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Derivative Instruments: Understanding the Working of Options, Futures, Swaps and Portfolio Insurance Contracts with Reference to Indian Securities Market

KEYWORDS

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Derivative instruments are the all-important building-blocks for financial engineering. Financial Engineering involves the use of mathematical techniques to solve financial problems through innovative engineering and re-engineering of financial instruments/products. Financial engineering uses tools and knowledge from the fields of conventional finance, computer science, statistics, economics and applied mathematics to address current financial situations and also to devise new and innovative financial products, in view of the specific investment goals. Financial engineering is used primarily by commercial banks, investment banks, insurance agencies and hedge funds.

Financial engineers deal with designing, creating and implementing new financial instruments, models and processes to solve problems in finance and take advantage of new financial opportunities. Financial engineering is also concerned with the strategies companies use to maximize profits or other important performance metrics. Examples include creating derivative instruments which can address the issue of unusual risks faced by a party to a transaction, structuring the cash flows from a purchase or sale in a way that better addresses the interests of the buyer and the seller, and using new methods to compute the fair market value of new or existing financial instruments.

Derivative Securities: The Building Blocks of Financial Engineering

Stocks, bonds, and market indexes represent the fundamental instruments that can be used to engineer or 'derive' a financial contract. Such derivative securities as options, forward contracts, and futures contracts comprise the next level of building blocks.

Options

An option is a contract that provides the holder with the right to purchase or sell a security at a predetermined price regardless of the prevailing market price. To obtain such a contract, the potential holder must buy it from a seller who has assessed the **stock market risk** associated with the potential gains and losses on the contract. The option to buy is referred to as a call and the option to sell is a put.

For example, suppose an individual paid Rs 500 to purchase a call option on XYZ stock with an exercise price of Rs 6000 and the stock subsequently rose to Rs 7200. This individual could exercise the option to buy at Rs 6000 and, ignoring brokerage fees and taxes, resell the stock for Rs 7200 for a gross profit of Rs 1200. When the initial cost of the option is factored in, the net profit to the call buyer is Rs 700. If XYZ's price had gone higher the profit would have been even greater. On the other hand, if XYZ's price had fallen to, say, Rs 5000, the call buyer would not elect to exercise the right to buy at Rs 6000. The maximum loss at any price below Rs 6000 would be limited to the initial cost of the option, Rs 500 in this case. So, **the call option buyer has unlimited potential for gains while losses are limited** to the option price, or premium, initially paid. Conversely, the seller of the option has limited gains, but the potential for significant losses.

Contrast the position of the call buyer with that of the put buyer. Suppose an individual buys a put option on XYZ's stock for Rs 500 with an exercise price of Rs 6000. This individual now has the right but not the obligation to sell XYZ for Rs 6000. If the price falls to Rs 5200, the put holder can buy the stock in the market and sell it for Rs 6000 by exercising the put option. This produces a gross profit of Rs 800 and a net profit of Rs 300 when the original put premium is factored in. The gains to the put buyer will increase as the value of XYZ continues to fall, but will diminish if the price rises. If the price is above the exercise price of Rs 6000, the put buyer will not exercise the option and will incur a net loss of Rs 500, the amount of the put premium. Therefore, **the put buyer has significant potential for gains if XYZ's stock price falls significantly, but losses are limited** to the amount of the put premium. Again, the converse is true for the put seller. The seller incurs significant losses if XYZ's value falls materially, but gains are limited to the amount of the premium.

Since there must be a buyer for every seller, both must agree to the initial price or premium. This premium will be influenced by the difference between the current price for the stock (or other asset) and the exercise price on the contract. Options are essentially a "zero-sum" game. This means that what the buyer gains, the seller loses. Only one party to the contract will have made the proper assessment. Both parties, however, will agree that stocks with greater potential for large price movements are worthy of higher option premiums than those with more stable prices. Also, options have an expiration date and buyers are willing to pay more for an option that has longer to live. While these examples have centred on stock options, there are also many actively traded contracts on various government bonds, market indexes, commodities (e.g., corn, oil, gold), and foreign currencies.

