options available for this share, many of which are not reported in the table presented in the *Financial Times*, part of which is reproduced as Table 19.1.

TABLE 19.1
Call options on Cadbury Schweppes shares, 4 February 2004

	Call option prices (premiums) pence		
Exercise price	*April*	*June*	*September*
390p	33.5	35.5	40.5
420p	13.5	17.5	24.0
Share price on 4.2.04 = 416.5p			

Source: *Financial Times*, 5 February 2004. Reprinted with permission.

So, what do the figures mean? If you wished to obtain the right to buy 1,000 shares on or before late June 2004, at an exercise price of 420p, you would pay a premium of £175 (1,000 × 17.5p). If you wished to keep your option to purchase open for another three months you could select the September call. But this right to insist that the writer sells the shares at the fixed price of 420p on or before a date in late September[1] will cost another £65 (the total premium payable on one option contract is £240 rather than £175). This extra £65 represents additional *time value*. Time value arises because of the potential for the market price of the underlying to change in a way that creates intrinsic value. The intrinsic value of an option is the pay-off that would be received if the underlying were at its current level when the option expires. In this case, there is currently (4 February) no intrinsic value because the right to buy is at 420p whereas the share price is 416.5p. However if you look at the call option with an exercise price of 390p then the right to buy at 390p has intrinsic value because if you purchased at 390p by exercising the option, thereby obtaining 1,000 shares, you could immediately sell at 416.5p in the share market: intrinsic value = 26.5p per share, or £265 for 1,000 shares. The longer the time over which the option is exercisable the greater the chance that the price will move to give intrinsic value – this explains the higher premiums on more distant expiry options. Time value is the amount by which the option premium exceeds the intrinsic value.

The two exercise price (also called strike price) levels presented in Table 19.1 illustrate an *in-the-money-option* (the 390 call option) and an *out-of-the-money-option* (the 420 call option). The underlying share price is above the strike price of 390 and so this call option has an intrinsic value of 26.5p and is therefore in-the-money. The right to buy at 420p is out-of-the-money because the share price is below the option exercise price and therefore has no intrinsic value. The holder of a 420p option would not exercise this right to buy at 420p because the shares can be bought on the stock exchange for 416.5p. (It is sometimes possible to buy an *at-the-money option*, which is one where the market share price is equal to the option exercise price.)

To emphasize the key points: The option premiums vary in proportion to the length of time over which the option is exercisable (e.g. they are higher for a September option than for a June option). Also, call options with a lower exercise prices will have higher premiums.

Illustration

Suppose that you are confident that Cadbury Schweppes shares are going to rise significantly over the next four-and-a-half months to 700p and you purchase a June 390 call at 35.5 pence.[2] The cost of this right to purchase 1,000 shares is £355 (35.5p × 1,000 shares). If the share rises as expected then you could exercise the right to purchase the shares for a total of £3,900 and then sell these in the market for £7,000. A profit of £3,100 less £355 = £2,745 is made before transaction costs (the brokers' fees, etc. would be in the region of £20–£50). This represents a massive 773 percent rise before costs (£2,745/£355).

However the future is uncertain and the share price may not rise as expected. Let us consider two other possibilities. First, the share price may remain at 416.5p throughout the life of the option. Second, the stock market may have a severe downturn and Cadbury Schweppes shares may fall to 300p. These possibilities are shown in Table 19.2.

TABLE 19.2
Profits and losses on the June 390 call option following purchase on 4 February

	Assumptions on share price in June at expiry		
	700p	416.5p	300p
Cost of purchasing shares by exercising the option	£3,900	£3,900	£3,900
Value of shares bought	£7,000	£4,165	£3,000
Profit from exercise of option and sale of shares in the market	£3,100	£265	Not exercised
Less option premium paid	£355	£355	£355
Profit (loss) before transaction costs	£2,745	–£90	–£355
Percentage return over $4\frac{1}{2}$ months	773%	–25%	–100%

In the case of a standstill in the share price the option gradually loses its time value over the four-and-a-half months until, at expiry, only the intrinsic value of 26.5p per share remains. The fall in the share price to 300p illustrates one of the advantages of purchasing options over some other derivatives: the holder has a right to abandon the option and is not forced to buy the underlying share at the option exercise price – this saves £900. It would have added insult to injury to have to buy at £3,900 and sell at £3,000 after having already lost £355 on the premium for the purchase of the option.

