13

Advanced Options Strategies

The basic options techniques used by speculators or investors are buying naked calls and puts to profit from an increase or decrease in the price of the underlying, respectively. These were introduced in chapter 10. The preceding chapter looked at more complicated scenarios such as protective puts and covered calls where options were used in conjunction with holdings of the underlying.

This chapter explains some more advanced applications of options:

- Strategies in which more than one option is used at the same time on the same underlying, i.e., strategies where options are *combined* in various ways;
- Arbitrage and statistical arbitrage strategies.

Collars, cylinders and spreads

Options strategies that combine more than one option often come with interesting names, usually reflecting the graphical shape of the pay-off.

Zero cost collar or fence/cylinder: Combination of selling calls and buying puts while holding the underlying security.

Example 13.1

Sarojini feels that the SBI shares she owns may fall from the present level of ₹ 1,900 and wishes to protect herself from such a decline. At the same time she does not want to incur any option premia. Option premia are quoted as follows (say):

Strike Price (₹)	*Premium (₹)*	
	Call	*Put*
1700	*300*	*70*
1800	*200*	*82*
1900	*100*	*100*
2000	*80*	*200*
2100	*70*	*295*

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Note that the 1,800 call and the 2,000 put are both quoted at 200 (in real life, premia on equidistant strikes, one being a call and another a put, are unlikely to be exactly the same but it is assumed here to simplify the example). Sarojini can adopt the following strategy:

a. Buy a 1,800 put at 200, and

b. Write a 2,000 call at 200

The premium paid on the put is offset by the premium received on the call. Thus, the net premium is zero (hence 'zero cost'). In assessing this strategy, the point to remember (ignoring the premium which is nil in net terms) is:

a. If the market price at expiry is above 1,800, Sarojini will earn a profit on the call.

b. If the market price at expiry is below 2,000 the put will be exercised, creating a loss for Sarojini, on the put.

The pay-off is depicted in Table 13.1 and Figure 13.1.

Table 13.1: Pay-off table for zero cost collar at expiry

Price	Spot gain on long underlying	Gain (ignoring premium) from buying 1,800 put	Loss (ignoring premium) from selling 2,000 call	Net position (option premia cancel each other)
1500	-400	300	0	-100
1600	-300	200	0	-100
1700	-200	100	0	-100
1800	-100	0	0	-100
1900	0	0	0	0
2000	100	0	0	100
2100	200	0	-100	100
2200	300	0	-200	100
2300	400	0	-300	100

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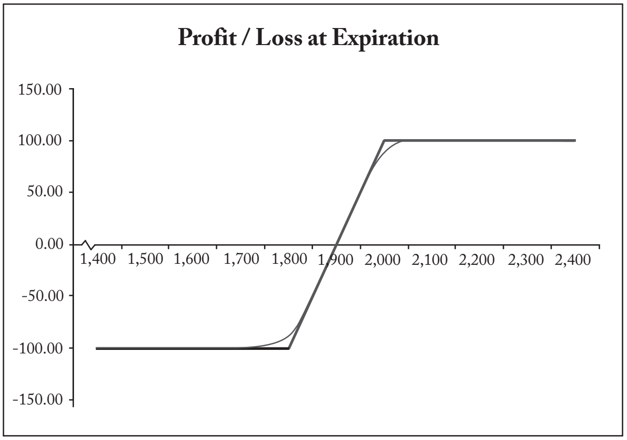
Figure 13.1: Zero cost collar pay off on expiry
(curve represents market value before expiry)



This combination of trades places a ceiling and a floor on the profit/loss, while allowing participation in profits and losses within a certain range. This strategy is known as a collar (based on the shape of the pay-off graph) and also as a fence or cylinder**.** It puts limits on the range of values a position can take. Because of the 'hedged' nature of the position, margin requirements for the combined position are much lower than for the individual positions.

This approach was used by some investors to effectively sell shares without paying the capital gains taxes (see Box 13.1). With the advent of tax provisions like 'constructive sale' in the USA and other similar laws elsewhere (see chapter 17), this has become less common. A constructive sale is one where, even though an actual sale has not taken place, a sale is deemed to have occurred through legal 'construction'. Under these rules, the range of position values after the implementation of a collar or similar strategy should be wide (say, above 15 per cent) to avoid paying the capital gains tax.

Box 13.1: Using options to avoid contracts and taxes?

During the dot-com 'bubble' in the late 90s when shares of internet-based companies rose to very high levels, many founder-owners were required to not sell their stock after the Initial Public Offering (IPO).

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Some owners used options strategies to circumvent these provisions. A collar mechanism (shown above in Example 13.1) is a way of effectively fixing the sale price within a range without actually selling the shares. A shareholder could effectively sell the share from a financial point of view, while nominally and legally remaining a shareholder. Of course, such a situation would mean that the owner of the shares would no longer have a real stake in the success of the company, thereby defeating the purpose of the ownership requirement.

