Chapter 4

Applications of futures and options

The phenomenal growth of financial derivatives across the world is attributed the fulfilment of needs of hedgers, speculators and arbitraguers by these products. In this chapter we first look at how trading futures differs from trading the underlying spot. We then look at the payoff of these contracts, and finally at how these contracts can be used by various entities in the economy.

A payoff is the likely profit/loss that would accrue to a market participant with change in the price of the underlying asset. This is generally depicted in the form of payoff diagrams which show the price of the underlying asset on the X–axis and the profits/losses on the Y–axis.

4.1 Trading underlying versus trading single stock futures

The single stock futures market in India has been a great success story across the world. NSE ranks first in the world in terms of number of contracts traded in single stock futures. One of the reasons for the success could be the ease of trading and settling these contracts.

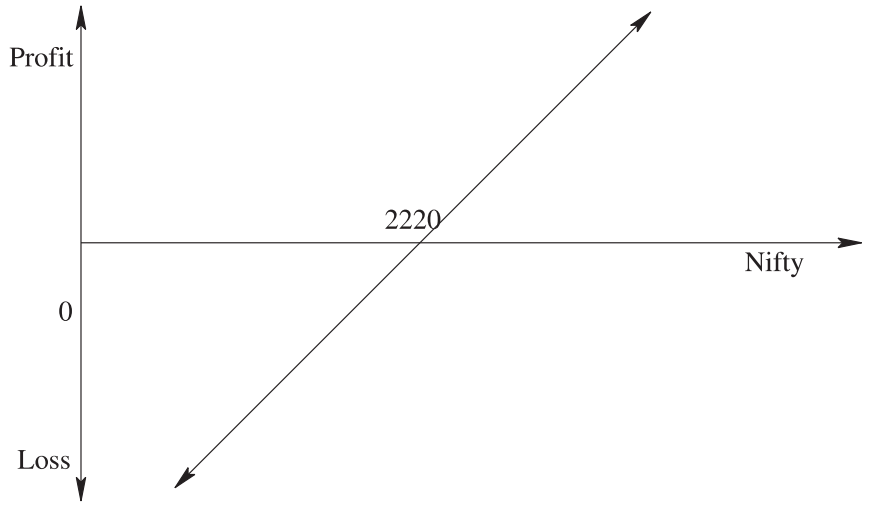
To trade securities, a customer must open a security trading account with a securities broker and a demat account with a securities depository. Buying security involves putting up all the money upfront. With the purchase of shares of a company, the holder becomes a part owner of the company. The shareholder typically receives the rights and privileges associated with the security, which may include the receipt of dividends, invitation to the annual shareholders meeting and the power to vote.

Selling securities involves buying the security before selling it. Even in cases where short selling is permitted, it is assumed that the securities broker owns the security and then "lends" it to the trader so that he can sell it. Besides, even if permitted, short sales on security can only be executed on an up-tick.

To trade futures, a customer must open a futures trading account with a derivatives broker. Buying futures simply involves putting in the margin money. They enable the futures traders to take a position in the underlying security without having to open an account with a securities broker. With the purchase of futures on a security, the holder essentially makes a legally binding promise or obligation to buy the underlying security at some point in the future(the expiration date of the contract). Security futures do not represent ownership in a corporation and the holder

Figure 4.1 Payoff for a buyer of Nifty futures

The figure shows the profits/losses for a long futures position.The investor bought futures when the index was at 2220. If the index goes up, his futures position starts making profit. If the index falls, his futures position starts showing losses.



is therefore not regarded as a shareholder.

A futures contract represents a promise to transact at some point in the future. In this light, a promise to sell security is just as easy to make as a promise to buy security. Selling security futures without previously owning them simply obligates the trader to selling a certain amount of the underlying security at some point in the future. It can be done just as easily as buying futures, which obligates the trader to buying a certain amount of the underlying security at some point in the future. In the following sections we shall look at some uses of security future.

