BASICS OF DERIVATIVES

DEFINITION OF A DERIVATIVE

- A DERIVATIVE IS A FORMAL CONTRACT BETWEEN TWO COUNTERPARTIES, VIZ, BUYER & SELLER, WHICH DERIVES ITS VALUE FROM ONE OR MORE UNDERLYING ASSETS

- SOME EXAMPLES OF THE UNDERLYING ASSETS CAN BE EQUITY STOCKS, CURRENCY, INTEREST RATES, BONDS, COMMODITIES, MARKET INDICES, ETC.

CHARACTERISTICS OF A DERIVATIVE

AS PER IFRS9 :

- THE VALUE OF THE DERIVATIVE INSTRUMENT CHANGES IN RESPONSE TO A CHANGE IN VALUE OF THE UNDERLYING ASSET

- IT REQUIRES COMPARATIVELY LITTLE NET INITIAL INVESTMENT, WHICH IS SMALLER THAN OTHER TYPES OF SIMILAR CONTRACTS OR AN OUTRIGHT PURCHASE OF THE UNDERLYING ASSET

- IT IS SETTLED AT A FUTURE DATE, CALLED CONTRACT MATURITY, BY WAY OF ACTUAL DELIVERY OF UNDERLYING ASSET OR AN EQUIVALENT CASH VALUE

ALSO WORTH NOTING IS THAT AT TRADE INITIATION, THERE IS NO PROFIT OR LOSS FOR BOTH THE COUNTERPARTIES IN A DERIVATIVE CONTRACT

TYPES OF DERIVATIVES

DERIVATIVES CAN BE

A. OVER THE COUNTER (OTC) TRADED or
B. EXCHANGE TRADED (ETD)

MOST WIDELY USED DERIVATIVE INSTRUMENTS ARE

1. OPTIONS
2. FUTURES
3. FORWARDS
4. SWAPS

ADVANTAGES & DISADVANTAGES OF A DERIVATIVE CONTRACT

ADVANTAGES:

- GREATER LIQUIDITY THAN UNDERLYING ASSETS
- TOOL FOR RISK MANAGEMENT VIA PRINCIPLE OF RISK TRANSFER
- ACCESSIBILITY TO UNAVAILABLE MARKETS
- PROVIDES LEVERAGE AS INITIAL COST OF INVESTMENT IS LOW
- AIDS IN PRICE DISCOVERY & MARKET EFFICIENCY VIA ARBITRAGE
- LOWER TRANSACTION COSTS

DISADVANTAGES

- OTC DERIVATIVES HAVE CREDIT/ COUNTERPARTY RISK
- SPECULATIVE IN NATURE
- HIGH LEVERAGE COMES AT HIGHER FINANCIAL RISK
- ADDITIONAL COST FOR BANKING PARTICIPANTS VIA CAPITAL PROVISIONS
- COMPLEX DERIVATIVES ARE DIFFICULT TO VALUE

MARKET PARTICIPANTS

SIZE OF DERIVATIVE MARKETS - ETD

Exchange-traded futures and options, by location of exchange

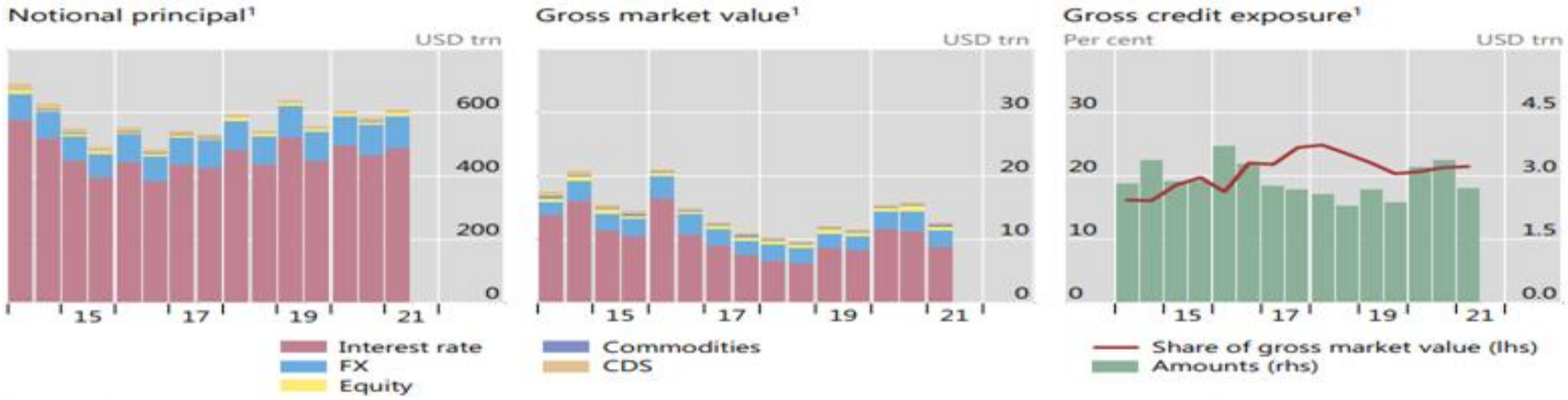
Notional principal, in billions of US dollars

‹ Q4 2021	Open interest			Daily average turnover						
Level: 1 2 3 4	Dec 2020	Sep 2021	Dec 2021	2020	2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
Futures										
All markets	28,995	35,055	34,129	5,415	5,863	4,462	5,342	7,790	7,128	5,016
North America	18,839	22,947	23,518	3,691	3,840	3,013	3,235	5,156	5,278	3,642
Europe	8,065	10,134	8,584	1,461	1,754	1,213	1,800	2,305	1,603	1,130
Asia and Pacific	1,252	1,090	1,200	180	170	129	193	211	163	165
Other Markets	839	884	828	82	99	107	113	118	84	80
Options										
All markets	36,955	49,731	45,961	1,414	1,523	1,102	1,530	2,305	1,946	1,285
North America	23,713	32,448	30,057	1,113	1,135	902	930	1,548	1,551	1,029
Europe	12,112	16,454	15,065	279	367	185	577	738	382	230
Asia and Pacific	8	5	7	6	9	7	9	11	10	12
Other Markets	1,122	824	832	17	12	9	14	8	2	14

Source – www.bis.org

SIZE OF DERIVATIVE MARKETS - OTC

Global OTC derivatives markets — Graph A.1



¹ At half-year end (end-June and end-December). Amounts denominated in currencies other than the US dollar are converted to US dollars at the exchange rate prevailing on the reference date.

Source: BIS OTC derivatives statistics (available at www.bis.org/statistics/derstats.htm).