Others used options to defer payment of capital gains tax by selling deep-in-the-money options with expiry dates in the future (beyond the current tax period). These were also called 'Low Exercise Price Options' (LEPOs). Under this strategy, the holder sells a deep-in-the-money call, generally OTC, on his or her underlying stock holding. Since the option is ITM, it is almost certain to be exercised, but that will happen in the future. The holder can effectively sell the shares this year but defer the actual sale to the next. Das quotes the example of Lend Lease Corporation which, in 1996 wanted to sell its 9 per cent holding in Westpac and used LEPOs. According to Das, at a time when Westpac shares were trading at 5.40 Australian dollars, the strike price of the LEPOs was 0.01 Australian dollars. 'The low exercise price ensured that the options were certain to be exercised. Lend Lease had effectively sold the shares… deferred its substantial capital gains…'.[1]

The LEPO strategy is less useful if the share yields dividends. In this case, the difference between the stock price and a long-term call option (with a strike price just above zero) can be substantial. Conceptually the two strategies – collar and LEPO – are very similar. A LEPO, in terms of its pay-off, is equivalent to a short collar where the long put strike is 0 and the short call strike is just above 0. Thus, collars can also be used to defer taxes. The main difference is that LEPOs result in an immediate cash inflow while a collar is usually zero cost. However, even a zero-cost collar can enable an investor to obtain a cash inflow because by buying such a collar, one can 'freeze' the value of the overall portfolio and thereby

1 Satyajit Das, 'Traders, Guns and Money: Knowns and Unknowns in the Dazzling World of Derivatives', *Financial Times*, Prentice Hall, 2006, 261.

margin requirements can be reduced to almost nil (if the arrangement is so recognised by the broker); hence the margin money can be withdrawn. However, this is usually only feasible for large investors for whom brokers may be willing to structure such a deal.

Theoretically, a similar *de facto* sale can be effected through futures by selling the futures and rolling over.

Apart from tax implications, these strategies may be unethical depending on the circumstances (for instance, when used to evade prescribed ownership levels).

Selling 'bull call spreads' on existing holding to gain income without sacrificing entire upside

Example 13.2

George owns 100 stocks of Microsoft (MSFT). The current price is $29.30 (therefore the position is worth $2930). He has a target price for the stock of about $32 (10 per cent appreciation) in about five weeks' time which he feels would be a fair value based on long term fundamentals. He intends to sell if that price is reached. Microsoft's next quarterly results announcement is expected within that period, and there is a plausible, though not likely, chance that Microsoft shares could shoot up significantly. He does not want to take the risk of any significant fall in MSFT. He is considering the use of options to protect himself against a large drop while retaining as much upside as possible. What approaches can he use? The various option prices for the relevant period are as in Table 13.2.

Table 13.2: *Microsoft option prices*

Call bid	*Call ask*	*MSFT price*	*Put bid*	*Put ask*
7.35	7.45	22.00	0.02	0.03
6.40	6.45	23.00	0.04	0.05
5.40	5.45	24.00	0.06	0.07
4.45	4.50	25.00	0.11	0.12
3.50	3.60	26.00	0.18	0.19
2.62	2.64	27.00	0.29	0.31
1.85	1.88	28.00	0.49	0.51

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Call bid	*Call ask*	*MSFT price*	*Put bid*	*Put ask*
1.19	*1.20*	*29.00*	*0.81*	*0.83*
0.65	*0.67*	*30.00*	*1.29*	*1.32*
0.31	*0.33*	*31.00*	*1.96*	*2.00*
0.14	*0.15*	*32.00*	*2.78*	*2.82*
0.06	*0.07*	*33.00*	*3.65*	*3.75*
0.01	*0.03*	*34.00*	*4.65*	*4.75*
0.01	*0.02*	*35.00*	*5.60*	*5.75*
0.01	*0.01*	*36.00*	*6.60*	*6.70*
0.01	*0.02*	*37.00*	*7.35*	*8.40*

Solution:

a. *Covered calls:*

A simple approach could be to sell covered calls as in Example 12.4. George could sell one lot of call options with a strike price of $32 per share expiring five weeks from now for about $15. (Each call option is worth about $0.15—assuming that the trade is executed at 0.15, and not 0.14 – and each option lot is a multiple of 100. The options are assumed to be European options, i.e,. exercisable only at expiry.) $15 received from an option expiring in 5 weeks on an underlying position of $2930 means a rough annualised yield of

(52/5) x (15/2930)=5.32 per cent

There are three possibilities after five weeks depending on whether MSFT shares end below, at, or above 32 USD.

i. *If the share price is below 32, then the call option will lapse without being exercised. George will get the 5.32 per cent annualised yield as a 'bonus' over and above, any dividends and capital gains or losses.*

ii. *If MSFT ends at exactly 32, George gets this 5.32 per cent annualised yield. In addition he retains the dividends and the 9.22 per cent capital gain over five weeks (95.88 per cent yield annualised) that he would have got by just holding the shares.*

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iii. If MSFT ends at a price higher than 32 the option will be exercised and he will have to sell the shares at $32 per share. He will get the same amount of money as in item (ii) above but if the price of MSFT shares goes above $32.15 ($32 plus the premium of $0.15 he earned) he could have made more money by not selling the call.

b. Another approach is a 'bull call spread'. George could:

- *sell the call option with a $32 strike price; and*
- *simultaneously buy the call option with a $33 strike price.*

Selling the former would get him about $15 for one lot of 100 options, but buying the latter would cost him about $7 (as seen from the option price table above). His net income from option premium would thus be $8. This represents an annualised yield of

(52/5) x (8/2930) = 2.84 per cent.

