



Introduction

In the early 1980s, the word ‘derivative’ was used mainly in chemistry (as in, hydrocarbon derivatives) or mathematics (as in, the second derivative of a function). Today, it is most commonly used in the context of financial markets. This is a reflection of the phenomenal speed with which these new financial instruments have evolved. Derivative markets today have an estimated value of over ₹ 378 crore crores or ₹ 3.78×10^{16} .¹ To put this figure in perspective, it is several times larger than the whole world’s Gross Domestic Product (GDP)! Once considered exotic instruments used only by the high priests of international finance, these have now become ubiquitous. More and more companies and even some governments are using, or being forced to use, derivatives in a fast-changing world of unprecedented opportunities and unprecedented risks. An understanding of derivatives is thus a necessity for anyone interested in the financial markets.

Definition of derivative

A derivative security (commonly shortened to derivative) is *a security or contract designed in such a way that its price or value is derived from the price of an underlying asset.*

For instance, the price of gold ‘futures contracts for October maturity’ is derived from the price of gold. The value of a ‘September call option’ on sugar is derived from the price of sugar. The value of a ‘five year interest rate swap’ is derived from the prevailing rate of interest. The price of a derivative security is not arbitrary; it is linked to the price of the underlying asset. A rise in the

1 According to the Bank for International Settlements, total notional value outstanding on derivative contracts (interest rates and foreign exchange) traded at exchanges (as of March 2016) and over-the-counter (interest rates, commodities, equities and credit default swaps as of second half of 2015) but excluding exchange traded equity derivatives was USD 566 trillion (approx.). Separately, turnover in equity derivatives (single stock and index futures and options) in 2015 reported by the World Federation of Exchanges amounted to USD 346 trillion (approx.).

price of the underlying may lead to a rise (or fall) in the price of the derivative, but in a predictable way. Because the relationship is predictable, transactions in derivatives can be used as a method to compensate for, or offset, the risk of price changes in the underlying asset. Formulae can usually be used to calculate the effect of the price of the underlying in the price of the derivative. However, the relationship is not always precise and the formulae are not always accurate and hence derivatives may not always work exactly as intended.

The simple definition presented above is widely used. However, it does contain errors of inclusion and exclusion.

Firstly, a security does not become a derivative merely because its price is 'derived' from that of another. The cost of a basket of vegetables containing potatoes, carrots and cabbages in a particular ratio is indeed 'derived' from the price of the individual vegetables in the basket. Does that mean that the basket of vegetables is a derivative of potatoes, carrots and cabbages? The answer is no. This is because the basket is simply a collection of those assets. In the financial markets, there are similar notional 'baskets' known as mutual funds. Among mutual funds, there is a special category called 'exchange traded funds' (ETFs) and among them is a sub-class of index funds. Index funds, in their performance, attempt to exactly mimic the performance of an index by holding the same combination of securities or commodities as the index. Mutual funds and such ETFs are generally not treated as derivatives. Thus, to exclude them from the 'conventional' definition, it is necessary to note that a derivative is a security which derives its price from the underlying *without actual ownership of the underlying*.

Secondly, some securities now called, or regarded as, 'derivatives' do not derive their price from the price of some other asset or liability or instrument. Rather, they derive their value from the occurrence or non-occurrence of some event and conceptually are similar to insurance. For instance, 'credit default swaps' are securities whereby,

- one party pays a fixed fee every year; and
- in return, the second party agrees to compensate the first party if there is a default on repayment of a loan by another (third) party.

Similarly, certain types of securities known as 'catastrophe derivatives' have a cash flow which is triggered only when a defined natural disaster (say, a cyclone) occurs. These instruments are actually closer to insurance contracts than to

conventional derivatives but are usually classified as derivatives. The definition needs to be expanded to include them.

Thirdly, some types of bets will also fit the simple definition of derivatives. For example, if a person has a wager with another whereby he wins ₹ 100 if the share price of Tata Consultancy Services Limited Motors is more than ₹ 2,500 on a certain date, then this wager might constitute a financial derivative in terms of the simple conceptual definition. Such agreements may however be legally invalid, because betting is seen as socially unproductive or indeed harmful. Pure bets are usually not regarded as derivatives (though some scholars argue that they should be).

