Swapskills Pte Ltd

Fundamental Options

Options 101

An option contract gives its owner the right, but not the legal obligation, to conduct a transaction at a certain future date (expiry) at a certain price (strike).

The transaction may be the purchase / sale of an asset or a basket of assets. A call option is a right to purchase the asset, while a put option is a right to sell the asset. The price paid to acquire this right is called the option "premium".

An Analogy

Bad health might mean being incapacitated to work and being slapped with large hospital bills. So we pay a small fee to purchase health insurance to obtain protection during times of ill health. Similarly, investors in every asset class can protect themselves from the price fluctuations of a volatile asset but purchasing options for a small fee called the "premium". By choosing an appropriate strike price, a depreciation in asset value may be offset by the payout of the option.

Inside this issue:

Points Of Interest

- **Reduces the cost and increases leverage for speculators**
- **Premium is only a small percentage of asset value**
- **Allows investors to selectively participate in gains profile while reducing potential downside**
- **Liquid exchange traded and OTC markets**
- **Available for most asset classes**

Types Of Options

European options can only be exercised on the contract's expiration date.

American options are more flexible and can be exercised at any time up to and including the contact's expiration date. This additional flexibility for an option of same maturity makes an American option more expensive than European options. At expiration an American option and a European option will be identical in value. Prior to expiration however, they may have different values and these two types of options are easily distinguishable.

4 Types Of Option Positions

LONG CALL • The buyer of a call option has the right to buy the underlying asset. He is "Long". • The option has value when the price of the underlying asset is higher than the strike price.	**SHORT CALL** • The seller of a call option has the obligation to sell the underlying asset . He is "short". • The option has value when the call is out of the money. The seller of the call option receives the premium upfront.
LONG PUT • The buyer of a put option has the right to sell the underlying asset. • The option has value when the price of the underlying asset is lower than the strike price.	**SHORT PUT** • The seller of a put option has the obligation to buy the underlying asset. • The option has value when the put is out of the money. The seller of the put option receives the premium upfront.

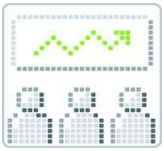
The Owner's Decision

The owner of the option is the one who decides whether to exercise the option.

If the option has value the buyer may either exercise the option or sell it in the secondary market.

Exchange Traded vs. Over The Counter (OTC) Options

Over the counter (OTC) options are predominantly available for currencies, swaps and equities primarily for institutional buyers. Like the forwards market the OTC options market is unregulated and the contracts aren't standardized. There is more inherent counterparty risk associated with these as they aren't backed by clearing houses.



Exchange traded options are listed on major world exchanges and their trading is regulated, standardized, highly liquid and backed by the Clearing Houses of the exchanges.

For What Underlying Assets Are Options Available?

Options are available on several types of underlying assets.

Financial options: These include equity options and other options based on stock indices, treasury bonds, interest rates and currencies. While the strike price for an equity option is quoted in dollar value terms, those for bonds / interest rates are quoted in terms of a yield to maturity or a rate. For FX options, the strike is based on a currency exchange rate. LIBOR based interest rate options have payoffs that are determined by the difference between the LIBOR at expiration and the strike rate in the options contract.

Bond options: They are based on Treasury bonds and are mostly over the counter. Their payoffs are much like equity options, but they are based on bond prices and a specific face value. For example, the buyer of a call option on a bond will gain if interest rates were to fall and the bond price consequently rises. They may be deliverable or settled in cash.

Options on Futures: A call futures option is the option to enter into the long position on a futures contract at a given futures price.

Cash Settlement

This means that the buyer of a call option needn't take ownership of the underlying asset upon exercising his right. Instead he can be asked to be paid the difference between the strike price and the current market price of the asset in a manner as if he took ownership and subsequently sold the asset to the market.

Index Options: These options are cash settled. Nothing is delivered. The payoff is the difference between the index level at expiry and the strike level. The contract is however specified for an agreed number of units of the index. E.g. 1000 units of Nikkei 225 index strike at 4500 and the Nikkei 225 reaches 4745 upon expiry. The call option will hence pay (245*1000).

Swaptions: A swaption is an option to enter into a swap. For example in the world of interest rate swaps, A payer swaption gives its purchaser the right, but not the obligation, to enter into an interest-rate swap at a preset rate within a specific period of time. The swaption buyer pays a premium to the seller for this right. A receiver swaption gives the purchaser the right to receive fixed payments. The seller agrees to provide the specified swap if called upon.

Commodity Options: These give the holder the right to either buy / sell a fixed quantity of some physical asset at a fixed (strike) price. E.g. Barrels of oil, bushels of wheat etc.

Ultra-Vires! A Note on Suitability!

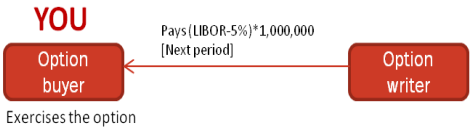
Ultra vires is a latin phrase that means "Beyond your powers". It applies to a corporate body, a government department or a local council so that any act done by the body which is beyond its capacity to act will be considered void. So, before you sell options to a subsidiary of a large corporation with a centralized treasury, or a small town council, make sure they're authorized to partake in option contracts. In the event they aren't, even if you sell them an option, there is no legal onus on them to honour their payouts.

Interest Rate Options and FRAs

Interest rate options are similar to stock options except that the exercise price is an interest rate and the underlying asset is a reference rate such as LIBOR. Interest rate options are also similar to FRAs as there is no deliverable asset and that they are cash settled. A notional amount is agreed and the payoff is based on the spread between the reference rate and the strike rate. So an FRA is sometimes called a Contract for Difference (CFD).

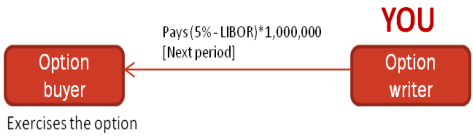
An Example

Example (A) Imagine you own a call option (cap) on LIBOR for a notional amount of $1,000,000 at a strike rate of 5%. At expiration the LIBOR is greater than 5%. Here's what happens—



If LIBOR is less than 5%, the option expires worthless and you'll receive nothing and the option writer keeps the premium.