A comparison of Figures 19.1 and 19.2 shows the extent to which the purchase of an option gears up the return from share price movements: a wider dispersion of returns is experienced. On 4 February 2004, 1,000 shares could be bought for £4,165. If the value rose to £7,000, a 68 percent return would be made, compared with a 773 percent return if options are bought. We would all like the higher positive return on the option than the lower one available on the underlying – but would we all accept the downside risk associated with this option? Consider the following possibilities:

- If share price remains at 416.5p:
  - Return if shares are bought: 0%
  - Return if one 390 June call option is bought: –25% (paid £355 for the option which declines to its intrinsic value of only £265*)

  * £265 is the intrinsic value at expiry (416.5p – 390p) × 1,000 = £265
- If share price falls to 300p:
  - Return if shares are bought: –28%
  - Return if one 390 June call option is bought: –100% (the option is worth nothing)

FIGURE 19.1

Profit if 1,000 shares are bought in Cadbury Schweppes on 4 February 2004 at 416.5p

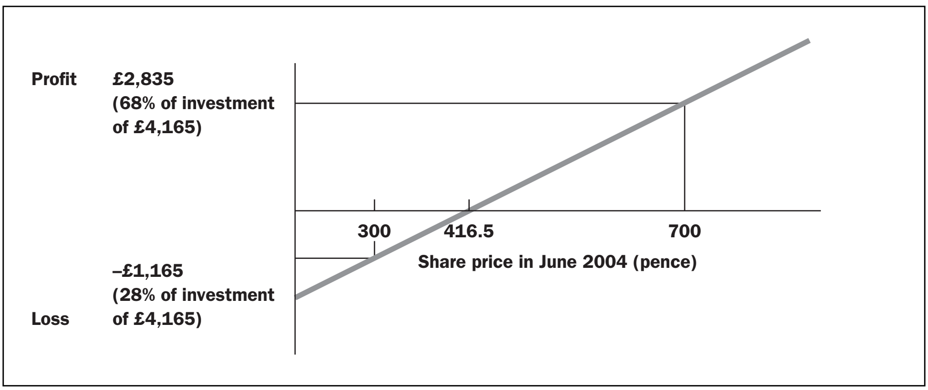
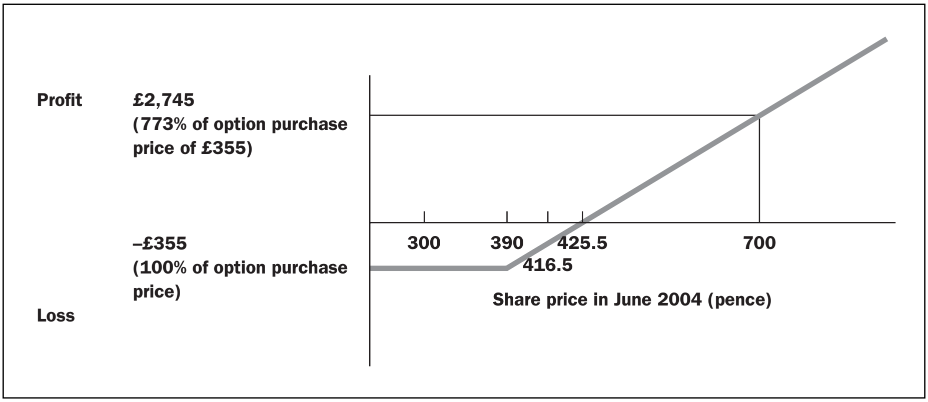


FIGURE 19.2

Profit if one 390 January call option contract (for 1,000 shares) in Cadbury Schweppes is purchased on 4 February 2004 and held to maturity



The holder of the call option will not exercise unless the share price is at least 390p. At a lower price it will be cheaper to buy the 1,000 shares on the stock market. Break-even does not occur until a price of 425.5p because of the need to cover the cost of the premium (390p + 35.5p). However at higher prices the option value increases, pence for pence, with the share price. Also the downside risk is limited to the size of the option premium.

Call option writers

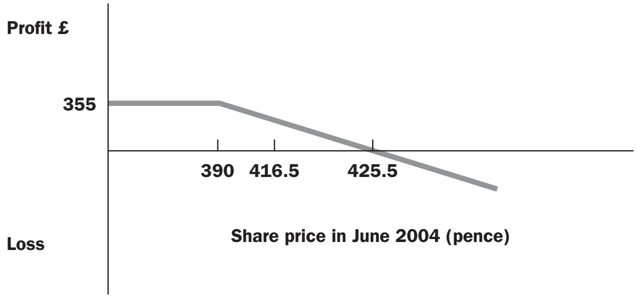
The returns position for the writer of a call option in Cadbury Schweppes can also be presented in a diagram (*see* Figure 19.3). With all these examples note that there is an assumption that the position is held to expiry.

If the market price is less than the exercise price (390p) in June the option will not be exercised and the call writer profits to the extent of the option premium (35.5p per share). A market price greater than the exercise price will result in the option being exercised and the writer will be forced to deliver 1,000 shares for a price of 390p. This may mean buying shares on the stock market to supply to the option holder. As the share price rises this becomes increasingly onerous and losses mount.