For practical purposes, a better definition of derivatives would be that:

A derivative is a legally enforceable security or contract designed in a way that its value is derived from the value of an underlying asset (without actual ownership thereof) or from the value of an event which may or may not take place.

The term 'asset' includes a liability which can be thought of as a negative asset.

While there is now a bewildering variety of derivatives, the most prominent types of derivatives are those known as:

- *forwards* and *futures* which involve the purchase/sale of an asset to be delivered at a future date with a *price fixed now*;
- *options* which give one party a *unilateral right* to buy (or, alternatively, to sell) an asset from another at a price fixed now but *without the compulsion or obligation* to actually do so (i.e., the first party can on its own decide to whether or not to exercise the right); and
- *swaps*, which are contracts where two parties exchange (swap) two different sets of cash flows.

Each of these (and more exotic instruments often involving combinations of these) will be described in detail in subsequent chapters.

Derivatives trading: Exchanges vs. 'over-the-counter'

Many derivatives transactions are carried out through *exchanges*. These are organised and regulated markets (similar to stock exchanges) which provide standardised and well-regulated arrangements for buyers and sellers to transact. Table 1.1 lists the main derivatives exchanges of the world.

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Table 1.1: Important derivatives exchanges

	Name of the exchange	Main instruments traded
1	The Korea Exchange	Index futures and options, single stock futures and options, interest rate futures, foreign exchange futures and options, commodity futures
2	Chicago Mercantile Exchange (CME) Group, includes Chicago Board of Trade (CBOT), OneChicago and New York Mercantile Exchange (NYMEX)	Futures and options in agriculture, interest rates, energy, equities, metals, foreign exchange, weather indices, Bitcoin derivatives
3	Eurex (Germany)	Interest rate futures/options/futures on swaps, equity futures/options, volatility futures and options, exchange traded funds (ETF) derivatives, commodity futures and options, total return and dividend -based derivatives, property derivatives
4	New York Stock Exchange (NYSE) Euronext	Equities (stock indices, stock options), stock index futures, commodity futures, interest rate futures, options on ETFs
5	National Stock Exchange or NSE (India)	Stock index futures and options, single stock futures and options, currency futures, interest rate futures. (Commodity options to be launched soon and likely to be traded on NSE, Multi Commodity Exchange or MCX and National Commodity Derivatives Exchange or NCDEX)
6	BM&F Bovespa (Brazil)	Futures in equities, commodities, foreign exchange; stock index options
7	Chicago Board Options Exchange or CBOE (USA)	Index options, index futures, equity options, options on exchange traded notes/products (ETP), credit options
8	NASDAQ OMX Group (USA, Scandinavia)	Stock options/futures/forwards, Index option/futures, ETF options, Dividend Futures, Forwards on Baskets, Binary Options (Over-Under), Gold/Oil and other derivatives

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	Name of the exchange	Main instruments traded
9	Multi Commodity Exchange of India (includes MCX-SX)	Commodity futures (metals, bullion, agricultural, energy) and currency futures
10	Moscow Exchange (Russia)	Single stock futures and option, stock index futures, interest rate futures, foreign exchange and commodity futures
11	Intercontinental Exchange or ICE (USA)	Exchange traded futures and options in agricultural products, oil products, natural gas, electricity and other underlyings. Over-the-counter (OTC) instruments in oil products, natural gas, electricity
12	Zhengzhou Commodity Exchange (China)	Commodity futures especially agricultural and chemical product such as wheat, sugar, cotton, rapeseed oil, and petroleum based products
13	London Metal Exchange or LME (U.K.)	Futures and options of a variety of base metals and other commodity products
14	Tokyo Commodity Exchange or TOCOM (Japan)	Futures and other derivatives for agricultural commodities, base and precious metals, energy products
15	Singapore Exchange Limited or SGX	Equity index and options; dividend index, foreign exchange, interest rates and commodities (metals, agricultural, petrochemical and electricity) futures, forwards and swaps

Source: Compiled from exchange websites.