Example (B) Imagine you sold a put option on LIBOR for a notional amount of $1,000,000 and a strike rate of 5%. At expiration the LIBOR is below 5%. Here's what happens—



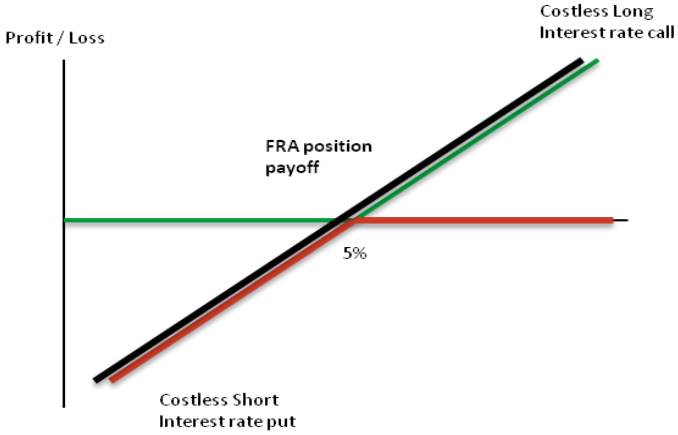
If LIBOR is greater than 5%, the option expires worthless and the owner will receive nothing and you keep the premium.

The payoff on these positions are one sided—
The long call receives a payoff when LIBOR > strike rate
The short put makes a payout when LIBOR < strike rate

Notice that the payment on the interest rate option only happens next period. Interest options "pay in arrears", and this is characteristic to them. An option buyer who is to receive a payout next period, can however ask to be paid the discounted value of the future payoffs instead.

What Happens When The 2 Positions Are Combined?

The combination of a long interest rate call option plus a short interest rate put option will has the same payoff as a Forward Rate Agreement. For costless options the payoff is as below—



Hence by combining these option positions creatively it is possible to create payoffs that mimic those of other assets. This is called synthetically recreating the asset.

Synthetic Positions

Using payoff diagrams, what positions do the following combinations of assets and options replicate?
(Assume that the premium equals the strike price)

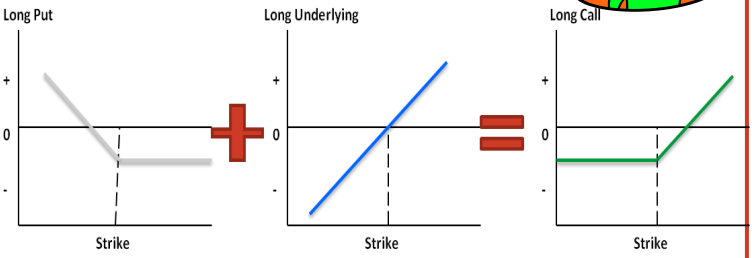
A) Long Put and Long Underlying

B) Long Call and Short Put

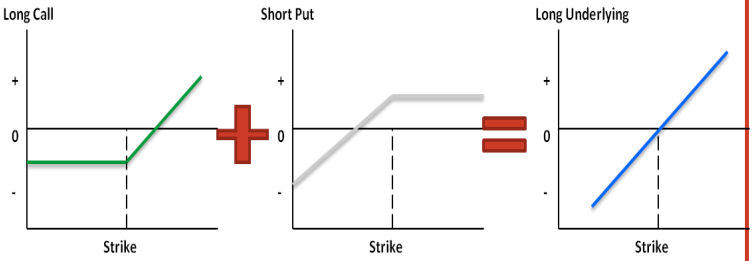
C) Long Underlying and Short call

Answers!

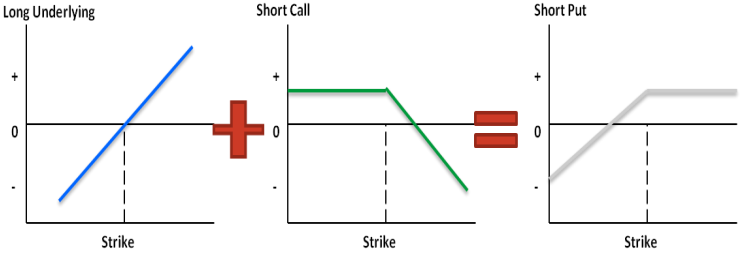
A) Long Put and Long Underlying



B) Long Call and Short Put



C) Long Underlying and Short Call



By combining different positions in the asset and options into portfolios it's possible to structure any kind of payoff curve.
This way an investor can selectively participate in the upswing while limiting his downside and vice versa. Portfolio combinations involving options form a cost-effective way to express a view for investors.

Moneyness Of An Option

Moneyness of an option refers to whether the option is "in the money" or "out of the money".

In the money: If there's a positive payoff associated with immediate exercise of an option, then the option is said to be in the money.

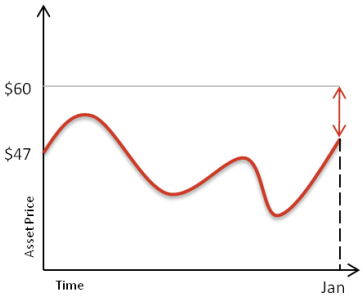
At the money: At the point where the price of the underlying asset is equal to the strike price, immediate exercise will generate a zero payoff and the option is said to be at the money.

Out of the money: If immediate exercise of the option would result in a loss or a negative payoff the option is said to be out of the money.

Moneyness	*Call option*	*Put option*
In the money	Asset Price > Strike price	Asset price < Strike price
Out of the money	Asset price = Strike price	Asset price = Strike price
At the money	Asset price < Strike price	Asset Price > Strike price

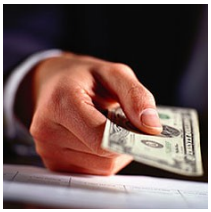
Example

Consider a January 60 call and a January 60 put both on a stock that is currently selling for $47 per share. Calculate how much these options are in / out of the money.



Answer

The call option is $13 out of the money and the put option is $13 in the money.



Option Payoffs For Different Instruments

Calculating the payoff for a stock option or other type of option with a monetary based exercise price, is straightforward. At expiration, a call owner receives the spread between the asset price and the strike price if asset price exceeds the strike and nothing otherwise.

