PAYOFFS, COMBINATIONS and STRATEGIES

This chapter, which focuses on options at their expiration, has three fundamental purposes:

1. It formalizes the basic principles of options introduced in chapter 1. By elaborating on what an options does, in particular the “optionality” contained in the contract, the first part of the chapter will give you the insight into options necessary for employing them in the strategies contained in the remainder of this book.
2. It demonstrates how market participants employ options to produce risk-return trade-offs available only through the use of options.
3. Understanding the determinants of an option’s value at expiration is a necessary first step in understanding the determinants of an option’s premium. And understanding the determinants of an option’s premium – hence its dynamics – is the crucial ingredient in understanding all the market applications covered in chapter xxx and onward.

OPTION PAYOFFS

An option’s payoff is its value at expiration. And its value at expiration is the same as its cash flows. Consider a call on Chicago Bridge and Iron (CBI) with an exercise price of 60. Its current price is 58 per share but, as we will say, that is not relevant to its payoff. Table I presents the payoffs of the call for various prices of CBI *at expiration*.

FIGURE I

Payoffs, Call on CBI, Exercise Price 60

Price of CBI Option Payoff

40 0

50 0

60 0

65 5

70 10

75 15

80 20

90 30

100 40

Because the call is expiring, its original term to expiration – whether it was a three-month, one-year, etc. option – is irrelevant. The same is true of its style – American or European. The decision to exercise, and its cash flow in doing so, is independent of the past.[[1]](#footnote-1) That is why the option’s original premium is not a factor in the payoff as well. The reverse, of course, is not true: the call’s payoff is a crucial factor in determining the option’s premium. In short, we are free to examine the payoff independently of these factors.

Below the Strike

If CBI is trading at $40/share at the option’s expiration, it would be foolhardy to exercise the call struck at 40. Consider two buyers of the call, with different financial agendas:

* An investor who has determined to purchase CBI. As an owner of the call, he has a choice: buy CBI in the cash market, or exercise the call. The former costs $40, the latter requires spending $60. Obviously, he chooses to forego the call alternative, instead buying CBI in the market. And, certainly, no other investor, who does not own the call, but desires to purchase CBI, would pay any money for this call in order to exercise it now. *Note that this analysis said nothing about the premium the buyer originally paid for the call.* It does not impact the decision at all.
* A speculator who doesn’t intend to purchase CBI, but wishes to profit from a price increase. If she exercises, she will pay $60 for each share in the contract. Since she doesn’t wish to own the stock, she will set it for $40 in the cash market and lose $20/share.

So, neither the investor nor the speculator will exercise the option. Furthermore, there is no point in holding on to it because it expires. If it won’t be used now, and cannot be used later, it is worth nothing, right? Hence, the call’s payoff equals zero, as shown in the Table.

At a price of $50 per share for CBI the exact same analysis applies. The payoff is again 0. In fact, for any price of CBI below 60/share at the call’s expiation the payoff will be zero. We can generalize: A call option’s payoff is zero for prices of the underlying below the exercise price.

At the Strike

What if CBI is exactly 60 at the call’s expiration? For the investor above, there is no advantage in exercising the call compared to purchasing CBI in the market.[[2]](#footnote-2) It does not present him with any value. Looked at another way, no other investor with an interest in purchasing CBI would be willing to pay anything for the call at this point. Why would she? The sum of the exercise price and this payment, however small, exceeds the price of CBI! The speculator as well has no reason to exercise – it would produce zero profit.[[3]](#footnote-3) The call’s payoff at 60 is, therefore, zero.