India now figures in the top league in terms of volume of trading of derivatives. In 2015, the NSE was first in the number of stock index option contracts traded and second in the number of single stock futures contracts traded. In currency options, NSE occupied the top position in the world in number of options traded and in terms of turnover, it was placed second.² From the 1970s, when even domestic derivative markets were gradually being closed down, the situation has changed so much that the NSE now offers derivatives for buying and selling an American stock market index (the S&P 500 share index). Table 1.2 provides the contract specification for this

² *Indian Securities Market Review 2015*, National Stock Exchange of India, Mumbai, 2015.

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contract and illustrates some of the typical features of an exchange-traded futures contract.

Table 1.2: Contract specifications for NSE's S&P 500 index futures contract

S&P® futures contract specifications	
Ticker symbol	S&P500
Contract size	250 units
Notional value	Contract size multiplied by the index level (For example: if the current index value is 1000 then the notional value would be $1000 \times 250 = ₹ 2,50,000$)
Tick size	0.25
Trading hours	As in equity derivative segment
Expiry date	Third Friday of the respective contract month. In case third Friday is a holiday in USA or in India the contract shall expire on the preceding business day.
Contract months	Three serial monthly contracts and three quarterly expiry contracts in the Mar-Jun-Sep-Dec cycle
Daily settlement price	Last half hour's weighted average price
Final settlement price	All open positions at close of last day of trading shall be settled to the special opening quotation (SOQ) of the S&P 500 Index on the date of expiry. (http://www.cmegroup.com/trading/equity-index/files/SOQ.pdf)
Final settlement procedure	Final settlement will be cash settled in INR based on final settlement price
Final settlement day	All open positions on expiry date shall be settled on the next working day of the expiry date (T+1)
Position limits	The trading member/mutual funds position limits as well as the disclosure requirement for clients is same as applicable in case of domestic stock index derivatives

Source: NSE

While a considerable amount of derivatives trading takes place on exchanges like those listed in Table 1.1, it is also common for derivatives to be transacted 'over-the-counter', i.e., directly without the intermediation of an exchange.

Such transactions are known as ‘over-the-counter’ (OTC) transactions. Swaps are predominantly traded over-the-counter. Overall, and primarily because of the swap market, the total value of derivatives traded over the counter exceeds that traded on exchanges.

Evolution of derivatives

Forward trading in some form or other is quite ancient. It is not clear where and when the first forward market came into existence. There are reports that forward trading existed in India as far back as 2,000 BCE and also that some forms of forward trading existed in Roman times. Forward trading in a somewhat systematic manner is believed to have been in existence in the twelfth century English and French fairs.

There was forward trading in rice in seventeenth century Japan. The trade, known as *cho-ai-mai a kinai* (rice-trade-on-book), centred around Dojima, a district of Osaka. The trade in rice grew and evolved to the stage where receipts for future delivery were traded with a high degree of standardisation. In 1730, the market received official recognition from the Tokugawa Shogunate (the ruling class of Shoguns or feudal lords). The Dojima rice market can thus be regarded as the first futures market in the sense of an organised exchange with standardised trading terms.³ The market and its successors went through many phases including closures in 1869 and 1937.

The first futures markets in the Western hemisphere were developed in the United States, in Chicago. These markets (in grain) had started as spot markets and gradually evolved into futures trading. This evolution occurred in stages. The first stage was the starting of agreements to buy grain in the future at a predetermined price with the intention of actual delivery. (This corresponds to the concept of non-transferable specific delivery forward contracts in commodities in India.) Gradually these contracts became transferable and over a period, particularly during the American Civil War between 1860 and 1865, it became commonplace to sell and resell agreements themselves, instead of taking delivery of the physical produce. Traders found that the agreements were easier to buy and sell if they were standardised

3 H. H. Bakken, ‘Futures Trading—Origin, Development and Economic Status’, *Futures Trading Seminar*, Mimir Publishers, Wisconsin, 1966.

in terms of quality of grain, market lot and place of delivery, thus creating modern futures contracts.