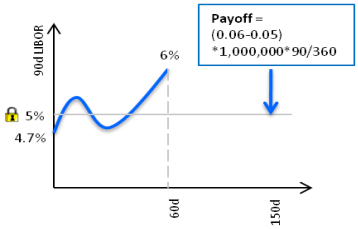
While bonds are quoted in terms of Yield-To-Maturity, T-bills as a discount yield, indices in index points and currencies as an exchange rate, they're all very similar in the sense that their price must be translated to a dollar price and their strike into a dollar based strike.

Interest Rate Options

The payoffs on interest rate options are different! For example, a call option based on 90d LIBOR makes a payment based on a stated notional amount and the difference between 90d LIBOR and the strike rate of the option. The payment is made however not at option expiration but rather 90 days after the expiration date of the option. This payment date often corresponds to the date at which a LIBOR based borrower would make next interest payments on a loan.

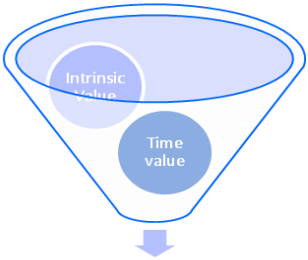
Example:

You buy a 60d call option on 90d LIBOR, and the strike agreed is 5% on a notional of 1,000,000. At expiry LIBOR is 6%. What is the payment to the call and when is it received? (***Remember***: Interest rate options pay in arrears)



Answer: You've got it right! LIBOR did rise at expiry. You as the option buyer will receive a payoff as shown 90 days after expiry of the option.

Value Of An Option



Option Value =
Intrinsic value + Time value

Intrinsic Value: The amount by which the option is in the money. It is the amount that the option owner would receive if the option were exercised.

For Calls
- Max(0, Asset price – Strike Price)

For Puts
- Max(0, Strike price – Asset Price)

Time Value: The amount by which an option's premium exceeds the intrinsic value. At any point during the life of an options contract, its value will typically be greater than its intrinsic value. This is because there is some probability that the stock price will change in an amount that gives the option a positive payoff at expiration greater than the current intrinsic value.

In short, for both European and American options—

Longer the Time to Expiration → Longer Period of Asset Price Volatility → Greater Time Value → Greater Option Premium

Effect Of Exercise Price or Strike Price On Option Price

Given 2 identical puts in all respects except strike:
Higher the strike, higher the option price. This is because the option has greater value to the buyer as he can sell the asset at a higher price.

Given 2 identical calls in all respects except strike:
Lower the strike, higher the option price. This is because the option has a greater value to the buyer as he can buy the asset at a lower price.

Effect Of Interest Rates

$$C = S + P - X/(1+RiskFreerate)^T$$
$$P = C - S + X/(1+RiskFreerate)^T$$

Put Call Parity, which is covered later gives us the above no arbitrage relations for the price of calls and the price of puts in terms of otherwise identical puts (calls), the underlying asset price and a pure discount riskless bond that pays the strike price (X) at maturity.

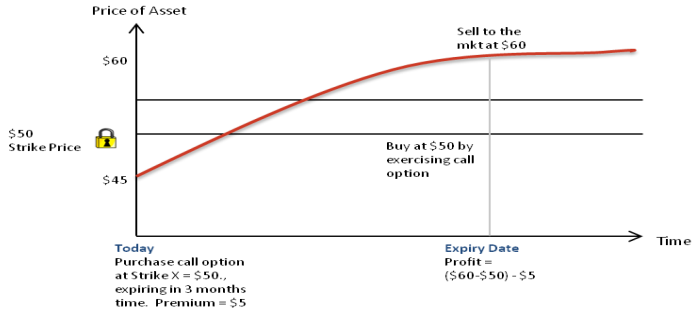
If the risk free rate increases, X/(1+RiskFreerate)^T decreases.
The value of calls increases and the value of puts decreases.

Effect Of Volatility

Option payoffs are "One sided" as you saw earlier.

Since an option's value is always greater than zero even when it expires out of the money, its downside is capped at 0. With greater volatility in the asset price, the potential for upside in the options payoff increases with no greater downside risk.

Call Options: Why Use Them?



Imagine you'd like to purchase an asset in a few month's time but its price has been rather volatile lately. You would like to buy it cheap in market were its price to fall, but are concerned it may be too expensive if its price in the market were to rise above $50.

Scenario 1: Long Call Position

The asset currently trades for $45 per unit. You purchase a call option at a strike of $50 expiring in 3 months time for a premium of $5.

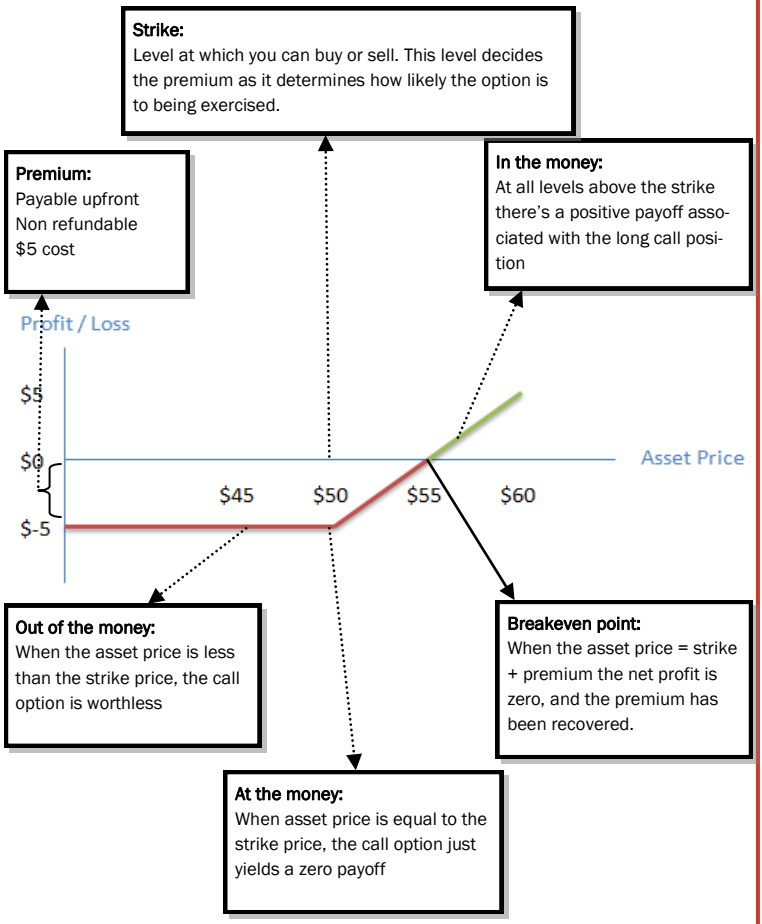
Since it is now cheaper to buy the asset in the market than under the call provision, the option is now worthless and is hence "out of the money." The loss incurred were the price to remain is only the $5 premium.

