



INTRODUCTION TO FINANCIAL ENGINEERING

PAPER –CC 303

FINANCIAL ENGINEERING

S.MUKHERJEE

Financial Engineering

- “**Financial engineering involves the design, the development and the implementation of innovative financial instruments and processes and the formulation of creative solutions to problems in finance.” John Finnerty**
- Financial engineering is the use of mathematical techniques to solve financial problems.**
- Financial engineering uses tools and knowledge from the fields of computer science, statistics, economics, and applied mathematics to address current financial issues as well as to devise new and innovative financial products.**
- Financial engineering led to an explosion in derivatives trading and speculation in the financial markets.**
- Financial engineers test and issue new investment tools and methods of analysis. They work with insurance companies, asset management firms, hedge funds, and banks.**

- Financial engineering has deeply penetrated the financial markets with its application in all core functions of the financial system. There are many environmental and intra-firm factors driving the growth of financial engineering such as price volatility, tax asymmetry, and risk aversion by managers. It has resulted in many innovative and customized financial products for individuals and corporates to achieve their specific objectives.
- Be it equity, debt, insurance, banking services or derivatives; financial engineering has innovated the financial products across categories. It has also aided to the innovation of processes and distribution in the financial services industry.
- Technology has been both source and it also enables this journey in innovation. The information technology companies have a major role to play in the sustainable growth of the financial services industry

AREAS OF FINANCIAL ENGINEERING

- 1. Corporate Finance: Mergers & Acquisitions, Takeovers, Leveraged Buyouts (LBO) etc.**
- 2. Trading: Securities and derivative products trading**
- 3. Investment in Money Management: High yield mutual funds, money market funds and Repo funds**
- 4. Risk Management**

TOOLS OF FINANCIAL ENGINEERING

(A)Conceptual Tools (Ideas and concepts), Valuation Theory, Portfolio Theory and Hedging Theory

(B)Physical Tools (i) Fixed income securities, (ii) equities (iii) Options (iv) Swaps

Factors Contributing to the Growth of Financial Engineering

- Environmental factors**
- Intra- firm factors**

Environmental factors

The factors which are not controllable by any firm and are part of external environment are included in this category. Though they are external to business but they have direct impact on one's business. Usually, PEST analysis is used to evaluate these factors and impact on any business. Most common examples are competitiveness, technological advancements, and new inventions, political and economical changes.

- 1. Price Volatility**
- 2. Globalisation of Markets**
- 3. Tax Asymmetries**
- 4. Technological Advances**
- 5. Advances in Financial Theory**
- 6. Regulatory Change and increased Competition**
- 7. Cost of information and Cost of Transaction**

Intra-firm factors

All those factors of the company which can directly progress the financial engineering process are included in intra firm factors. Likewise, agency costs, accounting policies, risk aversion and liquidity needs are included in this type.

- 1. Liquidity Needs**
- 2. Risk Aversion**
- 3. Agency Costs**
- 4. Quantitative Sophistication and Management Training**
- 5. Accounting Benefits**

DERIVATIVES

- The objective of an investment decision is to get required rate of return with minimum risk. To achieve this objective, various instruments, practices and strategies have been devised and developed in the recent past.
- With the opening of boundaries for international trade and business, the world trade gained momentum in the last decade, the world has entered a new phase of global integration and liberalization.
- The integration of capital markets world-wide has given rise to increased financial risk with the frequent changes in the interest rates, currency exchange rate and stock prices. To overcome the risk arising out of these fluctuating variables and increased dependence of capital markets of one set of countries to the others, risk management practices have also been reshaped by inventing such instruments as can mitigate the risk element. These new popular instruments are known as financial derivatives which, not only reduce financial risk but also open us new opportunity for high risk taker.

