

INTRODUCTION TO DERIVATIVES

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Overview Of Derivatives Markets

- A derivative instrument is a contract whose value derives from some underlying asset price, reference rate or index – such as a stock, bond, currency, or a commodity.
- The contract must also specify a principal, or notional amount, defined in terms of currency, shares, bushels, or some other unit.
- Movements in the value of the derivative depend on the notional and the underlying price or index.

Forward Contracts

- The most common transaction in financial instruments are **spot transactions**, that is, for physical delivery as soon as practical (perhaps in two business days or in a week).
- Historically, grain farmers went to a centralized location to meet buyers for their product. As market developed, the farmers realized that it would be beneficial to trade for delivery at some future date. This allowed them to hedge out price fluctuations for the sale of their anticipated production.
- This gave rise to **forward contracts**, which are private agreements to exchange a given asset against cash (or sometimes another asset) at a fixed point in the future. The terms of the contract are the quantity (number of units or shares), date, and price at which the exchange will be done.

Forward Contracts

- Forwards are private agreements ...
- To buy or sell an asset
- At a fixed point in the future
- The terms of the contract are the quantity (number of units or shares), date, and price at which the exchange will be done.
- USDINR is mostly traded as a forward (NDF)

Futures Contract

- Similar to a Forward
- Standardized Contract
- Exchange Traded
- Daily Mark to Market
- No Counterparty risk
- Convexity...

Options

Call

- Right but not the obligation to buy commodity
- At or before a certain time in future (Expiration Date or Maturity)
- For a certain price (called the Strike price) agreed today
- Similar to Long forward except for no obligation to fulfill contract. E.g., Call Option on Crude oil is similar to crude oil forward
- If spot oil price falls to \$98 at maturity, Long trader would lose \$2m. Call option owner can choose not to buy at \$100 as contracted earlier
- Possibility of walking away from unfavourable outcome valuable means that option cannot be free

Options

Put

- Right but not obligation to sell commodity
- At or before a date in future (Expiration Date or Maturity)
- At a fixed price agreed in advance called Strike Price

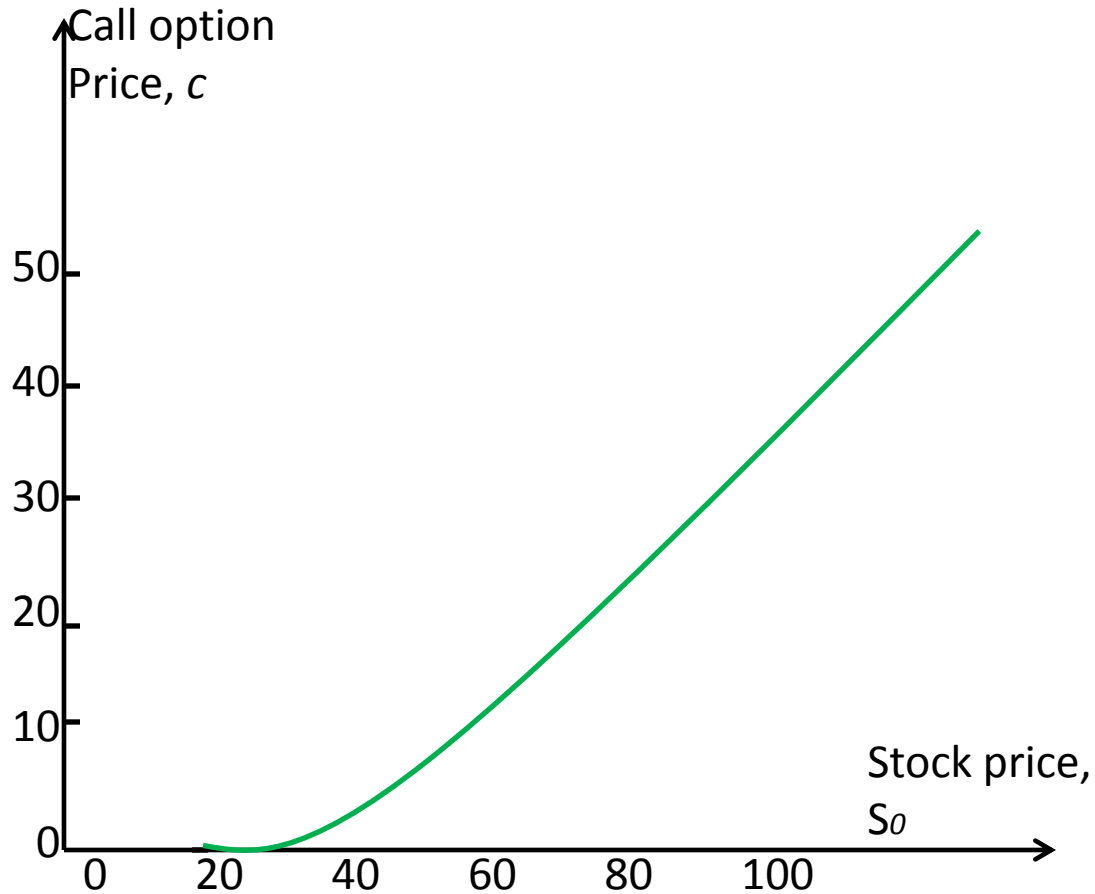
Pay off of Call and Put

- Call : $\text{MAX} (\text{Stock Price} - \text{Strike}, 0)$
- Put: $\text{MAX} (\text{Strike} - \text{Stock Price}, 0)$
- Intrinsic Value
- Time Value
- Option Value = Intrinsic Value + Time Value.
- European option – can only be exercised on maturity date itself
- American option – can be exercised any time up to maturity date

FACTORS AFFECTING OPTION PRICES

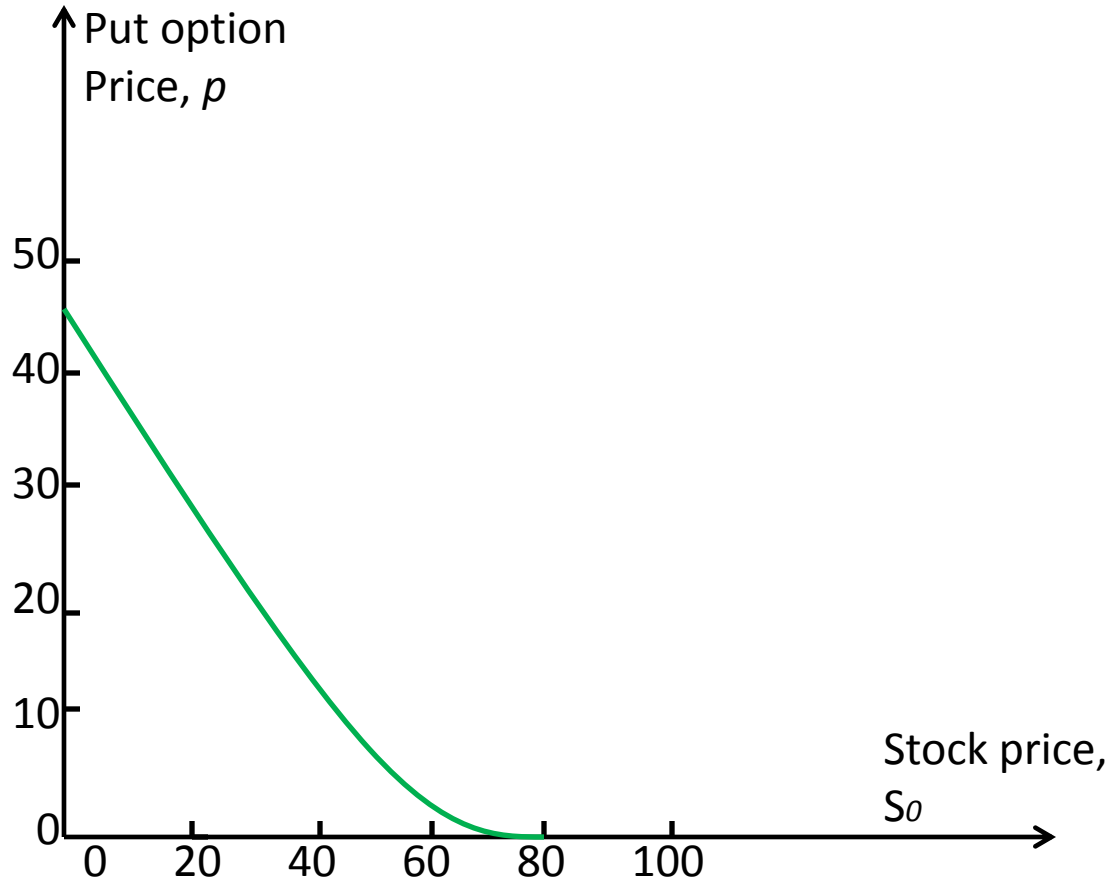
- There are six factors affecting the price of a stock option:
- The current stock price, S_0
- The strike price, K
- The time to expiration, T
- The volatility of the stock price, σ
- The risk-free interest rate, r
- The expected dividends