Some time has passed and the price of the asset is now $50. It now costs the same buy the asset in the market or under the call provision. The option is now "at the money" and the loss incurred is only the $5 premium.

So When Does The Call Option Have Value?

The price of the asset has risen to $60 in 3 months time and the option expires. It's now cheaper to buy the asset under the call provision. The Value of the call option is hence $10, and the payoff from purchasing the option is $5. The option is "in the money" at expiry. Had the price of the asset fallen over the 3 month period the option expires out of the money.

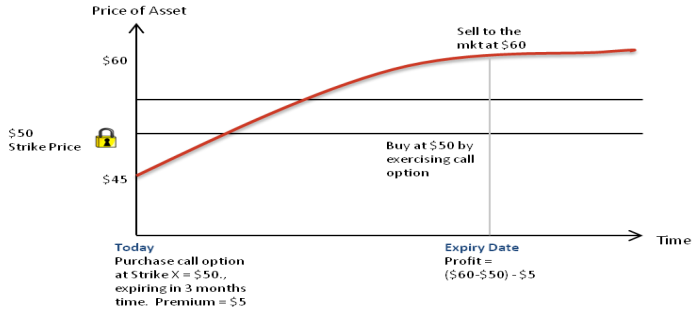
Payoff Plot



The maximum upside potential is unlimited, but the maximum downside is limited to the premium.

Using a payoff profile, an option player can clearly see the value of his position as the underlying reference asset price changes. This transparency is vitally important when considering appropriateness and suitability.

Call options: Why Use Them?



The short call position is the counterparty's position in our previous scenario. The call option writer's view on the price of the asset is that it will not exceed the chosen strike and hence the option will not be exercised. The maximum upside potential in this position is the premium.

Scenario 2: Short Call Position

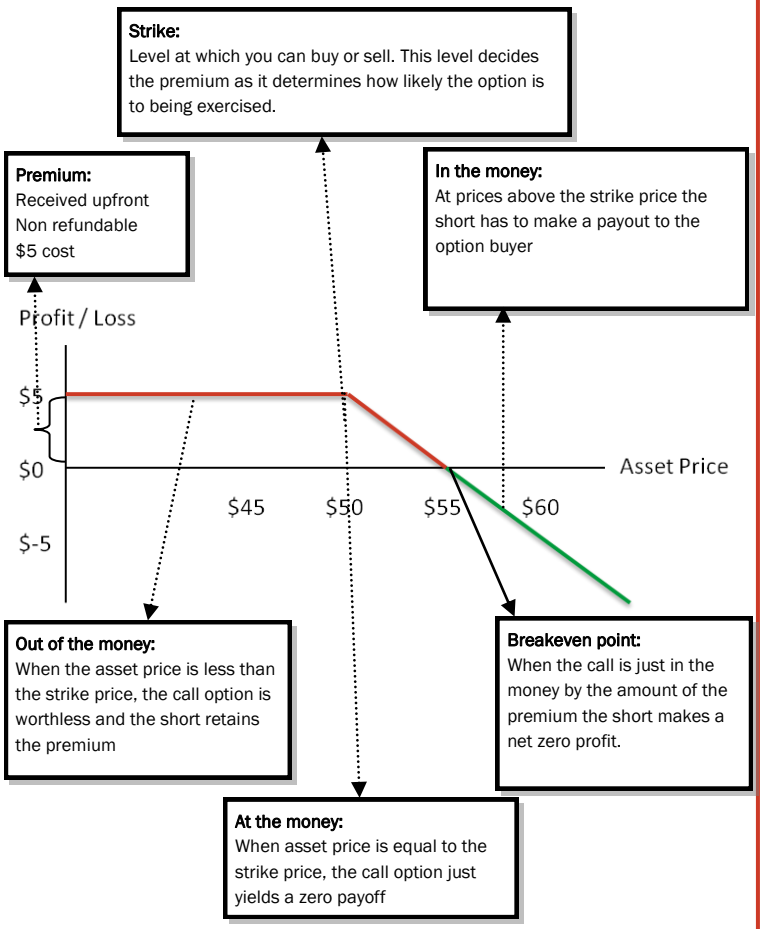
The asset currently trades for $45 per unit. You expect the price of the asset to trend only around the forties and you sell a call option at a strike of $50 expiring in 3 months time for a premium of $5.

One month on, prices are around $42 and the call you've sold is looking good. It is not likely to be exercised. Two months have passed and the price is now $50. The call is just at the money and any further rise in price will require you to make a payout to the option buyer. Surely enough, three months down the price is $60. You now owe the option buyer $60—$50 in dues. The $5 premium was received up front. Hence the net loss to you as the option writer in this case is $10—$5 = $5.

So When Is There Value For The Option Seller?

Banks and other institutions write out options for cash in order to fund other positions or strategies. For a call option writer, the maximum upside is capped at the premium. However it is important to note that the premium charged is a function of the strike price as the strike dictates how likely the option is to being exercised.

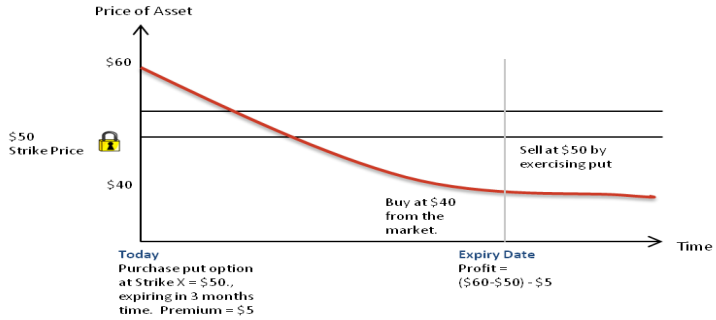
Payoff Plot



The maximum upside potential is limited to the premium earned by selling the option (going "short the call"), but the maximum downside is unlimited if asset prices far exceed the strike.