The CBOT, which opened in 1848, is the world's oldest futures and options exchange.⁴ The general rules framed by CBOT in 1865 became a pacesetter for many other markets. In 1870, the New York Cotton Exchange was founded. The London Metal Exchange was established in 1877.

The next big wave of expansion in derivatives trading happened after the 1970s. In the first phase of this expansion, new derivatives instruments and markets were developed in the western countries, particularly the United States and the UK. The first financial futures market was the International Monetary Market, founded in 1972 by the CME. This was followed by the London International Financial Futures Exchange in 1982. Towards the end of the twentieth century, as large countries including India and China moved away from socialism and exchange controls towards market-based economies and free movement of foreign capital, derivatives began to expand rapidly in the developing world. Today, many emerging market economies have thriving derivatives markets. China has become a major centre for commodity futures trading in recent years at the Dalian Commodity Exchange, Shanghai Futures Exchange and Zhengzhou Commodity Exchange.

There is evidence of options in wheat and other agricultural commodities during the middle ages in England. In seventeenth century Holland, there were options on tulip bulbs. Options trading in agricultural commodities and in shares came into existence in the United States from the 1860s. However, these were not standardised traded options, but one-to-one deals between traders (over-the-counter in today's parlance). The problem with such options was that there was no openness in operations, no secondary market and no method of guaranteeing that contractual obligations would be honoured by the option writers. Options trading remained peripheral and never grew as much as futures trading till the 1970s.

The first exchange-traded options market was started by CBOT on 26 April 1973. For the first time, standard maturities, standard strike prices, and standard delivery arrangements were evolved. The risk of default was virtually eliminated by introducing a clearinghouse and a margin system. Trading

4 In 2007, the CBOT merged with the Chicago Mercantile Exchange (CME) to form the CME Group.

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was done through the open outcry method, so that prices were announced in the open, reducing scope for malpractice and allowing dissemination of price information. Initially, options on futures contracts were not permitted. These commenced only in 1982. Nowadays many options are in fact options to purchase/sell a particular futures contract rather than the underlying commodity itself.

Box 1.1: Thales' call options on olives

The Greek philosopher Thales (pronounced Thay'leez) had been ridiculed as one whose philosophy was useless. Evidence of this was his extreme poverty. However, because of his extraordinary ability to read the stars, Thales forecast that the autumn olive harvest would be unusually large. It is believed that he secretly travelled to the olive farmers and purchased the right of first refusal on their olives at a fixed price (a call option). Because this was nine months before the harvest, the farmers were willing to sell this right very inexpensively. Since he was correct, Thales was able to purchase the entire olive crop at the pre-agreed upon price. He now controlled the entire crop and those who needed olives had to buy them at his price. Apparently, he made a fortune and silenced his critics.⁵

Options trading existed in India long before the introduction of regulated and exchange traded equity options in 2000. The Marwaris traded in indigenous options (*satta*), giving the buyers the right, but not the obligation, to buy or sell a certain commodity at a specified future date and price. These could be *teji* (call) or *mandi* (put), with the premium paid by the buyer of the option known as *nazrana*.⁶ Commodity options were banned after independence by the Forward Contracts (Regulation) Act, 1952.

The introduction of traded options opened the way for the evolution of more complex derivatives. (As will be shown later in the book, virtually all derivatives are based on the two building blocks of futures and options. Since traded options became commonly available only in the early 1980s, it is no surprise that complex derivatives started appearing only from then.)

5 This is one of three versions of this story. Source: Lecture Notes (Chapter 15), Course No. 3600 on Investments by Dr Timothy Mayes, Metropolitan State College of Denver. Available at: <http://slideplayer.com/slide/6895061/>, accessed on 24 December 2016.