Above the Strike

Consider again the investor and the speculator:

* If CBI is 65/share at the options expiration, will the investor who owns the call exercise? Surely. Paying $60 is $5 better than paying $65. Hence, the payoff is 5. Indeed, for any price of CBI above 60 at expiration the decision is the same – exercise and pay 60/share rather than the higher market price. The payoff, therefore, is the price of CBI at expiration less the strike price of 60. Thus, the call option provides insurance against an increase in CBI’s price above 60. Note – carefully – that this analysis holds regardless of the premium originally paid. Suppose he paid $2 for each call and CBI is 65 per share at the call’s expiration. The *total cost* of the purchase via the call is 60 (strike) + 2 (premium) = 62. But suppose he paid $8 per call. The total cost is $68. This is *still superior* to purchasing CBI in the cash market for $65/share. Why? Because the total cost via a market purchase is 65 (cash price) + 8 (premium) = 73. The premium has been paid, regardless of exercise or not. This is a crucial point. The decision to exercise, hence the option’s payoff, and its value, as we shall soon see, does not depend on the past. It is what is known in economics as a *marginal* decision. Does exercising *now* make the investor better or worse off. The answer, clearly, is better – without regard to the premium paid at the outset.
* The speculator is in a great position if CBI is trading at 65 at the option’s expiry. She will exercise, pay 60 and sell for 65. Her $5 profit equals the call’s payoff. Should this decision depend on the premium she originally paid? Of course not. If she does not exercise she is throwing $5 away. If the option cost her $2, her net profit is $5−$2=$3. If it cost her $8, her net profit equals $5−$8=−$3, or a net loss. But a net loss of $3 is superior to a net loss of $8, which would be the case without exercising. In short, exercising is an objective decision. Everyone holding the option now makes the same decision.[[4]](#footnote-4)

To summarize, if CBI is $65/share at the call’s expiration, the investor saves $5/share via exercise compared to making a cash market purchase. The speculator makes $5 in profit by exercising. Hence, the call’s payoff equals 5, as shown in the Table. Again, the investor’s *net* savings is $5 less the premium paid and the speculator’s *net* profit is $5 minus the premium. But the premium is different for each investor or speculator, depending on the prices each paid.[[5]](#footnote-5) The payoff, however, is 5 for all.

If CBI is 70/share at expiration the same arguments result in a payoff of 10: the investor saves 10/share using the option to purchase CBI, and the speculator earns 10/ share by exercising and selling. If CBI reaches 80, the payoff is 20. In short, for prices of the underlying above the exercise price, a call option’s equals the cash price at expiration less the strike.

Another Perspective: The Market

Appreciating an option’s payoff function is so important that it warrants thinking about from yet another perspective. Say CBI is 65 at expiration and the call holder, despite the reasoning above, does not wish to exercise. There is certainly someone else in the marketplace who sees an opportunity to make $5. He will pay the call holder up to $5 per option. More generally, for prices of the underlying at expiration above the strike, the call can be sold for – hence is worth – the price difference. Recognizing that an option’s value at its expiration depends on what the *market can* do with the option, as opposed to what the *individual* option holder *wishes* to do with it is fundamental to understanding options. This concept will reappear often in coming chapters.[[6]](#footnote-6)

Finally, we can express the call’s payoff function as:

Call Payoff. = max{0, cash price – exercise price}

Cash Settled Calls

The option writer and buyer may agree at the outset of their contract to “settle in cash.”[[7]](#footnote-7) This simply means that rather than exercising the call when the underlying asset’s cash price exceeds the strike at expiration, as described above, the writer pays the call holder the option’s value, or its payoff. In the example above, if CBI is 65/share at the call’s expiry the write pays $5 per option to the buyer. If CBI is 70, the writer pays $10 per share, etc.

There is no economic difference between physical exercise and cash settlement.[[8]](#footnote-8) Consider the investor above. For prices of CBI at 60 or below there is obviously no difference between physical or cash settlement. Suppose CBI reaches 70 at the call’s expiration. The investor will exercise, pay 60 and receive the shares from the writer, if the contract is physical. He saves $10/share (less the original premium paid). If the contract is cash settled, he receives the $10 in cash. He purchases the CBI shares in the market for a price of $70/share which, net of the call’s payoff, results in the same price of 60 (plus the premium). For the speculator cash settlement is even “cleaner.” At a price of 70 she exercises and sells the shares in the market for a $10 profit (less the premium). Under cash settlement, she receives the $10, period.