If the MSFT share price ends at or below $32, he would earn a smaller yield than in the covered call, but if it rises above $33, he can continue to benefit from the appreciation. Compared to strategy (A) (simply selling a covered call), George will receive 8 cents less in strategy (B) which involves selling a covered call and simultaneously buying a deeper-out-of-the-money call. Since (in this particular example) the next higher strike price for tradable options is $33 (there are no options available at, say, $32.75) and there is a net option income of $.08 per share, Strategy (B) would turn out to be superior to Strategy (A) only if MSFT ends higher than 33.08. [It should be noted that if the price ends above $33.08 then George would have been better off simply holding the shares without entering into any options transaction and with hindsight he would have been better off not trying to protect against a fall in price – but that is like saying that not paying an insurance premium is good if the risk does not materialise.]

The bull call spread shown in Example 13.2 is a lower risk / lower return strategy compared to the covered call. The scenarios are compared below in Table 13.3:

Table 13.3: Comparison between covered (short) call and bull call spread

Characteristic	**Uncovered stock holding**	**Covered call**	**Bull call spread**
Yield from option premium	Nil	High	Low
Gain if price rises above expected level	High (no opportunity loss)	Nil (opportunity loss)	Low (partial opportunity loss)

Example 13.3

Devi holds Reliance Industries (RIL) shares and she is considering appropriate options strategies to protect herself from a fall in price. RIL closed on May 17 at ₹ 686. The 31 May expiry ₹ 700 strike price call option is priced at ₹ 7, and the ₹ 720 call is priced at ₹ 3. Depending on her view and circumstances, there are various possible strategies:

a. *Covered short call: If she thinks RIL shares are likely to be mildly bearish to range-bound but does not want to sell for taxation or other reasons, then she could sell the 700 call for an income of ₹ 7 per share. She would be protected from a fall in price but would have forgone any major appreciation beyond 700.*

b. *Bull call spread: If her views range from neutral to mildly bullish, she could sell the 700 call and buy the 720 call (creating a bull call spread) for a net income of ₹ 4 per stock; she would retain upside potential if RIL rises above ₹ 720 while remaining protected from a fall.*

c. *If she is very bullish, then she is clearly no longer in a defensive mood and she should not sell any calls. She could just hold the stock, or (if she wants to increase her stake) perhaps even buy the 720 or other OTM calls.*

Selling 'bear put spreads' to gain income while retaining downside protection

Bull call spreads enable downside protection without missing the upside of the underlying stock; the obverse is the bear put spread. One can also sell bear put spreads instead of put options to instil buying discipline while protecting the downside of the stock that is to be bought.

Example 13.4

George wants to buy 100 shares of Microsoft (MSFT). The current price is $29.30. He believes that MSFT's fair valuation according to fundamentals is about 10 per cent lower than the current price and is interested in buying if it falls that far. Microsoft's next quarterly results announcement is expected in five weeks, and there is a plausible, though not very likely, possibility that Microsoft shares could fall significantly. If those results portend an unexpected slowdown and the shares fall much more than 10 per cent that would signify a change in fundamentals and his current outlook would no longer hold true; in that case he would not want to hold the stock.

What put option strategies could he use? Assume option prices for expiry in five weeks are as given in Table 13.2.

Solution

a. *Cash covered puts: George could sell $26 strike price puts (for 19 cents each). He would earn $19 in income (since each stock option lot consists of 100 options in the United*

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States, where MSFT trades). He has to set aside $2600 to be able to buy the shares if the option is exercised (hence he is 'covered'). If at expiry the shares are above $26 the put option will not be exercised and he would have earned a yield of:

(19/2600) x (52/5) = 6.2 per cent per annum.

This is over and above any interest that this liquid fund position was earning. If the price of MSFT shares closes below 26, the option will be exercised. He will be left owning MSFT at an effective price of $(26–0.19) = $25.81 per share which is approximately the target level he wanted.

b. *Bear put spread: George could sell $26 strike price puts (for 19 cents each) and simultaneously buy $22 strike price puts (for 3 cents each), for a net credit of $16 dollars. He should keep about $2,600 ready to buy 100 shares of MSFT if that stock price ends between 22 and 26 five weeks from now, at expiry. There are three possibilities for the price of MSFT on the expiry date which are analysed below:*

   i. *Above $26: Here, George does not have to buy anything. He has effectively earned 16 dollars on his cash of $2600 i.e. 6.2 per cent annualised return.*

   ii. *Between $22 and $26: George will have to buy MSFT at 26 (assuming the person who bought 26 strike price put options from him is rational enough to exercise them, which is almost a certainty). Say, MSFT is at 23 at expiry. Taking into account the 16 cents per share put spread premium, the effective cost price for Tom is $26 – 0.16 = $25.84. Ex post facto, George may regret paying $25.84 for this stock at a time when its price is lower than that, but ex ante, this position would have looked very favourable (since at the time the option was sold the stock was at $29.30.*

   iii. *Below $22: In this case, George can buy the stock at 26 (because of the put he sold), and sell the stock at 22 (because of the put he bought). He therefore suffers a loss of $4 per stock, which (after adjusting the premium earned of $19) is $381 net. But the fact that the price is below $22 signifies a change in his fundamental long view of MSFT. He is still better off compared to directly buying at $29.30 because then he would have lost $730.*