Effect of changes in Stock Price on Price of Call Option



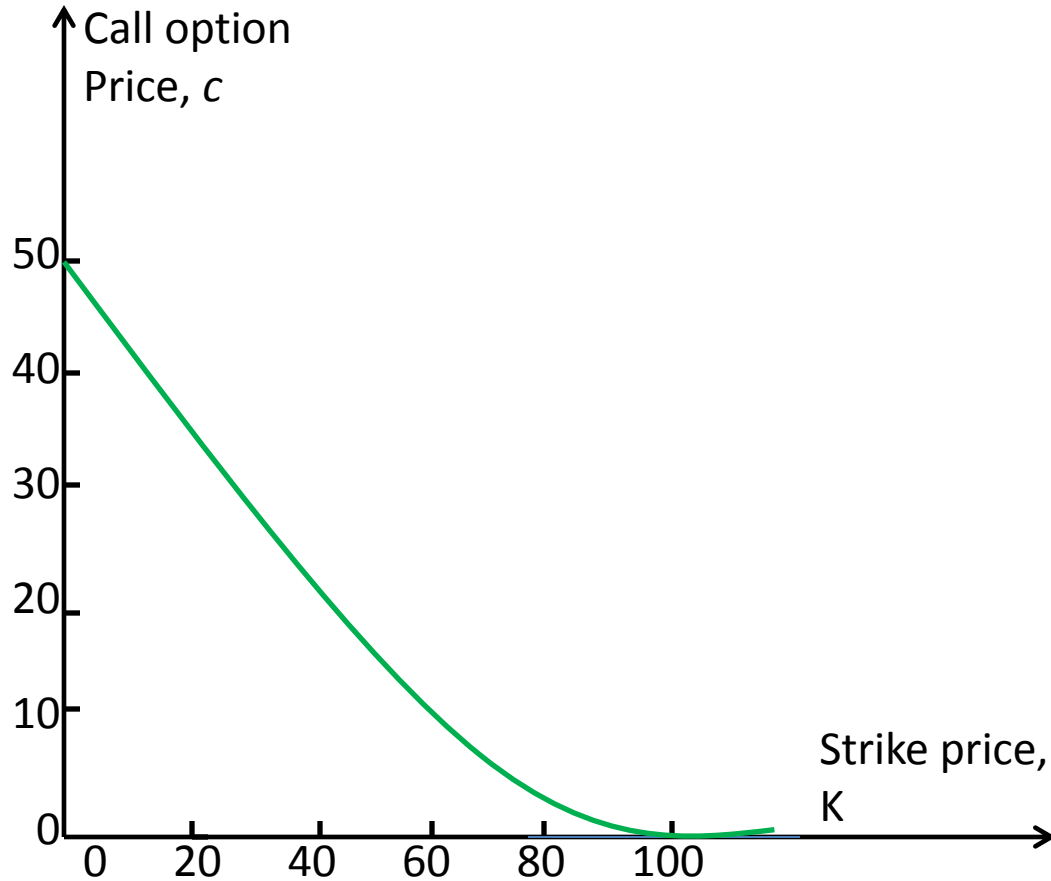
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Stock Price on Price of Put Option



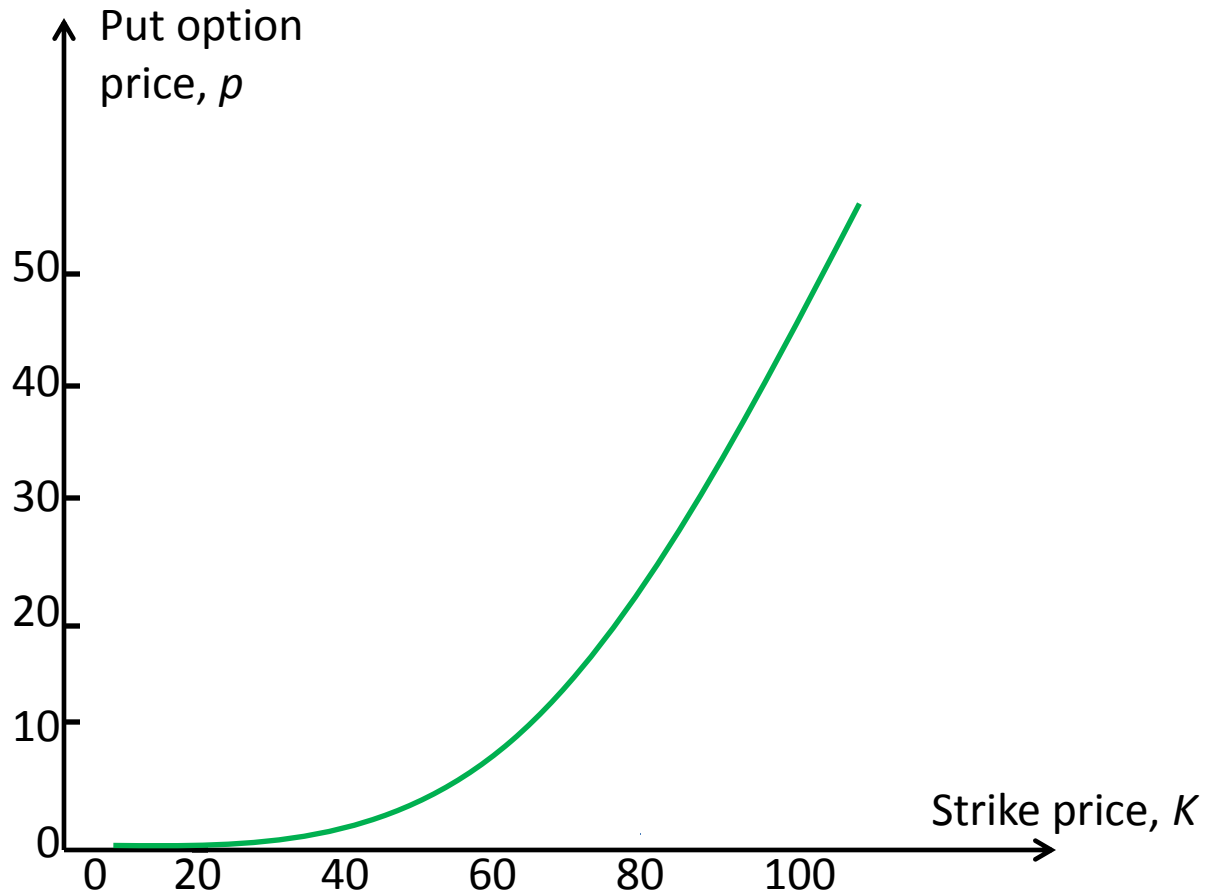
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Strike Price on Price of Call Option



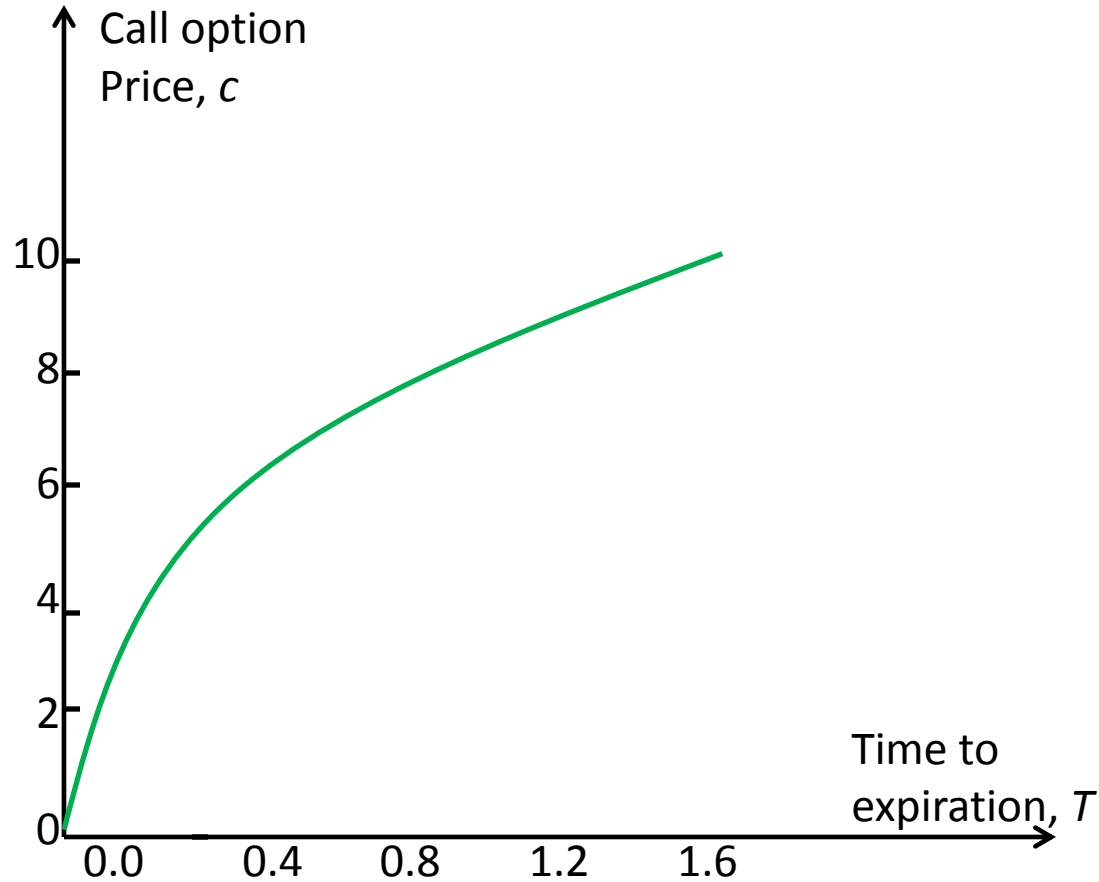
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Strike Price on Price of Put Option