Global OTC derivatives market

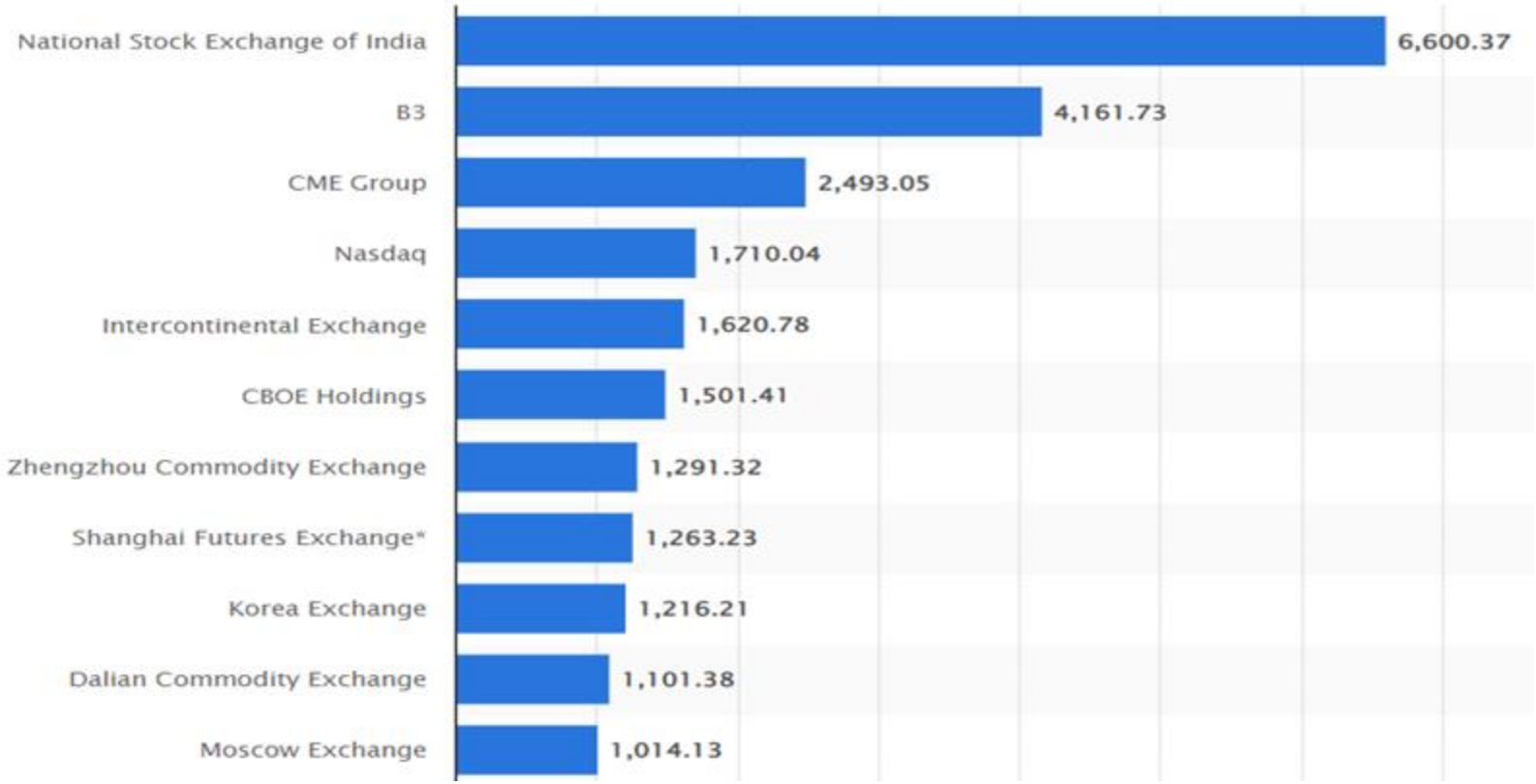
In billions of US dollars

‹ H1 2021	Notional amounts outstanding				Gross market value			
Level: 1 2 3 4	H2 2019	H1 2020	H2 2020	H1 2021	H2 2019	H1 2020	H2 2020	H1 2021
All contracts	558,513	606,821	582,055	609,996	11,598	15,481	15,783	12,617
⊞ Foreign exchange contracts	92,179	93,811	97,549	102,471	2,230	2,628	3,176	2,412
⊞ Interest rate contracts	448,966	495,141	466,494	488,099	8,352	11,718	11,319	8,940
⊞ Equity-linked contracts	6,874	6,457	7,084	7,506	583	659	840	730
⊞ Commodity contracts	2,129	2,099	2,051	2,453	197	260	216	300
Credit derivatives	8,119	9,050	8,649	9,121	222	200	219	220
⊞ Credit default swaps	7,578	8,809	8,359	8,813	199	185	202	205
Other derivatives	246	262	227	347	15	16	13	15
Gross credit exposure					2,360	3,204	3,366	2,713

Source – www.bis.org

SIZE OF DERIVATIVE MARKETS – BY EXCHANGE

No. of Contracts (in millions)



** Data as of 1st half of 2021*

** Source – www.statista.com*

TYPES OF DERIVATIVES

FUTURES Vs FORWARDS

CHARACTERISTIC	FUTURES	FORWARDS
TRADING	EXCHANGE TRADED	OVER-THE-COUNTER TRADED
NATURE	STANDARDISED	CUSTOMISED
DAILY MARGIN/ MTM	REQUIRED DAILY	NO MARGIN REQUIREMENT OR DAILY MTM
COUNTER PARTY RISK	NEGLIGIBLE	RISK PRESENT
LIQUIDITY	HIGH	LOW
SETTLEMENT	MOSTLY CASH SETTLED	MOSTLY SETTLED BY PHYSICAL DELIVERY
TRANSACTION COST	DIRECT COST HIGH (E.g. Exchange Costs)	INDIRECT COST HIGH (E.g. Bid Risk spreads)

WHAT IS A SWAP?

- SWAP IS A DERIVATIVE CONTRACT IN WHICH ONE PARTY EXCHANGES OR SWAPS THE VALUES OR CASH FLOWS OF ONE ASSET FOR ANOTHER.

- OF THE TWO CASH FLOWS, ONE VALUE IS USUALLY FIXED AND ONE IS VARIABLE AND BASED ON AN INDEX PRICE, INTEREST RATE, OR CURRENCY EXCHANGE RATE

- SWAP CONTRACTS ARE USUALLY NOT TRADED ON THE EXCHANGE. THESE ARE PRIVATE CONTRACTS WHICH ARE NEGOTIATED BETWEEN TWO PARTIES

- CONCEPTUALLY, ONE MAY VIEW A SWAP AS EITHER A PORTFOLIO OF FORWARD CONTRACTS OR AS A LONG POSITION IN ONE BOND COUPLED WITH A SHORT POSITION IN ANOTHER BOND

TYPES OF SWAPS - 1

INTEREST RATE SWAP

The parties decide to switch one type of interest rate payment with another type of interest rate payment. Types of Interest Rate Swaps:

1. Plain vanilla swap
2. Basis swap
3. Amortizing swap
4. Step-up swap
5. Differential swap

EQUITY SWAP

The underlying security in this swap is stock, or stocks, or a stock index

ZERO COUPON SWAP

Such a swap works similar to interest rate swap, but gives more freedom to one of the parties

CURRENCY SWAP

The parties agree to swap principal & interest money in distinct currencies.

COMMODITY SWAP

It enables parties to swap floating cash flows on the basis spot rate of a commodity with fixed cash flows on commodity's pre-determined price