Note that in the sophisticated traded option markets of today very few option positions are held to expiry. In most cases the option holder sells the option in the market to make a cash profit or loss. Option writers often cancel out their exposure before expiry – for example they could purchase an option to buy the same quantity of shares at the same price and expiry date.

FIGURE 19.3

The profit to a call option writer on one 390 June call contract written on 4 February 2004



An example of an option writing strategy

Joe has a portfolio of shares worth £100,000 and is confident that while the market will go up steadily over time it will not rise over the next few months. He has a strategy of writing out-of-the-money (i.e. no intrinsic value) call options and pocketing premiums on a regular basis. Today (4 February 2004) Joe has written one option on September calls in Cadbury Schweppes for an exercise price of 420p (current share price 416.5p). In other words, Joe is committed to delivering (selling) 1,000 shares at any time between 4 February 2004 and near the end of September 2004 for a price of 420p at the insistence of the person that bought the call. This could be very unpleasant for Joe if the market price rises to say 500p. Then the option holder will require Joe to sell shares worth £5,000 to him/her for only £4,200. However, Joe is prepared to take this risk for two reasons. First he receives the premium of 24p per share up front – this is 5.8% of each share's value, equivalent to double the annual dividend. This £240 will cushion any feeling of future regret at his actions. Second, Joe holds 1,000 Cadbury Schweppes shares in his portfolio and so would not need to go into the market to buy the shares to then sell them to the option holder if the price did rise significantly. Joe has written a *covered* call option – so-called because he has backing in the form of the underlying shares. Joe only loses out if the share price on the day the option is exercised is greater than the strike price (£4.20) plus the premium (24p). He is prepared to risk losing some of the potential up side (above 420p + 24p = 444p) to gain the premium. He also reduces his loss on the downside: if the shares in his portfolio fall he has the premium as a cushion.

Some speculators engage in *uncovered (naked)* option writing. It is possible to lose a multiple of your current resources if you write a lot of option contracts and the price moves against you. Imagine if Joe had only £10,000 in savings and entered the options market by writing 30 Cadbury Schweppes September 2004

420 calls receiving a premium of 24p × 30 × 1,000 = £7,200.[1] If the price moves to £5 Joe has to buy shares for £5 and then sell them to the option holders for £4.20, a loss of 80p per share: 80p × 30 × 1,000 = £24,000. Despite receiving the premiums Joe has wiped out his savings.

[1] This is simplified. In reality Joe would have to provide margin of cash or shares to reasure the clearing house that he could pay up if the market moved against him. So it could be that all of the premium received would be tied up in margin held by the clearing house (the role of a clearing house is explained in the next chapter).

LIFFE share options

The *Financial Times* lists over eighty companies' shares in which options are traded (*see* Exhibit 19.1).

Put options

A put option gives the holder the right, but not the obligation, to sell a specific quantity of shares on or before a specified date at a fixed exercise price.

Imagine you are pessimistic about the prospects for Cadbury Schweppes on 4 February 2004. You could purchase, for a premium of 9.5p per share (£95 in total), the right to sell 1,000 shares in or before late June 2004 at 390p (*see* Exhibit 19.1). If a fall in price subsequently takes place, to, say, 350p, you can insist on exercising the right to sell at 390p. The writer of the put option is obliged to purchase shares at 390p while being aware that the put holder is able to buy shares at 350p on the stock exchange. The option holder makes a profit of 390 – 350 – 9.5 = 30.5p per share, a 321 percent return (before costs).

For the put option holder, if the market price exceeds the exercise price, it will not be wise to exercise as shares can be sold for a higher price on the stock exchange. Therefore the maximum loss, equal to the premium paid, is incurred. The option writer gains the premium if the share price remains above the exercise price, but may incur a large loss if the market price falls significantly (*see* Figures 19.4 and 19.5).

As with calls, in most cases the option holder would take profits by selling the option on to another investor via LIFFE rather than waiting to exercise at expiry.