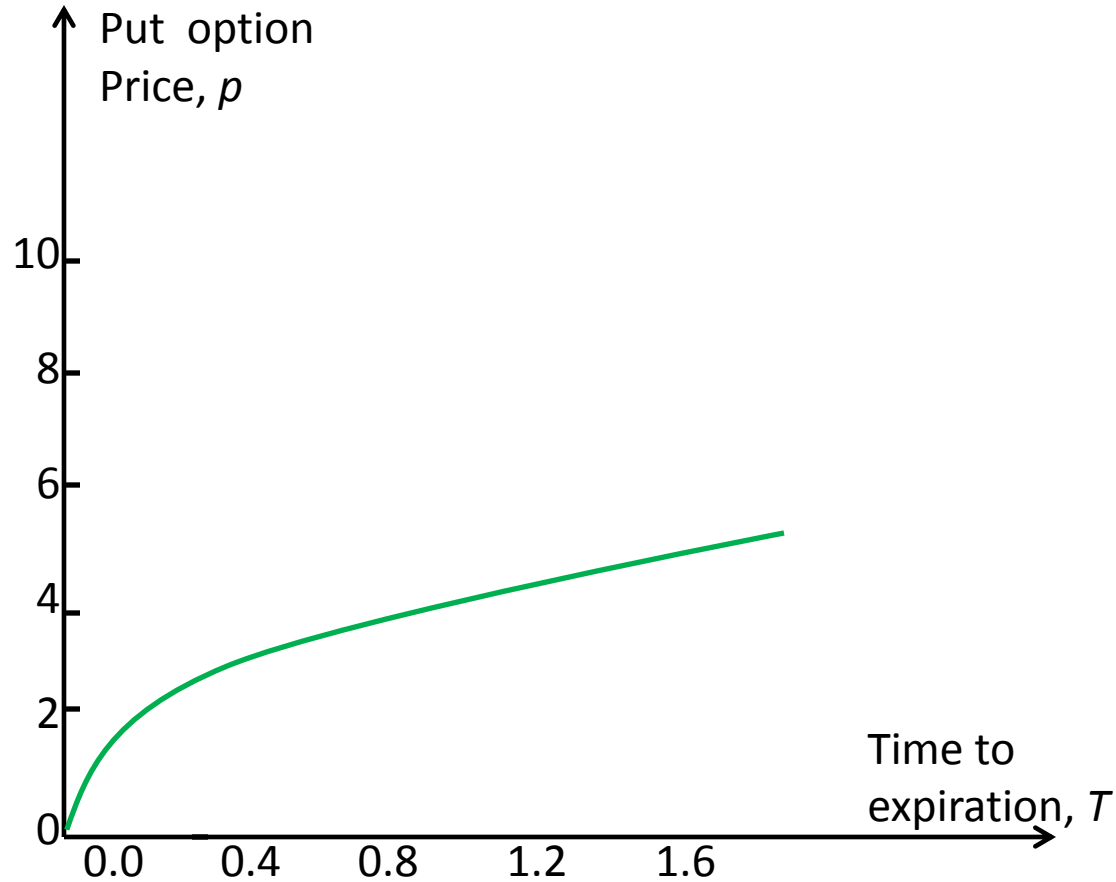
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Time to Expiration on Price of Call Option



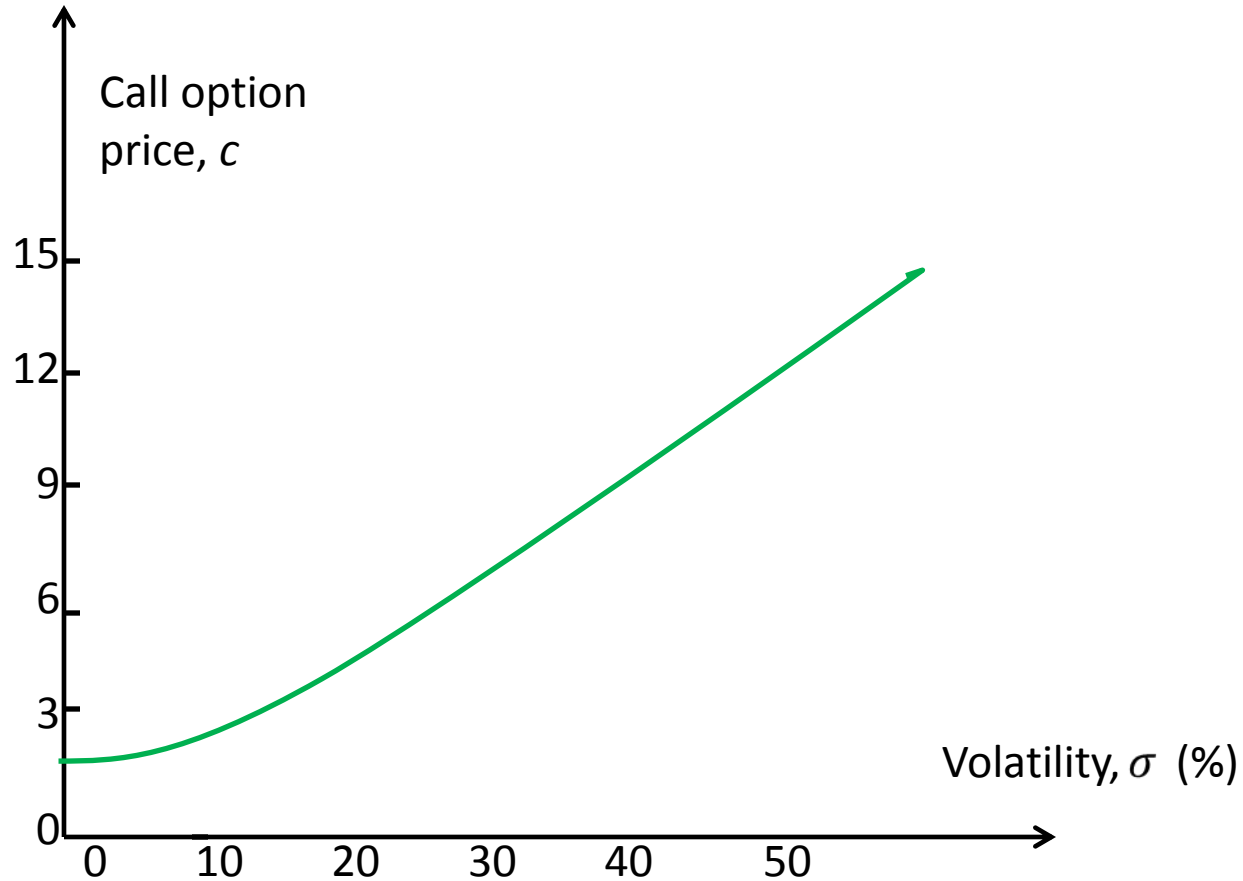
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Time to Expiration on Price of Put Option



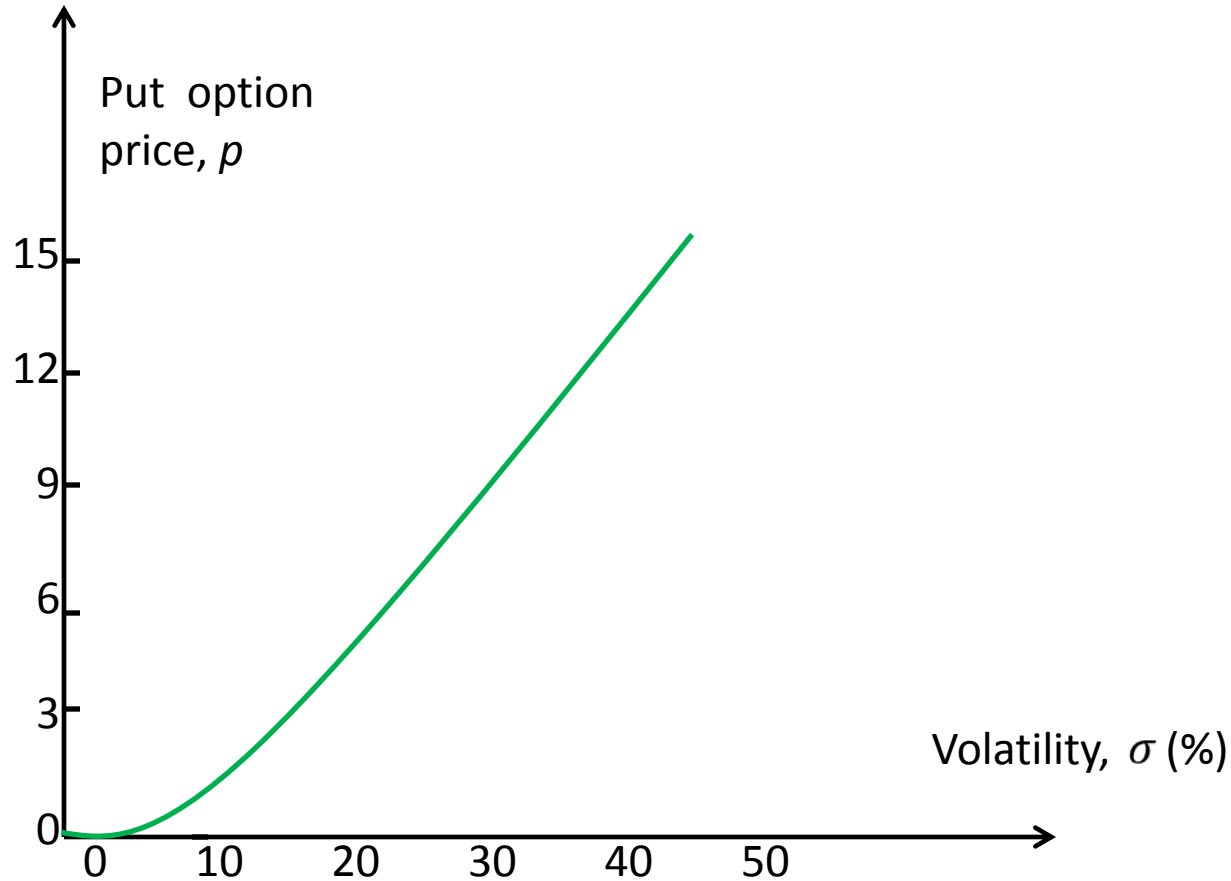
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Volatility on Price of Call Option