6 Harish Damodaran, 'The Marwari Business Model I and II', *The Hindu Business Line*, 7 and 8 April 2013.

The first swap transaction took place in 1981 between the World Bank and International Business Machines (IBM). This transaction was a currency swap. Interest rate swaps also commenced in 1981. The International Swap Dealers Association (as it was then known) introduced partial standardisation of the contract terms in 1985. However, swaps do not have much of a secondary market even now and hence they are largely not readily transferable. Other derivatives like forward rate agreements (FRAs), range forwards, collars and the like evolved in the second half of the 1980s.

Derivatives played a role in causing the global financial crisis of 2008 (see Appendix 1.1 for details). Since then, volumes of derivatives trading have stagnated or fallen in western markets but have continued to grow in developing countries.

Derivatives in India

As already mentioned, some form of forward trading probably existed in India also in the pre-modern era. Unfortunately, India has not had as good a tradition of written record-keeping as the west, and therefore, hard evidence of forward trading in our history is lacking. Organised forward markets came into existence in India in the late-nineteenth and early-twentieth century starting in 1875 with cotton in Mumbai followed later by trading in jute and jute goods in Kolkata.⁷ Several new markets grew over the first half of the twentieth century. Options trading also existed, as already mentioned, although not through recognised exchanges.

Chronologically, India's experience in organised forward trading is almost as long as that of the United Kingdom and certainly longer than many developed nations (not to speak of developing countries). However, the tidal wave of price controls, nationalisation and state intervention in markets which swept through all economic policymaking after independence, led to a rapid decline in the number of futures markets. Regulations under the Forward Contracts (Regulation) Act, 1952 imposed increasingly severe restrictions and banned options. Frequently, markets were closed due to the feeling that they were responsible for sudden movements in commodity prices; the presumption was that speculation on forward markets was creating or exacerbating price pressures.

Winds of change began to blow across the Indian economic landscape

7 M. G. Pavaskar, *Economics of Hedging*, Popular Prakashan, Mumbai, 1976.

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from the 1980s and these winds gathered in strength in the 1990s and the first decade of the new millennium. India's balance of payments crisis in 1991 spurred economic reforms and the government began to unshackle many areas of economic activity from government control. After 2002, the commodity futures markets in India experienced an unprecedented boom in terms of the number of exchanges, number of commodities allowed for derivatives trading as well as the value of futures trading in commodities.⁸ Prohibition of futures trading in many commodities was lifted in 2003. Whereas exchanges had previously been confined to one commodity or commodity group (for example pepper in the Indian Pepper and Spice Trade Association, Cochin, jute and jute goods in the East India, Jute and Hessian Exchange, Calcutta etc.), new multi-commodity exchanges came into existence and introduced modern methods of trading. The NSE also entered the field of derivatives.

Apprehensions about the role of futures in raising food prices became prominent again around 2007 and there was a partial reversal of the trend with the banning of futures in several essential commodities in which they had been introduced. In the year 2015–16, the aggregate turnover at all the exchanges in the domestic commodity derivatives segment increased by 9.1 per cent to ₹ 66,96,380 crore (a little under \$1.0 trillion based on the spot exchange rate of the Indian rupee against the US dollar) compared to ₹ 61,35,672 crore in 2014–15.⁹

The Indian stock market had a system of forward trading of indigenous origin known as *badla*. These transactions were also a form of derivatives, and were quite sophisticated, but because the *badla* market was unregulated, it left a lot of scope for manipulation. India's capital market regulator, Securities and Exchange Board of India (SEBI) banned the practice altogether in 2001, soon after the NSE and the Bombay Stock Exchange (BSE) both commenced trading in equity derivatives. Futures on the Nifty equity index were launched in the Indian markets in June 2000 followed by options on the index in June 2001, options in individual stocks in July 2001 and futures in single stocks in November 2001. Turnover on options and futures on equities (single stocks and

8 N. L. Ahuja, 'Commodity Derivatives Market in India: Development, Regulation and Future Prospects', *International Research Journal of Finance and Economics*, ISSN 1450-2887, Issue 2, 2006.