4.2 Futures payoffs

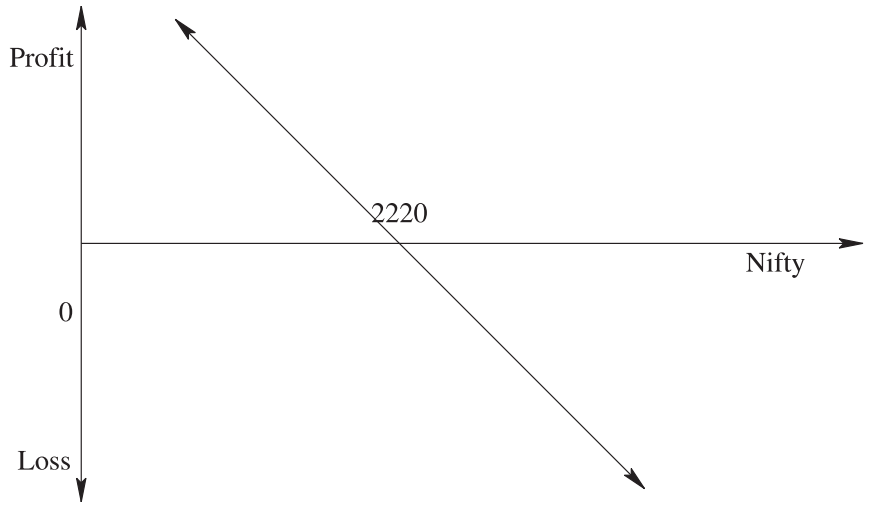
Futures contracts have linear payoffs. In simple words, it means that the losses as well as profits for the buyer and the seller of a futures contract are unlimited. These linear payoffs are fascinating as they can be combined with options and the underlying to generate various complex payoffs.

4.2.1 Payoff for buyer of futures: Long futures

The payoff for a person who buys a futures contract is similar to the payoff for a person who holds an asset. He has a potentially unlimited upside as well as a potentially unlimited downside. Take the case of a speculator who buys a two-month Nifty index futures contract when the Nifty

Figure 4.2 Payoff for a seller of Nifty futures

The fi gure shows the profi ts/losses for a short futures position.The investor sold futures when the index was at 2220. If the index goes down, his futures position starts making profi t. If the index rises, his futures position starts showing losses.



stands at 2220. The underlying asset in this case is the Nifty portfolio. When the index moves up, the long futures position starts making profits, and when the index moves down it starts making losses. Figure 4.1 shows the payoff diagram for the buyer of a futures contract.

4.2.2 Payoff for seller of futures: Short futures

The payoff for a person who sells a futures contract is similar to the payoff for a person who shorts an asset. He has a potentially unlimited upside as well as a potentially unlimited downside. Take the case of a speculator who sells a two-month Nifty index futures contract when the Nifty stands at 2220. The underlying asset in this case is the Nifty portfolio. When the index moves down, the short futures position starts making profits, and when the index moves up, it starts making losses. Figure 4.2 shows the payoff diagram for the seller of a futures contract.

4.3 Pricing futures

Pricing of futures contract is very simple. Using the cost–of–carry logic, we calculate the fair value of a futures contract. Everytime the observed price deviates from the fair value, arbitragers would enter into trades to capture the arbitrage profit. This in turn would push the futures price back to its fair value. The cost of carry model used for pricing futures is given below:

$$\mathrm{F} = \mathrm{S}e^{rT}$$

where:

r Cost of fi nancing(using continuously compounded interest rate)

T Time till expiration in years

e 2.71828

Example: Security XYZ Ltd trades in the spot market at Rs.1150. Money can be invested at 11% p.a. The fair value of a one–month futures contract on XYZ is calculated as follows:

$$\begin{aligned} F &= Se^{rT} \\ &= 1150 * e^{0.11*\frac{1}{12}} \\ &= 1160 \end{aligned}$$

4.4 Application of futures

We look here at some applications of futures contracts. We refer to single stock futures. However since the index is nothing but a security whose price or level is a weighted average of securities constituiting an index, all strategies that can be implemented using stock futures can also be implemented using index futures.

4.4.1 Hedging: Long security, sell futures

Futures can be used as an effective risk–management tool. Take the case of an investor who holds the shares of a company and gets uncomfortable with market movements in the short run. He sees the value of his security falling from Rs.450 to Rs.390. In the absence of stock futures, he would either suffer the discomfort of a price fall or sell the security in anticipation of a market upheaval. With security futures he can minimize his price risk. All he need do is enter into an offsetting stock futures position, in this case, take on a short futures position. Assume that the spot price of the security he holds is Rs.390. Two–month futures cost him Rs.402. For this he pays an initial margin. Now if the price of the security falls any further, he will suffer losses on the security he holds. However, the losses he suffers on the security, will be offset by the profits he makes on his short futures position. Take for instance that the price of his security falls to Rs.350. The fall in the price of the security will result in a fall in the price of futures. Futures will now trade at a price lower than the price at which he entered into a short futures position. Hence his short futures position will start making profits. The loss of Rs.40 incurred on the security he holds, will be made up by the profits made on his short futures position.