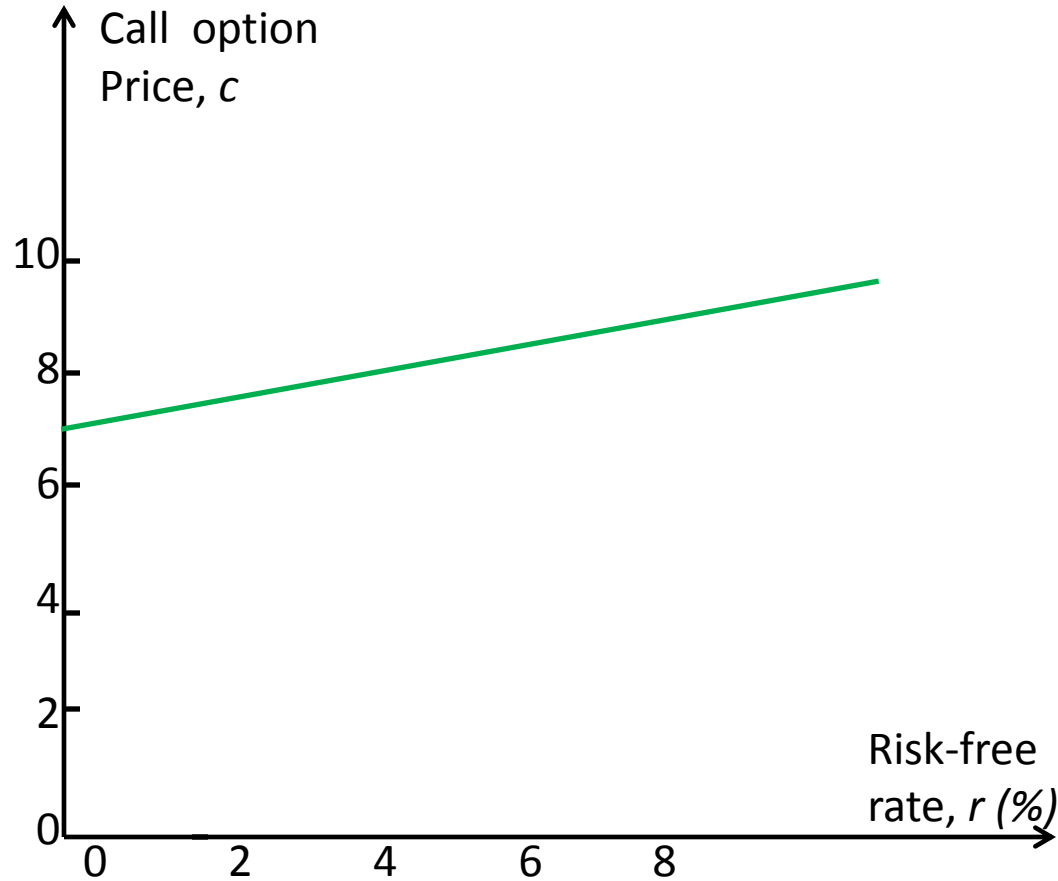
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Volatility on Price of Put Option



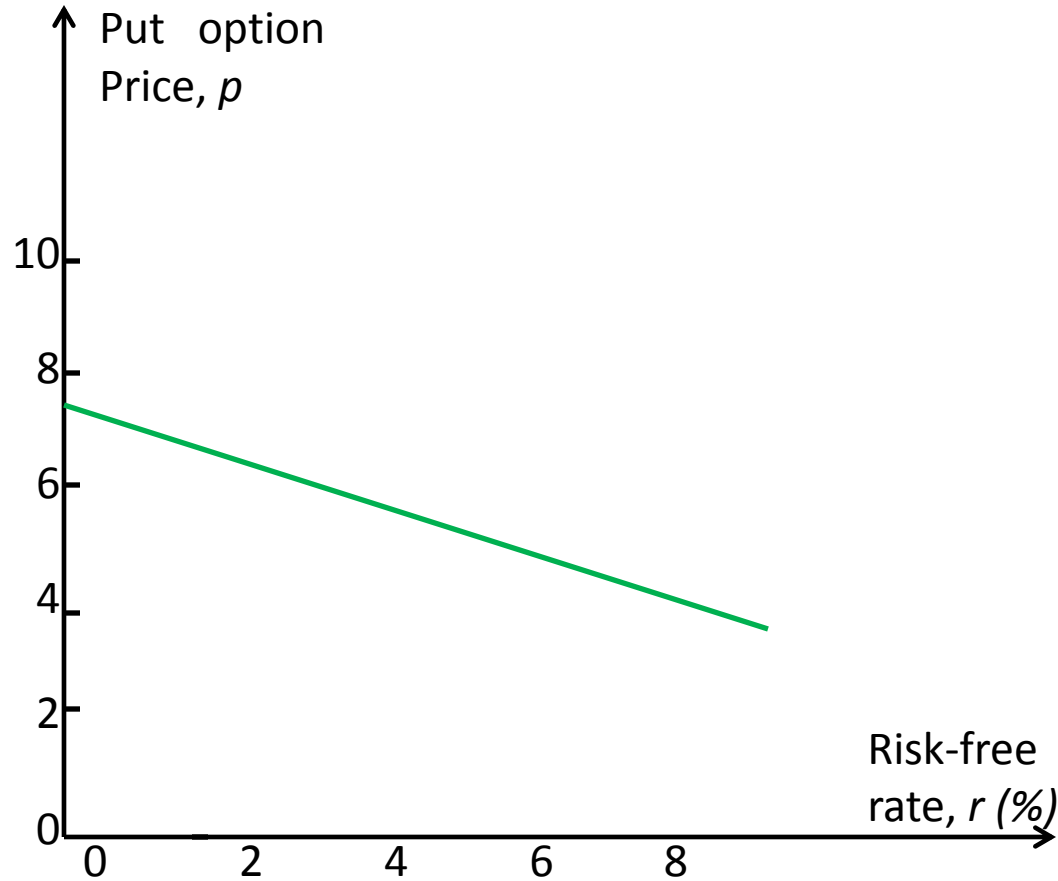
$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Interest Rate on Price of Call Option



$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Effect of changes in Interest Rate on Price of Put Option



$S_0 = 50$, $K = 50$, $r = 5\%$, $\sigma = 30\%$ and $T = 1$

Summary of the effect on the price of a stock option of increasing one variable while keeping all others fixed.

Variable	European call	European put	American call	American put
Current stock price	+	-	+	-
Strike price	-	+	-	+
Time to expiration	?	?	+	+
Volatility	+	+	+	+
Risk-free rate	+	-	+	-
Dividends	-	+	-	+

Risk Management and Greeks

Each Greek Letter :

(Delta Δ , Gamma γ , Theta θ ,Vega ϑ and Rho ρ)

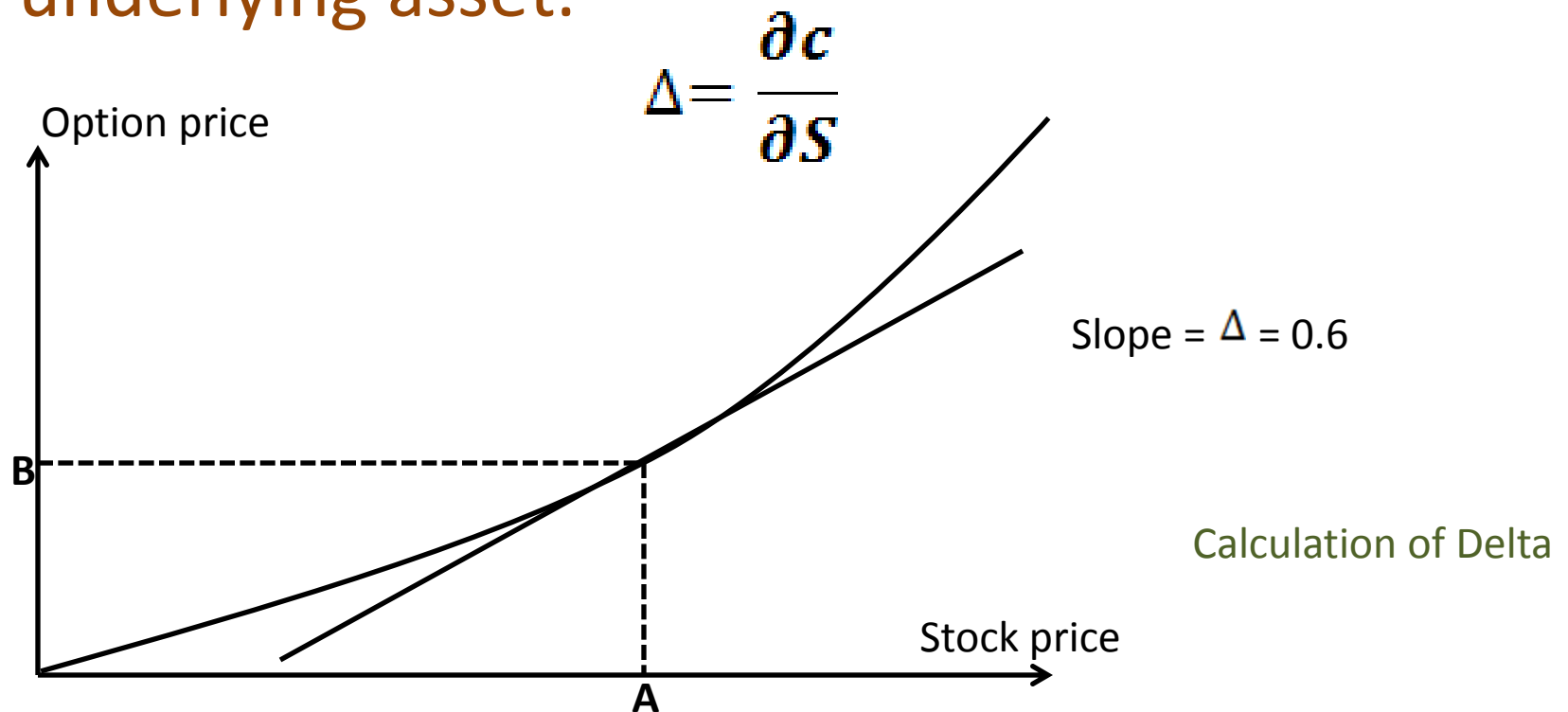
measures a different dimension to the risk of an option position

The aim of Risk Management is to manage the *Greeks* so that all dimensions of risk are within acceptable limits

Greeks are used in computing hedge ratios.

Delta

Delta is defined as the rate of change of the option price with respect to the price of the underlying asset.



Delta

- Measure Δ
- Function Exposure to directional price change.

$$\frac{\text{Dollar change in positional value}}{\text{Dollar change in underlying security price}}$$

Negative Delta ➔ Bearish, Position benefits from price decline

Zero Delta ➔ Neutral. No change in value for a small price change.

Positive Delta ➔ Bullish. Position benefits from price increases

Gamma

The gamma of a portfolio of options on an underlying asset, γ , is the rate of change of the portfolio's delta with respect to the price of the underlying asset. It is the second partial derivative of the portfolio with respect to asset price:

$$\gamma = \frac{\partial^2 \pi}{\partial S^2}$$

Gamma

Measure

γ

Function

Exposure to price instability; “non-directional price change”.