Graph

Figure II portrays the call’s payoff function. It shows the payoff amount as a function of the underlying asset’s price at expiration. We’ll describe the graph in two ways: using market terminology, then more analytically.

The graph is flat at 0 on the horizontal axis until 60, the strike price of the call. Once CBI passes 60/share, the payoff rises 1-for-1 with the stock price. The region of prices of CBI below 60 is known as “out-of-the-money” (OTM) because it has zero value – produces no money for the call owner – at expiration. The region above 60 is termed “in-the-money” (ITM). Notice that, similar to owning the stock, the call’s payoff has no upper bound. And the point of CBI = 60 is called “at-the-money” (ATM). Although this terminology applies technically to the option at expiration, market participants will use it prior to expiration as well. For example, if CBI is trading at 65 one month prior to the call’s expiry, the option will be said to be in-the-money because should CBI’s price remain where it is until expiration, the call be in-the-money then.

It is interesting that the market reserves a name for one single point:[[9]](#footnote-9) when the underlying asset’s price is equal to the call’s exercise price, the call is in-the-money. The in- and at-the-money designations, on the other hand, refer to regions, not points. This is not interesting; it is *crucial*.

Suppose you own CBI shares. For every 1 point increase in the price of CBI, for example from 65 to 66, your portfolio rises in value by $1/share. Correspondingly, a decrease in price of 1 point produces a loss of $1/share. Suppose instead you own the above call on CBI. For every point increase in CBI on the expiration date *in the (~~at)~~ in-the-money region* you will enjoy the same $1/share profit. And for every 1 point decrease in price in the ITM region you will suffer the same $1/share loss. Therefore, this call option is said to participate in the movements of CBI’s price – up and down – when it is *(~~at)~~ in*-the-money.

Suppose you own CBI shares and its price is 55/share. An increase to 56 produces a $1 profit per share, a decrease to 54 results in a $1/share loss. However, if you own the call rather than the share, a 1 point decrease in price on the expiration date *in the out-of-the-money region* does not result in any further loss. You are protected from price declines. On the other hand, you are “protected” from a price increase as well – you gain nothing owning the call if CBI rises in price within the OTM region.

Now consider the situation when the price of CBI is 60 on the call’s expiration. Should CBI increase, the call’s payoff increases 1-for-1 with the underlying. Should CBI decrease, the call owner does not lose anymore.[[10]](#footnote-10) In short, when the call is at-the-money – and *only* at that point – the owner participates in the underlying asset’s upside, and is protected from its downside. The ATM option, it is said, provides “full optionality.”

INSERT FIGURE II PORTRAYING PARTICIPATION & PROTECTION REGIONS

Payoff vs. Profit/Loss

Suppose a speculator paid $2 for the call. If it expires out-of- or in-the money, she will not exercise, hence lose the $2.[[11]](#footnote-11) A different speculator may have paid $3 for the option, perhaps having purchased it during a period of greater volatility, or further back in time. His loss is $3. If it finishes in-the-money, say CBI is 70/share at expiration, the former’s net profit is $8/share, the latter’s is $7/share. Now consider investors who intend to purchase CBI in the future and buy the call to insure against a significant price increase. Again, the net cost of the investment – exercise price plus call premium[[12]](#footnote-12) – depends on the premium paid, which will differ according to the timing of the call purchase by the particular investor. It should be clear that the profit/loss outcome is subjective – it depends on the particular call buyer’s history. The payoff function, on the other hand, is totally objective, independent of the particular buyer.[[13]](#footnote-13)

Graph P&L for Call with premium = 2. Show that it is a linear downward translation of the Payoff graph. What is the “break-even?”e