Example 13.5

Mala is a stock market investor considering purchase of RIL shares. RIL closed on 17 May at 686. The 31 May 680 Put is priced around ₹ 15, and the 640 put at ₹ 3.50. Depending on her view and circumstances, there are different options strategies she could consider:

a. *If she wants to hold RIL in the long run but does not expect any sharp rise in the short run, selling puts would be a good approach. She could sell the 680 put and earn ₹ 15 per share if she is ready to buy RIL. If the option gets exercised her nett price would be ₹ 680–15= ₹ 665. If the option is not exercised, she would have earned ₹ 15 and she can still buy the shares from the market if she wishes. So long as the price does not rise substantially, she would be better off this way than directly buying the share, ignoring transaction costs.*

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b. If she intends to buy but also feels that any steep fall in the said stock's price would imply some adverse information that others know but she does not, she could not only sell the 680 put, but also buy the ₹ 640 put as a downside hedge by paying ₹ 3.50 and earn a net income of ₹ (15 – 3.50) = Rs. 11.50. This way, she will be able to limit her loss in case there is a sharp fall in the interim.

To summarise, Examples 13.2 and 13.3 illustrated the selling of bull call spreads instead of selling stock-covered calls; this enabled the investor to exchange a lower call premium for keeping the upside on the underlying stock positions. Examples 13.4 and 13.5 illustrated the selling of bear put spreads instead of selling cash-covered puts; this fetches the investor a relatively lower premium but limits the downside on stock positions that the investor wants to buy at slightly lower prices. Similarly investors can use spreads instead of single options in virtually all options strategies**:** buying outright calls, buying outright puts, selling covered calls and short-covered puts etc.

Arbitrage and statistical arbitrage strategies

As discussed in chapter 2, arbitrage is the practice of buying and simultaneously selling the same asset in different markets or different forms to profit from price differences. Conventional or pure arbitrage is risk-free. Because of this, traders who spot such an opportunity try to trade as much as possible and this action helps, in and of itself, to eliminate the price difference between the two markets or two forms of the asset involved.

Such risk-free arbitrage is a major contributor to efficiency of markets. It ensures that the same asset cannot have unjustified differences in price in two different markets. Arbitrage between futures and spot of an asset which can be delivered in the futures market is risk-free. Similarly, arbitrage may be possible with options using the put-call parity: if margin costs are properly factored in where applicable, such a trade can also be considered risk-free and hence pure arbitrage.

Arbitrage through put call parity application

Example 13.6

Qasim, an investor, is considering an arbitrage possibility. The quarterly results of Reliance will be out next week and the implied volatility of a 1,000 put for Reliance options expiring one month from now expiry is around 40 per cent and the implied volatility of the 1,000 call with same expiry is at 45 per cent. Reliance is also currently trading at 1,000. The annual *interest rate is 12 per cent so the discount factor for time value of money for one month is 0.99. Assume 100 options have to be bought at a minimum, and there is no dividend involved. The 1,000 call is trading at ₹ 55 and the put at ₹ 40, reflecting these differing volatilities. Is there a profit potential through arbitrage and if so how much?*

Solution

The Put Call Parity (PCP) equation states that:

Put Market Price + Underlying Stock Price

= Call Market Price + Cash deposit equivalent to Present Time Value of the Strike Price

➞ *P (X) +Stock = C (X) + Xe–rt*

➞ *C (X) = P (X) + S – Xe–rt…………..…. (i)*

Given that here both the put and the call are of the same strike, having different implied volatilities means that theoretically, there is a possibility for an arbitrage trade. Whether the arbitrage is worth executing in practice depends on whether the difference in implied volatility is high enough for the various transaction costs (brokerage, etc.) to be covered.

Here, therefore as shown in Equation (i) to effect an arbitrage trade Qasim can:

- *SELL the relevant strike's call. That is, sell 100 calls for ₹ 5,500.*
- *BUY the put of the same strike and expiry (here, the strike being ₹ 1,000, and the expiry being in one month). That is, buy 100 puts for ₹ 4,000.*
- *BUY the underlying stock. That is, buy 100 Reliance shares at ₹ 1,000 for ₹ 100,000.*
- *BORROW an amount equivalent to the present value of the strike price under consideration. That is, borrow ₹ 99,000.*

Cash outflow today is = ₹ 100,000 + ₹ 4,000 – ₹ 5,500 – ₹ 99,000 = – ₹ 500, i.e., an inflow of ₹ 500.