DERIVATIVES : DEFINITION

- ❖ **Literal meaning of derivative is that something which is derived.**
- ❖ **Now question arises as to what is derived? From what it is derived? Simple one line answer is that value/price is derived from any underlying asset.**
- ❖ **The term ‘derivative’ indicates that it has no independent value, i.e., its value is entirely derived from the value of the underlying asset. The underlying assets could be equities (shares), debt (bonds, T-bills, and notes), currencies, and even indices of these various assets, such as the Nifty 50 Index.**
- ❖ **Derivatives derive their names from their respective underlying asset. Thus if a derivative’s underlying asset is equity, it is called equity derivative and so on.**

DERIVATIVES : DEFINITION

**The Securities Contracts (Regulation) Act 1956 defines “derivative” as under
Derivative” includes**

- 1. Security derived from a debt instrument, share, loan whether secured or unsecured,risk instrument or contract for differences or any other form of security.**
- 2. A contract which derives its value from the prices, or index of prices of underlying securities.**

The above definition conveys that

- 1. The derivatives are financial products.**
- 2. Derivative is derived from another financial instrument/contract called the underlying asset.**

□The basic purpose of derivatives is to transfer the price risk (inherent in fluctuations of the asset prices) from one party to another; they facilitate the allocation of risk to those who are willing to take it. In so doing, derivatives help mitigate the risk arising from the future uncertainty of prices.

KINDS OF DERIVATIVES

There are two types of derivatives:

- ❖ **Commodity derivatives**
- ❖ **Financial derivatives.**

- ❖ **Derivatives originated as a tool for managing risk in commodities markets. In commodity derivatives, the underlying asset is a commodity. It can be agricultural commodity like wheat, soyabeans, rapeseed, cotton etc. or precious metals like gold, silver etc.**
- ❖ **The term “financial derivative” relates with a variety of financial instruments which include stocks, bonds, treasury bills, interest rate, foreign currencies and other hybrid securities. Financial derivatives include futures, forwards, options, swaps, etc. Futures contracts are the most important form of derivatives, which are in existence long before the term ‘derivative’ was coined.**
- ❖ **Financial derivatives can also be derived from a combination of cash market instruments or other financial derivative instruments. In fact, most of the financial derivatives are not revolutionary new instruments rather they are merely combinations of older generation derivatives and/or standard cash market instruments**
- ❖ **The term financial market derivative can be defined as a treasury or capital market instrument which is derived from, or bears a close relation to a cash instrument or another derivative instrument. Hence, financial derivatives are financial instruments whose prices are derived from the prices of other financial instruments.**

DERIVATIVES(contd.)

Common underlying assets for derivatives are:

- **Equity Shares**
- **Equity Indices**
- **Debt Market Securities**
- **Interest Rates**
- **Foreign Exchange**
- **Commodities (Gold, Silver, Crude Oil, Plum Oil etc.)**
- **Derivatives themselves**

FACTORS DRIVING THE GROWTH OF DERIVATIVES

Some of the factors driving *the* growth of financial derivatives are:

- 1. Increased volatility in asset prices in financial markets,**
- 2. Increased integration of national financial markets with the international markets,**
- 3. Marked improvement in communication facilities and sharp decline in their costs,**
- 4. Development of more sophisticated risk management tools, providing economic agents a wider choice of risk management strategies, and**
- 5. Innovations in the derivatives markets, which optimally combine the risks and returns over a large number of financial assets leading to higher returns, reduced risk as well as transactions costs as compared to individual financial assets.**

EXCHANGE TRADED DERIVATIVES VERSUS OVER-THE-COUNTER DERIVATIVES

Not all trading of derivatives is done on exchanges. The over-the-counter market is an important alternative to exchanges and, measured in terms of the total volume of trading, has become much larger than the exchange-traded market. It is a telephone and computer-linked network of dealers. Trading is done over the phone and are usually between two financial institutions or between a financial institution and one of its clients (typically a corporate treasurer or fund manager). Financial institutions often act as market makers for the more commonly traded instruments. This means that they are always prepared to quote both a bid price (a price at which they are prepared to buy) and an offer price (a price at which they are prepared to sell).

EXCHANGE TRADED DERIVATIVES VERSUS OVER-THE-COUNTER DERIVATIVES

The derivatives that trade on an exchange are called exchange traded derivatives, whereas privately negotiated derivative contracts are called OTC contracts.