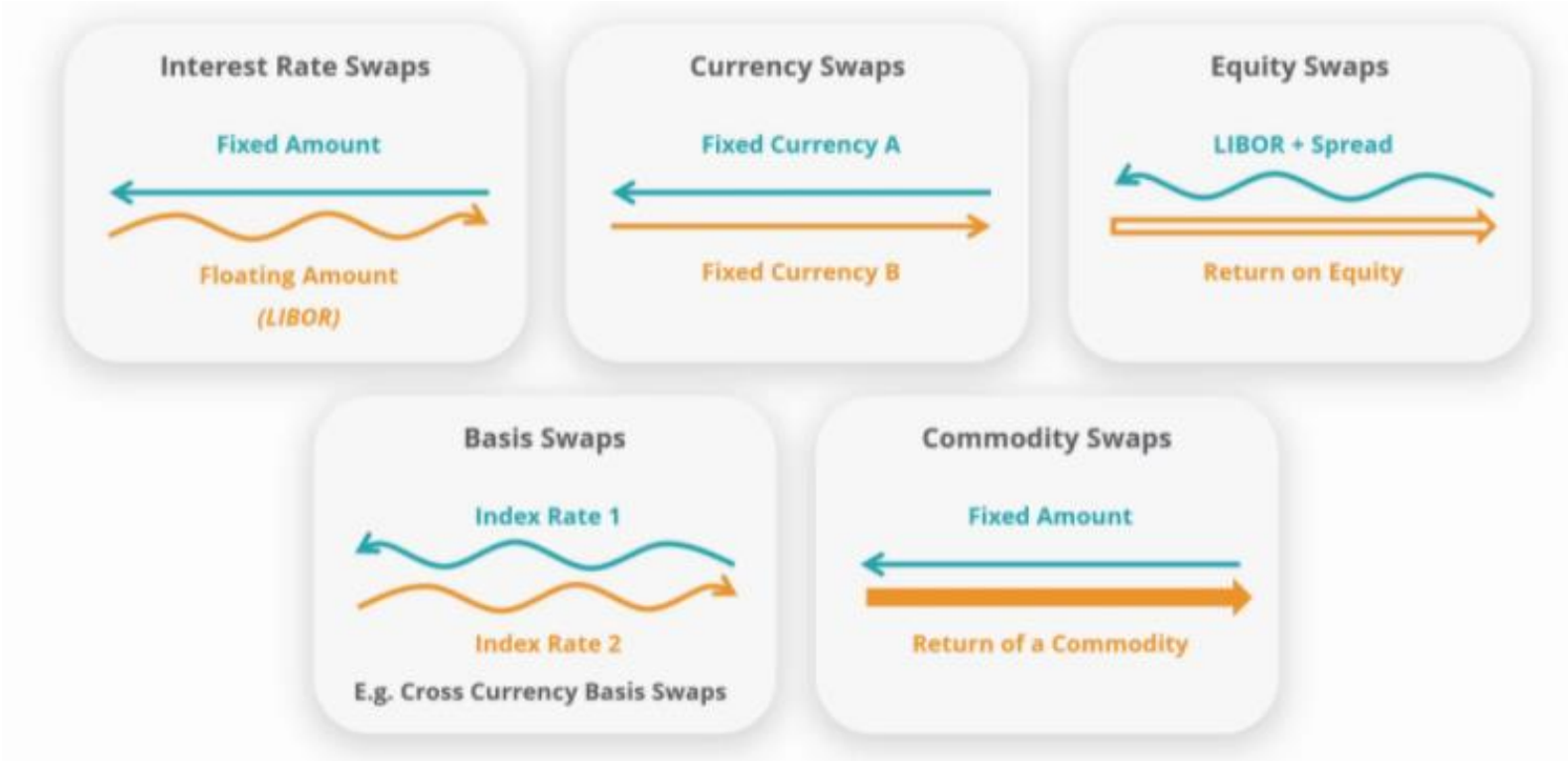
CREDIT DEFAULT SWAP

These swaps work like an insurance policy, and offer protection against the default of a debt instrument.

TOTAL RETURN SWAP

Such a swap enables parties to enjoy benefits of security, without actually owning it

TYPES OF SWAPS - 2



EQUITY SWAP - EXAMPLE

	A	B	C	D	E
6		Payment frequency / reset period	Semi-annual		
7		Equity index	S&P500 price return		
8		Floating rate	USD 6-month LIBOR		
9		6-month LIBOR (at start of first reset period)	3.0%		
10		Price return on S&P500 (during first reset period)	8.0%		
11		Dividend yield on S&P500 (during first reset period)	2.0%		
12		Notional principal ($m)	100.0		
13					
14		$ return on equity index leg ($m)	8.0	=C12*C10	
15		$ return on floating rate leg ($m)	1.5	=C12*C9/2	
16		Net payment ($m)	6.5	=C14-C15	
17					

TOTAL RETURN SWAP - EXAMPLE

	A	B	C	D	E
6		Payment frequency / reset period	Semi-annual		
7		Equity Index	S&P500 price return		
8		Floating Rate	USD 6-month LIBOR		
9		6-month LIBOR (at start of first reset period)	3.00%		
10		Price return on S&P500 (during first reset period)	8.00%		
11		Dividend yield on S&P500 (during first reset period)	2.00%		
12		Notional Principal ($m)	100		
13					
14		$ total return on Equity Index leg ($m)	10	=C12*(C10+C11)	
15		$ return on Floating Rate leg ($m)	1.5	=C12*C9/2	
16		Net Payment ($m)	8.5	=C14-C15	

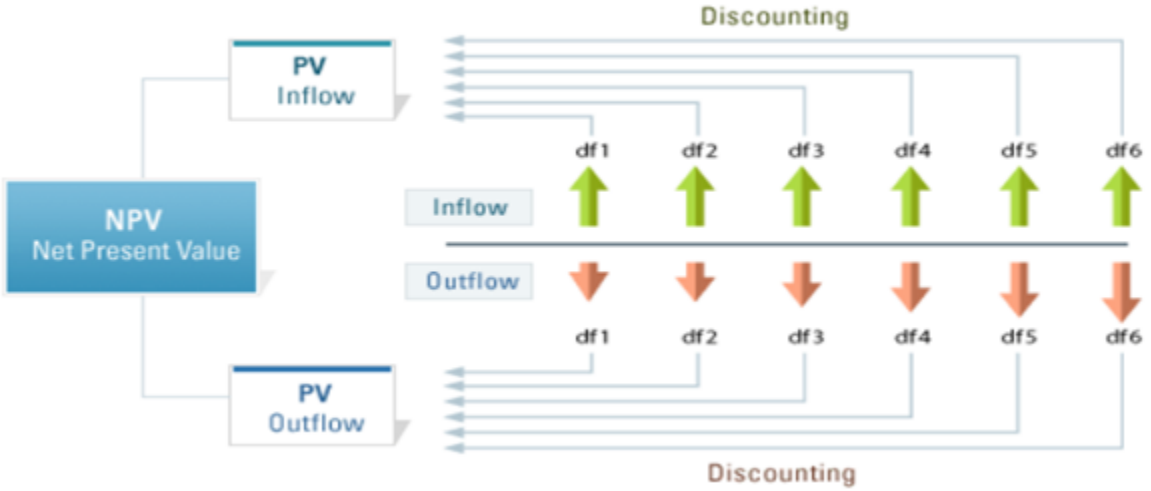
INTEREST RATE SWAP - PRICING

Swap Pricing : Discounted Cashflows

- A swap is constituent of the sum of individual cashflows.
- The fundamental of swap pricing is to find out the present values (PV) of these cash flows.
- Equating the present values of the amounts of the payments and receipts.

Calculation of Swap Rate

- Interest rate swaps are priced so that on the trade date, both sides of the transaction have equivalent NPVs.
- The fixed rate payer is expected to pay the same amount as the floating rate payer over the life of the swap, given the prevailing rate environment (where today's forward curve lies).
- On the trade date, swaps can be thought as an exchange of a fixed rate bond, for a floating rate bond



IRS PRICING (SWAP RATE) - EXAMPLE

Particulars	Year 1	Year 2	Year 3
ZCB Rate (Z)	5.75%	6.10%	6.25%
Discount Factor (DF = 1/Z^n)	1/(1.0575) = **0.9456**	1/(1.061)^2 = **0.8883**	1/(1.0625)^3 = **0.8337**
Expected Forward Rates (FR)	5.75%	(1.061)^2/(1.0575) = **6.45%**	(1.0625)^3/(1.061)^2 = **6.55%**
Swap Rate [(1-DFn)/sum of DF]	5.75%	(1-0.8883)/(0.9456+0.8883) = **6.09%**	(1-0.8337)/(0.9456+0.8883+0.8337) = **6.23%**

FIXED LEG for a 3 Year SWAP NOTIONAL $100			
YEAR	CASH FLOW (A)	DISCOUNT FACTOR (B)	PRESENT VALUE (A*B)
1	6.23	0.9456	5.8911
2	6.23	0.8883	5.5341
3	106.23	0.8337	88.5640
		TOTAL FIXED LEG NPV	**99.9891**