The option positions are closed just before expiry. Assume three scenarios whereby the price of Reliance shares is I) ₹ 900 II) ₹ 1,000 or III) ₹ 1,100 one month from now.

a. *In case I, when stock price goes to 900, the calls sold have no value, the puts are worth ₹ (1,000–900) x 100 = ₹ 10,000. The stock is worth ₹ 90,000.*
    i. *Qasim's assets are worth ₹ 90,000 + 10,000 = ₹ 100,000.*
    ii. *He has to repay ₹ 99,000 plus interest thereon of 1 per cent i.e., ₹ 1,000. Thus, he has to repay ₹ 100,000.*
    iii. *Item b offsets item a, and his total portfolio is worth 0.*
    iv. *He can retain the ₹ 500 cash received one month ago which is now worth ₹ 505 with interest.*

b. *In case II, when stock price remains same, calls and puts have no value. The shares are worth ₹ 100,000 but Qasim has to pay back ₹ 100,000; again the two offset each other. But the cash received plus interest (₹ 505) is still retained.*

c. *In case III, when stock price goes to ₹ 1,100, the calls sold will carry a loss of ₹ 10,000. The puts are worthless. The stock portfolio is worth ₹ 110,000. Qasim has to repay ₹ 100,000. The net position is once again nil, i.e.,*

–10,000 + 110,000 – 100,000 = 0

Again, the initial cash flow received remains as a profit.

In all cases, no matter what the stock price the arbitrageur gets to keep ₹ 500. So long as the transaction costs are lower than this, there is a profitable arbitrage possibility. Also, because a broker can see this overall position is a perfect arbitrage one, the arbitrageur may have to pay considerably less margin for carrying out this trade than for a normal options trade. Such arbitrage opportunities are rare and usually arbitrage margins are narrower. Nonetheless, the point is that professional arbitrageurs may be able to make small but riskless profits.

Arbitrage through box spreads

A box spread, in options' terminology, is a combination of transactions that involves a synthetic long position and a synthetic short position on the same underlying but at different strike prices. This involves *being long a call and short a put (at one strike price), and being short a call and long a put (at a higher strike price), all on the same underlying*. In other words, a box spread is a combination of a bull spread and a bear spread with the same expiry dates.

This strategy will always yield a fixed return on expiry date based on the value of the four options on the day of trading. Buying a box spread means buying the call at a lower strike and selling the call at a higher strike, with the opposite position in puts, requiring payment of net premium. Selling a box spread means selling the call at a lower strike and buying a call at a higher strike with the opposite position in puts, involving receipt of net premium. This is called a spread[2] since the net exposure to the underlying is a pre-fixed amount equal to the gap between the two strike prices. It is called a box because of the shape of the pay-off diagram (see Figure 13.2). Due to the four 'legs' to this strategy, some traders also call this the 'alligator spread' because of the resemblance to the legs of an alligator. (In Figure 13.2, as in similar diagrams, the horizontal axis represents the price of the underlying and the vertical axis represents the net profit or loss on the position.)

2 The term 'spread' here has a different meaning here *vis-à-vis* the chapters on futures where it is used as a synonym for 'basis' (difference between spot and futures price).

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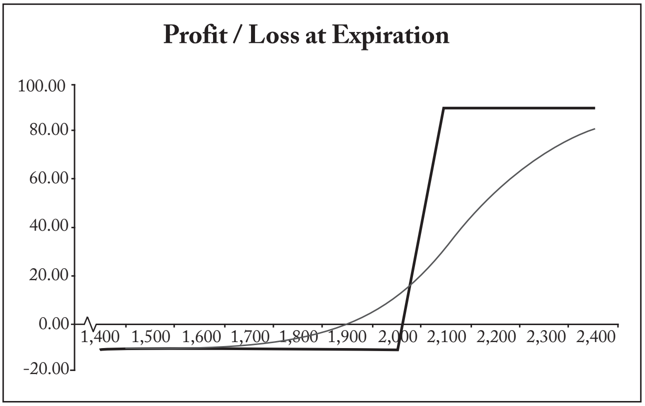
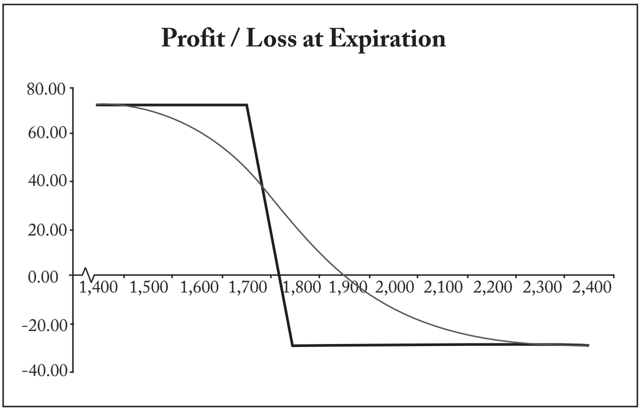
Figure 13.2: Bull spread (2,000 and 2,100 are the exercise prices of the call options, former being a long position and latter short)



The thick line represents the combined position's payoff at expiry and the curved line represents the market value before expiry. We can see that a net call option premium of around ten was paid, and therefore a maximum profit of 90 (2,100-2,000-10) can be made.

Figure 13.3: Bear spread (1,700 and 1,800 are the exercise prices of the put options, former being a short position and latter long)



The thick line represents the combined position's payoff at expiry and the curved line represents the market value before expiry. We can see that a net put option premium of around 30 was paid. Therefore, a maximum profit of 70 (1,800-1,700-30) can be made.