Writer’s Payoff Graph

The call option writer’s payoff function is exactly the reverse of that in Figure 1. Because she must sell CBI should the buyer exercise, she loses whatever he gains. Suppose she owns CBI shares. If CBI is 65/share at expiration, she will be forced to part with the shares at a price of 60, for a loss of 5/share. If she does not own the shares, she will need to buy them in the cash market for $65 and deliver them to the call buyer for $60, again sustain a loss of 5/share. If the contract is cash settled, she must directly pay 5/share to the call owner.[[14]](#footnote-14) Therefore, the call writer’s payoff equals the negative of the in-the-money value of the call. If, instead, CBI finishes below 60 at expiration, the call will not be exercised, hence the payoff is 0. Figure III graphs the writer’s payoff function. Note the obvious symmetry between Figures II and III. Symmetrically as well, the call writer’s potential loss is unbounded.

The writer’s profit/loss equals the payoff plus the premium received. This will be positive if the call’s ITM value is less than the premium, positive if the reverse. For example, suppose the CBI call above was sold for a premium of 2/share. If CBI is 59/share at expiration, the writer’s profit is 2, the full premium. If CBI is 61.5 at expiration, the writer loses 1.5/share due to the payoff, so her net profit is 2–1.5 = 0.5/share. If CBI is 63, her net profit is 2–3 = –1, or a net loss.[[15]](#footnote-15)

Review Exercise

Produce a payoff table similar to that in Figure I for a call on Chicago Bridge & Iron with an exercise price of 40. Which call should command a greater premium? Add a column for the difference between the payoffs (subtract the payoff of the 60-strike call from that of the 40-strike). Graph this value against CBI.

Changing the Exercise Price; Relative Value

Figure III displays the payoff function of the call option on CBI in the previous end-of-section question alongside that of the original call option of Figure !. The options differ solely according to their respective strikes (their original times to expiration are irrelevant to their payoffs). At a price of 40 and below for CBI, their payoffs are equal. Their difference rises 1-for-1 as CBI increases above 40, then levels out at 20 when it reaches 60/share, the exercise price of the first call. Clearly, the 40-strike call is more attractive than the 60-strike – the former’s payoff is never below, and sometimes above, the latter’s. Investor’s, therefore, would pay more for the 40-strike than for the 60-strike. In other words, the 40-strike call must be at a greater premium.

We now formalize these concepts with arguments that are ubiquitous in options analysis and applications. The first is known as the “no arbitrage profits” condition:

Relative prices of securities (including derivatives) must be such that there is no opportunity for arbitrage profits.

An arbitrage is a transaction, or a series of transactions entered into simultaneously, that results in a riskless cash flow.

Suppose the posited relationship is not true, say, the premium in the options market for the 40-strike call on CBI is 2/share, while for the 60-strike call it is 3/share. Set up the following arbitrage:

1. Write the 60-call, receive $3 today.
2. Buy the 40-call, pay $2 today.
3. Hold both positions to expiration.

You receive net $1 today per pair of options. For 1,000 pairs, you pocket $1,000. On the expiration date, there are three possibilities:

* CBI trades at 40/share or below. Both options expire, and you keep the $1/share (plus possible interest).
* CBI trades between 40 and 60 per share. The 60-Call expires worthless (i.e., you make no payoff to the option buyer). For the 40-Call you receive the difference between CBI’s price and 40 (either in cash, if settled as such, or by exercising and selling at the market price). For example, if CBI is 50/share on the calls’ expiration date, you earn $10 *on top of* the $1 received at inception.
* CBI trades above 60/share. You receive the excess of CBI’s price over 40 (via cash settlement or exercise) and pay the excess of CBI’s price over 60, for a net receipt of 20. For example, if CBI reaches 65 at expiration, the 40-Call’s payoff is 25, the 60-Call’s payoff is 5, for a net gain to you of 25 - 5 = 20 + the 1 received at inception of the trades.

No matter what happens you will make a net profit with zero outlay on your part. This is impossible. Impossible because everyone sees the same opportunity. Everyone will buy – as much as possible – of the 40-Call and sell the same number of 60-Calls. This will increase the price of the 40-Call and decrease the premium of the 60-Call. The process will continue until the inequality that led to the arbitrage – the excess of the 60-Call premium of the 40-Call premium – is erased.[[16]](#footnote-16) Algebraically, we write this result as:

Call40 ≥ Call60

where the subscripts denote the option exercise prices.

