2

Some Basic Concepts

This chapter introduces the reader to some basic concepts that will be useful when reading subsequent chapters and in gaining a deeper understanding of derivatives. It describes the main types of derivatives, the economic functions of derivative markets and some related concepts.

Types of derivatives

Derivatives are described and classified in many ways. The primary method of describing derivatives is based on the type of contract.

Types of contracts

The main contract types are:

- Forward contracts
  - Futures contracts (which are special types of forward contracts traded through an exchange and thus a sub-set of forwards)
- Swaps (in theory, these are similar to a string of forward contracts)
- Options contracts
- Complex derivatives (futures and options are the basic building blocks of complex derivatives)
  - Forward rate agreements
  - Range forwards
  - Exotic options
  - Collars
  - Swaptions

Underlying

Each of these types of contracts may have as its 'underlying' one of various kinds of assets. Thus, a futures contract can be on the share of an individual

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company (say, Tata Consultancy Services or TCS) or on a commodity (e.g., gold) or on a foreign currency (e.g., Japanese yen) and so on. Similarly, there can be options or swaps on various kinds of underlying assets or liabilities. Derivatives are thus often described on the basis of the type of contract and the nature of the underlying, e.g., 'pepper futures' means a futures contract with pepper as the underlying commodity, a 'currency swap' means a swap contract where the underlying is a foreign currency and so on.

Underlying assets are also grouped into classes, like commodities or financial instruments. Based on this classification, derivatives can be classified into the following.

- Financial derivatives in which the underlying is a financial instrument (individual share, a stock market index, bonds, a foreign currency, a cost of living index, a credit risk etc.).
- Commodity derivatives in which the underlying is a commodity which may include:
  a. gold, silver and platinum often collectively known as 'bullion markets';
  b. base metals like nickel, tin, lead, copper etc.;
  c. 'soft' commodities like coffee, cocoa, cotton, etc.; and
  d. other commodities.
- Weather and catastrophe derivatives in which the underlying is an index related to weather or other natural conditions like rainfall, temperature, etc.

Economic functions of derivatives markets

It goes without saying that an elaborate structure of derivatives markets would not exist without some definite function or purpose. What then, are the purposes and are they economically useful?[1]

The primary economic function and *raison d'etre* of derivatives markets is

1 For a full discussion of this subject, see Chapter 3 of *The Economics of Derivatives*, T. V. Somanathan and V. Anantha Nageswaran, Cambridge University Press, 2015. Academic readers interested in studying the different viewpoints can also refer to the following: J. B. Baer and O. G. Saxon, *Commodity Exchanges and Futures Trading,* Harper & Row, New York, 1948, 30–31; W. R. Natu, *Regulation of Forward Markets,* Asia Publishing House, Bombay, 1962, 16–17; H. S. Houthakker and P. J. Williamson, *Economics of Financial Markets,* Oxford University Press, New York, 1996, 255–56. For a comparative study, see T. V. Somanathan, *Commodity and Financial Futures Markets: An Economic Analysis,* Unpublished Ph D Dissertation, Calcutta University, 1993, 8–13.

the hedging function also known as the *risk-shifting* or *risk transference function*. Derivatives markets provide a vehicle by which participants can hedge, i.e., *protect themselves from adverse price movements in a commodity or financial instrument in which they face a price risk, by transferring that risk to others*. This primary function is common to all derivative instruments: futures, options, swaps and exotic derivatives, whether or not they are exchange traded.