Definition

Change in position delta

Dollar change in underlying security price

Negative Gamma → Position benefits from price stability

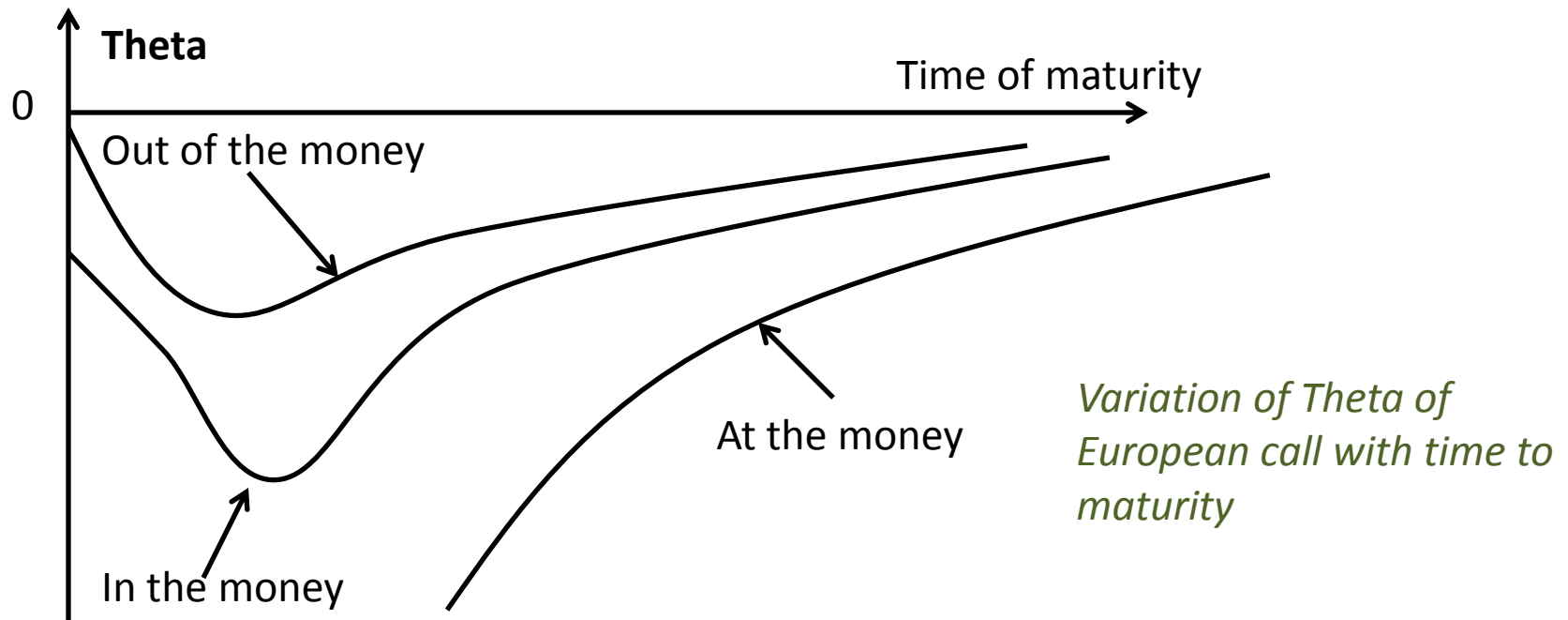
Zero Gamma → Position is unaffected by price stability

Positive Gamma → Position benefits from price instability

Theta

The theta of a portfolio of options, θ , is the rate of change of the value of the portfolio with respect to the passage of time with all else remaining the same.

Theta is also referred to as the time decay of the portfolio.



Theta

Measure

θ

Function

Exposure to time decay.

Definition

Dollar change in position value

Decrease in time to expiration

Negative Theta → Position value declines with the passage of time

Zero Theta → Position is unaffected by the passage of time

Positive Theta → Position benefits from the passage of time

Vega or Kappa

The Vega of an option is the rate of change of the value of the option with respect to the underlying asset.

$$\vartheta = \frac{\partial c}{\partial \sigma}$$

If the Vega is high in absolute terms, the option's value is very sensitive to small changes in volatility.

If the Vega is low in absolute terms, changes in volatility do not have a significant impact on the value of the option.

Vega or Kappa

Measure **K**

Function Exposure to changes in volatility of price

Definition Dollar change in position value
One percent change in volatility

Negative → Position benefits from a drop in volatility

Zero → Position is unaffected by changes in volatility

Positive → Position benefits from an increase in volatility

Option Strategy : Long Call

- Strategy Long call
- Implementation Purchase long call option.
- Delta Positive
- Gamma Positive
- Theta Negative

Long Call Details

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Settings ▾ 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh ▾ 7) Add to Portfolio 8) Matrix Pricing 89) Trade ▾

Underlying	NIFTY Index	NSE S&P CNX NIFTY INDEX	Trade	12/03/11	19:03
Price	5050.15	INR	Settle	12/05/11	

Net Option Values

Price (Total)	298.84	Currency	INR	Vega	9.11	Time value	248.69
Price (Share)	298.8401	Delta (%)	61.58	Theta	-1.92	Gearing	16.90
Price (%)	5.9174	Gamma (%)	3.3663	Rho	6.32	Break-Even (%)	4.92

European Vanilla ... Leg 1

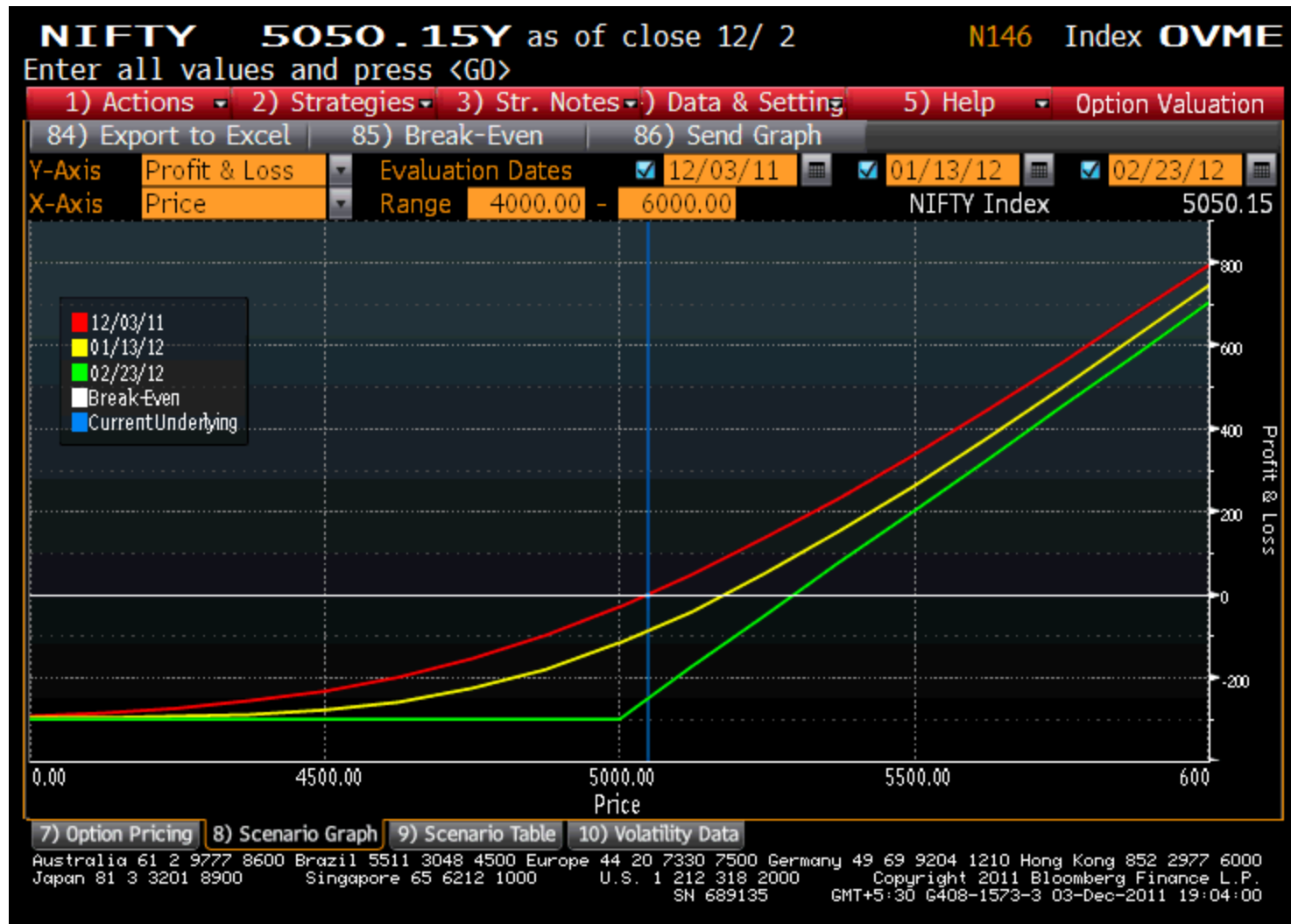
Style	Vanilla	Dividend yield	0.777%
Exercise	European	Borrow cost	0.000%
Call/Put	Call		
Direction	Buy		
Strike	5000.00		
Strike % Money	0.99% ITM		
Shares	1.00		
Expiry	02/23/12 16:00		
Time to expiry	81 20:57		
Model	BS - continuous		
Vol Bloomberg	23.901%		
Forward Carry	5133.54		
INR Rate MMkt	8.535%		