The second argument is the principle of “dominance.” A security or strategy is said to dominate another if for all possible future outcomes the former’s payments, or cash flows, are never below and sometimes above those of the latter. Examine Figure III. For CBI prices 40 or below at the calls’ expiration, both options make zero payments. For CBI prices above 40, the 40-Call’s payments always exceed those of the 60-Call. The 40-Call’s payoff is never worse, and sometimes better, than that of the 60-Call. Hence, the price of the former must exceed the latter. Or:

Call40 > Call60 [[17]](#footnote-17)

Review Exercise

Draw one P&L graph for both calls, assuming a $2 premium for the 60-strike and a $4 premium for the 40-strike. Now show that neither dominates. In which range of CBI prices at expiration is the 40-call superior in terms of net profit/loss? In which range is 60-call superior?

Put Payoffs

The reasoning behind the payoff of a put option, its table and graph, follow that of calls. Consider a put on Coca-Cola (symbol: KO), with an exercise price of 40. Figure IV displays the payoffs for various prices of Coke shares at expiration.

FIGURE IV

Payoffs, Put on KO, Exercise Price 40

Price of KO Option Payoff

0 40

20 20

40 0

60 0

100 0

The payoff for an ordinary put involves the relationship between the option’s exercise price and the price of the underlying asset at expiration. As was the case with calls, the put’s original time to expiration, its style (American or European) and , indeed, its premium, is irrelevant. What the owner of the put does as the put is about to expire depends only on the here and now; the past is irrelevant.

The analysis follows that of the call option, so we can be relatively brief. Suppose Coke shares are priced at 60 at expiration. Assume first the put buyer owns Coke shares, that is, he has a put struck at 40 for as many shares of the underlying he owns. Exercising the put would be silly – he would receive 40/share instead of 60/share selling in the cash market. He can’t hold on to it, because it’s expiring. Because he would not use it, nor hold it, the put is worthless. If the put buyer does not own KO shares, exercising the put would produce a loss – buy the shares in the market and pay 60 and deliver them to receive 40. The payoff, therefore, is 0. The same analysis holds for any price of KO above 60 at expiration.

If Coke shares are exactly 60 at the put’s expiration, the put holder gains nothing from exercising versus selling the shares in the market. And no one else would pay anything for the right to sell at the market price, and there would be no opportunity to do so later. Again the payoff is 0.

Suppose now Coke shares trade at 30 at expiration of the option. An owner of Coca Cola shares will gain 10/share by exercising the put rather than selling at the market price. The payoff is 10. Even if she has no intention of selling the shares now she will gain 10/share. For she can exercise the put, receive 40/share thereby, and repurchase the shares in the market for 30. (Or sell the put to someone else who does want to exercise). If she is a speculator and does not own Coke shares, she purchase KO in the cash market for 30, exercises, and delivers the shares to the put writer for 40/share. As we can perform this exercise for all prices below 40, we see that the put’s payoff is the excess of the strike price over the cash price of the underlying asset.

Three items worthy of note (or repetition):

* As with calls, the analysis is independent of the premium paid for the put.
* The net profit/loss of a speculator who purchased the put and held it to expiration is the payoff less the put premium paid. This is a subjective number, as it depends on the premium paid by the particular put buyer. The payoff function, on the pother hand, is totally objective.
* *Unlike a call*, a put’s payoff has a maximum value. The lowest KO, or any other stock price, can fall to is 0.

The *value* of a put at expiration is the price the market places on the put. Regardless of what the individuals above decide to do with their put, market participants will, on the expiration date, pay the put holder the payoff amount, which can be expressed as:

Put Payoff. = max{0, exercise price – cash price}

If the put contract specifies cash settlement, then on the settlement date the put writer pays the put buyer the payoff. The section exercise asks you to show that there is no economic difference between cash settled and physical delivery puts (on the settlement date).