=

FLOATING LEG for a 3 Year SWAP NOTIONAL $100			
YEAR	CASH FLOW (A)	DISCOUNT FACTOR (B)	PRESENT VALUE (A*B)
1	5.75	0.9456	5.4372
2	6.45	0.8883	5.7295
3	106.55	0.8337	88.8307
		TOTAL FLOATING LEG NPV	**99.9975**

GOLDEN RULE: NET NPV SHOULD BE ZERO AT DAY 0

OPTIONS

- OPTIONS ARE FINANCIAL DERIVATIVES THAT GIVE BUYERS THE RIGHT, BUT NOT THE OBLIGATION, TO BUY OR SELL AN UNDERLYING ASSET AT AN AGREED-UPON PRICE AND DATE

BASIC CHARACTERISTICS

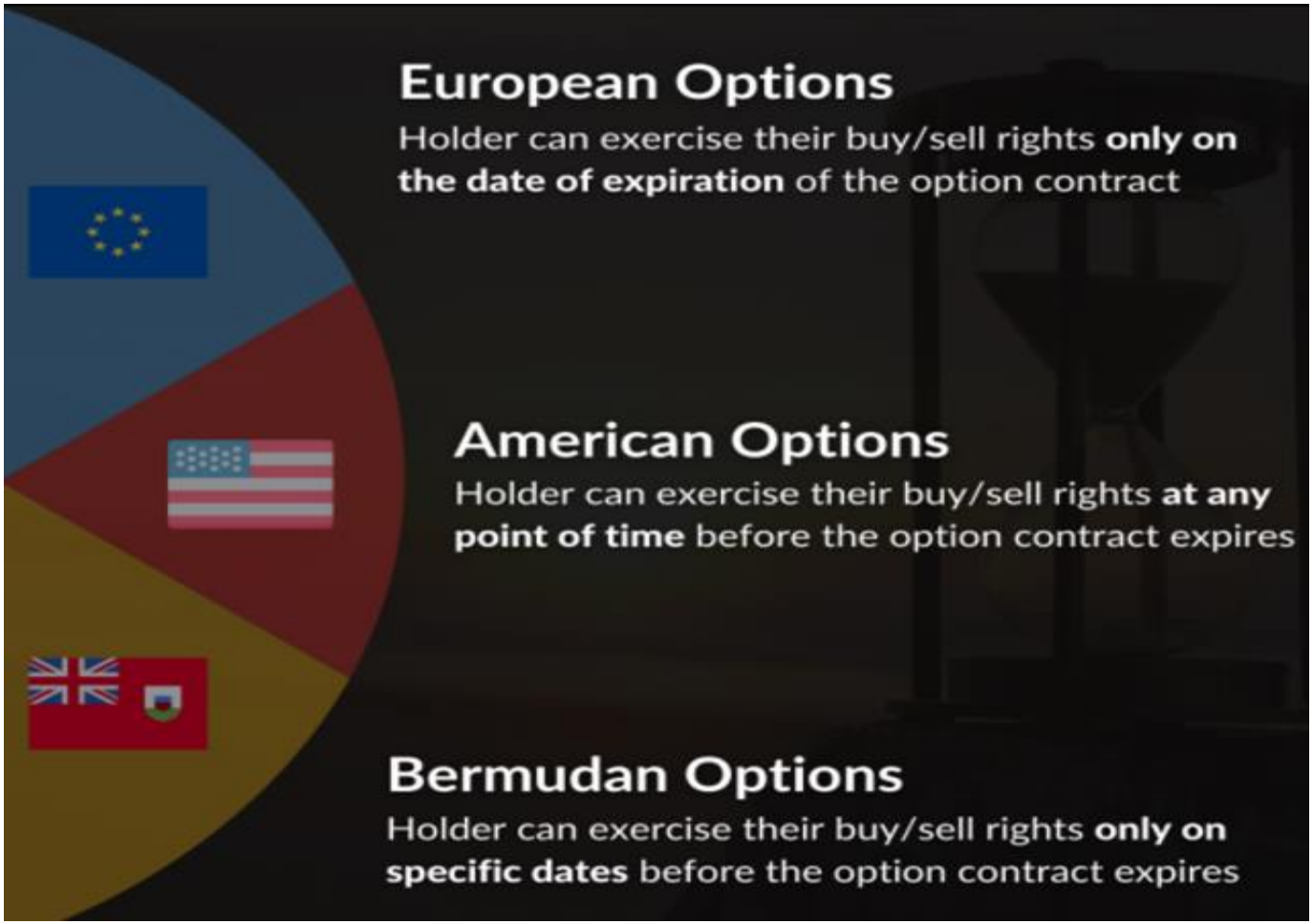
- UNDERLYING ASSET – Eg. EQUITY STOCK, EQUITY INDEX, COMMODITY, FX, ETC
- TYPE OF OPTION – CALL OR PUT
- STRIKE PRICE – PRICE AT WHICH THE OPTION CAN BE EXERCISED
- PREMIUM – PRICE PAID BY OPTION HOLDER TO OPTION WRITE FOR THE CONTRACT RIGHTS
- EXPIRATION DATE - WHEN THE OPTIONS CONTRACT BECOMES VOID AND THE OPTION HOLDER LOSES THE RIGHTS TO THE OPTION
- OPTION STYLE – SPECIFIES WHEN THE OPTION IS EXERCISABLE.

TYPES OF OPTIONS

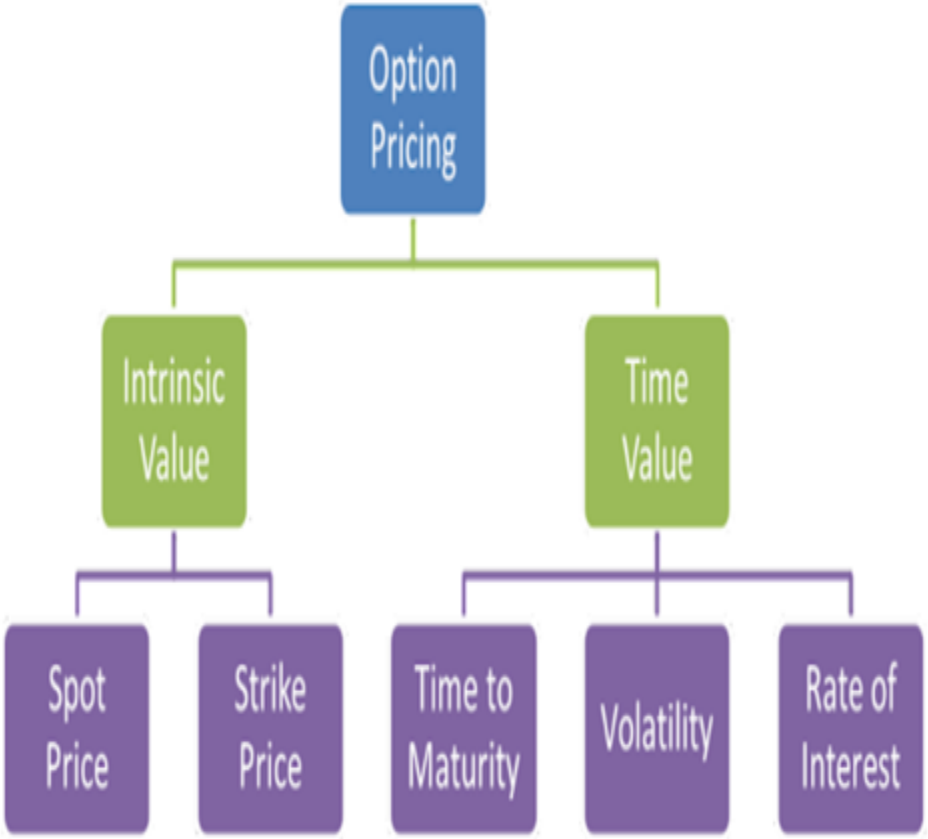
PARTICULARS	LONG CALL	SHORT CALL	LONG PUT	SHORT PUT
Market View	Bullish	Bearish	Bearish	Bullish
When to use	When the underlying price is expected to move positively in future	When the underlying price is not expected to rise beyond a certain point	When the underlying price is expected to move negatively in future	When the underlying price is not expected to drop beyond a certain level
Max Profit	Unlimited	Premium received	Strike Price	Premium received
Max Loss	Premium Paid	Unlimited	Premium Paid	Strike Price
Breakeven	Strike + Premium Paid	Strike + Premium Received	Strike - Premium Paid	Strike - Premium Received