Forward Contracts and Future Contracts

Forward and futures contracts are typically derived from price levels for various market indexes, interest rate sensitive securities such as bonds, commodities, and foreign currencies. These contracts are designed to transfer the risk associated with the price level of the underlying asset from one party to the other. Forward contracts represent an agreement to make or take delivery of a specific asset at a specific future date for a price that is also predeter-

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mined. For example, suppose A, an Indian businessman, has an obligation denominated in US dollars that is due in six months, in respect of goods imported from the U.S. A's major concern is that the rupee may weaken with respect to the dollar. If the current rate of exchange is Rs 60 per $, then a weaker rupee will produce an exchange rate of, say Rs 65 per $ in six months. This means that A will have to pay more rupees for the same number of dollars. Conversely, if the rupee strengthens and the exchange rate moves to Rs 55 per $, then A can meet the dollar denominated obligation with fewer rupees. A's concern is **exchange rate risk**. One way to avoid this risk is to buy dollars on the forward market. Suppose that A can enter into an agreement to take delivery of the necessary dollars in six months for a price of Rs 62 per $. The fact that the forward price of the forex viz. dollars is fixed, it amounts to eliminating exposure to subsequent fluctuations in the exchange rate, favourable or unfavourable. **This practice is referred to as hedging.**

Who will sell the dollars to A using the forward contract? There are two possibilities. B is a US businessman who has an upcoming obligation denominated in rupees. B is also subject to exchange rate fluctuations and may be willing to sell dollars at Rs 62 per $ in six months. B's willingness to sell dollars can also be interpreted as an interest in buying rupees in the forward market. In this example, both A and B are hedging to eliminate exchange rate risk. B is apprehensive that the dollar may weaken in future vis-à-vis Indian rupee. If B is not interested or unavailable to accept the other side of this contract, there is another possibility. C is a speculator in exchange rate movements. C believes that the current rate of Rs 60 per $ will be stable for the next six months and is therefore willing to agree to sell to A at Rs 62 per $ in six months. Again, A has eliminated concern with exchange rate fluctuation. C is willing to speculate on the future exchange rate of rupees for dollars. C expects to be able to buy rupees for Rs 60 per $ and sell them to A for Rs 62 per $ earning Rs2 per $. If the rate rises to Rs 65 per $, C will lose Re 3 per $. **Exchange rate risk has not been eliminated. It has only been transferred from A the hedger, to C the speculator** (to the extent of Rs 3 per $). However, if the dollar strengthens and the rate falls to Rs 55 per $, C will earn Rs 7 per $.

While forward contracts can be customized to meet the very specific needs of the parties involved, they also create counterparty risk. Counterparty risk is an important underlying concept in all financially engineered contracts. It represents the potential that one of the parties to the contract will not follow through on its obligation. For example, if A entered into a forward contract to purchase five lakh dollars from C six months from now and C failed to deliver, A would be obliged to purchase the necessary dollars at the prevailing market price. Conversely, after six months, A may find that the market price for dollars is favourable to the price specified in the forward contract and renege on the promise to purchase from C. Though the contract itself can (and does) penalize each party for deviations in promised performance, it may be inconvenient and costly to enforce these provisions.

Though the oldest among financial instruments hedging risk, forward markets continue to thrive inspite of the subsequent emergence of futures markets - which are very similar to futures in many ways - because of different clienteles and other reasons. First, forward contracts are tailored to fit the needs of the customer. Second, futures do not exist for all commodities and on all financials. Third, there is a difference in accounting treatment between futures and forwards in some countries. And lastly, there is the likelihood of a possible mismatch between the length of the hedger's hedging horizon and the maturity date of the futures. Forwards take care of this.

Futures contracts are similar to forward contracts in that they represent an agreement to engage in a transaction at some future date. Futures contracts, however, are standardized with respect to size, expiration date, and many other relevant features. This means that hedgers may not be able to obtain the exact contract parameters to completely eliminate risks associated with price movements.

At the same time, it also means that buyers (who agree to take delivery of an asset) and sellers (who agree to make delivery) of futures contracts are pricing identical contracts. This allows all trades to be funnelled through a clearing house that can assume all counterparty risk. It also means that traders can quickly purchase or sell additional contracts to perfect a hedged position or to amplify a speculative one. Likewise, positions in the futures market can be "unwound" by selling contracts to offset previous purchases or by buying contracts to offset previous sales.

Another important distinction between forward and futures contracts regards the timing of the cash exchange between the parties. In a forward contact, the cash flow from the buyer to the seller of the asset occurs at the end of the contract period. With a futures contract, the buyer and seller agree on a price for future delivery at a particular time, but that future price is changed continuously.

If the price for future delivery rises in a given day, the buyer is now holding a claim that is more valuable than it was previously. The seller now finds it more costly to fulfil the contract. To adjust for this change, an amount equivalent to the aggregate change in value is transferred from the seller's account to the buyer's account. Likewise, if the price for future delivery falls during the day, funds are transferred from the buyer's account to the seller's account.

This process is repeated daily for the life of the contract and is called "marking to market." As a result, at the contract's expiration, all favourable or unfavourable movements in the market price of the asset to be delivered have already been accounted for. If the buyer of the contract opts to take delivery of the asset at this point, the transaction occurs at the prevailing market price. Most financial futures contracts fall into three categories viz. interest rate futures, foreign currency futures and share price index futures.