Index futures in particular can be very effectively used to get rid of the market risk of a portfolio. Every portfolio contains a hidden index exposure or a market exposure. This statement

is true for all portfolios, whether a portfolio is composed of index securities or not. In the case of portfolios, most of the portfolio risk is accounted for by index fluctuations (unlike individual securities, where only 30–60% of the securities risk is accounted for by index fluctuations). Hence a position LONG PORTFOLIO + SHORT NIFTY can often become one–tenth as risky as the LONG PORTFOLIO position!

Suppose we have a portfolio of Rs.1 million which has a beta of 1.25. Then a complete hedge is obtained by selling Rs.1.25 million of Nifty futures.

Warning: Hedging does not always make money. The best that can be achieved using hedging is the removal of unwanted exposure, i.e. unnecessary risk. The hedged position will make less profits than the unhedged position, half the time. One should not enter into a hedging strategy hoping to make excess profits for sure; all that can come out of hedging is reduced risk.

4.4.2 Speculation: Bullish security, buy futures

Take the case of a speculator who has a view on the direction of the market. He would like to trade based on this view. He believes that a particular security that trades at Rs.1000 is undervalued and expect its price to go up in the next two–three months. How can he trade based on this belief? In the absence of a deferral product, he would have to buy the security and hold on to it. Assume he buys a 100 shares which cost him one lakh rupees. His hunch proves correct and two months later the security closes at Rs.1010. He makes a profit of Rs.1000 on an investment of Rs.1,00,000 for a period of two months. This works out to an annual return of 6 percent.

Today a speculator can take exactly the same position on the security by using futures contracts. Let us see how this works. The security trades at Rs.1000 and the two-month futures trades at 1006. Just for the sake of comparison, assume that the minimum contract value is 1,00,000. He buys 100 security futures for which he pays a margin of Rs.20,000. Two months later the security closes at 1010. On the day of expiration, the futures price converges to the spot price and he makes a profit of Rs.400 on an investment of Rs.20,000. This works out to an annual return of 12 percent. Because of the leverage they provide, security futures form an attractive option for speculators.

4.4.3 Speculation: Bearish security, sell futures

Stock futures can be used by a speculator who believes that a particular security is over–valued and is likely to see a fall in price. How can he trade based on his opinion? In the absence of a deferral product, there wasn't much he could do to profit from his opinion. Today all he needs to do is sell stock futures.

Let us understand how this works. Simple arbitrage ensures that futures on an individual securities move correspondingly with the underlying security, as long as there is sufficient liquidity in the market for the security. If the security price rises, so will the futures price. If the security price falls, so will the futures price. Now take the case of the trader who expects to see a fall in the price of ABC Ltd. He sells one two–month contract of futures on ABC at Rs.240(each contact for 100 underlying shares). He pays a small margin on the same. Two months later, when the futures contract expires, ABC closes at 220. On the day of expiration, the

spot and the futures price converges. He has made a clean profit of Rs.20 per share. For the one contract that he bought, this works out to be Rs.2000.

4.4.4 Arbitrage: Overpriced futures: buy spot, sell futures

As we discussed earlier, the cost-of-carry ensures that the futures price stay in tune with the spot price. Whenever the futures price deviates substantially from its fair value, arbitrage opportunities arise.

If you notice that futures on a security that you have been observing seem overpriced, how can you cash in on this opportunity to earn riskless profits? Say for instance, ABC Ltd. trades at Rs.1000. One–month ABC futures trade at Rs.1025 and seem overpriced. As an arbitrageur, you can make riskless profit by entering into the following set of transactions.