Review Exercise

Consider both an investor (who owns KO) and a speculator (who doesn’t). Each has purchased the put option referred to in the text. Show that if KO is 35 at expiration, each trader’s outcome will be the same whether the put contract entails cash settlement or physical delivery. Proceed as the “Cash Settled Calls” section above.

In terms of necessary transactions and associated transactions costs, the investor prefers physical delivery, the speculator, cash settlement. Why is that?

FIGURE V

Put Graph and Regions

Figure V graphs the put’s payoff against the price of Coke stock at expiration. The graph is flat at the zero line for prices exceeding 40, since the put will be allowed to expire unused. As Coke shares fall below 40, the payoff increases one-for-one, hence the graph rises in a northwest direction – the slope is −1. The put option is “in-the-money” when Coke is below 40/share at expiration. Market participants describe the put as in-the-money if the underlying asset’s price is below the strike even prior to expiration. For KO prices above 40 the put is termed “out-of-the—money,” as the payoff is 0. Finally, the put is said to be “at-the-money” if Coke’s cash price is exactly equal to the put’s strike, in this case 40.

Once again we ask why it is necessary to give a name to the single ATM point, as opposed to a region. The answer is just as crucial as before, and involves the option’s role as providing participation versus protection. For calls, the analysis compared the option to owning the underlying asset. Here, we need to compare the put to being short the asset.

A Digression on Selling Short

Briefly, the dynamics of a short sale are as follows (displayed in Figure VI, where the dashed lines describe a borrowing/lending transaction and the solid lines a purchase/sale transaction):

1. A trader who does not own KO sells shares in the cash market.
2. She borrows the shares because she needs to deliver in order to comply with the sale.
3. Upon delivery of the shares to the buyer, the trader receives the cash price per share.
4. The proceeds of the sale are typically given to the stock lender as collateral for the borrowing.
5. After a period of time, the short seller purchases KO shares at the then cash market price (“covers” her short). She returns the shares to the lender, who gives her back her cash collateral – the price of KO when she sold short.

FIGURE VI

Shorting Stock

KO

$

KO

$

OWNER

The short seller believes the price of KO is about to fall.[[18]](#footnote-18) For example, suppose Coke was trading at 42/share when she borrowed and sold the shares. Two weeks later Coke is trading at 40. She pays 40 for the shares in the cash market, delivers them to the KO lender and retrieves her 42 per share for a profit of 2/share.[[19]](#footnote-19)

What are her risks? Substantial. A short seller must eventually cover her position. KO shares can rise, theoretically, to any price, and she’ll be forced to pay that price. Her risks, therefore, are unlimited. Her potential gains are capped. The most KO can fall to is 0. Therefore, her maximum gain is the price at which she sold, or shorted, the stock. (Compare this to the unlimited upside of a long position in the underlying asset and its limited downside.)

Protection, Participation and Optionality

Now we’re ready for the put as a provider of protection or participation. Jack borrowed KO shares and sold them short at 36/share. Every point decline in price of KO below 36 adds a dollar per share profit for Jack when he covers his short. Every point increase in price above 36 causes a further dollar loss per share when Jack covers. Jill bought the 40-Put on KO. At expiration, since the put is in-the-money when KO is 36/share, every point drop in KO price adds a dollar to her payoff. Every point increase in KO prices subtracts a dollar while the put is in the ITM range. The put, therefore, participates in the short’s dynamics when it is in-the-money.

Suppose instead Jack shorted Coke at 45/share. Again, every point decline in price produces more profit, every point increase produces greater loss. Jill bought the put option. An increase in KO price above 45 does not produce losses because the put is out –of-the-money – the payoff is already 0. Jill is protected from an increase in KO’s price. ~~On the other hand, a decline in the price of KO produces zero profit for the same reason.~~ OTM puts, in short, provide protection (and no participation).