Thus the derivative securities can correctly be considered as products of financial engineering. These contracts were invented and in some cases standardized in order to provide clients with a more effective vehicle for avoiding particular types of risk or of speculating on specific price movements.

Complex Financial Engineering Contracts
Swaps

Another broad category of contracts which result from financial engineering is referred to as swaps. Swaps represent exchanges of cash flows generated by distinct sets of assets or tied to distinct measures of value. An early example of an engineered swap is the currency swap. In this example, consider two firms in different countries each having continuing financial obligations in the other's country.

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More specifically, consider a U.S. firm with an Indian subsidiary that requires Indian rupees to operate in India and an Indian firm with a U.S. subsidiary that has need for dollars, so as to operate in U.S. One alternative is to borrow the funds in the home country and exchange them for the foreign currency needed by the subsidiary. Another alternative is for the subsidiary to borrow the needed funds in the local currency. This second alternative will provide needed funds for the subsidiary and avoid the costs associated with foreign exchange transactions. However, it is a strong likelihood that the subsidiary is at a disadvantage when negotiating the rate on a loan in the local currency. For example, the U.S. based subsidiary of an Indian corporation may not have the perceived creditworthiness equivalent to that of a U.S. corporation and as a result will be forced to pay a higher rate of interest on the dollar-denominated loan, if it borrows in U.S. on its own.

If each firm becomes aware of the other's needs, they can do the following. First, each parent corporation should borrow an equivalent amount in their home currencies. These amounts will be equal based on the current exchange rate between dollars and rupees. Second, they will simultaneously transfer the proceeds of the loan to the other firm's subsidiary (i.e., the Indian parent will transfer the borrowed francs to the U.S. firm's Indian subsidiary, and the U.S. parent will transfer the borrowed dollars to the Indian firm's U.S. subsidiary). As interest payments become due, the India-based subsidiary pays the Indian parent and the U.S.-based subsidiary pays the U.S. parent. Finally, when the term of the loans expires, each subsidiary will repay the other's parent. **Note that this financially engineered contract has (a) effectively exploited each firm's ability to borrow at more favourable rates in its home country and (b) avoided all need for foreign currency exchange.**

Obviously, the crucial factor in the formation of such a mutually advantageous contract is the identification of two parties with offsetting needs. In recent years, many financial intermediaries have developed services to fill this need. Swap dealers and brokers have developed the expertise to serve a broad variety of needs by matching the interests of counterparties and by engineering contracts that are mutually advantageous to the contracting parties and profitable for the intermediary.

A second common swap agreement is the interest rate swap. This typically takes the form of an exchange of a fixed-rate interest payment for a floating-rate interest payment. Suppose a bank has made a large number of loans at a fixed rate, but most of its liabilities are floating-rate obligations. If interests rise materially, its expenses will rise but its revenues are fixed. Profitability will suffer. If the bank can swap its 9-per cent fixed-rate loans for a comparable amount of floating-rate obligations that generate the yield on the 5% long term Indian Govt./RBI Treasury Bills plus 4 per cent, it has materially reduced the influence of interest rate fluctuations on its profitability. In this example, once the bank has found a willing swap partner, the parties will agree to a notional principal amount. That is, the counterparties will agree on the amount of interest-generating capital that will be used to design the agreement. Typically, the parties will not exchange these notional amounts because they are identical. As time elapses, the bank will swap interest payments with its counterparty. For example, if the Treasury bill rate is 6 per cent during a particular period, the agreement mandates that the bank receive 10 per cent while it pays 9 per cent. The swap agreement will require only that the net difference be exchanged, one per cent paid to the bank in this case. If the Treasury bill rate drops to 4.5 per cent, then the bank is obligated to pay the net difference between 8.5 per cent (or 4.5 per cent + 4 per cent) and 9 per cent, or 0.5 per cent to the counterparty. If the Treasury bill rate remains at 5 per cent, the fixed and floating rates are equivalent and no cash exchange would be necessary. Since there was no need for an actual exchange of the identical principal amounts at the beginning of the swap, none is required to close the positions at expiration of the agreement.

More complex swaps could involve trades of fixed and floating-rate payments denominated in different currencies. Others could involve swaps of the income from debt instruments for the income generated by an equity investment in a specific portfolio such as the BSE SENSEX-30. Swaps can also provide the basis for engineering a more efficient method of diversifying risk or allocating assets across asset classes. Consider this well-documented example. A chief executive officer (CEO) of a major corporation has accumulated a significant equity stake in his firm. While the CEO has other investments, he is not effectively diversified since he has an enormous amount of his own firm's stock. The CEO can contact a swap dealer who will arrange to swap the cash flows generated from the CEO's stock (capital gains and/or dividends) for a cash flow generated by an identically valued investment in a broadly diversified portfolio or market index. In this example, the CEO has (1) avoided the cost of selling his stock and any capital gains taxes that may result from the sale; (2) retained the voting rights of his stock; and (3) created a "synthetic" portfolio that is much less sensitive to the fluctuations in value of any particular company.