The option buyer therefore has a credit risk on the option seller. Will the seller be able to honour any potential payout?

Put Options: Why Use Them?



Imagine you'd like to sell an asset in a few month's time but its price has been rather volatile lately. You would like to sell it to the market at the highest price possible were prices to rise, though you'd like to have the right to sell at a predetermined minimum sale price even were prices to fall sharply.

Scenario 3: Long Put Position

The asset currently trades for $60 per unit. You purchase a put option at a strike of $50 expiring in 3 months time for a premium of $5.

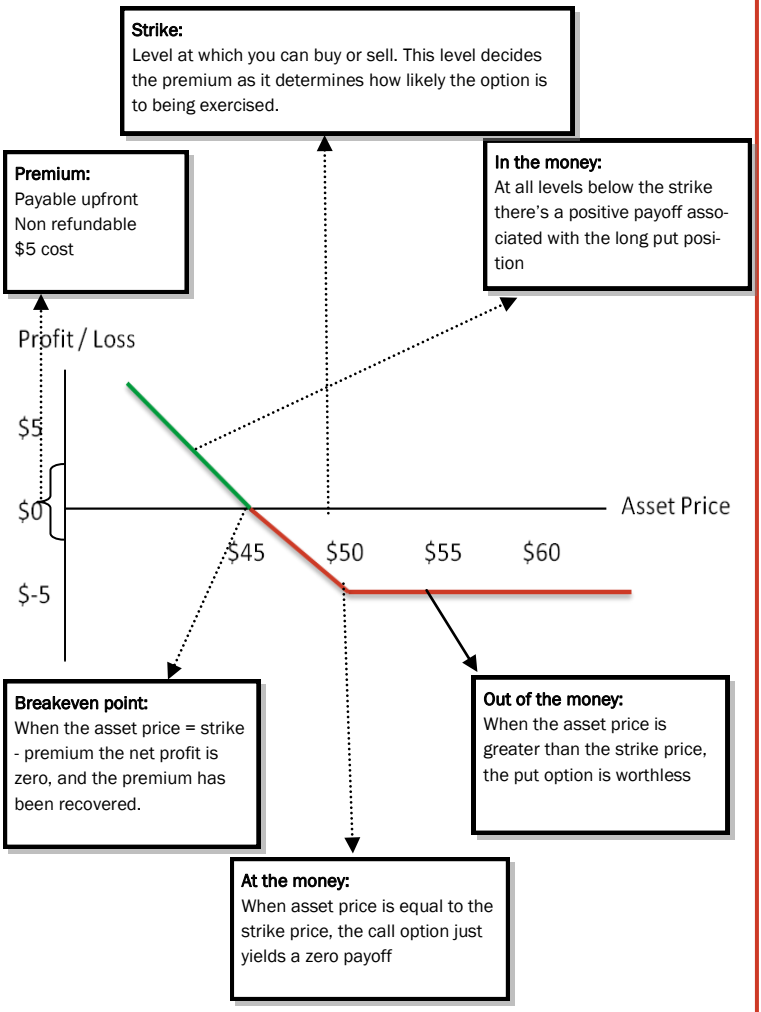
Since it is now better to sell to the market at $60 than under the put provision, the option is now worthless and is hence "out of the money." The loss incurred were the price to remain is only the $5 premium.

Some time has passed and the price of the asset is now $50. It now costs the same sell the asset in the market or under the put provision. The option is now "at the money" and the loss incurred is only the $5 premium.

So When Does The Put Option Have Value?

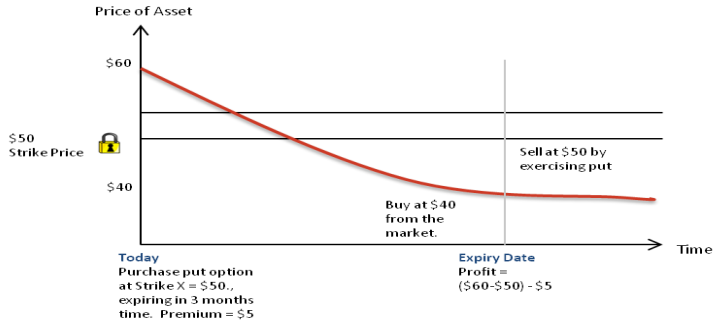
The price of the asset has fallen to $40 in 3 months time and the option expires. It's now better to sell the asset at the higher price under the put provision. The Value of the put option is hence $10, and the payoff from purchasing the option is $5. The option is "in the money" at expiry. Had the price of the asset risen instead over the 3 month period the option expires out of the money.

Payoff Plot



The maximum upside potential is unlimited, but the maximum downside is limited to the premium if asset prices were to exceed the strike.

Put Options: Why Use Them?



The short put position is the counterparty's position in our previous scenario. The put option writer's view on the price of the asset is that it will not fall below the chosen strike and hence the option will not be exercised. The maximum upside potential in this position is the premium.