Apart from this primary function, some kinds of derivatives may perform secondary economic functions. The secondary (or incidental) functions are the following:

- Price discovery function: Futures markets provide a mechanism by which diverse and scattered opinions of the future are coalesced into one readily discernible number which provides a 'consensus of knowledgeable thinking'. Organised spot markets perform a price discovery function too, but only in respect of the spot (i.e., current) price. Futures prices provide an expression of the consensus of today's expectations about some point in the future. By publishing and disseminating this, they also perform an *information* or *publicity function*. The process of price discovery also leads to the *inter-temporal inventory allocation function,* by which market participants are able to compare the current and future prices and decide the optimal allocation of their stocks of an asset between immediate sale and storage for future sale. Over-the-counter transactions where prices are not published do not contribute to price discovery. Options and swaps do not directly contribute to price discovery for the underlying itself.
- Information discovery: Options and swaps markets do not contribute to price discovery in the underlying itself. However, they may contribute useful information by helping to discover the prevailing market perceptions of the level of various risks. For example, the market for Credit Default Swaps helps to 'discover' the probability (according to market perceptions) that a particular borrower will default. The actual practical utility of such information is however, debatable.
- Financing function: The trading of contracts in derivatives exchanges makes it easier to raise finance against stocks of commodities, since lenders have an assurance of quality and quick liquidity. Again, this function is not unique to futures or derivatives as spot markets perform the same

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function. However, there is a small part of the financing function that is unique to derivatives markets. This is the fact that lenders are often more willing to finance hedged inventories than unhedged inventories, since the former are protected against risk of loss of value.

- Liquidity function: Futures markets operate on a fractional margin whereby the buyer and seller deposit only a fraction of the contract value (say 10 per cent) at the time of entering into it. This enables traders to buy and sell a much larger volume of contracts than in a spot market, and makes markets more liquid, so that large transactions can be put through with ease. Other derivatives also do not require the payment of the full value of the underlying and so perform the financing function.

Price stabilisation and destabilisation

While the functions noted above are not disputed, there is another function which is the subject of debate and controversy. Traditionally, economists believed that speculation on markets is stabilising in nature and therefore that futures trading, by facilitating speculation, performs a price stabilising function by reducing the amplitude of short term fluctuations. However, in more recent years, it has been shown that in certain circumstances and situations, futures trading can exercise a destabilising influence too. Other derivatives, which do not perform a price discovery function for the underlying, do not have a stabilising influence.

An alternative view: Futures markets as implicit loan markets

In the discussion above, hedging (to avoid price risks) was treated as the primary function of futures markets. This is the conventional consensus in the literature. Jeffrey Williams challenged this consensus and opined that futures markets are primarily implicit loan markets which enable commodities to be lent and borrowed, just as the money market enables money to be lent and borrowed. According to Williams, like money, commodities also have a 'transactions' and 'precautionary' demand. Users will pay to have access to a commodity. For example, a wheat mill may be willing to pay to have access to wheat stocks (beyond normal predictable requirements) to take care of any disruption in

supply, so that idle time of costly machinery is prevented. The motive is similar to that for having a line of credit with a bank, for access to money in case of a sudden need for working capital. Thus, the commodity has a 'yield' to the access-holder. One way of having access is to buy the commodity, but since the need is temporary, another way is to borrow it.

According to Williams, hedging is essentially a repurchase agreement akin to the repurchase or 'repos' transactions in the financial markets. In a repurchase transaction, sale and pre-determined repurchase of a bill or bond is used as a device for borrowing/lending money. The difference between the sale and repurchase prices is the interest to the lender. In Williams' view, the commodity lender charges a commodity-specific interest rate as a reward for parting with its use value or yield, but he has to simultaneously borrow money and pay interest thereon. The interaction between the money interest rate, the commodity-specific interest rate and the physical storage cost determines the relationship between spot and futures prices.[3]

A detailed discussion of Williams' theory is beyond the scope of this book. The implicit loan market concept adds a new perspective, but, given the strong evidence that many users actually use the markets for hedging, it is somewhat difficult to accept it as the primary function of futures markets.

Derivatives trading: A 'zero sum' activity

Derivatives' trading is almost always a 'zero sum game' where gains of one party are equal to the losses of the counter-party. However, this does not by itself imply that derivatives trading has no economic utility.