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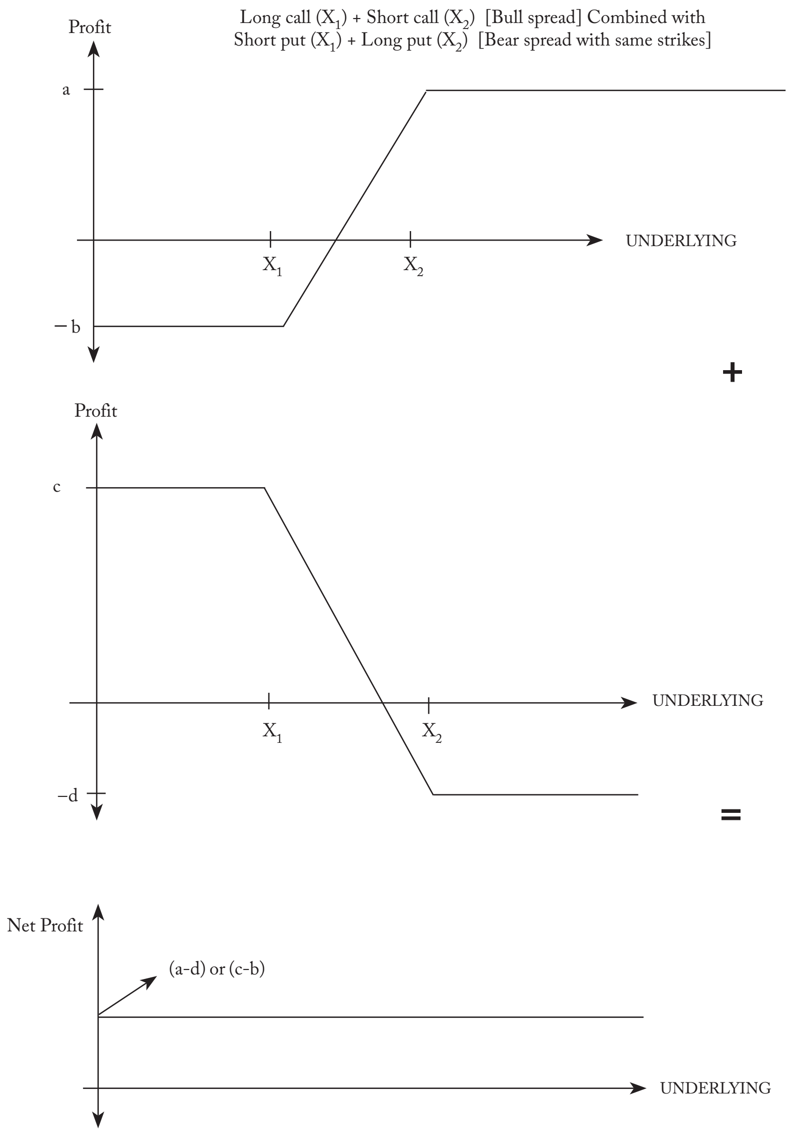
Figure 13.4: 'Box spread' pay off on expiry



Note: If a-d ≠ c-b, then there is a possibility of arbitrage.
Also, a - d ≠ 0 because there is a time value of money.

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Depending on the premium spent/earned on buying/selling the box and the pre-determined fixed gain or loss based on the difference in strike prices, there may be an arbitrage opportunity. This is illustrated in the following example.

Example 13.7

Eshwar is considering an arbitrage opportunity in MSFT shares. One month MSFT options are priced as in Table 13.2. Is there an opportunity for Eshwar to profitably sell a box?

Solution:

Selling a box means selling the call with lower strike and buying a call with higher strike while buying a put with lower strike and selling a put with higher strike. If Eshwar sells a 29 call and buys a 29 put (for say 1.19 and 0.83 respectively as per the price table) he will get a net inflow of 36 dollars per option contract (each contract corresponds to 100 stocks). By buying a 30 call for 0.67 and selling a 30 put for 1.29, he will get a net inflow of 62 dollars. Overall, he gets an initial inflow of $98. The outcome of this strategy on the expiry date, at various market prices of the underlying is shown in Table 13.4.

Table 13.4: *Pay-offs on each leg of box spread sold (per share; market lot=100 shares) [Figures in brackets denote losses]*

Scenario	***Price of MSFT on expiry date ($)***	***Gain / (loss) on 29 call sold***	***Gain / (loss) on 29 put bought***	***Gain / (loss) on 30 call bought***	***Gain / (loss) on 30 put sold***	***Combined gain/loss on all 4 options***
1	*28*	*0 Call will not be exercised*	*1 Put will be exercised by Eshwar – causing a profit of 29–28=1.*	*0 Call will not be exercised*	*(2) Put will be exercised by the other party causing a loss of 28–30= (2)*	*(1)*