Traditional options

The range of underlyings available on LIFFE and other exchanges are limited. Traditional options, on the other hand, are available on any security, but there is no choice on the strike (exercise) price: this is set as the market price on the day the option is bought (or close to it). Also all options expire within three months (traded options have up to nine months to expiry) and the option cannot be sold

EQUITY OPTIONS

Option		Calls Apr	Calls Jun	Calls Sep	Puts Apr	Puts Jun	Puts Sep
3i Group	600	47.5	58.0	67.0	12.5	22.0	31.0
(*631.0)	650	19.5	30.5	40.5	34.5	46.0	55.0
Abbey Natl	550	26.0	33.5	42.5	26.5	34.5	45.0
(*558.5)	600	6.0	13.5	22.0	60.5	66.0	74.5
Ald Domecq	420	32.5	41.0	46.0	6.0	12.0	18.5
(*443.0)	460	10.5	18.0	25.0	24.5	29.5	37.5
Amvescap	390	42.0	50.5	62.0	19.0	28.0	39.5
(*414.0)	420	25.0	35.5	47.0	33.0	43.0	54.0
BAA	500	36.0	42.5	46.5	6.0	13.0	17.0
(*527.5)	550	8.5	14.5	20.5	28.5	38.5	42.0
BAT	750	45.0	48.0	52.5	10.5	16.5	26.5
(*792.0)	800	10.0	18.5	25.5	37.0	42.5	52.0
BHP Billiton	420	41.5	48.0	57.0	11.0	17.0	25.0
(*447.5)	460	18.0	24.5	33.0	27.5	34.0	41.5
Boots Group	700	27.0	34.0	40.0	19.5	33.0	41.0
(*702.5)	750	7.5	13.0	19.0	51.0	66.5	72.5
Br Airways	280	27.00	33.25	42.00	17.50	24.75	31.50
(*287.50)	300	17.25	23.25	31.50	28.00	34.50	40.75
Cadbury Sch	390	33.5	35.5	40.5	4.0	9.5	14.5
(*416.5)	420	13.5	17.5	24.0	14.5	23.0	28.5
Centrica	200	15.0	16.0	19.0	4.5	6.5	8.5
(*209.0)	220	5.5	6.0	9.0	15.0	17.0	19.0
Corus	35	6.00	7.00	8.75	2.00	3.00	4.25
(*38.75)	40	3.25	4.75	6.25	4.25	5.50	6.75

Option		Calls Feb	Calls Mar	Calls Apr	Puts Feb	Puts Mar	Puts Apr
Vodafone	130	6.75	8.75	10.25	1.25	3.00	4.00
(*135.25)	140	1.75	3.50	4.75	6.25	7.75	8.50
Option		**Feb**	**Mar**	**Apr**	Feb	Mar	Apr
Allce & Leics	850	24.5	40.0	53.5	6.0	33.5	54.0
(*867.0)	900	2.5	15.0	28.5	34.5	65.0	82.5
Anglo Amer	1200	47.5	81.0	111.0	11.5	55.5	79.5
(*1234.0)	1250	20.0	56.0	85.5	33.5	81.0	104.5
BAE Systems	160	5.75	11.50	16.75	3.25	12.00	16.00
(*162.00)	180	0.25	3.75	8.75	18.00	25.00	28.25
BOC Group	850	38.5	67.0	81.0	5.0	25.5	48.5
(*882.5)	900	9.0	38.0	53.0	25.5	47.0	73.0
Capita	240	11.0	18.5	25.0	1.0	8.5	13.5
(*249.5)	260	1.0	9.0	15.5	11.0	19.0	24.0
Carlton Com xe	280	11.5	23.5	33.5	7.0	17.5	26.0
(*284.0)	300	3.5	15.0	24.5	19.0	28.5	36.5
Gallaher	600	24.0	29.5	36.5	1.5	17.0	26.0
(*621.0)	650	1.5	7.5	14.5	30.0	51.0	56.0
Hilton	220	10.5	16.0	22.0	1.5	10.5	16.0
(*228.5)	240	1.5	7.0	13.5	12.5	22.0	27.5
Impl Tobacco	1100	41.0	71.5	94.0	4.0	25.0	45.5
(*1135.0)	1150	12.0	42.0	66.5	25.0	47.0	69.0
Invensys	20	4.25	6.00	7.25	0.50	2.00	3.00
(*23.75)	25	1.25	3.25	4.75	2.50	4.25	5.50
Kingfisher	260	**20.0**	**25.5**	**31.5**	0.5	7.5	12.0

Share price at the end of the trading day

Strike or exercise price for this line of options

Put option premium – in this case with a March 2004 exercise date

Premium payable per share for call options with a April 2004 exercise date

EXHIBIT 19.1 LIFFE equity options

Source: *Financial Times* 5 February 2004

FIGURE 19.4
Put option holder profit profile (Cadbury Schweppes 390 June put, purchased 4 February 2004)