9 *Securities and Exchange Board of India Annual Report 2015-16* (published on 19 August 2016 and accessed on 20 August 2016)

stock indices) boomed in the first decade of the century and surpassed the cash market turnover. In recent years, equity options turnover has grown steadily while equity futures volumes have fluctuated, partly because of favourable tax treatment for options.¹⁰

Causes of rapid expansion of derivatives trading

The decades after 1970 have witnessed a dramatic increase in volume, large expansion in scope and rapid globalisation in the reach of derivatives. There were several reasons for this.

The first reason was a major increase in the level of financial risks because of systemic changes in the financial markets. In the late 1960s and early 1970s, the two most important currencies of that time (the US Dollar and Pound Sterling) came out of the fixed exchange rate system and became floating currencies. Because of this, the exchange rate of these currencies became uncertain whereas it had been fixed earlier. For example, an exporter of textiles who expected to receive dollars in three months from his date of sale no longer knew how much would he actually receive in his local currency. The 1970s also saw a great degree of volatility in commodity prices, due in part to the oil price hike by the Organization of the Petroleum Exporting Countries (OPEC) and the turmoil in the currency market.

In the late 1970s, another very important change occurred. Earlier, central banks had followed a policy of relatively stable interest rates. But guided by the advice of monetarist economists like Milton Friedman, central banks began to exercise greater control over money supply and started using interest rate changes as a means for controlling it. As a result, frequent changes of interest rate – both upwards and downwards – became the order of the day. These *changes in financial markets increased uncertainties*. The greater the risk, the greater the need to manage it. Necessity being the mother of invention, the increased risk led to the growth of risk management tools – derivatives.

The second reason was a *change in economic philosophy in many countries*. In economic matters, China moved away from communism in 1980. India moved away from socialism in 1991. The Soviet Union collapsed in 1990. These and

10 Securities transaction tax is levied only on the premium in an option but on the whole value in a futures contract.

many other countries which had controlled economies with limited room for market forces, liberalised and moved to market-based economies. Eventually they also allowed the establishment of derivatives markets.

The third reason was the change in the international system of trade. Traditionally, international trade had been characterised in most countries by high tariffs (i.e., import duties) and non-tariff barriers (e.g., import quotas, licensing). The creation of the World Trade Organisation (WTO) in the 1990s and the liberalisation of international trade (through reductions in import duties and the ending of many kinds of import restrictions) greatly increased the volumes of exports and imports. For many years, most countries also had exchange controls (controls on conversion of domestic currency into foreign exchange) and capital controls (controls on remittance of capital to a foreign country). From the Second World War until 1979, the UK, one of the world's most developed economies, still had exchange controls and restrictions on convertibility of the pound to foreign currency. Beginning in the late 1970s, often with encouragement from the International Monetary Fund (IMF), many countries abolished exchange controls and capital controls. This resulted in a big increase in the flow of capital from one country to another, whereby funds borrowed or raised in one country would be invested in another. The *combination of international trade liberalisation and liberalisation of international capital flows* greatly increased the volumes of transactions which would need protection against exchange rate and interest rate fluctuations. This greatly increased the need for derivatives.

The fourth reason, applicable particularly in the United States, was *deregulation* (removal of regulatory restrictions) of derivatives trading towards the end of the twentieth century. Under the Commodity Futures Modernisation Act of 2000, various controls and regulations in America applicable to derivatives were either abolished or liberalised. This allowed a further increase in derivatives volumes as transactions which were not allowed earlier became legally permissible. (This deregulation was later found to be one of the causes of the global financial crisis of 2008.)

A fifth reason was the *development of new mathematical techniques* for valuing complex derivatives. The development of the Black-Scholes Option Pricing Formula in the 1970s greatly enhanced the ability of market participants to determine the price of many kinds of derivatives.

However, to do such calculations manually was tedious and this restricted the extent to which such derivatives could be introduced and traded. This difficulty ended because of the sixth change: the *development of computing power*, enabling complex mathematical calculations to be done in seconds. The computer revolution and the ability to perform such calculations instantly at a terminal enabled such derivatives to be introduced and traded actively.