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
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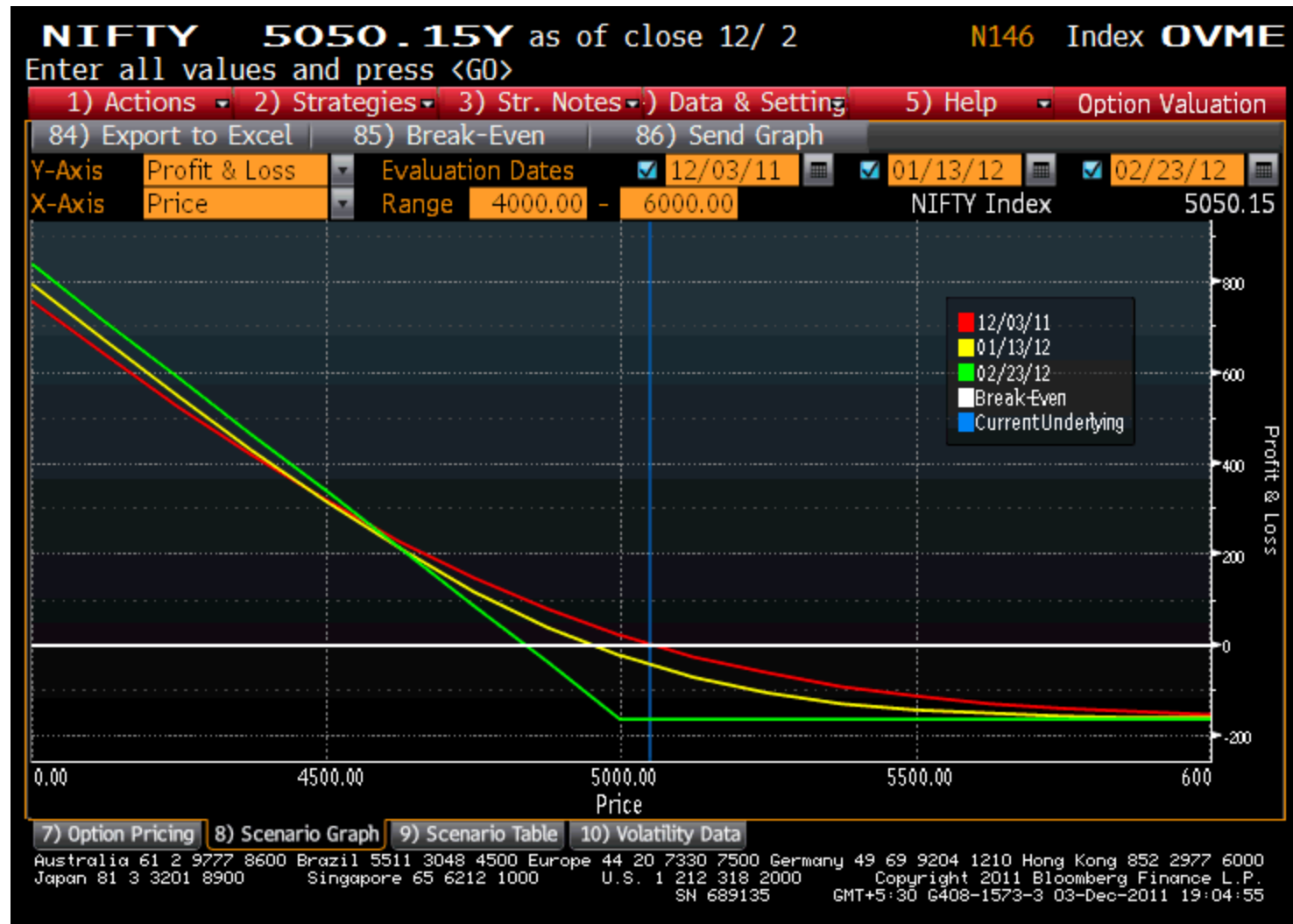
Long Call Payoff



Option Strategy : Long Put

- Strategy Long put
- Implementation Purchase long put option
- Delta Negative
- Gamma Positive
- Theta Negative

Long Put Payoff



Option Strategy : Vertical Spread

- **Strategy** Vertical Spread
- **Implementation** Buy one call, and write another call with a higher exercise price. Both options have the same time to expiration
- **Delta** Positive
- **Gamma** Neutral
- **Theta** Neutral

Vertical Spread Detail

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Settings ▾ 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh ▾ 7) Add to Portfolio ▾ 8) Matrix Pricing ▾ 89) Trade ▾

Underlying	NIFTY Index		NSE S&P CNX NIFTY INDEX	Trade	12/03/11	18:58
Price	5050.15	INR		Settle	12/05/11	

Net Option Values

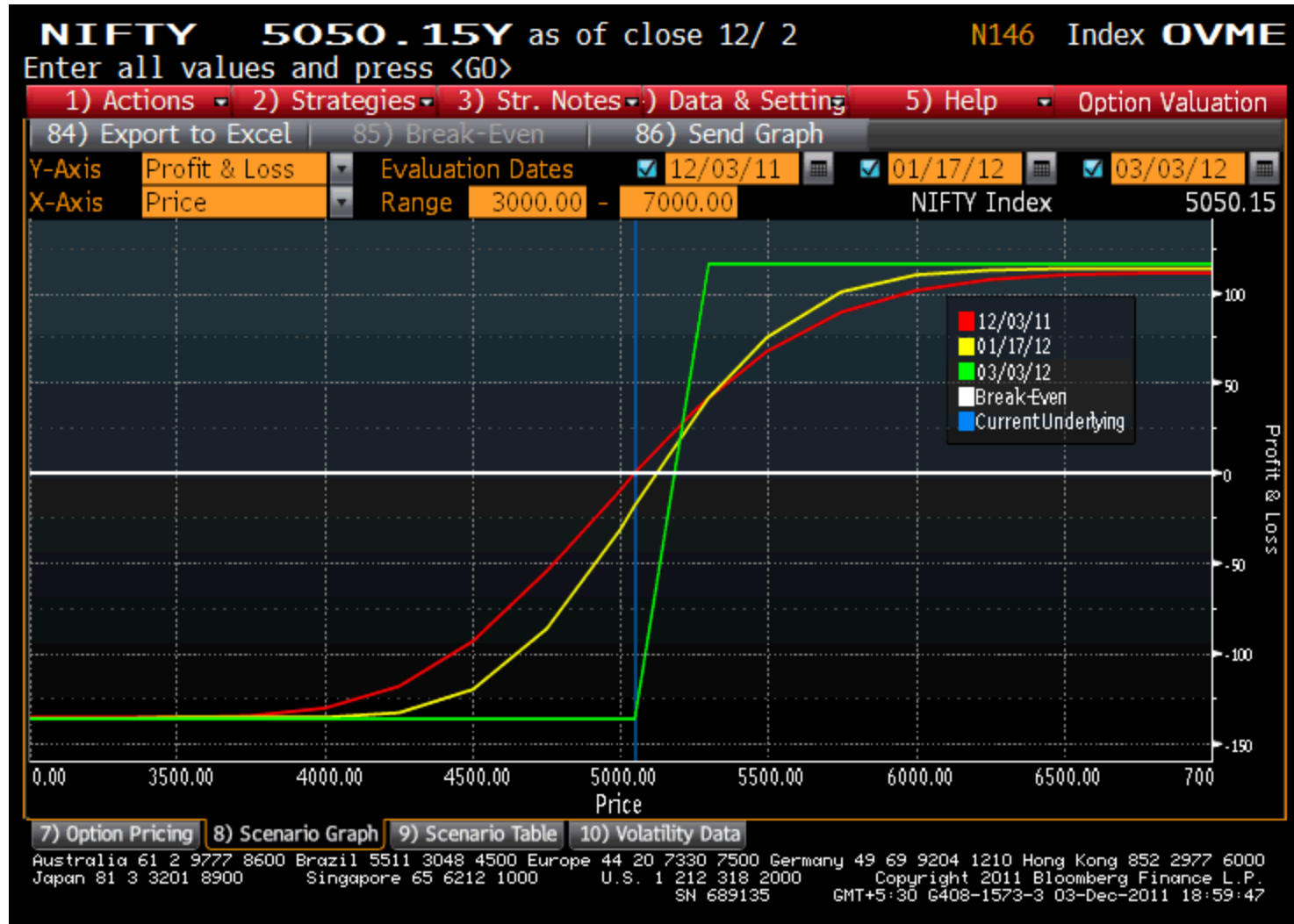
Price (Total)	136.05	Currency	INR	Vega	0.02	Time value	136.05
Price (Share)	136.0539	Delta (%)	17.99	Theta	-0.29		
Price (%)	2.6941	Gamma (%)	-0.3632	Rho	1.93		

Call/Put Spread	Leg 1	Leg 2
Style	Vanilla	
Exercise	European	
Call/Put	Call	
Direction	Buy	Sell
Strike	5050.15	5302.66
Strike % Money	ATM	5.00% OTM
Shares	1.00	1.00
Expiry	03/03/12	16:00
Time to expiry	90	21:02
Model	BS - continuous	
Vol Bloomberg	23.181%	20.886%
Forward Carry	5143.75	
INR Rate MMkt	8.502%	

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

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Vertical Spread Payoff



Option Strategy : Horizontal Spread

- **Strategy** Time Spread
- **Implementation** Write one call, and buy another call with a longer time to expiration. Both options have the same exercise price
- **Delta** Neutral
- **Gamma** Negative
- **Theta** Positive

Calendar Spread Detail

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Settings ▾ 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh ▾ 7) Add to Portfolio ▾ 8) Matrix Pricing ▾ 89) Trade ▾

Underlying	NIFTY Index	NSE S&P CNX NIFTY INDEX	Trade	12/03/11	19:00
Price	5050.15	INR	Settle	12/05/11	