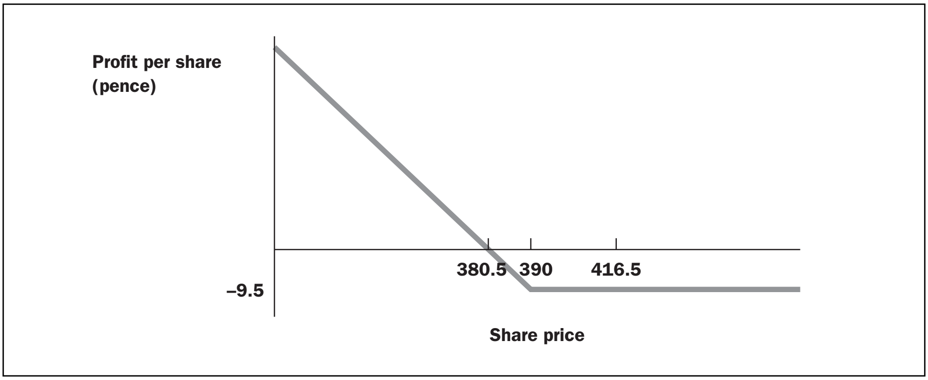
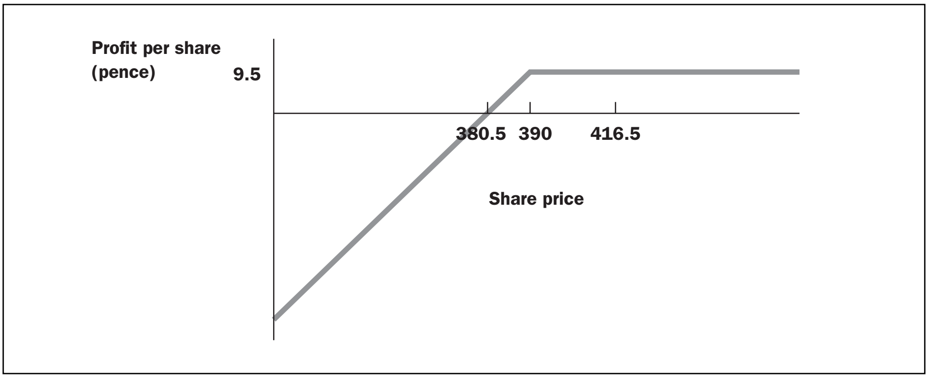


FIGURE 19.5
Put option writer profit profile (Cadbury Schweppes 390 June put, sold 4 February 2004)



on to another investor: it has to be either exercised by the original purchaser or left to lapse (it can be exercised at any time before expiry). The purchaser may close a position during the life of an option by doing the reverse (e.g. if he has bought a call option he could sell a call option at the same strike price).

Using share options to reduce risk: hedging

Hedging with options is especially attractive because they can give protection against unfavorable movements in the underlying while permitting the possibility of benefiting from favorable movements. Suppose you hold 1,000 shares in

Cadbury Schweppes on 4 February 2004. Your shareholding is worth £4,165. There are rumors flying around the market that the company may become the target of a takeover bid. If this materializes the share price will rocket; if it does not the market will be disappointed and the price will fall dramatically. What are you to do? One way to avoid the downside risk is to sell the shares. The problem is that you may regret this action if the bid does subsequently occur and you have forgone the opportunity of a large profit. An alternative approach is to retain the shares and buy a put option. This will rise in value as the share price falls. If the share price rises you gain from your underlying share holding.

Assume a 390 September put is purchased for a premium of £145 (*see* Exhibit 19.1). If the share price falls to 330p in late September you lose on your underlying shares by £865 ((416.5p – 330p) × 1,000). However the put option will have an intrinsic value of £600 ((390p – 330p) × 1,000), thus reducing the loss and limiting the downside risk. Below 390p, for every 1p lost in a share price, 1p is gained on the put option, so the maximum loss is £410 (£265 intrinsic value + £145 option premium).

This hedging reduces the dispersion of possible outcomes. There is a floor below which losses cannot be increased, while on the upside the benefit from any rise in share price is reduced due to the premium paid.

A simpler example of risk reduction occurs when an investor is fairly sure that a share will rise in price but is not so confident as to discount the possibility of a fall. Suppose that the investor wished to buy 10,000 shares in Boots, currently priced at 702.5p (on 4 February 2004) – *see* Exhibit 19.1. This can be achieved either by a direct purchase of shares in the market or through the purchase of an option. If the share price does fall significantly, the size of the loss is greater with the share purchase – the option loss is limited to the premium paid.

Suppose that ten June 750 call options are purchased at a cost of £1,300 (13p × 1,000 × 10). Table 19.3 shows that the option is less risky because of the ability to abandon the right to buy at 750p.

TABLE 19.3
Losses on alternative buying strategies

Boots share price falls to:	Loss on 10,000 shares	Loss on 10 call options options
700	£250	£1,300
650	£5,250	£1,300
600	£10,250	£1,300
550	£15,250	£1,300
500	£20,250	£1,300

Index options

Options on whole share indices can be purchased, for example, Standard and Poors 500 (USA), FTSE 100 (UK), CAC 40 (France), DAX (Germany) and so on.