If Jack shorts KO at 40, a decline in KO price adds a dollar per point, an increase in KO price subtracts a dollar per point. Jill purchases the put. She is protected from an increase in KO price above 40 yet participates in a drop in KO price below 40. The put’s “full optionality” is present when it is at-the-money.

Put Writer’s Payoff

If KO is 40 or above at expiration, the put will not be exercised, hence the put writer has no obligation and suffers no loss. At 38, the writer loses $2 per share. If she needs to purchase KO (perhaps to cover a short position), she will be required to pay 40 instead of 38. Otherwise, she will pay 40 and then sell in the market for 38. As this is true for all prices below 40, Figure VII shows that the writer’s payoff slopes downward as KO falls deeper in-the-money.[[20]](#footnote-20) Her maximum loss is 40, unlike the call writer’s maximum loss, which is unlimited.

FIGURE VII

Relative Prices of Puts

Consider a new put on Coca Cola, this one struck at 30 with the same expiration date. Clearly, the right to sell something at 30 is worth less than the right to sell the same thing at 40. Should its premium be above that of the 40-strike put, arbitrageurs would quickly put an end to the situation. Suppose the 40-strike put’s premium is 5 while the 30-strike put trades at 3. Selling the 30-strike and buying the 40-strike produces profits of no less than 2/share under any scenario at ex1piration. For if Coke is above or equal to 30, both puts expire. If Coke is between 30 and 40 the arbitrageur will exercise the 40 put and keep that payoff in addition to the $2. And if KO is below 30, both are exercised at their respective strikes, giving the arbitrageur 10 plus the 2. Thus, we have proved that:[[21]](#footnote-21)

Put40 ≥ Put30

END-OF-SECTION EXERCISES

Similar to Figure III, draw a graph containing the payoff diagrams for both the 30-strike and 40-strike puts. Use the principle of dominance to show that Put40 > Put30.

Assume the premia for the 30-put and 40-put are $5 and $10, respectively. Draw one graph showing both net P&Ls. In which range of KO prices at expiration is the 40-strike put superior, in which region the 30-strike? At which price do they “cross over?”

BREAKEVENS & BREAK-POINTS

An option’s breakeven point is the price of the underlying *at expiration* which results in zero net profit and loss for the option buyer (and writer). Let’s assume the underlying stock pays no dividends, at least from the time purchased until its expiration. If we ignore interest rates, or the time value of the premium until the expiration date, then a call’s breakeven must be its strike price plus the premium:

SBE = K + CallK

At this price the payoff equals the premium paid, hence a zero profit/loss.

Figure VIII presents break-evens for various strike prices for CBI, where the calls were initially purchased when CBI was 60/share. Note that each line in the table corresponds to a different strike for the same initial price of CBI. For example, the at-the-money call – i.e., K=60 – carries a premium of 3. CBI must be 63 at expiration in order for the call owner to fully recover the cost, and no more.

FIGURE VII

K Call SBE △S Loss if ST = K Loss if ST = S0

END-OF-CHAPTER QUESTIONS

Why are American-style and Look-back options both path-dependent, yet the former’s payoff function does not depend on the past while the latter’s does?

Why can there not be a break-even price for a binary option?

Helen of Troy is a consumer products company. Its current price is 55/share. It does not pay a dividend. Suppose a three-month call struck at 55 is trading at 2/share, while a three-month put with the same strike is 1/share. Assume interest rates are low enough to be ignored. What is the arbitrage you should engage in which will produce a riskless profit? (Hint: Write the call and purchase the put, and do something else.)

* Given the call priced at 2, what must the put price be to erase arbitrage? What if the call is 1?
* Consider now a call/put combination struck at 57. If the call premium is 3, what must the put premium be?