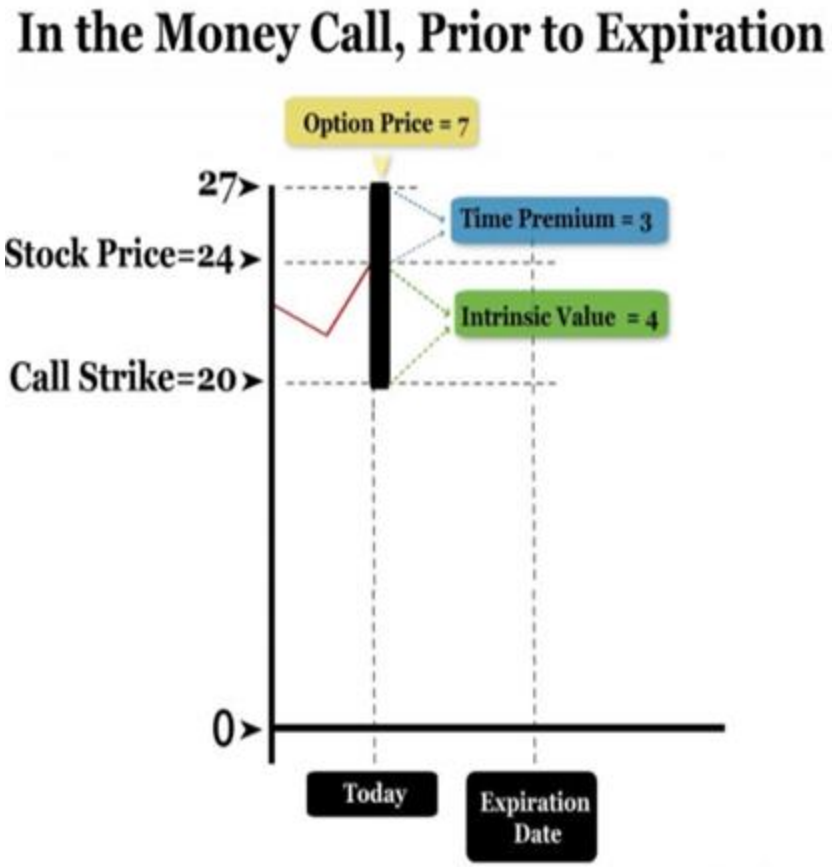
OPTION PAYOFF

OPTION EXECUTION STYLES

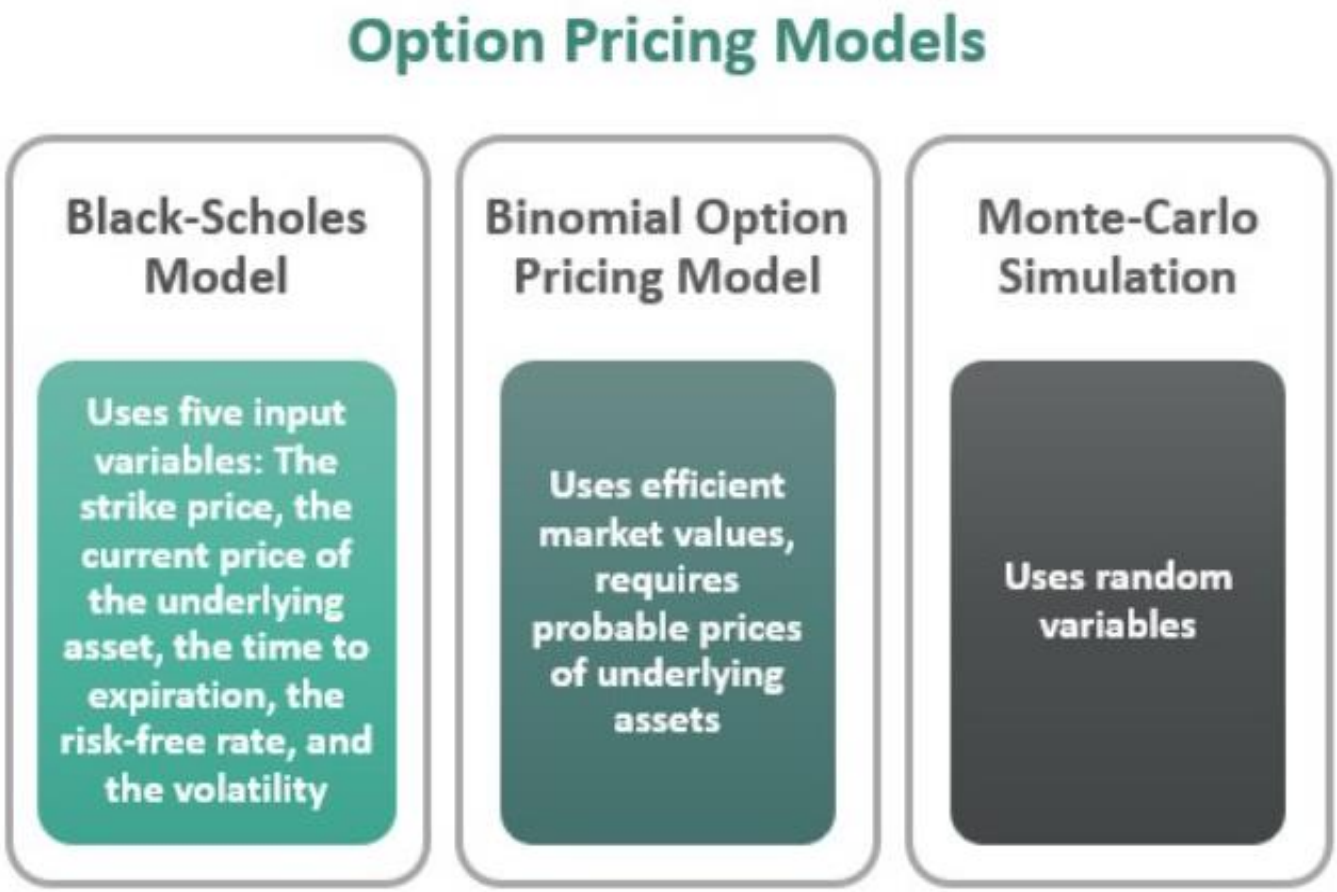


OPTION VALUATION



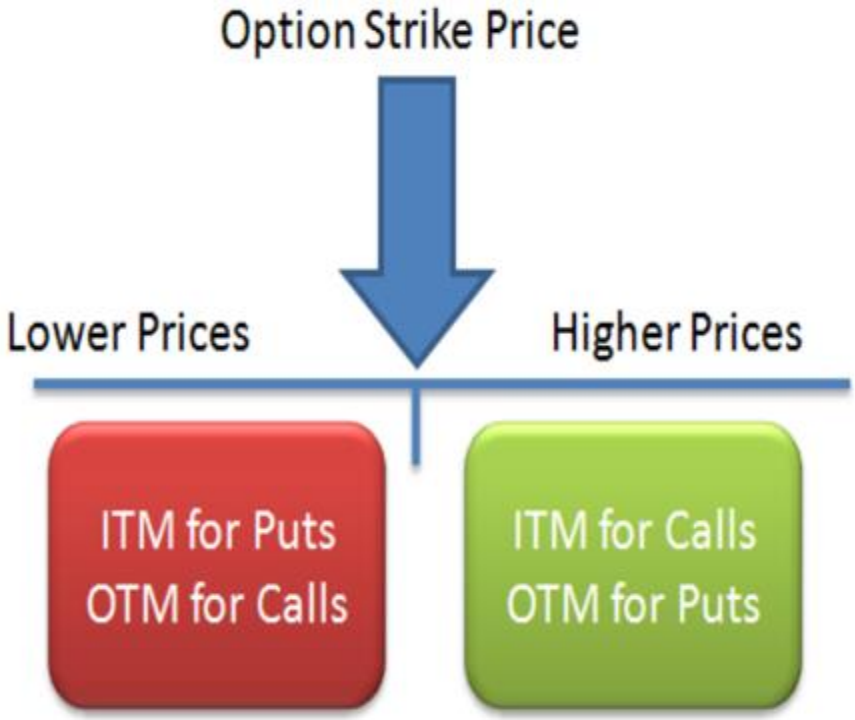


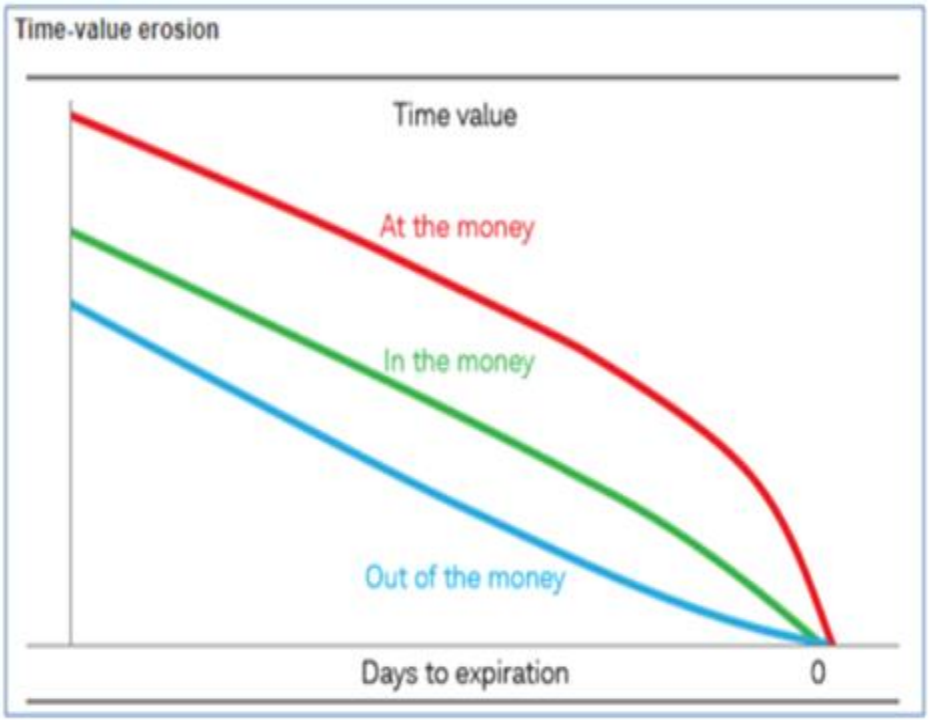
OPTION VALUATION MODELS