The 'zero sum' characteristic is not confined to derivatives. When existing shares are bought and sold on the stock exchange (ignoring transaction costs and taxes), the buyer will gain exactly as much as the seller loses (notionally) if share prices go up, and vice versa if share prices go down. If A buys a share of Reliance at ₹ 800 per share from B and if after a month, the price of Reliance shares is ₹ 850, then A's ₹ 50 unrealised profit is the same as B's ₹ 50 notional loss. Seen in this context, the trade is indeed zero-sum. However, this does not imply that this type of trading has no social utility. Continuous trading helps in price discovery, and makes investors more willing to buy and to hold shares, which indeed makes a real difference to companies in raising capital from investors. Effectively, *the presence of a liquid secondary market makes*

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it easier to raise resources on the primary market and thus lowers the cost of capital. Likewise, the presence of an efficient futures market enhances the efficiency of the spot market.

Another simple example of a zero sum but socially useful financial instrument is group or mutual insurance. If 1,000 workers in a farming community get together and decide to pay ₹ 1 per day and distribute all the premium proceeds to whoever happens to die that year, it is a zero sum activity; but it is obviously socially useful because it reallocates and spreads the risk. Similarly, derivatives too can be useful in allocating risk from those less willing or able to bear it to those more willing or able to bear it, and in other ways. Trading of futures, options, swaps and other derivatives gives market participants better information on the likely range of future prices, default probabilities, price volatility etc. Therefore, while there may indeed be valid criticisms of derivatives markets, the fact that they are'zero sum' is not one of them.

The 'law' of one price

In economic theory, if markets are free and efficient then, ignoring transport and transaction costs and tariffs, all goods will cost the same throughout the world. This is called the 'law' of one price though, like many 'laws' in economics, it is based on specific restrictive assumptions and may not actually be true in real life.

A more realistic formulation of this 'law' is that when transport costs, transaction costs and tariffs are low, prices of goods are not likely to diverge much between countries. For example, crude oil whether it is delivered in Europe or in India does not have a large price difference. Therefore, crude oil derivatives traded in India denominated in rupees often 'track' (i.e., are closely correlated with) the crude oil market in other countries, adjusted for exchange rate fluctuations.

The 'law' of one price is 'enforced' in the marketplace through arbitrage (see next section). In the marketplace for real goods, traders, exporters and importers buy and sell to reduce the difference between prices at different locations. In the derivatives marketplace, financial traders do the same, with the added contribution of removing price discrepancies over time too. Therefore, ignoring currency movements, just one derivative for each underlying could be theoretically enough for global use. In the case of crude oil, even if an importing country does not have a separate derivatives contract, local speculators and

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hedgers may be manage most of their price risk by just trading in the foreign contract. They might still need local derivatives to hedge their currency risk. However, if the commodity is costly to store and transport, then no global standardised derivatives contract can be used as a benchmark. Natural gas is a good example. Unlike crude oil (or agricultural products and metals), natural gas is difficult to transport and hence the landing price in an importing country can be many times higher than the price in the exporting country.

If understood properly, the 'law' of one price is a useful theoretical concept in helping market participants identify opportunities for profitable arbitrage and identify situations where 'mispricing' (i.e., pricing not reflecting market conditions accurately) occurs. However, when the assumptions do not hold, the 'law' may not work.

Hedging, speculation and arbitrage

It was noted earlier that the primary purpose of derivatives markets is to provide hedging facilities to those who wish to transfer risks. When one party transfers risks, there has to be another party to take on the risk. In some cases, two parties may have opposite risks and may be able to transfer the risk in a mutually beneficial manner – for example, when a rice mill and a paddy farmer are able to agree on a future price, both are benefitted by reduced uncertainty, but such exact equivalence of quantity, value and timing would only be a rare coincidence. Taking futures markets as an example, *a priori,* there is no reason why the volume of sales by hedgers should equal the volume of purchases by hedgers, since these groups have different reasons for hedging and respond differently to price changes. If a futures market was restricted to hedgers alone, it is quite conceivable that one or other group of hedgers – the longs or the shorts,would be unable to hedge because of the absence of counterparties to the transactions.