Scenario 4: Short Put Position

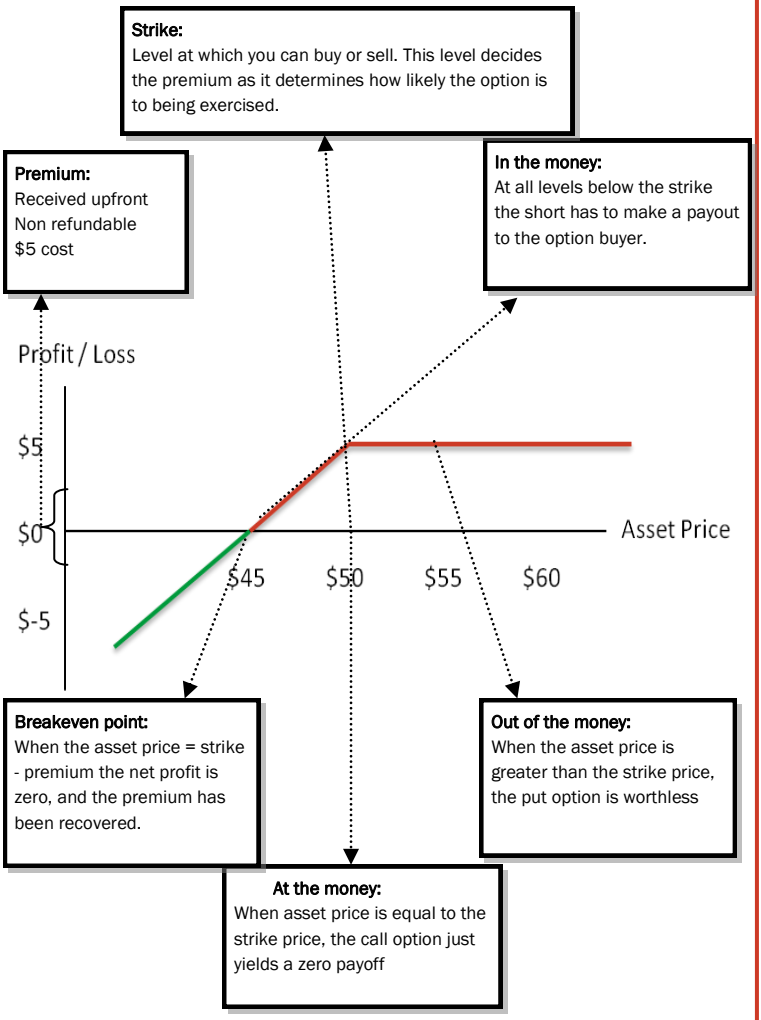
The asset currently trades for $60 per unit. You expect the price of the asset to trend in the sixties and you sell a put option at a strike of $50 expiring in 3 months time for a premium of $5.

One month on, prices are around $63 and the put you've sold is looking good. It is not likely to be exercised. Two months have passed and the price is now $50. The put is just at the money and any further drop in price will require you to make a pay-out to the option buyer. Surely enough, three months down the price is $40. You now owe the option buyer $50—$40 in dues. The $5 premium was received up front. Hence the net loss to you as the option writer in this case is $10—$5 = $5.

So When Is There Value For The Option Seller?

Banks and other institutions write out options for cash in order to fund other positions or strategies. For a put option writer, the maximum upside is capped at the premium, while the downside is limitless were prices to fall way below expected. However it is important to note that the premium charged is a function of the strike price as the strike dictates how likely the option is to being exercised.

Payoff Plot

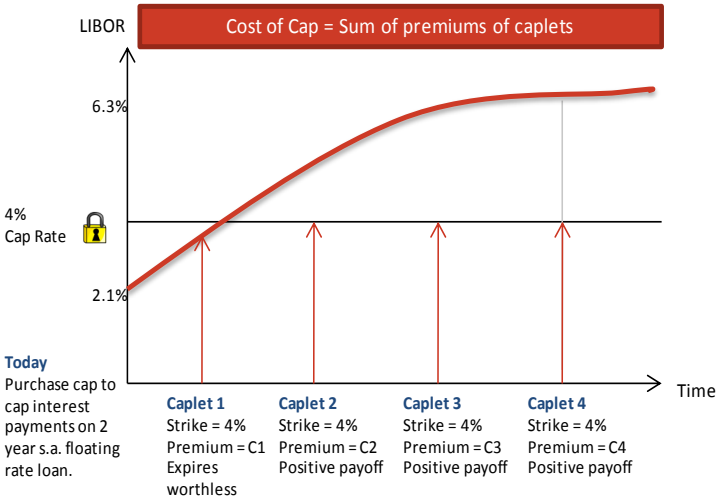


The maximum upside potential is limited to the premium for the short position, but the maximum downside is unlimited if asset prices far fall below the strike.

Uses For Corporates

Capping Borrowing Costs using Interest Rate Caps

If rates remain low a corporation borrowing at a floating rate of interest would prefer to service their loans at this low rate. However, were rates to increase the cost to the borrower is high and corporations may like to limit the amount paid out in interest. This is facilitated using an interest rate cap which is a series of interest rate call options having an expiry date that corresponds to the reset date on a floating rate loan. Each call option in the cap is called a "caplet" and the strike rate for each of these options is called a "cap rate".



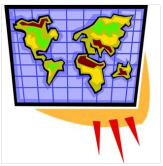
The First Ever Options!

Some say Thales of Miletus did the first option trade when he reserved all of the olive presses six months before the season. He anticipated a great crop, which duly arrived. He then sold out the right to use the presses at very profitable rates!

Hedging Commodity Price Risk

Imagine you are an airline company who purchases jet fuel to run its aircrafts. If the cost of Jet fuel rises above $88/ barrel, your margins will fall steeply and the reduction in profit may drive you out of business. Hence it is possible to hedge the risk of rising jet fuel prices by purchasing call options on jet fuel with a strike price at $88 which will payout if the price is above the $88 strike.

Hedging Currency Risk



Imagine you are an American company and own large subsidiary businesses in Japan and in Switzerland. Since the majority of your receivables are in JPY and CHF, you stand a large risk were the JPY or CHF to weaken versus the USD. A way to protect yourself is by purchasing USD/CHF and USD/JPY call options, which give u the right to call USD (Buy) and put JPY or CHF (sell) at a predetermined rate which help limit your translation risk to the strike rate agreed.