Large investors may hedge through options on the entire index of shares.

Large investors usually have a varied portfolio of shares so, rather than hedging individual shareholdings with options, they may hedge through options on the entire index of shares. Also speculators can take a position on the future movement of the market as a whole.

A major difference between index options and share options is that the former are 'cash settled' – so for the FTSE 100 option, 100 different shares are not delivered on the expiry day. Rather, a cash difference representing the price change passes hands.

If you examine the table in Exhibit 19.2, you will see that the index is regarded as a price and each one-point movement on the index represents £10. So if you purchased one contract in June expiry 4425 calls (C) you would pay an option premium of 130.5 index points × £10 = £1,305. Imagine that the following day, i.e. 5 February 2004, the FTSE 100 Index moved from its closing level on 4 February 2004 of 4398.5 to 4450 and the option price on the 4425 call moved to 210 index points (25 points of intrinsic value and 185 points of time value). To convert this into money you could sell the option at £10 per point per contract (210 × £10 = £2,100). In 24 hours your £1,305 has gone up to £2,100, a 61 percent rise. This sort of gain is great when the market moves in your favor. If it moves against you large percentage losses will occur in just a few hours.

All the calls (indicated by C) in Exhibit 19.2 with exercise prices below 4398.5 (the columns headed 4025, 4125, 4225, 4325) are in-the-money; they have intrinsic as well as time value. Calls with exercise prices above 4398.5 have no intrinsic value and so are out-of-the-money. By contrast, all puts (indicated by a P) with an exercise price lower than 4398.5 do not have intrinsic value and are out-of-the-money.

Hedging against a decline in the market

A fund manager controlling a £30m portfolio of shares on behalf of a group of pensioners is concerned that the market may fall over the next few months. One strategy to lower risk is to purchase put options on the share index. If the market does fall, losses on the portfolio will be offset by gains on the value of the index put option.

First the manager has to calculate the number of option contracts needed to hedge the underlying. With the index at 4398.5 on 4 February 2004 and each point of that index settled at £10, one contract has a value of 4398.5 × £10 = £43,985. To cover a £30m portfolio:

$$\frac{£30\text{m}}{£43{,}985} = 682 \text{ contracts}$$

OPTIONS

■ FTSE 100 INDEX OPTION (Euronext.liffe) £10 per full index point 04 Feb

	4025		4125		4225		4325		4425		4525		4625		4725	
	C	P	**C**	P	**C**	P	**C**	P	**C**	P	**C**	P	**C**	P	**C**	P
Feb	**373**	3	**275**	4½	**179½**	8½	**93½**	22½	**32**	60½	**7**	135½	**1**	229½	**½**	329
Mar	**365**	15½	**274½**	24½	**188½**	38	**115**	64	**58½**	107½	**24**	172	**9**	257	**3**	350½
Apr	**383**	31½	**295½**	43½	**213½**	60½	**141**	87½	**84**	129½	**44**	189	**20**	264	**7½**	351
May	**406½**	49	**321**	63½	**242**	84½	**170**	112½	**110½**	153	**66**	208½	**35½**	278	**16½**	359
Jun	**415**	61	**334**	78½	**257**	100	**188½**	129½	**130½**	170½	**84**	222	**49**	286	**28**	363

Calls 19,428; Puts 49,555. *Underlying index value. Premiums shown are based on settlement prices.

EXHIBIT 19.2 FTSE 100 Index option prices

Source: *Financial Times* 5 February 2004

The manager opts to buy 682 June 4425 puts for 170.5 points per contract.[3] The premium payable is:

$$170.5 \text{ points} \times £10 \times 682 = £1{,}162{,}810$$

This amounts to a 3.9 percent 'insurance premium' (1.1628m/30m) against a downturn in the market.

Consider what happens if the market does fall by a large amount, say, 15 percent, between February and June. The index falls to 3739, and the loss on the portfolio is:

$$£30\text{m} \times 0.15 = £4{,}500{,}000$$

If the portfolio was unhedged the pensioners suffer from a market fall. However in this case the put options gain in value as the index falls because they carry the right to sell at 4425. If the manager closed the option position by buying at a level of 3739, with the right to sell at 4425, a 686-point difference, a gain is made:

Gain on options (4425 – 3739) × 682 × £10	= £4,678,520
Less option premium paid	– £1,162,810
	£3,515,710

A substantial proportion of the fall in portfolio value is compensated for through the use of the put derivative.