The OTC derivatives markets have the following features compared to exchange traded derivatives:

- The management of counter-party (credit) risk is decentralized and located within individual institutions,**
- There are no formal centralized limits on individual positions, leverage, or margining.**
- There are no formal rules for risk and burden-sharing.**
- There are no formal rules or mechanisms for ensuring market stability and integrity, and for safeguarding the collective interests of market participants, and**
- The OTC contracts are generally not regulated by a regulatory authority and the exchange's self-regulatory organization, although they are affected indirectly by national legal systems, banking supervision and market surveillance.**

Risks in derivatives market

- **Counterparty (or default) Risk:** Very low or almost zero because the exchange takes on the responsibility
- **Operational Risk:** Risk that operational systems might fail.
- **Legal Risk:** Risk that legal objections might be raised; regulatory framework might disallow some activities.
- **Market Risk:** Risk that market prices may move up or down Liquidity risk: risk that unwinding of transactions might be difficult if the market is illiquid.

Market Participants

There are three broad categories of participants - hedgers, speculators and arbitrageurs who trade in the derivative market.

- **Hedgers face risk associated with the price of an asset. They use futures or options markets to reduce or eliminate this risk.**
- **Speculators wish to bet on future movements in the price of an asset. Futures and options contract can give them an extra leverage; that is, they can increase both the potential gains and potential losses in a speculative venture.**
- **Arbitrageurs are in business to take advantage of a discrepancy between prices in two different markets. If, for example, they see the futures price of an asset getting out of line with the cash price, they will take offsetting positions in the two markets to lock in profit.**

USES OF DERIVATIVES

- **Derivatives help in discovering future as well as current prices.**
- **Derivatives help to transfer risks from the risk averters risk-takers.**
- **Assured returns attract many investors.**
- **Investors can ensure normal or speculative or arbitrage profit, whichever they like.**
- **In futures, the long-buying investors cannot go for putting down stock market price movements as it is due to MTM arrangement. So many long contracts in futures and many call contracts in option will create more open interest for the underlying counter. This open interest is healthy sign for the stock price appreciation as if it shows many people are willing to buy the stock.**
- **Investors can resort to limit their profit or losses by preferring to option contracts.**
- **Market prices will not be affected by market sentiments.**
- **Because of margining system, both buying and selling transactions are guaranteed. In NSE, there is a nodal agency called NSCCL (National Securities Clearing Corporation Limited), which takes care delivery of shares and settling payment for both buyers and sellers in cash market as well as F&O Market.**

BENEFITS OF FINANCIAL DERIVATIVES

The benefits of using financial derivatives as follows:

- 1. A prudent use of financial derivatives can provide a new mechanism to manage or reduce various business risks at low transaction cost.**
- 2. The innovative use of financial derivatives can greatly help end-users cut their financing cost.**
- 3. Financial derivatives can provide more access to financial markets, especially to unfamiliar ones at lower costs. Put another way, they can create more complete markets to investors.**
- 4. Financial derivative instruments play an important role in asset management due to their lower transaction costs relative to the spot market instruments.**
- 5. The users of financial derivatives can expect to be offered opportunities on taking advantage of asymmetries in tax and regulatory requirements across different countries, markets or securities.**
- 6. Financial derivatives can be used to speculate and make profits by assuming certain risks, probably with suitable degree.**

TYPES OF DERIVATIVE PRODUCTS OR CONTRACTS

The most common types of derivatives are forwards, futures, swaps and options.

- 1. Forward Contract:** It is an agreement to buy or sell an asset at a certain future time for a certain price. It can be contrasted with a spot contract, which is an agreement to buy or sell an asset today. A forward contract is traded in the over-the-counter market—usually between two financial institutions or between a financial institution and one of its clients.
- 2. Future Contracts:** Unlike forward contracts, futures contracts are normally traded on an exchange. To make trading possible, the exchange specifies certain standardized features of the contract. As the two parties to the contract do not necessarily know each other, the exchange also provides a mechanism that gives the two parties a guarantee that the contract will be honoured.
- 3. Option Contracts:** Options are traded both on exchanges and in the over-the-counter market. There are two types of option. A call option gives the holder the right to buy the underlying asset by a certain date for a certain price. A put option gives the holder the right to sell the underlying asset by a certain date for a certain price.
- 4. Swap:** It is an agreement between counterparties to make periodic payments, based on a specified financial asset, to each other for a specified period.