An interesting point to note that—

Long USD/JPY call option on USD = Long USD/JPY put option on JPY

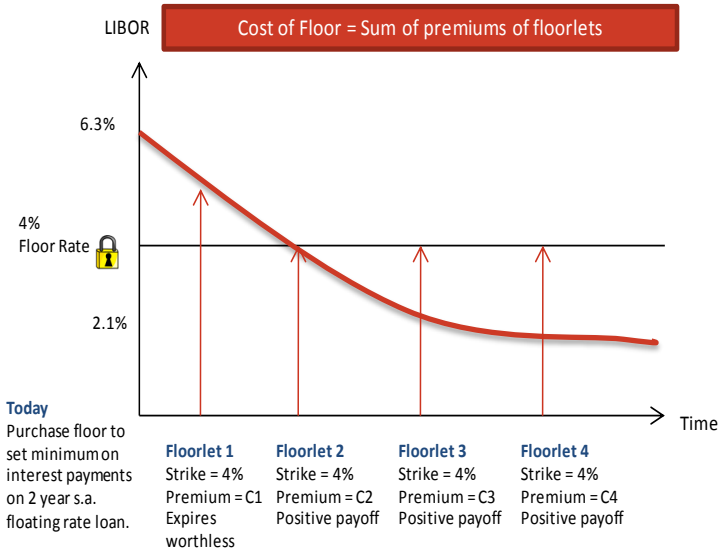
Protecting Sales Margins

Imagine you are a sugar producer. You have capped the commodity price risk on your inputs such as cane and beet by purchasing appropriately priced call options, and your currency risk by purchasing currency options on your receivable currencies. However you still stand a risk that the price of your produce (sugar) will fall. You would like to sell your sugar at a fixed minimum rate if prices were to fall (cut your downside) while still being able to sell to the market if prices were to rise (participate in upswing). In order to protect your profit margins from a steep fall in sugar prices, you can buy put options on sugar at an appropriate strike price.

Uses For Financial Institutions

Ensuring a Minimum Return on Loans (Interest Rate Floors)

If rates were to rise, a financial institution lending at a floating rate of interest would prefer to receive interest payments at this higher rate. However, were rates to fall sharply, return on capital on loans reduces and financial institutions may like to secure a minimum rate of interest received at the time of lending. This is facilitated using an interest rate floor which is a series of interest rate put options having an expiry date that corresponds to the reset date on a floating rate loan. Each put option in the floor is called a "floorlet" and the strike rate for each of these options is called a "floor rate".



Source of Cash for Funding Portfolio Positions

Writing out options for cash can help defray some costs for purchasing other assets. A classic example is an interest rate collar.

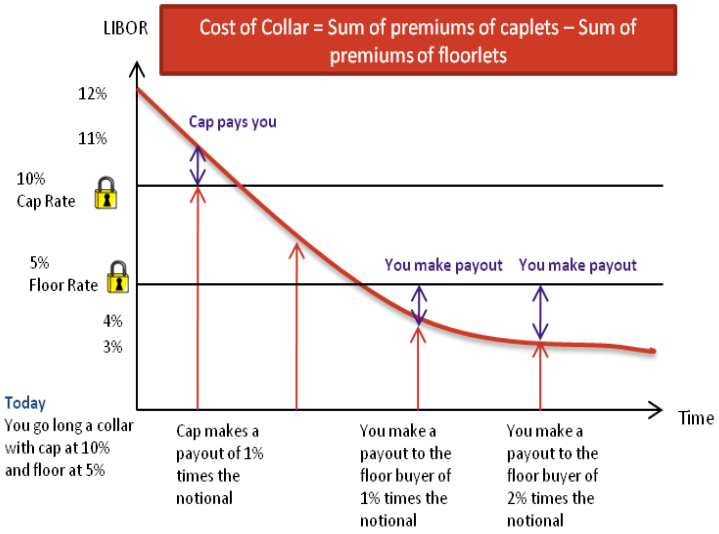
Uses For Financial Institutions

Defraying purchase costs for caps (interest rate collars)

This use applies to corporations as well, and in general for any floating rate borrower.

Imagine you have issued a floating rate bond and are making quarterly payments on 90d LIBOR. You are weary of rates rising above 10% and like to set your maximum payouts at 10%, by *"buying a cap"* with a strike of 10%. However this is proving to be expensive. A way to raise some funds to defray the cost of this protection is by *"selling a floor"* at a strike rate you do not anticipate LIBOR to trend below (say 5%).

If LIBOR>10% the cap will make a payment to offset any interest expense in excess of an annual rate of 10%. However if rates fall below 5%, since we are short the floor we will be required to make a payout. This is shown below—



Uses For Speculators And Leverage

What is Leverage?

Leverage amplifies the outcome of a deal. If the market goes your way, you do really well. If it goes against you, you could lose a lot of money very quickly.

Leveraged Returns

You are a speculator and anticipate a stock to rise in value from $65 to $85 over the next 2 months. In order to cash-in on your view you have a few alternatives—

	The Red Pill 	The Blue Pill 
	Buy one unit of stock at $65 today	Buy a call option for $5 (say) at a strike of $65 expiring in 2 months time
In 2 months if the stock's value is $85, as anticipated.	Returns on initial capital outlay = $20/$65 = 30.76%	Returns on initial capital outlay assuming you sell the call at expiry and no sooner = ($20-$5)/$5 = 300%
If the stock's value had moved to $55 instead	Losses = -$10/$65 = **-15.38%** and you are long the underlying.	Losses = -$5/$5 = **-100%** (You lose your premium)

Clearly we can see that when using options to express your view on the market, the gains and losses are "amplified". This is called using leverage.

Arbitrage using Put Call Parity

We saw earlier that it is possible to replicate the payoff to a particular instrument, using a combination of options. Hence if the underlying is underpriced, speculators can make arbitrage profits by buying the underlying and selling the synthetic position, and by doing the reverse when the underlying is overpriced.

Put Call Parity And Synthetic Positions

Consider the following portfolios where S=asset price, and X=strike —

Fiduciary call		Payoff when	
	Comprises -	In the money call	Out of the money call
	Call option (Strike = X)	S-X	0
	Riskless pure discount bond yields X at maturity	X	X
Total Payoff		S	X

Protective Put		Payoff when	
	Comprises -	Out of the money put	In the money put
	One share of Stock	S	S
	Put option on the stock	0	X-S
Total Payoff		S	X

Put-call parity holds that portfolios with identical payoffs must be equally priced. Since the payoffs from the 2 portfolios are identical, we can express the following relations -

$$C = S + P - X/(1+RiskFreerate)^T$$
$$P = C - S + X/(1+RiskFreerate)^T$$

Hence a call option can be replicated by taking a long position in the asset, a long position in the put option at a similar strike and a short position in the risk free bond that pays X at maturity.

Put-Call Parity and Synthetic Positions

Similarly a put option payoff can be replicated by taking a long position in the corresponding call at similar strike, a long position in a risk free bond that pays X at maturity and a short position in the underlying stock.