Aims and organisation of the book

This book aims to describe and to explain the various derivative instruments, and how they are used and priced. As far as possible, English rather than mathematics is used to explain the concepts, functions, pricing and valuation of derivatives. There are two reasons for this. First and foremost, the approach of the book is to make derivatives more understandable and less daunting. Risk arises not only from volatility or uncertainty but also from ignorance: what is not understood is the most risky. Therefore, the book seeks to de-mystify and make the concepts accessible to a wide spectrum of readers with different backgrounds. (Advanced readers and those desirous of further research into these topics will find useful references to go beyond the discussions offered in this book.) Secondly, mathematics has often bestowed a spurious sense of precision to financial and economic models creating a false sense of security in the minds of the users of those models.

The book has 21 chapters organised into seven parts. This chapter and the next introduce the reader to derivatives and to some basic concepts which are necessary for an understanding of the rest of the book. Part II, comprising chapters 3 to 7, deals with forward and futures trading. Part III, consisting of chapters 8 and 9, deals with swaps. Part IV, consisting of chapters 10 to 14, covers options. Chapters 15 and 16, which form Part V, examine other derivatives and certain financial instruments which may or may not be derivatives in the strict sense of the term but which have some characteristics akin to derivatives. Part VI, comprising chapters 17 to 19, describe the accounting, taxation and the regulatory framework for derivatives with particular reference to India. The concluding part looks at derivatives in the context of portfolio management (chapter 20) and finally (chapter 21) at the management of risks arising from derivatives trading. For some chapters, more detailed or more advanced material, not essential for an understanding of the chapter, is placed in appendices.

Appendix 1.1

The global financial crisis of 2007–08

Derivatives were a factor in the global financial crisis of 2007–08, one of the most important economic events of recent decades. This appendix provides a brief description of the causes of the crisis and the role of derivatives.

Causes of the crisis

Between 2000 and 2006, there was a rapid growth in lending by US banks to American residents for purchasing house property. Interest rates were very low in the US at this time. When borrowing money for a house, the borrower is required to ‘mortgage’ the property to the bank, i.e., the bank has the legal right to take over the property if the loan and interest are not paid on time. Thus, this kind of lending is referred to as mortgage lending. All mortgage borrowers are expected to ensure that the value of their loan is less than the value of the house property. The difference between the house value and the amount of loan is the ‘equity’ that the owner of the house has to contribute towards the cost and to maintain.

Borrowers with good creditworthiness (i.e., those who are assessed as very likely to repay the loans with interest on time) are known as prime borrowers. Over a period, mortgage lending was extended even to ‘sub-prime’ borrowers, i.e., those whose creditworthiness (income and assets) was below that normally expected for bank lending. The lending was on very liberal terms with very small levels of equity contribution by the borrower. It was based on optimism that house prices would continuously rise and therefore the borrower’s lack of creditworthiness or inadequacy of equity would not be a problem in recovering the loan. Sub-prime borrowers were often allowed to start with very low payments using a low ‘introductory rate’ initially, with the interest rate and monthly payments increasing after a year or two.

The individual loans were ‘securitised’ or ‘packaged’ by banks into ‘Mortgage Backed Securities’ (MBS), consisting of a group of mortgage loans. (The term ‘Asset Backed Securities’ is similar and refers to a wider class of assets.) These were then further grouped together into ‘collateralised debt obligations’ (CDOs). A CDO would have several MBS in it, with different credit ratings. The CDO

would then have different tranches or slices with different credit ratings. The highest slice or tranche might have a very high (AAA) credit rating.

Based on the credit rating, the owner of the CDO securities would enter into a derivative transaction called a Credit Default Swap (CDS – described later in the book in chapter 15) which is like credit insurance. The buyer of the CDS would pay a premium to the seller. If the borrowers failed to pay their dues on the underlying loans that went into a CDO, the CDO would stop yielding cash flows to its owner. That could be deemed a default. In that case, the seller of the CDS would have to reimburse the buyer for the amount of the shortfall. That is why a CDS contract is akin to an insurance contract. The buyer of a CDS contract buys default protection from the seller. Buyers and sellers of CDS included many banks and insurance companies and the amounts involved were very large.