The swap can be engineered to provide immediate **international diversification**. Suppose two portfolio managers, one in the India and another in Japan, manage purely domestic portfolios. They may agree to swap notional values that would generate returns on their own managed portfolios or generate cash flows commensurate with an investment in a market index. For example, the Indian manager may agree to provide the cash flow generated by a Rs 2 crore investment in the NSE-Nifty in exchange for returns generated from a similar-sized investment in the Nikkei 225 index. This would provide instant international diversification without the sizable cost of purchasing a large number of individual foreign securities. In addition, many countries impose fees or taxes on returns to foreign owners. A properly engineered swap agreement can avoid most or all of these expenses.

Portfolio Insurance

Another prominent example of financial engineering to meet the needs of clients is portfolio insurance. **Portfolio insurance is essentially a strategy of hedging, stabilizing, or reducing the downside risk** associated with the market value of a portfolio of financial assets such as stocks and bonds. There are a variety of techniques to protect the value of such a portfolio.

As an example, suppose a portfolio manager wants to build a floor under the current value of a well-diversified portfolio. Furthermore, suppose that this portfolio is currently valued at Rs 2 crore, and its changes in value closely correspond with changes in the BSE-SENSEX index. Ideally, the manager would like to reap the benefits of further increases in portfolio value, but wants to assure investors that the value will not fall below a certain, specific level.

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One solution is to purchase put options on the BSE-SENSEX index.

These options are heavily traded at a variety of exercise prices. If the current level of the BSE-SENSEX index is 25000 and the manager wants to ensure that the value of his portfolio does not fall by more than 10 per cent, put contracts with an exercise price of 22,500 (approximately 10 per cent below the current level) can be purchased.

The manager must purchase enough put option contracts so that the underlying value of the optioned asset is equal to the value of the portfolio. In this example, the portfolio value is approximately 800 times the current value of the BSE-SENSEX index. Therefore, if the manager could buy puts on 800 "units" of the index, the position could be fully hedged. So, the manager would purchase put contracts worth 800 units of index (say 4 contracts, each having 200 units of the BSE-SENSEX). Subsequent to the purchase, if the BSE-SENSEX index (and the portfolio) rises in value, the manager will not exercise the put. Gains to the portfolio will be reduced by the modest amount of the put premium that was paid. On the other hand, if the index and the portfolio dropped in value, say by 20 per cent, the put could be exercised at a significant profit that would generate a combined net loss for the position of approximately 10 per cent. If the index value fell even lower, the profit from the put would be even greater and always provide a net loss of 10 per cent.

Other techniques of portfolio insurance use futures contracts on stock and other market indexes. In the previous example, the manager could "synthetically" sell some or all of the portfolio by selling futures contracts on the BSE-SENSEX index. If the portfolio subsequently fell in value along with the BSE-SENSEX index, the futures position would generate profits that would partially or entirely offset the loss. If market prices rose, the portfolio would rise in value but the futures position would generate a loss that would tend to offset the gain. Note that this technique not only stabilizes the value of the stock portfolio, but also allows the manager to create a position with profits and losses that is equivalent to a smaller stock portfolio. This lower risk position is achieved without the significant expense of actually selling a portion of each individual stock position within the portfolio. Technically, this is an example of hedging, or maintaining a particular market value for a period rather than ensuring a minimum value while retaining the opportunity for upside gains. It is possible, however, to sell the proper number of BSE-SENSEX index futures in order to mimic the overall profits of the put insured portfolio. This would require periodic adjustment to the hedge, or the number of futures contracts sold, as prices changed and the time to expiration of the contracts diminished.

In summary, financial engineering is the design and construction of new financial contracts, which 'derive' their value from the value of the underlying basic securities. More complex derivative contracts are typically assembled from a modest number of basic financial instruments including stocks, bonds, representative market index and also the elementary derivatives like options, futures and forward contracts. The need for properly engineered financial contracts is motivated by the client's interest in reducing risk, reducing costs associated with foreign exchange or other market transactions, and to provide the potential to enhance returns. Many financial intermediaries have developed specialized services in the area of financial engineering. As they have done so, the markets where elaborate and specialized derivative contracts can trade efficiently have expanded and are likely to continue to do so.

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