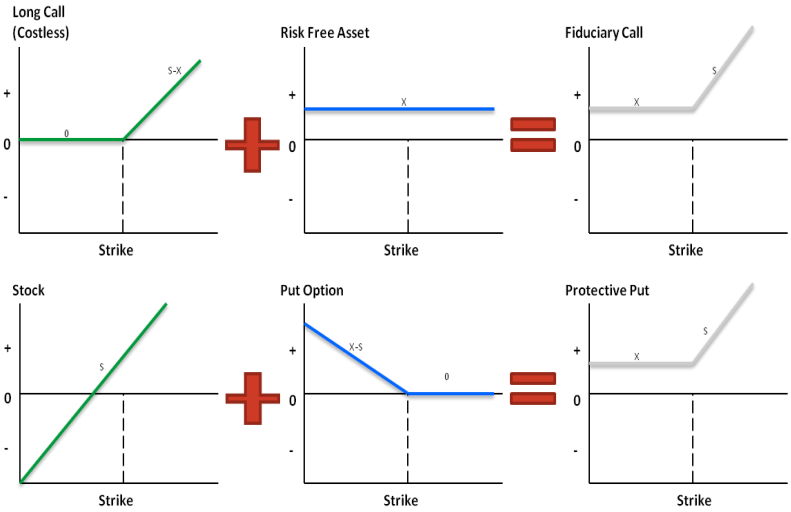
The portfolios on the right hand side of the relation are called a **synthetic equivalents** of those on the left.

> **NOTE**: For these relations to hold though, the options must necessarily be European style options and the strike price on the call and the put must be identical.

Example

Plot the payoff plots of a fiduciary call and a protective put!

Answer:



For you to do the work!

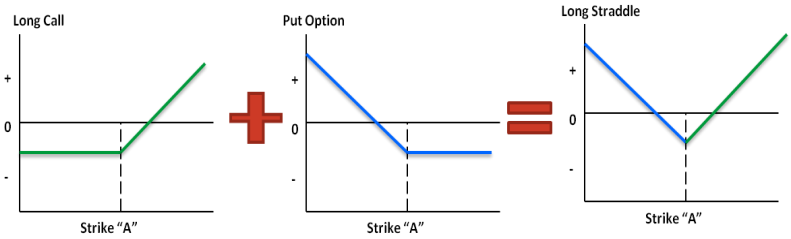
1) You anticipate high volatility in the asset price, but are unsure if the price is going to trend up or down. You expect the price of the underlying to break a specified range. You hence buy a call with a strike "A" and a put also with strike "A". Plot the payoff curve for this portfolio. (**Note:** This portfolio is called a Long Straddle)

2) You are still holding onto the a few lots of the Long straddle position from the previous exercise. But you've just suffered a margin call on another futures position you were holding onto and are pressed for funds at the moment! Suggest what you could do to raise some funds to payoff the margin call. At this point you really do not mind foregoing a little of the upside potential of the long straddle position. (**Note:** We're introducing a new option strategy called the *Short Butterfly)*

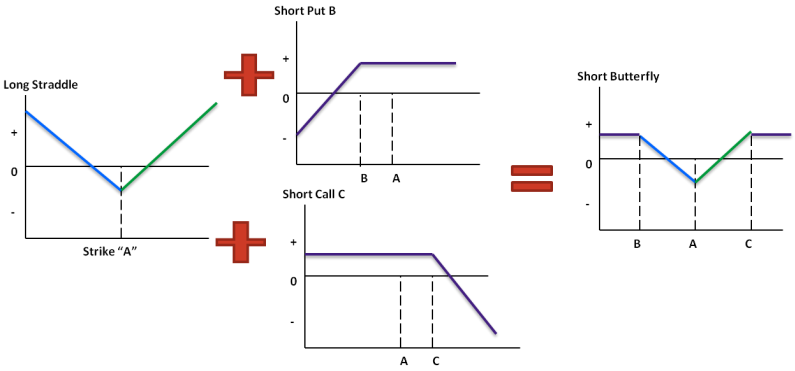
3) A day has passed and the markets are still looking rather volatile and your measure of implied volatility is on a steady rise. Your view is still one of a "Range Break" (the underlying asset will trade out of a specific range). You'd like to cash in on this view, but a straddle is too expensive for you. You hence decide to be compensated at above and below 2 different strike rates. Hence you buy a put and a call at different strikes. Plot the payoff and show why this is a cheaper means of expressing the same view. (**Note:** This premium reduction strategy is called a *Long Strangle*)

Here Are the Answers!

1) Here is the payoff of a long straddle

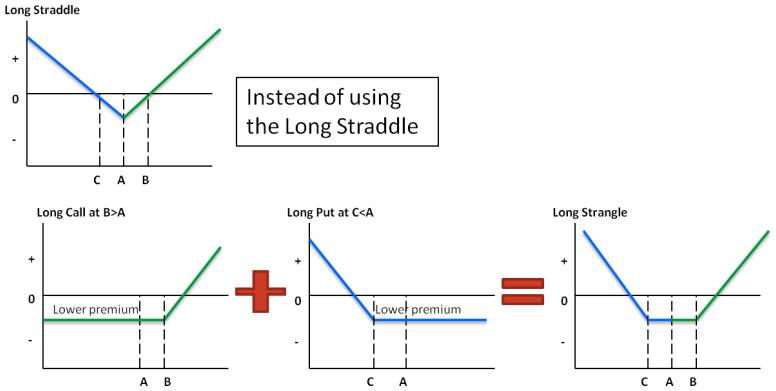


2) You will raise the cash, by selling a put at a strike B < A, and by selling a call with a strike C > A. Take a look at what this does—



The negative payout to the short put position below B, cancels away the upside from the straddle and we retain the call premium below B. The negative payout to the short call position above C, cancels away the upside from the straddle and we retain the put premium above B. We have hence limited the upside potential and collected cash by the sale of the call and the put to cover our margin call.

3) The payoff to the Long Strangle is shown overleaf. If we set the strike lower for the put, the less likely is it to payout as volatility rises and hence the cost of this put is lower. Similarly setting the strike higher for a call reduces its premium.



This hence gives us a cheaper way to make returns in times of increased volatility, the returns nevertheless being lower than that from a straddle.

Notes

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