Net Option Values

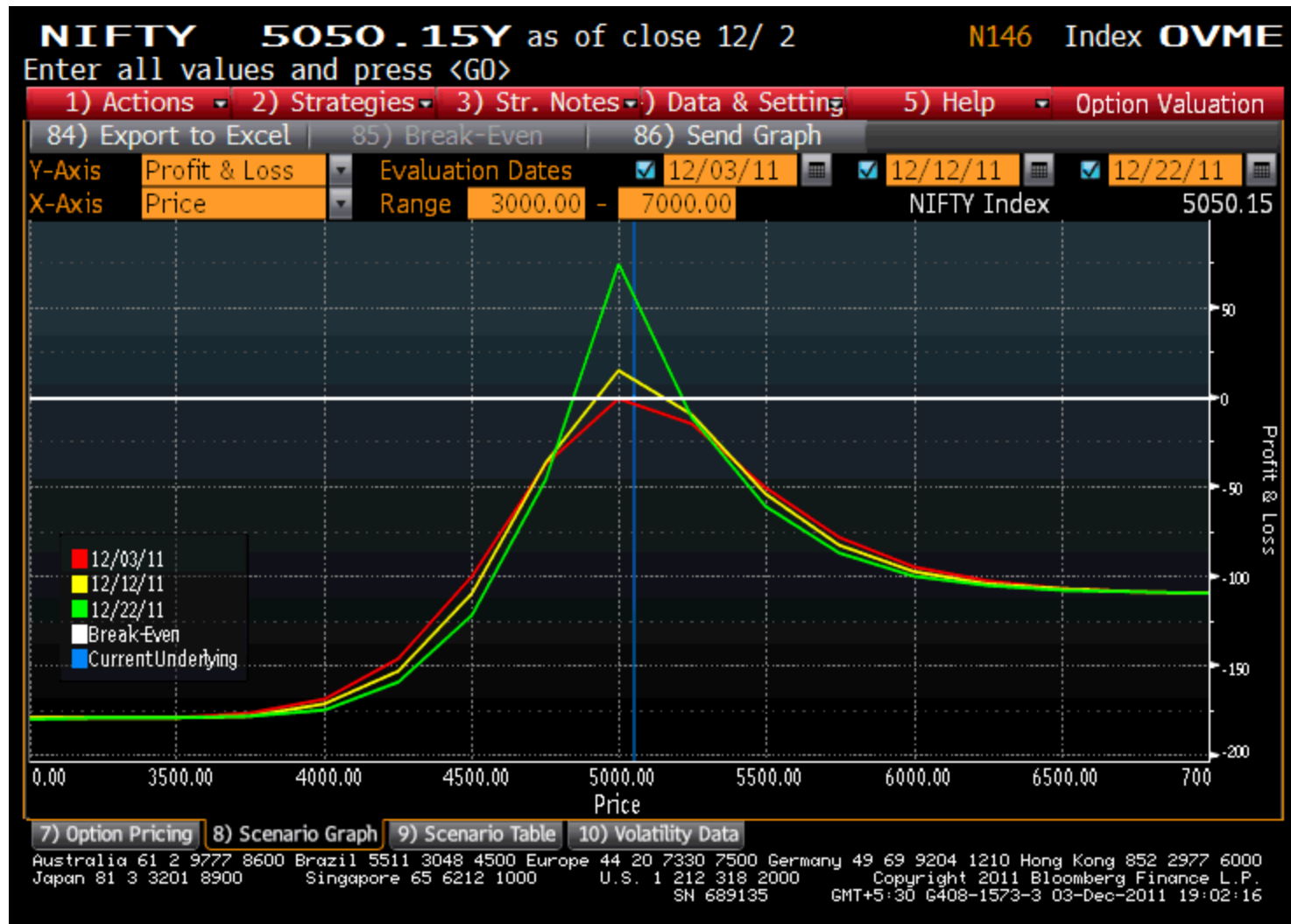
Price (Total)	179.76	Currency	INR	Vega	5.22	Time value	179.76
Price (Share)	179.7582	Delta (%)	-0.42	Theta	1.42		
Price (%)	3.5595	Gamma (%)	-4.3452	Rho	5.42		

Two Leg	...	Leg 1	Leg 2
Style		Vanilla	Vanilla
Exercise		European	European
Call/Put		Call	Call
Direction		Sell	Buy
Strike		5000.00	5000.00
Strike % Money		0.99% ITM	0.99% ITM
Shares		1.00	1.00
Expiry		12/22/11 16:00	03/03/12 16:00
Time to expiry		18 21:00	90 21:00
Model		BS - continuous	BS - continuous
Vol Bloomberg		22.435%	24.522%
Forward Carry		5068.01	5143.75
INR Rate MMkt		8.605%	8.502%

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

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Calendar Spread Payoff



Option Strategy : Back Spread

- Strategy Back Spread
- Implementation Buy one call and write another call with a longer time to expiration. Both options have the same exercise price
- Delta Neutral
- Gamma Positive
- Theta Negative

Option Strategy : Straddle

- Strategy Straddle
- Implementation Purchase call and put, both with the same exercise price and time to expiration
- Delta Neutral
- Gamma Positive
- Theta Negative

Long Straddle Detail

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Settings ▾ 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh ▾ 7) Add to Portfolio ▾ 8) Matrix Pricing ▾ 89) Trade ▾

Underlying **NIFTY Index** NSE S&P CNX NIFTY INDEX Trade **12/03/11** 19:05
 Price **5050.15** INR Settle **12/05/11**

Net Option Values

Price (Total)	462.12	Currency	INR	Vega	18.23	Time value	411.97
Price (Share)	462.1216	Delta (%)	23.33	Theta	-2.80		
Price (%)	9.1507	Gamma (%)	6.7327	Rho	1.63		

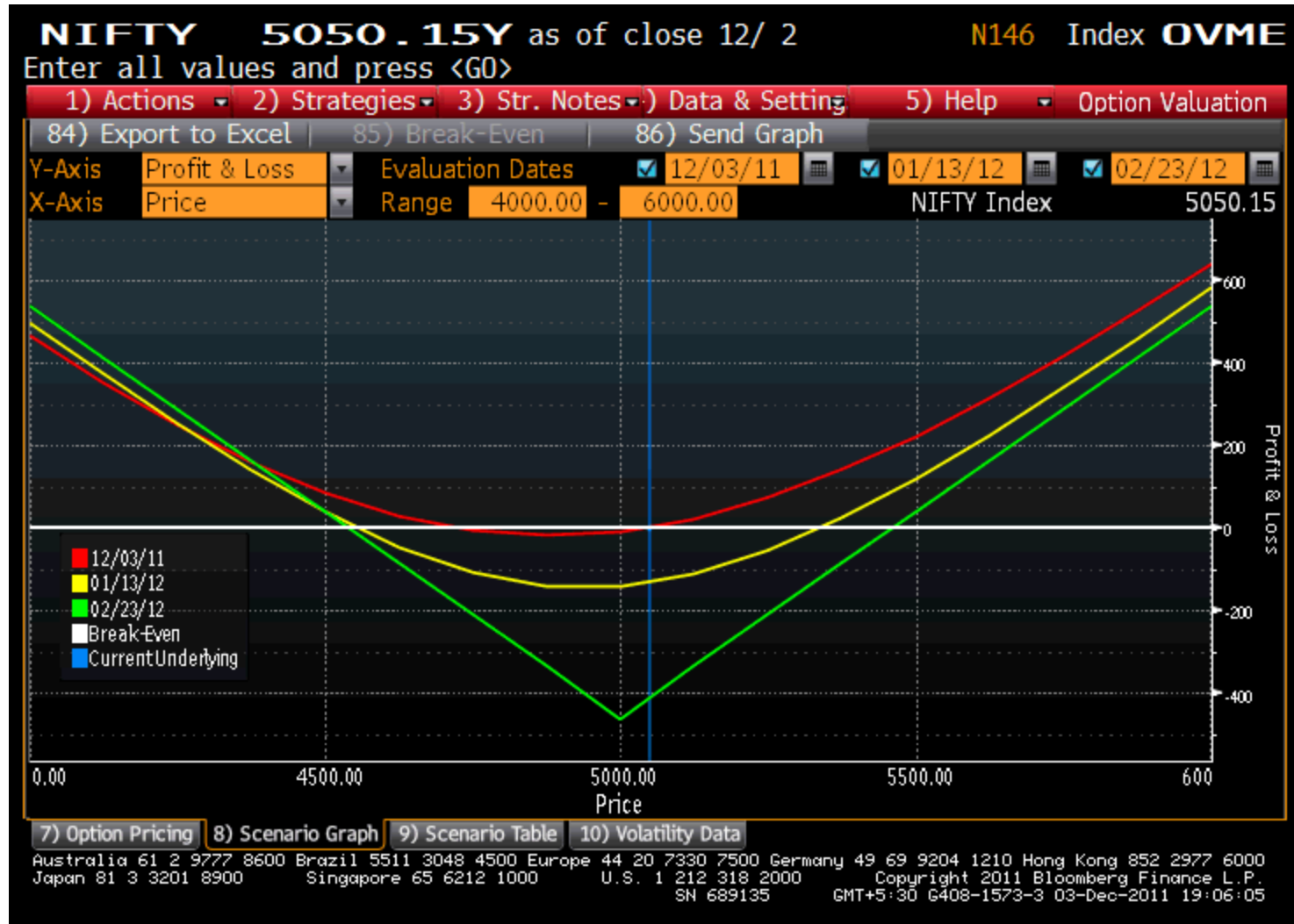
Straddle ... Leg 1 Leg 2

Style	Vanilla	
Exercise	European	
Call/Put	Call	Put
Direction	Buy	
Strike	5000.00	
Strike % Money	0.99% ITM	0.99% OTM
Shares	1.00	
Expiry	02/23/12	16:00
Time to expiry	81	20:55
Model	BS - continuous	
Vol Bloomberg	23.901%	
Forward Carry	5133.54	
INR Rate MMkt	8.535%	

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

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Long Straddle Payoff



Option Strategy : Strangle

- Strategy Strangle
- Implementation Purchase call and put, each equally out of the money, and each with the same time to expiration
- Delta Neutral
- Gamma Positive
- Theta Negative

Long Strangle Details

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Setting ▾ 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh ▾ 7) Add to Portfolio 8) Matrix Pricing 89) Trade ▾

Underlying	NIFTY Index	NSE S&P CNX NIFTY INDEX	Trade	12/03/11	21:34
Price	5050.15	INR	Settle	12/05/11	

Net Option Values

Price (Total)	231.00	Currency	INR	Vega	16.99	Time value	231.00
Price (Share)	230.9991	Delta (%)	12.63	Theta	-2.43		
Price (%)	4.5741	Gamma (%)	6.7152	Rho	0.92		