After 2006, housing prices in the US unexpectedly began falling. One reason was that the low introductory rate period ended and the monthly payments required from many of the sub-prime borrowers went up. When they were unable to pay these higher monthly instalments, their property was ‘foreclosed’ and ‘repossessed’ (taken over) by the banks. When the house value fell, many loans began to have negative equity, i.e., house value became less than the value of the loan. Being sub-prime borrowers, the owners were unable to make up the difference and the loans went into default. The rate of default on such loans turned out to be much higher than had been anticipated by the credit-rating agencies. As a result, many of the CDOs (groups of mortgage loans) also began to suffer default on the payments. Those who had insured against such defaults by purchasing derivatives (CDS) began to invoke the CDS and this created an unexpected liability for the banks and insurance companies who had sold the CDS. Many of them were unable to meet the liabilities.

Eventually many ‘venerable’ financial institutions collapsed. Bear Stearns, Northern Rock, American Insurance Group, Lehman Brothers were among those that collapsed (or were nationalised on the verge of collapse) while many others suffered catastrophic losses. The economic damage caused by the crisis was estimated at between \$6,000 billion and \$14,000 billion, and the latter figure is close to one full year’s GDP of the United States.¹¹

11 David Luttrel, Tyler Atkinson and Harvey Rosenblum, ‘Assessing the Costs and Consequences of the 2007–09 Financial Crisis and its Aftermath’, Federal Reserve Bank of Dallas, 2010.

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The availability of CDS derivatives had two effects. Firstly, once holders of the security had purchased a CDS they felt very safe (since the risk had been ‘insured’) and therefore increased their exposure to such securities. This is called ‘moral hazard’ in economics. Secondly, the instrument of CDS transmitted the problem to a much wider set of institutions who sold CDS without directly being involved in the mortgage loans. Even some Indian private sector banks were affected. It made it very difficult to quantify and pinpoint the location and extent of the problem. If CDS had not been available, the banks involved may have been more cautious and fewer of them would have been involved. Thus, without CDS, the impact of bad loans would have been smaller and would have been distributed over a smaller number of institutions.

Overall, there were several causes for the crisis:

- a monetary policy that was too loose and led to very low interest rates and imprudent expansion in credit;
- misplaced faith in the benefits of unregulated free financial markets and an assumption that the market would always act in an economically optimal manner;
- too much deregulation of derivatives in the US after 2000 when many regulatory restrictions were removed; this in turn led to excessive financial ‘innovation’ through creation of new instruments, including derivative instruments, whose risks were not properly understood; and
- credit rating failures by the rating agencies which gave very optimistic ratings to certain derivative instruments.

Impact of the crisis

Prior to 2008, there were many who felt that derivatives markets were self-regulating and that government regulation was largely unnecessary. That has changed irrevocably. American Congressmen Chris Dodd and Barney Frank took the lead in authoring a new set of regulations in 2009 for the financial sector in America. (By virtue of the inter-dependent nature of global finance and its strong links with American finance in particular, these have had influence far beyond the USA.) The law requires greater standardisation and margin requirements for OTC derivatives and effectively pushes them towards an exchange-traded derivative model which would facilitate netting out of positions and make market volumes and exposures more transparent.

There have been moves to introduce the ‘Volcker Rule’, based on the idea of Paul Volcker, former Chairman of the US Federal Reserve. Volcker’s basic idea was to reparate proprietary trading and other ‘non-bank’ risk-taking and potentially harmful speculation from ‘traditional’ banking. Governments in most countries provide deposit insurance to protect bank depositors. Since the safety of deposits is guaranteed by the government, the government (and hence all citizens) bear a contingent liability for failures of the banking system. But profits are earned only by the owners of the banks, thus the risks incurred by banks create a ‘negative externality’. The asymmetric nature of risks and compensations creates a ‘moral hazard’. The idea behind the Volcker Rule is to make sure that the government’s support is confined to commercial banking and does not extend to investment activities undertaken by banks.

In sum, the crisis has led to a more cautious approach among regulators to derivatives as a whole especially in those countries where they had earlier been very lightly regulated.