Risk transference: The speculator's role

It is here that the role of the speculator becomes apparent. Speculators take up the slack in the market and provide liquidity for both long and short hedging. The speculators have no specific interest in the commodity *per se.* They are risk seekers whose interest stems from the profit which they expect to make from assuming the price risk.

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A liquid and active hedging market cannot exist without speculation. In a broader sense, one could say that futures markets are an extension of the principle of specialisation: speculators take onto themselves the burden of bearing risk. By specialisation in this field, they are able to carry the risks better than other market participants. For those (i.e., hedgers) who are mainly interested in the use of a commodity, price risk is a nuisance that they would normally prefer to do without. Futures trading enables them to delegate this process to the breed of speculators, leaving the hedgers to specialise in what they know best. Thus, hedging in cotton enables the textile mill to concentrate on its manufacturing activity instead of cotton price fluctuations, while hedging in foreign exchange enables the exporter to concentrate on export price and quality, instead of worrying about exchange rates.

Thus, derivatives market participants are of two main types:

- hedgers who are off-loading price risk so as to *avoid loss*; and
- speculators who are taking up price risk in order to *make profit*.

Arbitrage

It was seen earlier that the law of one price indicates that the price of a particular good or instrument should tend to be the same between different locations, unless there are transport costs, transaction costs or tariffs. Arbitrage is the term used to describe transactions that involve buying and selling a good or asset in two different markets in order to achieve a riskless profit through the difference in price between them. While hedgers and speculators are the two main types of participants in the markets, the arbitrageur is a third type of participant – one who trades only to realise profits from discrepancies in the market. Of course, in real life the arbitrageur is not a separate class of person: either a hedger or a speculator can indulge in arbitrage when the opportunity arises.

Example 2.1

On a particular day, the shares of X Ltd are selling at ₹150 in the NSE while at the same time the price in the BSE is ₹ 152. A stockbroker simultaneously buys the share in the NSE and sells it in the BSE. By doing so, he realises a profit of ₹2 without any risk. This is an arbitrage transaction.

Example 2.2

A commodity is trading at ₹ 5,000 per tonne in the spot market and at ₹ 5,200 per tonne in

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the futures market for delivery after one month. The interest rate is 12 percent per annum, i.e., 1 per cent per month. The storage cost (including insurance) of the commodity is 6 per cent per annum, i.e., 0.5 per cent per month. In this case, it is possible to earn a riskless arbitrage profit by simultaneously buying on the spot market and selling the one-month futures:

Buy 1 tonne on the spot market for:	*5,000*
Incur 1.5 per cent thereof as interest and storage cost:	*₹ 75*
Total cost:	*₹ 5,075*
Selling price on futures market:	*₹ 5,200*
Profit:	*₹ 125*

Note that the cost or value of every element in this transaction can be fixed at the time of entering into the transaction and is not dependent on future events.

Arbitrage plays a big role in ensuring that prices in futures markets do not diverge from the level dictated by supply and demand and in ensuring speedy correction of any pricing anomalies. In the Example 2.1, the arbitrageur bought shares in the cheaper (BSE) market. By adding to the demand in that market, he exerted an upward pressure on the price. At the same time, he sold in the costlier (NSE) market. By doing so, he added to the supply and imparted a downward push to the price there. In Example 2.2, the arbitrageur bought in the spot market and sold in the futures market; he added to demand in the spot market thus imparting upward pressure on the spot price and sold in the futures market exerting downward pressure on the futures price. This type of arbitrage will continue until the price difference is eliminated. Thus, arbitrage opportunities are temporary and self-correcting. Arbitrage is even more effective in derivatives markets (compared to spot markets) because of the higher liquidity and ease of trading.