Aunt Agathas and derivatives

Millions of ordinary small investors (Aunt Agathas in the City jargon) have their money applied to the derivatives markets even though they may remain blissfully unaware that such 'exotic' transactions are being conducted on their behalf. Take the case of equity-linked bonds. Investors nervous of investing in the stock market for fear of downward swings are promised a guarantee that they will receive at least the return of their original capital, even if the stock market falls. If it rises they will receive a return linked to the rise (say the capital gain element – excluding dividends). The bulk of the capital invested may be placed in safe fixed-interest investments, with the stock market linked return created through the use of options and other derivatives. Following the Barings Bank fiasco there was some discussion over the wisdom of using such highly geared instruments. However the financial services industry easily defended itself by pointing out the risk-reducing possibilities of these products if properly managed.

EXHIBIT 19.3 Aunt Agathas and derivatives

Corporate uses of options

There are a number of corporate uses of options.

- *Share option schemes* Many companies now grant (or sell to) employees share options (calls) as a means of achieving commitment and greater goal congruence between agents and principals. Employees are offered the right to buy shares at a fixed price some time in the future. They then have the incentive over the intervening years to perform well and push up the share price so as to realize a large gain when the options may be exercised.
- *Warrants* A share warrant is an option issued by a company which gives the owner the right, but not the obligation, to purchase a specified number of shares at a specified price over a given period of time. Note that it is the company that writes the option rather than speculators or hedgers.
- *Convertible bonds* A convertible bond can be viewed as a bundle of two sets of rights. First, there are the usual rights associated with a bond, for example interest and principal payments, and second, there is the right, but not the obligation, to exercise a call option and purchase shares using the bond itself as the payment for those shares.
- *Rights issues* In a rights issue shareholders are granted the right, but not the obligation, to purchase additional shares in the company. This right has value and can be sold to other investors.
- *Share underwriting* Effectively when an underwriter agrees to purchase securities if investors do not purchase the whole issue, a put option has been bought with the underwriting fee, and the company has the right to insist that the underwriter buys at the price agreed.
- *Commodities* Many firms are exposed to commodity risk. Firms selling commodities, or buying for production purposes, may be interested in hedging against price fluctuations in these markets. Examples of such firms are airlines, food processors, car manufacturers, chocolate manufacturers. Some of the commodity options available are:
  - crude oil
  - aluminum
  - copper
  - coffee
  - cocoa.
- *Taking control of a company* A novel use of options occurred in 2003 when the family that founded the retail chain Monsoon sold put options to shareholders owning 19.5 percent of Monsoon's shares. The holders of the puts bought a right to sell their shares at 140p. If the share price on the

stock market remains below 140p many holders will exercise the option. The founding family controlled 72.5 percent of the company and saw the use of put options as a cheap way of raising their stake to over 90 percent (cheaper than a full takeover bid).

- *Protecting the company from foreign exchange rate losses.* This is topic covered in Chapter 21.

Real options

Managers often encounter decisions with call or put options embedded within them. Examples of these are given below.

The expansion option

Firms sometimes undertake projects that apparently have negative NPVs. They do so because an option is thereby created to expand, should this be seen to be desirable. The value of the option outweighs the loss of value on the project. For example, many Western firms are setting up offices, marketing and production operations in China, which run up losses. This has not led to a pull-out because of the long-term attraction to expand within the world's largest market. If they withdrew they would find it very difficult to re-enter, and would therefore sacrifice the option to expand. This option is considered to be so valuable that some firms are prepared to pay the price (premium) of many years of losses.

This option is considered to be so valuable that some firms are prepared to pay the price (premium) of many years of losses.

Another example would be where a firm has to decide whether to enter a new technological area. If it does it may make losses but at least it has opened up the choices available to the firm. To have refused to enter at all on the basis of a crude NPV calculation could close off important future avenues for expansion. The pharmaceutical giants run dozens of research programs knowing that only a handful will be money-spinners. They do this because they do not know at the outset which will be winners and which the losers – so they keep their options open.

The option to abandon

With some major investments, once the project is begun it has to be completed. For example, if a contract is signed with a government department to build a bridge the firm is legally committed to deliver a completed bridge. Other projects have options to abandon (put options) at various stages and these options can have considerable value. For example, if a property developer purchases a prime site near a town center there is, in the time it takes to draw up plans and gain planning permission, the alternative option of selling the land. Flexibility could also be incorporated in the construction process itself – for example, perhaps alternative materials can be used if the price of the first choice increases. Also, the buildings could be designed in such a way that they could be quickly and cheaply switched from one use to another, for example from offices to flats, or from hotel to shops. At each stage there is an option to abandon plan A and switch to plan B. Having plan B available has value. To have plan A only leaves the firm vulnerable to changing circumstances.