1. On day one, borrow funds, buy the security on the cash/spot market at 1000.
2. Simultaneously, sell the futures on the security at 1025.
3. Take delivery of the security purchased and hold the security for a month.
4. On the futures expiration date, the spot and the futures price converge. Now unwind the position.
5. Say the security closes at Rs.1015. Sell the security.
6. Futures position expires with profi t of Rs.10.
7. The result is a riskless profi t of Rs.15 on the spot position and Rs.10 on the futures position.
8. Return the borrowed funds.

When does it make sense to enter into this arbitrage? If your cost of borrowing funds to buy the security is less than the arbitrage profit possible, it makes sense for you to arbitrage. This is termed as cash–and–carry arbitrage. Remember however, that exploiting an arbitrage opportunity involves trading on the spot and futures market. In the real world, one has to build in the transactions costs into the arbitrage strategy.

4.4.5 Arbitrage: Underpriced futures: buy futures, sell spot

Whenever the futures price deviates substantially from its fair value, arbitrage opportunities arise. It could be the case that you notice the futures on a security you hold seem underpriced. How can you cash in on this opportunity to earn riskless profits? Say for instance, ABC Ltd. trades at Rs.1000. One–month ABC futures trade at Rs. 965 and seem underpriced. As an arbitrageur, you can make riskless profit by entering into the following set of transactions.

1. On day one, sell the security in the cash/spot market at 1000.
2. Make delivery of the security.
3. Simultaneously, buy the futures on the security at 965.

4. On the futures expiration date, the spot and the futures price converge. Now unwind the position.

5. Say the security closes at Rs.975. Buy back the security.

6. The futures position expires with a profi t of Rs.10.

7. The result is a riskless profi t of Rs.25 on the spot position and Rs.10 on the futures position.

If the returns you get by investing in riskless instruments is more than the return from the arbitrage trades, it makes sense for you to arbitrage. This is termed as reverse–cash–and–carry arbitrage. It is this arbitrage activity that ensures that the spot and futures prices stay in line with the cost–of–carry. As we can see, exploiting arbitrage involves trading on the spot market. As more and more players in the market develop the knowledge and skills to do cash–and–carry and reverse cash–and–carry, we will see increased volumes and lower spreads in both the cash as well as the derivatives market.

4.5 Options payoffs

The optionality characteristic of options results in a non-linear payoff for options. In simple words, it means that the losses for the buyer of an option are limited, however the profits are potentially unlimited. For a writer, the payoff is exactly the opposite. His profits are limited to the option premium, however his losses are potentially unlimited. These non-linear payoffs are fascinating as they lend themselves to be used to generate various payoffs by using combinations of options and the underlying. We look here at the six basic payoffs.

4.5.1 Payoff profile of buyer of asset: Long asset

In this basic position, an investor buys the underlying asset, Nifty for instance, for 2220, and sells it at a future date at an unknown price, S_t. Once it is purchased, the investor is said to be "long" the asset. Figure 4.3 shows the payoff for a long position on the Nifty.

4.5.2 Payoff profile for seller of asset: Short asset

In this basic position, an investor shorts the underlying asset, Nifty for instance, for 2220, and buys it back at a future date at an unknown price, S_t. Once it is sold, the investor is said to be "short" the asset. Figure 4.4 shows the payoff for a short position on the Nifty.

4.5.3 Payoff profile for buyer of call options: Long call

A call option gives the buyer the right to buy the underlying asset at the strike price specified in the option. The profit/loss that the buyer makes on the option depends on the spot price of the underlying. If upon expiration, the spot price exceeds the strike price, he makes a profit. Higher the spot price, more is the profit he makes. If the spot price of the underlying is less than the strike price, he lets his option expire un-exercised. His loss in this case is the premium he paid

Figure 4.3 Payoff for investor who went Long Nifty at 2220

The figure shows the profits/losses from a long position on the index. The investor bought the index at 2220. If the index goes up, he profits. If the index falls he looses.