Wider use of the term 'arbitrage'

Nowadays, the term arbitrage is also used somewhat loosely to describe any trade where positions of opposite direction are taken in the same or a similar underlying, even if the trade is not completely riskless. The so-called arbitrage is based on a statistical analysis of the past which shows that a particular ratio or numeric value has normally prevailed in the past. In practice, such arbitrage trading (statistical arbitrage) has often led to large unexpected losses. Therefore, the reader should always consider the term in its proper context and not assume that arbitrage is necessarily risk-free.

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Example 2.3

The various outcomes of a single die throw can be marked as {1,2,3,4,5,6} [all equally probable], and the outcomes of a coin toss as {0,6} [corresponding to tails and heads respectively, and again both equally probable]. The average outcome of the die throw is 3.5, (i.e., 21 divided by 6) and that of the coin is 3. Consider a game where the player will receive a payment of one rupee multiplied by the result of the die throw and lose one rupee multiplied by the result of the coin toss. Thus, the player is 'long' on the die throw and 'short' on the coin toss. The combined outcome of the two actions would range from −5 (die =0, coin = 6) to +6 (die= 6, coin =0) with the probability of each of these outcomes being $1/12^{th}$ each. However, if we repeated this many times, we would on average make half a rupee every turn of this 'game', i.e., 3.5 minus 3 multiplied by one rupee. A strategy of repeatedly combining these two actions would be a highly simplified example of statistical arbitrage. If players play this game long enough, they will ultimately come out ahead. If they play this game a 1,000 times, they are likely to earn for themselves ₹500. But they have a $1/144^{th}$ chance of losing ₹10 in the first two rounds, even though the expected gain is only 50 paisa; in other words, the loss in the first two rounds could be ten times the expected gain. If the transaction had been 'geared' by taking debt (such that the amount payable was the outcome of the die throw /coin toss multiplied by ₹10, say), the consequences could be larger. If the game was being played by a small boy with ₹10 in his pocket it may mean that he would not be able to even play the game beyond the first two rounds even though in the long run he could earn a decent sum. Institutions and individuals with deep pockets (i.e., sufficient capital to withstand initial losses) can however, play this game with success.

In real life, most examples of statistical arbitrage involve probabilities that are based on past observation and not *a priori* probabilities as in throwing a coin or a die. This introduces a much greater level of risk. The collapse in 1998 of Long Term Capital Management, a hedge fund managed by Nobel laureates, happened because spreads on bonds and derivatives that were expected to narrow actually widened because of unexpected events (the Russian sovereign default). Since the fund was highly leveraged, it could not by its own admission remain 'solvent longer than the market could remain irrational' (to quote John Maynard Keynes). This is why strategies like statistical arbitrage are sometimes called 'picking small coins in front of a roller coaster'. The higher the leverage used by the statistical 'arbitrageur', the bigger and closer the roller coaster gets. Statistical arbitrage depends heavily on mean reversion, or the closing in of spreads that 'should' be either narrower or 'should' not exist in the first place. But, things do not always turn out the way they should' and the theories that indicate convergence are usually merely theories.

When combined with the risks from leverage, statistical arbitrage is often not low risk at all and the use of the term 'arbitrage' (though well-established among

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industry participants) is actually misleading. In this book, the term 'arbitrage', when used without any prefix or suffix, is generally used in its precise economic sense of a riskless transaction, and the terms 'arbitrage trading' or 'statistical arbitrage' are normally used to refer to the looser concept of a trade which is not completely risk-free but expected to be low risk based on past observation.

Hedging vs. insurance

Insurance is essentially confined to those types of risks, which are subject to some form of theoretical or empirical probability distribution. In any insurance contract, the assumption is that the probability of loss (that is, the probability of the risk coming true) to any one individual is less than the probability of no loss. Thus, the eventuality against which insurance is taken is always more remote than the prospect of no loss. Furthermore, the risks are often independent of each other. The occurrence of a fire in Kolkata does not increase the risk of a fire in Delhi. Because of this, risks can be pooled,through insurance, among many people.

