



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

QUANTITATIVE INVESTMENT MANAGEMENT

LECTURE 33

Derivatives, A Recapitulation

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DERIVATIVES



WHAT IS A FINANCIAL DERIVATIVE?

- A derivative is an instrument whose value depends on, or is derived from, the value of another asset.
- Examples: forwards, futures, options, swaps, future options, etc.



IFRS DEFINITION OF “DERIVATIVE”

- IFRS 9 defines a derivative as a financial instrument with all three of the following characteristics:
- Its value changes in response to the change in an underlying variable which may be price, interest rate, index of prices or rates, credit risk or the like.
- It requires no initial net investment or a smaller initial net investment relative to other instruments having similar risk-return characteristics.
- It is settled at a future date.

PRICE FUNCTION OF A DERIVATIVE

- As mentioned earlier, the instantaneous price P_t of a derivative is a function of the instantaneous price of the underlying asset S_t , whence,

$$P_t = f(S_t, t)$$

- Explicit time dependence! Why?



EXPLICIT TIME DEPENDENCE OF PRICE

- We can express the price of common derivatives as the “present value” of the expected payoff (calculated with reference to a special set of probabilities) from the derivative.

$$P_t = e^{-r(T-t)} E_Q \left[f(S_T) \right]$$

- Since, this “present value” is an explicit function of time, the explicit time dependence of the price of derivative follows.

RANDOMNESS IN PRICE OF UNDERLYING

- Randomness in the price of the underlying is the genesis of the creation of derivative contracts.
- A derivative on a deterministic process like a risk-free bond will be worthless.
- Hence, in derivatives we are dealing with proper functions of random variables.

COMMON APPLICATIONS OF DERIVATIVES

- **Speculation**
- **Hedging**
- **Arbitrage**
- **Changing the nature of asset or liability**



COMMON VARIETIES OF DERIVATIVES

- **Forward Contracts**
- **Futures Contracts**
- **Options Contracts**
- **Swaps**



FORWARD CONTRACTS

- Forwards are customized contracts negotiated today ($t=0$) at today's agreed price and other terms of delivery.
- However, the settlement of the contracts takes place on a specified future date ($t=T$). The settlement date is also agreed today.
- Cash flow occurs in the future. No cash flow now except margin.
- Since forwards are private contracts, they are susceptible to default risk.



FUTURES CONTRACT

- **Futures are similar to forwards. However, They are traded on futures exchanges.**
- **Since futures are exchange traded, they are standardized to facilitate liquidity.**
- **To enable uninhibited trading, the exchange's clearing house guarantees performance of both legs of these contracts. Hence, these contracts carry negligible default risk.**
- **The exchange protects itself by imposing margin & MTM.**

FORWARDS VS FUTURES

- **Forwards are private contracts**
- **Forwards are customized**
- **Forwards carry one specified delivery date usually**
- **Forwards are settled at maturity by delivery or cash settlement**
- **Forwards carry some credit risk**



FORWARDS VS FUTURES CONTD...

- **Futures are exchange traded contracts**
- **Futures are standardized**
- **Futures may carry one or a range of specified delivery dates**
- **Futures are settled daily by MTM**
- **Futures are usually closed out before maturity**
- **Futures carry virtually no credit/default risk**



OPTION CONTRACTS

- **Option contracts are contracts whereby the holder of the option acquires a right to buy/sell a certain asset by/on a certain date for a certain price.**
- **The seller of the option has the obligation to honor the option if the holder decides to exercise the option. He has no discretion.**
- **Option contracts that give a right to the holder to buy (sell) the underlying asset are called calls (puts).**

SWAPS

- Swaps are private agreements between two parties to exchange cash flows in the future according to a pre-arranged formula. They can be regarded as a portfolio of forward contracts. Common swap contracts are
 - Interest Rate Swaps (IRS)
 - Currency Swaps

FORWARD CONTRACTS



TERMINOLOGY

- **Underlying Asset:** The asset that forms the substratum of the forward contract is called the underlying asset.
- The underlying assets include stocks, currencies, interest rates, commodities, debt instruments, electricity, insurance payouts, weather etc.
- **Maturity:** The date on which the forward contract mandates delivery of the underlying asset is called its maturity or exercise date.

LONG & SHORT POSITIONS

- **Underlying Asset**: Long position in an asset means owning the asset. Shorting the asset means borrowing the asset.
- **Forward**: An entity has a long position in a forward/future if it will buy the underlying asset under the forward/future contract. The short party will deliver the asset.
- **Option**: An entity is long in an option if it bought the right to exercise the option. The short party has the obligation but no right under the option.

LONG & SHORT...

- **A party having a long position in a forward would benefit from a price rise of the underlying asset.**
- **A party having a short position would benefit from a price fall of the underlying asset.**

THE FORWARD PRICE

- The value of a forward contract at the point of its inception is invariably zero.
- The forward price for a contract is the delivery price that would be applicable to the contract if **were negotiated today** (i.e., it is the delivery price that would make the contract worth exactly zero).

WHY ARE FORWARDS “DERIVATIVES”?

- Consider a forward contract entered at $t=0$ with maturity $t=T$ at price $F(0,T)$. At this point, the contract is worth zero. $F(0,T)$ reflects the market's current perception of the price at $t=T$.
- However, as time evolves, this perception may change since we live in a dynamic environment. Let us assume that at $t=t^*$ such that $0 < t^* < T$, the forward price of the asset for delivery at $t=T$ has increased i.e. $F(t^*,T) > F(0,T)$.
- Then, because the original contract envisages purchase at a lower price than the current price, it (original contract) will command a positive value today ($t=t^*$) for the party long in the contract.