Scenario	***Price of MSFT on expiry date ($)***	***Gain / (loss) on 29 call sold***	***Gain / (loss) on 29 put bought***	***Gain / (loss) on 30 call bought***	***Gain / (loss) on 30 put sold***	***Combined gain/loss on all 4 options***
2	*29*	*0 Call will not be exercised / if exercised will not entail any gain / loss*	*0 Put will not be exercised*	*0 Call will not be exercised.*	*(1) Put will be exercised by the other party causing a loss of 29–30=(1)*	*(1)*
3	*30*	*(1) Call will be exercised by the other party causing a loss of 29–30=(1)*	*0 Put will not be exercised*	*0 Call will not be exercised.*	*0 Put will not be exercised / if exercised will not entail any gain /loss*	*(1)*
4	*31*	*(2) Call will be exercised by the other party causing a loss of 29–31=(2)*	*0 Put will not be exercised*	*1 Call will be exercised by Eshwar, causing a profit of 31–30=1*	*0 Put will not be exercised*	*(1)*

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What the table shows is that regardless of the price of MSFT on the expiry date, Eshwar will make a net loss of $1 per share on the box, which is exactly equal to the difference between the two strike prices. Since the lot size is 100, the aggregate loss will be $100. The total cash flows from the box strategy can now be summarised:

- *At the time of selling the box (i.e., entering into the four options trades), Eshwar receives $98.*
- *One month later, he has to pay $100.*

He makes a net loss of $2 on this box, ignoring the interest element. There is a loss of approximately 2 per cent in one month. Hence, there is no profitable arbitrage opportunity in this case.

However, suppose the option prices were such that the premium income earned in the beginning was $101 instead of $98, then the selling of the box would have yielded a riskless arbitrage profit. Even if the premium income was such that along with interest for a month it would exceed the pre-determined and fixed loss of $100 on the box, there may be a profitable arbitrage opportunity subject to transaction costs.

Box spread selling as a means of borrowing

In Example 13.7, Eshwar was able to get money now with a payment later. In a way, this is equivalent to borrowing money for one month. The effective interest rate was 2/98 = 2.04 per cent per month. This shows that, apart from its use as an arbitrage strategy, selling boxes is also a way to borrow money from the market. Depending on the option prices, the implicit rate of interest on such borrowings may or may not be economical. However, it illustrates the manner in which some companies can use derivative markets as a source of off-balance sheet short term financing.

Example 13.8: Box spread buying

Reliance stock is trading at 1,000 and, as in the Example 13.6 the call option with a strike price of 1,000 for a given expiry has an implied volatility (i.v.) of 45 per cent and the put option with a strike price of 1,000 for the same expiry has an i.v., of 40 per cent. The other option contract for the same expiry with good liquidity is the one with a strike price of 950; this has both call and put with implied volatilities of 45 per cent. The volatility figures imply that the 1,000 call is overvalued. An arbitrageur does the following:

- *Buys the 950 call and sells the 950 put (creating a synthetic long at 950), and*
- *Sells the 1,000 call and buys the 1,000 put (creating a synthetic short at 1,000).*

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Thus she buys a box spread. Since she is short the overvalued 'vol' (1,000 call), if the valuation returns to normal this call will fall in price disproportionately compared to the other legs of the spread. Therefore she can expect to realise a net risk-free profit from this strategy, assuming the interest cost on the margin and transaction costs do not exceed the profit.

Statistical arbitrage

Examples 13.6, 13.7 and 13.8 are true or conventional (riskless) arbitrage. The next two examples are of statistical arbitrage in the context of volatility trading.[3] They are not free of risk and profitability depends on the future conforming to expectations based on the past.

Example 13.9: Mean reversion application (similar to, but distinct from, put call parity application)

Qasim is considering options strategies on RIL shares. The quarterly results of RIL are not for another two months. The implied volatility of a 1,000 put for RIL options expiring one month from now is around 40 per cent and the implied volatility of the 1,100 call with same expiry is at 45 per cent. This is a blue-chip stock where sudden large movements are unlikely.

RIL is currently trading at 1,000, the annual interest rate is 12 per cent and the discount factor for the time value of money sense for one month ahead is 0.99. Assume a market lot of 100 shares. have to be bought at a minimum, and there is no dividend involved. The relevant call is trading at ₹ 20 and the put at ₹ 40.

What can Qasim do and how?

Solution:

The Put Call Parity (PCP) equation only applies for the same strike price. In this case, the options under consideration are at different strike prices so there is no pure arbitrage. What can be attempted is statistical arbitrage or mean reversion. Essentially, it represents an assumption that prices which have deviated from their mean or normal level, will revert to that mean.

In this example, a higher strike price (i.e., the call option) has a higher implied volatility. It can be assumed that the put option at the higher strike price (₹ 1,100) will also have a very similar implied volatility as explained in the last example (implied volatility is simply reverse-calculated based on the Black-Scholes equation by putting in the option market price, time to expiry, interest rate, dividend if any, and current underlying price).