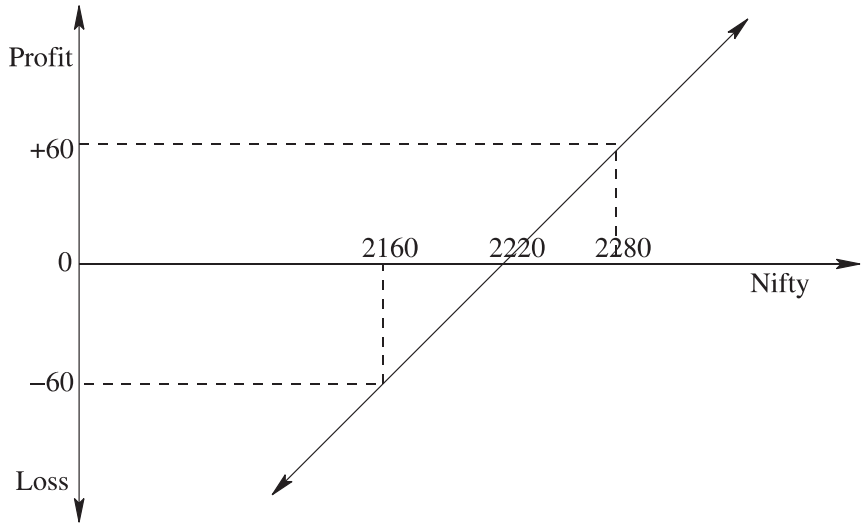


Figure 4.4 Payoff for investor who went Short Nifty at 2220

The figure shows the profits/losses from a short position on the index. The investor sold the index at 2220. If the index falls, he profits. If the index rises, he looses.

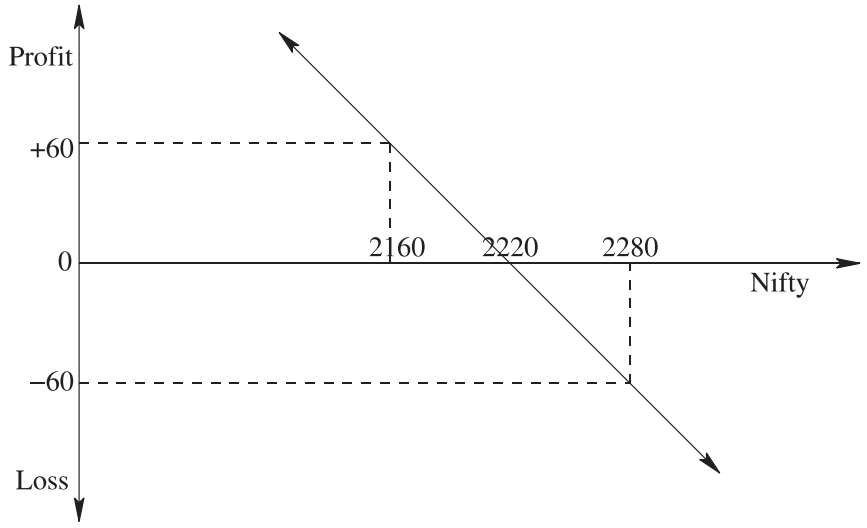
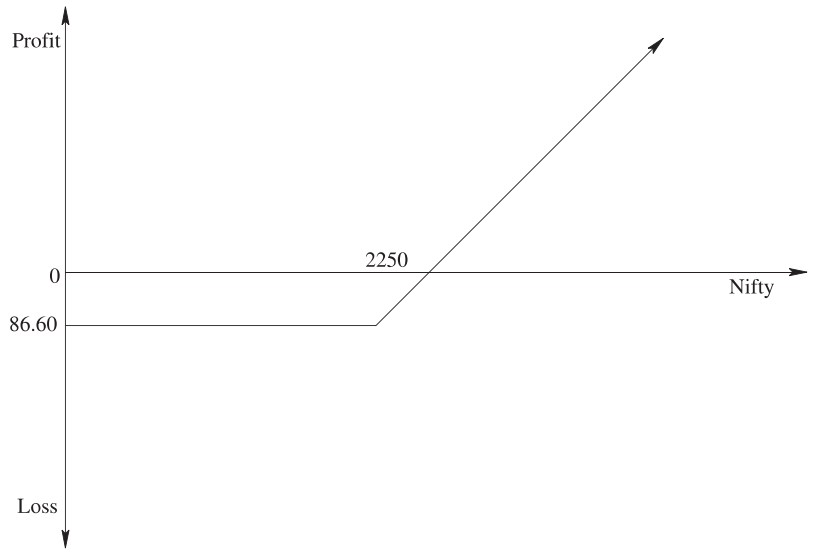


Figure 4.5 Payoff for buyer of call option

The figure shows the profits/losses for the buyer of a three-month Nifty 2250 call option. As can be seen, as the spot Nifty rises, the call option is in-the-money. If upon expiration, Nifty closes above the strike of 2250, the buyer would exercise his option and profit to the extent of the difference between the Nifty-close and the strike price. The profits possible on this option are potentially unlimited. However if Nifty falls below the strike of 2250, he lets the option expire. His losses are limited to the extent of the premium he paid for buying the option.