Option on timing

Perhaps in the example of the property developer above it may be possible to create more options by creating conditions that do not compel the firm to undertake investment at particular points in time. If there was an option to wait a year, or two years, then the prospects for rapid rental growth for office space *vis-à-vis* hotels, flats and shops could be assessed. Thus a more informed, and in the long run more value-creating, decision can be made.

True NPV

The NPV formula discussed in the first part of this book needs to be supplemented with the value of options.

$$\text{True NPV} = \text{Crude NPV} + \begin{array}{c}\text{NPV of}\\\text{expansion}\\\text{option}\end{array} + \begin{array}{c}\text{NPV}\\\text{of the}\\\text{option to}\\\text{abandon}\end{array} + \begin{array}{c}\text{NPV of}\\\text{timing}\\\text{option}\end{array} + \begin{array}{c}\text{NPV of}\\\text{other option}\\\text{possibilities}\end{array}$$

The difficult part is putting a numerical value on each of these options. There are complex mathematical models, mostly focussed on some estimate of past volatility of returns, that academics discuss with great vigor, but it has to be admitted that in most cases the input numbers are little more than guesses. Generally, the mathematical presentation of real option values is less important than a ball-park figure, allowing for more informed decision-making. However, the alternative, of ignoring option values completely, is a poor way of proceeding because the option value can be a very high proportion of the NPV value.

> **In most cases the input numbers are little more than guesses.**

Illustration

Suppose your company owns an oil field that is largely played out. You estimate that the net (after costs) cash flows from the oil still remaining have a discounted present value of $100m. It would cost $105m now to revive the oil field. On a simple NPV analysis the project is not worthwhile with a negative NPV of $5m.

Taking a real options approach we see the oil reserves as having option value. This value arises because conditions may change in the future in such a way as to make the right to develop the field very valuable. For example, the price of oil could rise significantly. So, how do we derive the numbers showing the likelihood of oil prices moving to various elevated levels? Analysts generally look to the volatility of the oil price in the past. From this it is possible (with a leap of faith that the past volatility of oil prices represents future volatility) to come up with some numbers for the volatility of the developed reserve value.

Currently the call option to develop the field has no intrinsic value. However it might have time value – that is, there might be a reasonable expectation, judging from historic price movements that the oil price will move to a level that gives the oil field intrinsic value – i.e. a positive NPV.

Of course the value of the oil in the ground is subject to many uncertainties other than the oil price. For example, the difficulty of extraction has to be estimated by specialists. Thus, any model developed to assist this decision has to be both sophisticated in its breadth of input variables and sufficiently transparent so that managers realize the subjective nature of many of the figures and evaluate the numerical results accordingly.

Also consider whether the managers have to make the decision to spend $105m now? There is option value in waiting to see what happens to the oil price – keep open a variety of possible dates of implementation.

Conclusion

From a small base in the 1970s derivatives have grown to be of enormous importance. Almost all medium and large industrial and commercial firms use derivatives, usually to manage risk, but occasionally to speculate and arbitrage. Banks are usually at the center of derivatives trading, dealing on behalf of clients, as market makers or trading on their own account. Other financial institutions are increasingly employing these instruments to lay off risk or to speculate. They can be used across the globe, and traded night and day.

The trend suggests that derivatives will continue their relentless rise in significance. They can no longer be dismissed as peripheral to the workings of the financial and economic systems. The implications for investors, corporate institutions, financial institutions, regulators and governments are going to be profound. These are incredibly powerful tools, and, like all powerful tools, they can be used for good or ill. Ignorance of the nature of the risks being transferred, combined with greed, has already led to some very unfortunate consequences. However, on a day-to-day basis, and away from the newspaper headlines, the ability of firms to quietly tap the markets and hedge risk encourages wealth creation and promotes general economic well-being.

Derivatives can no longer be dismissed as peripheral to the workings of the financial and economic systems.

The next chapter examines derivative tools in the form of futures, forwards and swaps among others.

Websites

www.bloomberg.com	Bloomberg
www.reuters.com	Reuters
www.money.cnn.com	CNN Financial News
www.wsj.com	Wall Street Journal
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www.ukcitymedia.co.uk/tradedoptions.html	UKCityMedia
www.cbot.com	Chicago Board of Trade
www.cboe.com	Chicago Board Options Exchange
www.amex.com	American Stock Exchange
www.nyse.com	New York Stock Exchange
www.eurexchange.com	Eurex, the European Derivative Exchange
www.isda.org	International Swaps and Derivatives Association

Notes

1 Expiry date is third Wednesday in expiry month.

2 For this exercise we will assume that the option is held to expiry and not traded before then. However in many cases this option will be sold on to another trader long before expiry date approaches (probably at a profit or loss).

3 This is not a perfect hedge as there is an element of the underlying risk without offsetting derivative cover.