WallStreetMojo

IN/ AT/ OUT OF THE MONEY





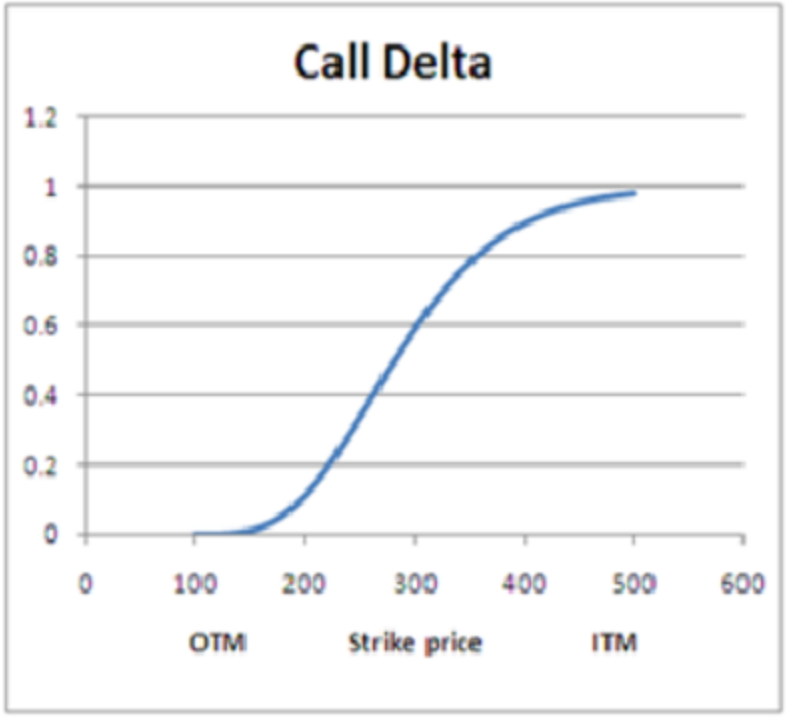
OPTION GREEKS

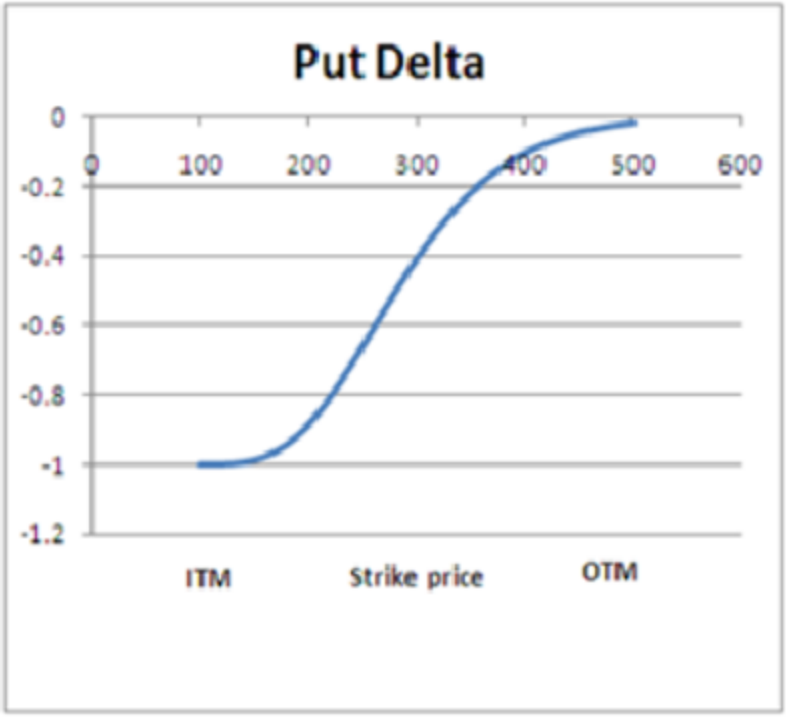
GREEKS ARE THE FINANCIAL MEASURES OF THE SENSITIVITY OF THE OPTION PRICE TO ITS UNDERLYING DETERMINING PARAMETERS.