1. This is not the case for the “look-back” options introduced in chapter 1. By their very nature, these options’ payoffs are a function of the past. [↑](#footnote-ref-1)
2. We are ignoring transactions costs; e.g., brokerage commissions and other possible costs of executing trades. There may be a slight difference between exercising and purchasing. [↑](#footnote-ref-2)
3. To say nothing of the transactions costs that exercise and the subsequent sale would entail. [↑](#footnote-ref-3)
4. Net cost for investors and net profit (loss) for speculators are subjective, because they depend on the particular historical price paid. The exercise decision, and the value in doing so, or the payoff, are objective. [↑](#footnote-ref-4)
5. The determinants of the premium and how the option’s parameter and market factors interact to produce the premium are the subjects of chapters xx and yy. [↑](#footnote-ref-5)
6. Indeed, this is fundamental to all areas of finance. The market determines the price of a security. The individual makes his/her decision *given* the market. [↑](#footnote-ref-6)
7. If the option is entered into on an exchange, the exchange determines whether it will be physically or cash settled. [↑](#footnote-ref-7)
8. Other than possible transactions costs factors. [↑](#footnote-ref-8)
9. Since the price of an asset follows a continuous, rather than a discrete, distribution, the probability of CBI equaling exactly 60 at expiration is zero! [↑](#footnote-ref-9)
10. Remember – the call’s premium is a “sunk” cost. It has no effect at the margin, as explained in chapter 1. [↑](#footnote-ref-10)
11. She actually loses the premium plus interest (explicitly or as an opportunity cost). The amount of interest depends on the interest rate and the time between the option’s purchase and expiration, hence is a function of the call’s original term. Unless specified, we will ignore the interest cost component. [↑](#footnote-ref-11)
12. Plus interest. See the previous footnote. [↑](#footnote-ref-12)
13. This is a general idea. The current price of a stock, bond commodity, etc. is an objective measure. The profit/loss to an owner of any of these assets depends on the price paid, which differs widely across owners. [↑](#footnote-ref-13)
14. If the call writer owns the shares, the combination of the shares and the written call is a “buy-write” strategy, which is examined in section xxx. [↑](#footnote-ref-14)
15. Again, these figures ignore potential interest earned on the premium. [↑](#footnote-ref-15)
16. A few caveats are in order:

    1. This is strictly true only for European-style options.
    2. We are ignoring transactions costs.
    3. We are also ignoring the margin that needs to posted by the short (see previous chapter). Indeed, were it not for the collateral required for margin, the arbitrage profits would be even greater as interest is earned on the net cash received at inception.

    [↑](#footnote-ref-16)
17. The principle of dominance and the no arbitrage profits condition are actually closely related. Return to the no arbitrage argument. Suppose both call premiums are 3/share, so that the arbitrageur who writes the 60-Call and purchases the 40-Call expends no cash (nor does he receive any) at the outset. If CBI is below 40 at expiration, both call expire worthless. If CBI is between 40 and 60, his net profit is the difference between the price and 40. If above 60, his net profit is 20. So, he’ll never lose a penny, but may gain. Everyone will want to do this, again forcing Call40 up and/or Call60 down. This leads to the strict inequality result of dominance. [↑](#footnote-ref-17)
18. This is not the exclusive motivation for short selling. Others include “risk arbitrage” positions following a merger announcement, and “relative value” trades involving two stocks or a stock and a derivative. Note also that the short typically must provide margin in excess of the sale proceeds as collateral. This serves to reduce the risk of “non-performance;” i.e., that she will not be able to return the borrowed shares (similar to the margin demanded by options exchanges – see chapter II.) [↑](#footnote-ref-18)
19. This is actually her gross profit. The short seller’s net profit subtracts (or adds) other cash flows associated with the short position. These include fees for the borrowing, possible interest received for the cask collateral and any dividend payments made by KO in the interim. Together, these determine the “net carry” of the short positon, a concept more thoroughly covered in the next chapter. [↑](#footnote-ref-19)
20. Interestingly, as KO’s price rises in the ITM region, the writer’s payoff becomes less negative. Its slope, in other words, is positive (+1). This suggests that writing a put can serve as a substitute for being long the underlying asset. [↑](#footnote-ref-20)
21. We leave the proof of the strict inequality using the dominance principle as an exercise. [↑](#footnote-ref-21)