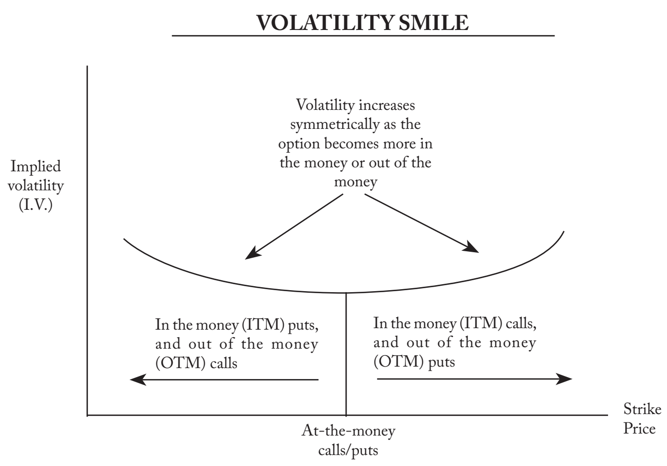
The implied volatilities at different strikes would be the same if the probability distributions of an up or down move in the stock price in any given unit of time were symmetrical, and the

3 Note that 'statistical' arbitrage may not be riskless and thus differs from classic economic 'arbitrage'.

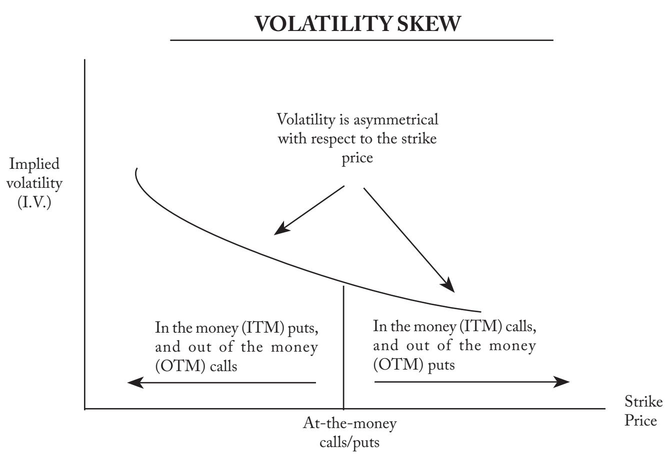
market was efficient. Even assuming the latter in a broad sense, in real life (based on past data), the distribution of equity returns is only approximately symmetrical at best. Assume that, as a general pattern, the market tends to display a skew or smirk, whereby implied volatilities for options at lower strikes tend to be higher (Note: This volatility structure of a skew or 'smirk' occurs when implied volatilities of ITM calls are higher than out-of-the-money calls. This is in contrast to a symmetrical 'smile'.)

Figure 13.5: *Smile pattern (symmetrical) and Skew or Smirk pattern (asymmetrical)*

Smile



Skew or Smirk



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In the given example, the higher-strike call has a higher annualised implied volatility than that of the lower-strike put which is not 'normal' vis-à-vis the generally observed pattern of a skew. So while there is no conventional arbitrage profit, it may be reasonable to assume that this 'reverse skew' will become a 'skew' or at least a 'smile' in one month, or at least there is a high enough chance of the same if historical data shows that to be the case (for which the necessary analysis would have to be done).

Qasim can sell the higher 'vol' (by selling the 1,100 call options, in a lot of 100), while buying the lower 'vol' (1,000 put), and buying 100 stocks of RIL. If the expected correction or mean reversion happens, the strategy will yield a profit.

Example 13.10: Statistical arbitrage.

Assume that, the implied volatility of RIL at-the-money options has averaged, say, 35 per cent. Assume implied Nifty volatility is currently near its historical average of say 20 per cent i.e., there is no excess volatility or fear in the general market. The market also does not expect any major results from, or significant corporate news about RIL, i.e., there is no prima facie reason to expect unusually high volatility in the spot. RIL stock is trading at 1,000 and the 1,000 call has an i.v., of 50 per cent and the 1,000 put has an i.v., of 50 per cent also (For simplicity, assume that RIL's share price is perfectly correlated with the market index, i.e. the correlation is 100 per cent and the correlation coefficient or beta is one). The Nifty is trading at 5,000.

Sandeep, a statistical arbitrageur, observes that the ratio of the implied volatility of RIL to the implied volatility of the Nifty (50:20) is higher than usual (35:20). He gathers information to make sure that no news is around the corner that could sharply increase or decrease the relevant stock price. In the absence of such news, the higher-than-normal i.v., of the RIL shares becomes a statistical arbitrage opportunity. He sells five RIL 1,000 calls and five 1,000 puts, and buys one Nifty 5,000 call and one Nifty 5,000 put (with the Nifty and RIL expiry coinciding), basically short selling ('shorting') the RIL 'vols' and buying the market 'vols' (after suitable numerical adjustments, ignored here for simplicity.) He can, on average and going by the past, expect to make money from this four-leg strategy.

In the above example, going by the past, prices are expected to change in such a manner that the ratio returns to its expected level. However, any one such transaction could make a profit or a loss. The only way to increase the chance of making profits (but always with uncertainty and a chance of making a loss) is to replicate this strategy across many different stocks and expiries. If volatility has empirically been seen to be mean-reverting, statistical arbitrageurs can expect to make money on average. *However, the reader should be cautioned that mean-reversion may not always take place and it is even possible that a 'new mean' gets established!* Large hedge funds have found this out at huge cost to themselves and to investors.

Notes regarding examples:

a. The use of examples using specific companies such as State Bank of India, Microsoft or Reliance Industries does not imply any endorsement or criticism of those companies; they are used for illustration simply because they are large companies whose shares are, at the time of writing, highly liquid in their respective markets.

b. The prices, volatilities and scenarios mentioned are purely hypothetical and the cases described are imaginary.

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