Delta	δ	Measures change in Option premium due to a change in the underlying price
Gamma	γ	Measures change in Delta due to a change in the underlying price
Theta	θ	Indicates how time decay (reduction in time to expiration) impacts the Option premium
Vega	ν	Measures change in Option premium because of changes in market implied volatility
Rho	ρ	Measures the change in Option premium because of a change in the risk-free rate

OPTION DELTA

Change in the price of the Option = Delta * Change in the spot price of underlying



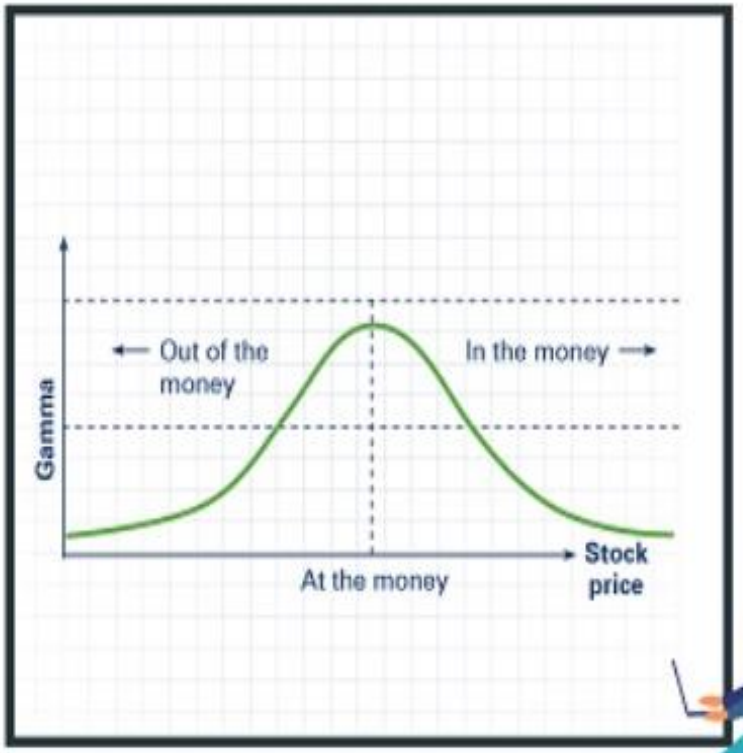


** DELTA DISTRIBUTION IS BOUND BETWEEN -1 TO 1*

GAMMA

Example:

- STRIKE – 50
- SPOT – 55
- DELTA – 0.7
- GAMMA – 0.05
- OPTION PRICE - 7

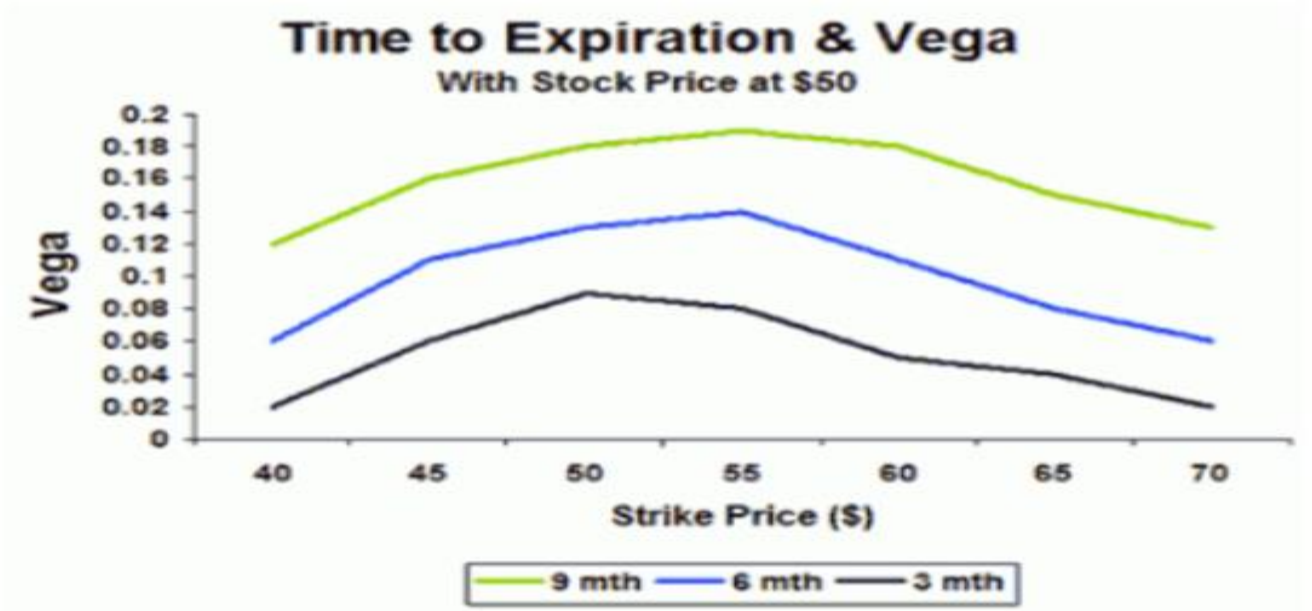


- NEW SPOT – 56
- NEW OPTION PRICE – 7+0.7 = 7.7
- NEW DELTA – 0.7+0.05 = 0.75

** GAMMA DISTRIBUTION IS BOUND BETWEEN 0 & 1*

VEGA-1

- **VEGA** – Sensitivity of an option to change in implied volatility
- **VOLATILITY** – Fluctuation of market price of underlying asset
  a) **HISTORICAL VOLATILITY** : OBSERVED VOLATILITY OVER A PRE DETERMINED PRIOR PERIOD
  b) **IMPLIED VOLATILITY** : REPRESENTS EXPECTED VOLATILITY OF AN UNDERLYING, USING SUPPLY & DEMAND



** VEGA IS PROPORTIONATE TO OPTION MATURITY*

**VEGA IS BOUND BETWEEN -1 AND 1*

VEGA - 2

Eg:

- *OLD VOLATILITY:* ***20***
- *OLD OPTION PRICE:* ***7.5***
- *NEW VOLATILITY:* ***21.5***

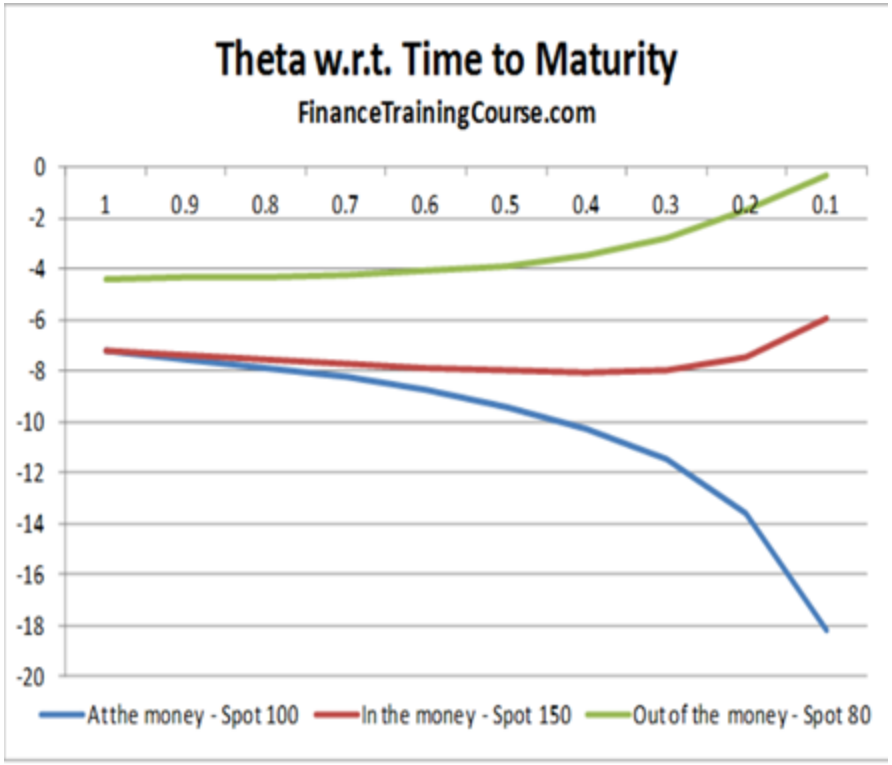
CHANGE IN OPTION PREMIUM

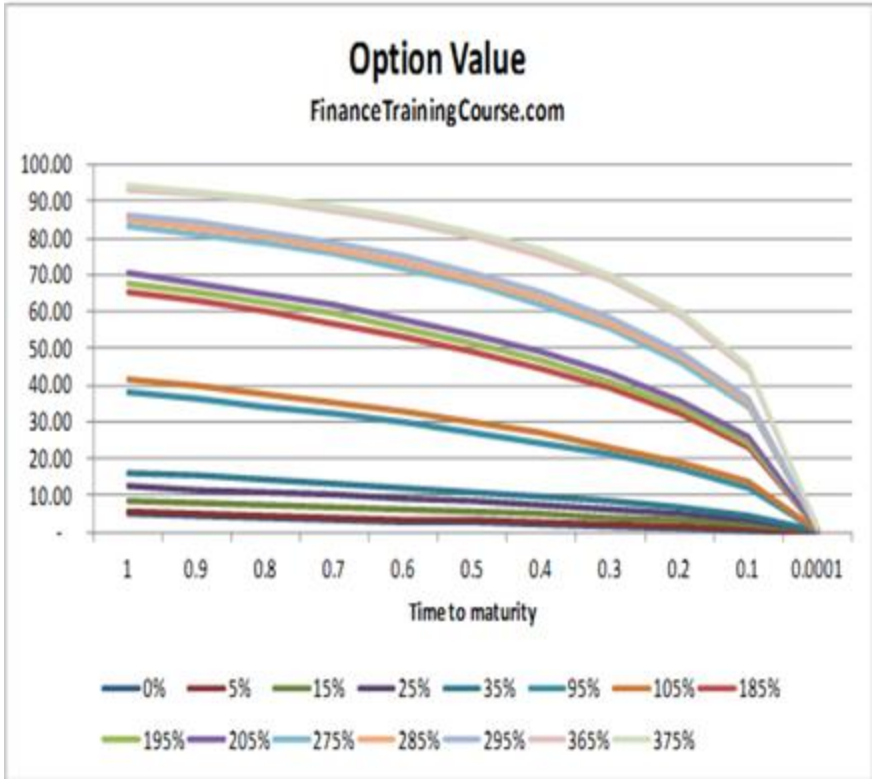
=

(NEW VOL-OLD VOL) x VEGA

THETA

THETA/ TIME DECAY BENEFITS THE SELLER AS IT IS ALWAYS NEGATIVE





AT THE MONEY OPTION HAS MAX THETA

VALUE OF THETA IS PROPORTIONATE TO VOLATILITY OF OPTION

RHO-1

CALL OPTION RHO

• Another benefit of Options is the Leverage, i.e, it allows you to enjoy the upside with minimum payment

Eg:
Stock Price - $50
Cost of outright purchase of 100 shares - $5,000
3m $50 strike Option price - $2
Cost of 100 shares Option contract - $200

The option effectively delays your payment of $5,000 (Strike Price) for 3 months (option's expiration). It is like a 3-month loan of $5,000. Therefore, the option's time value must reflect not only the optionality, but also the value of the loan

Call options are more valuable with higher interest rates and have positive rho.

PUT OPTION RHO

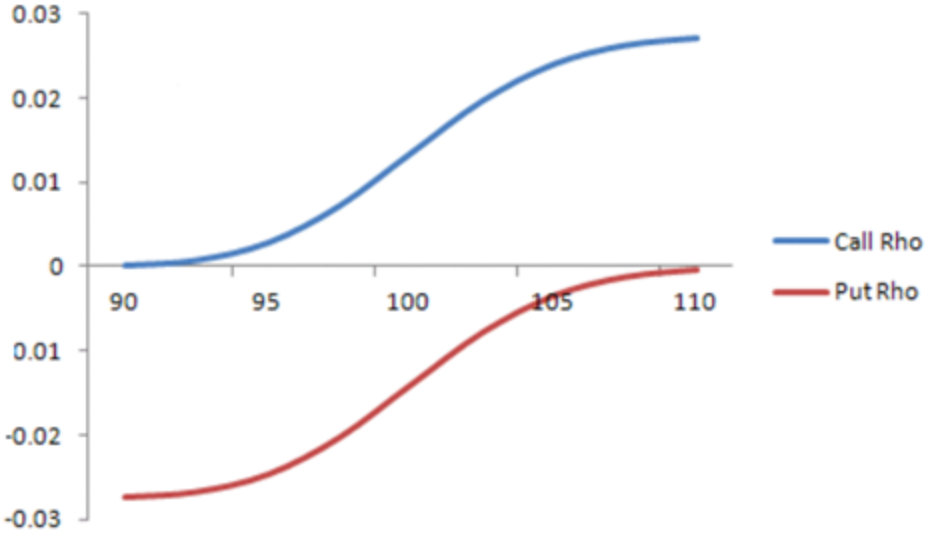
• Let's say you already own 100 shares of the same stock. You are worried the stock will fall. You can sell the stock in the stock market and get $5,000 in cash.

• Alternatively, you can buy a 3-month, $50 strike put option. If the stock does fall, you can exercise the put later and get $5,000. Without the put, you receive $5,000 now (and you can put it in a bank for 3 months and earn interest); with the put you will get the Cash Flow in 3 months.

• The higher the interest rate, the more attractive it is to sell the stock and get the money earlier, rather than buy the put and get the money later.

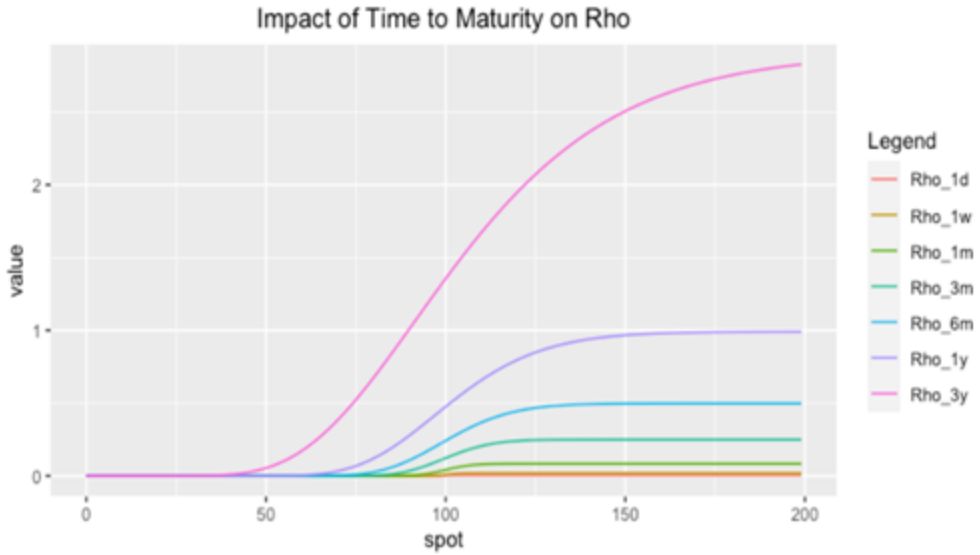
Put options are less valuable when interest rates are higher. They have negative rho.

RHO-2



RHO INCREASES AS OPTION GOES IN THE MONEY

LONGER MATURITY OPTIONS HAVE MORE RHO



OPTION GREEK RISK MATRIX

PARTICULARS	LONG CALL	SHORT CALL	LONG PUT	SHORT PUT
DELTA	LONG	SHORT	SHORT	LONG
GAMMA	LONG	SHORT	LONG	SHORT
VEGA	LONG	SHORT	LONG	SHORT
THETA	SHORT	LONG	SHORT	LONG
RHO	LONG	SHORT	SHORT	LONG

Thank You