For market price risks however, this is not the case. These are highly unpredictable (notwithstanding the vast industry of analysts who make a living from predicting them), and are not subject to any reliable probability distribution. Both the size, as well as the frequency of risks are too large for conventional insurance. Risk pooling also may not apply. If the market price moves in an unanticipated direction, all participants may be affected at the same time, so no pooling may be possible. Hence, the need arises for hedging as a form of risk transference. Insurance cannot, and will never be able to, perform this role.

The distinction between insurance and hedging can perhaps be better understood on an analytical plane by looking at the distinction between risk and uncertainty. Knight used the distinction between objective and subjective probabilities to distinguish between 'risk' and 'uncertainty' with risk being insurable and uncertainty being non-insurable.[2]

In terms of this analytical distinction, hedging can, therefore, be described as a method of *protection against uncertainty* (with 'uncertainty' used in its economic sense à la Knight). However, it provides a lower degree of protection than insurance since (as will be seen later) hedges are often only partially effective.

2 F. H. Knight, *Risk, Uncertainty and Profit*, Houghton Mifflin, Boston, 1921, 224–25.

Speculation vs. gambling

Critics of derivatives markets argue that the speculation which such markets engender is little different from gambling and should therefore be discouraged. However, there are several important differences between speculation and gambling, as Baer and Saxon[3] very clearly brought out. Firstly, speculation is based on existing risks, which are not created by the speculator. Gambling, on the other hand, usually involves the deliberate creation of risks for the purpose of laying the wager. The risks inherent to producers and consumers in commodity prices would not disappear if speculation were eliminated whereas a horse race has no 'risk' unless a person chooses to gamble. Thus, speculation is a transaction involving transference of risk while gambling is an exercise in the deliberate creation of risk. Secondly, there is a legal distinction. Many speculative contracts, and particularly futures contracts on a recognised exchange, are recognised by law as contracts in which the speculator is fully and legally bound. In fact, when a person enters into a futures contract, there is no way of determining whether he is a speculator or hedger purely by examining the contract itself. The distinction between a speculative futures contract and a hedge contract lies purely in the intention of the party concerned. On the other hand, a gambling contract may not be enforceable in law, as it does not involve giving and taking of valid consideration. Thirdly, speculation is arguably an integral part of the marketing process and has been shown to play a useful role therein. It thus has economic utility. Gambling serves no such purpose. However, many modern derivatives markets do bear resemblance to pure gambling vehicles and in practice, the distinction is not always clear. This is particularly so in those markets where there is little or no hedging activity and most participants are speculators. The increasingly frequent use of the term 'bet' by modern financial writers in the context of financial investments is a clue to the growing similarity between speculation and gambling especially in the case of exotic derivatives.

Is speculation desirable?

The short answer to this question is yes, though the longer answer is more complicated. Speculation is distinct from manipulation, which is a deliberate attempt to move the price artificially in a favourable direction, which is always

3 Baer and Saxon, *Commodity Exchanges and Futures Trading, op. cit.*, 58–63.

undesirable. Without speculation, as has already been pointed out, there can be no effective hedging since the volume of demand for long and short hedging will not be equal except by occasional coincidence. Secondly, speculative activity increases the liquidity of markets thereby enabling hedgers to transact large volumes of business on the market quickly, easily and without unduly affecting the market price. In a 'thin' market, a single large transaction would have an unduly high impact on the market price and might, in the process, defeat the aims of the hedger. Thus, speculation, by facilitating hedging and increasing liquidity, reduces the costs of marketing. The reduction in marketing costs accrues (eventually) to the consumer.[4] Thirdly, speculation in futures markets is expected, in conventional theory, to reduce inter-temporal price disequilibria by reducing seasonal fluctuations and several empirical studies have corroborated this.

However, there may be certain situations in which speculation can be destabilising (i.e., destabilise spot prices) and in those situations, speculation may indeed give rise to undesirable consequences. Recent economic studies have shown that the possibility of destabilisation is real in certain situations and circumstances.

4 T. A. Hieronymus, *The Economics of Futures Trading*, Commodity Research Bureau, New York, 1977, 146.