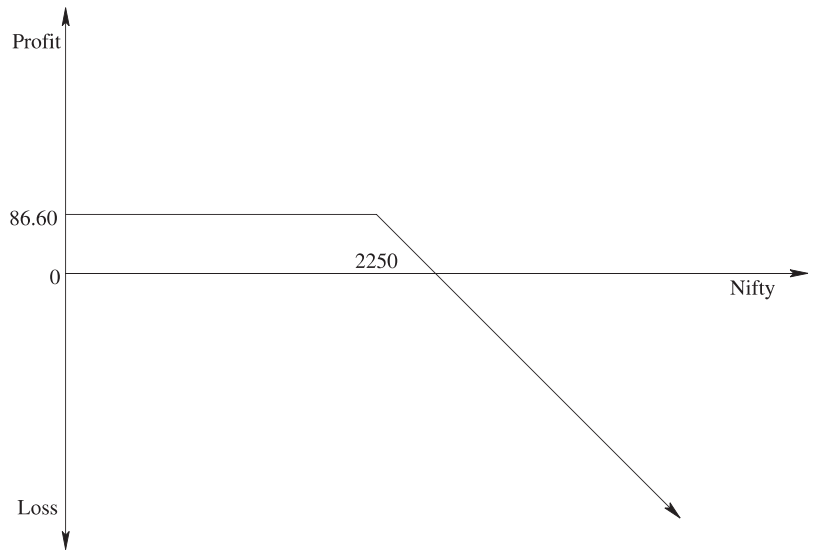
for buying the option. Figure 4.5 gives the payoff for the buyer of a three month call option (often referred to as long call) with a strike of 2250 bought at a premium of 86.60.

4.5.4 Payoff profile for writer of call options: Short call

A call option gives the buyer the right to buy the underlying asset at the strike price specified in the option. For selling the option, the writer of the option charges a premium. The profit/loss that the buyer makes on the option depends on the spot price of the underlying. Whatever is the buyer's profit is the seller's loss. If upon expiration, the spot price exceeds the strike price, the buyer will exercise the option on the writer. Hence as the spot price increases the writer of the option starts making losses. Higher the spot price, more is the loss he makes. If upon expiration the spot price of the underlying is less than the strike price, the buyer lets his option expire un-exercised and the writer gets to keep the premium. Figure 4.6 gives the payoff for the writer of a three month call option (often referred to as short call) with a strike of 2250 sold at a premium of 86.60.

Figure 4.6 Payoff for writer of call option

The figure shows the profits/losses for the seller of a three-month Nifty 2250 call option. As the spot Nifty rises, the call option is in-the-money and the writer starts making losses . If upon expiration, Nifty closes above the strike of 2250, the buyer would exercise his option on the writer who would suffer a loss to the extent of the difference between the Nifty-close and the strike price. The loss that can be incurred by the writer of the option is potentially unlimited, whereas the maximum profit is limited to the extent of the up-front option premium of Rs.86.60 charged by him.



4.5.5 Payoff profile for buyer of put options: Long put

A put option gives the buyer the right to sell the underlying asset at the strike price specified in the option. The profit/loss that the buyer makes on the option depends on the spot price of the underlying. If upon expiration, the spot price is below the strike price, he makes a profit. Lower the spot price, more is the profit he makes. If the spot price of the underlying is higher than the strike price, he lets his option expire un-exercised. His loss in this case is the premium he paid for buying the option. Figure 4.7 gives the payoff for the buyer of a three month put option (often referred to as long put) with a strike of 2250 bought at a premium of 61.70.

4.5.6 Payoff profile for writer of put options: Short put

A put option gives the buyer the right to sell the underlying asset at the strike price specified in the option. For selling the option, the writer of the option charges a premium. The profit/loss that the buyer makes on the option depends on the spot price of the underlying. Whatever is the buyer's profit is the seller's loss. If upon expiration, the spot price happens to be below the strike price, the buyer will exercise the option on the writer. If upon expiration the spot price of the