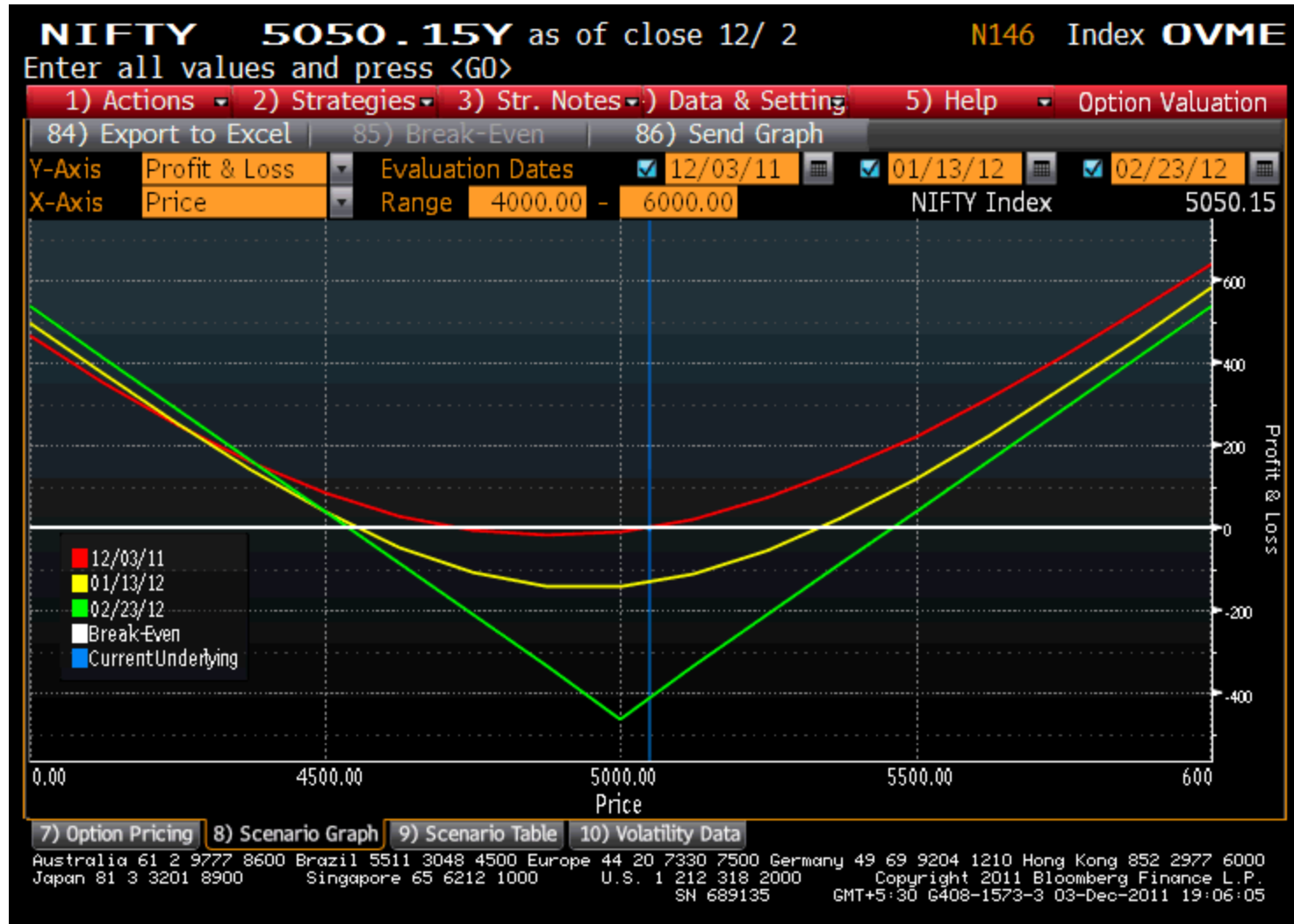
Strangle ... Leg 1 Leg 2

Style	Vanilla	
Exercise	European	
Call/Put	Call	Put
Direction	Buy	
Strike	5300.00	4800.00
Strike % Money	4.95% OTM	4.95% OTM
Shares	1.00	
Expiry	02/23/12	16:00
Time to expiry	81	18:26
Model	BS - continuous	
Vol Bloomberg	20.318%	25.343%
Forward Carry	5133.54	
INR Rate MMkt	8.535%	

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

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Long Strangle Payoff



Option Strategy : Butterfly

- Strategy Butterfly
- Implementation Write two at-the –money calls, and buy two calls, one in the money, and the other equally far out of the money
- Delta Neutral
- Gamma Negative
- Theta Positive

Butterfly Details

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Setting 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh 7) Add to Portfolio 8) Matrix Pricing 89) Trade ▾

Underlying **NIFTY Index** NSE S&P CNX NIFTY INDEX Trade 12/03/11 21:31
 Price 5050.15 INR Settle 12/05/11

Net Option Values

Price (Total)	-188.60	Currency	INR	Vega	-1.63	Time value	-188.45
Price (Share)	-188.5970	Delta (%)	-4.60	Theta	0.15		
Price (%)	-3.7345	Gamma (%)	-0.7952	Rho	-0.11		

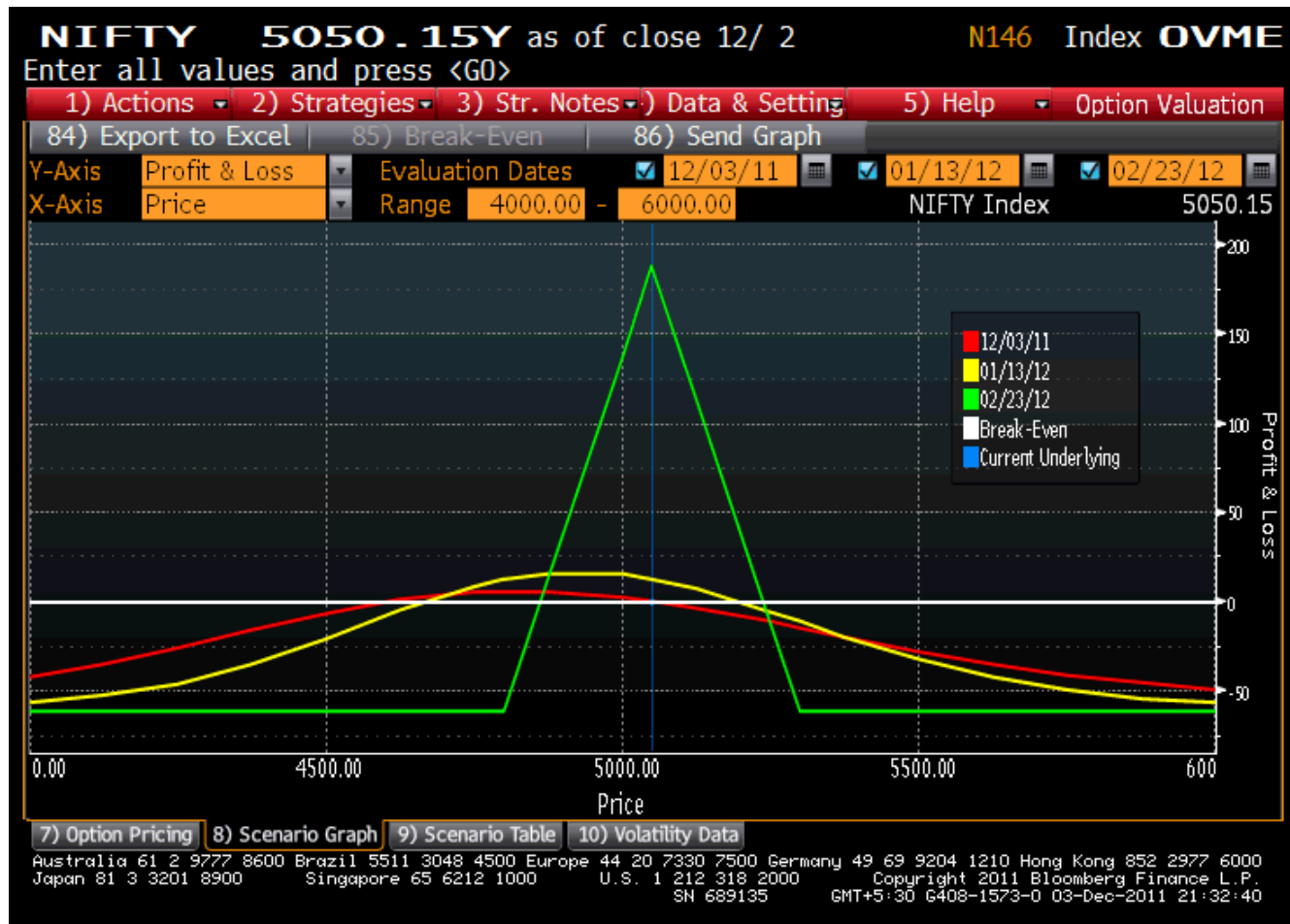
Butterfly ... Leg 1 Leg 2 Leg 3 Leg 4

Style	Vanilla			
Exercise	European			
Call/Put	Call	Put	Call	Put
Direction	Buy		Sell	
Strike	5300.00	4800.00	5050.00	
Strike % Money	4.95% OTM	4.95% OTM	ATM	ATM
Shares	1.00		1.00	
Expiry	02/23/12			16:00
Time to expiry	81			18:29
Model	BS - continuous			
Vol Bloomberg	20.214%	25.092%	21.769%	
Forward Carry	5133.54			
INR Rate MMkt	8.535%			

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

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Butterfly Payoff



Butterfly Spread Details

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Settings ▾ 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh ▾ 7) Add to Portfolio ▾ 8) Matrix Pricing ▾ 89) Trade ▾

Underlying	NIFTY Index		NSE S&P CNX NIFTY INDEX	Trade	12/03/11	21:28
Price	5050.15	INR		Settle	12/05/11	

Net Option Values

Price (Total)	56.83	Currency	INR	Vega	-1.63	Time value	-193.02
Price (Share)	56.8276	Delta (%)	-4.60	Theta	0.21		
Price (%)	1.1253	Gamma (%)	-0.7951	Rho	-0.64		

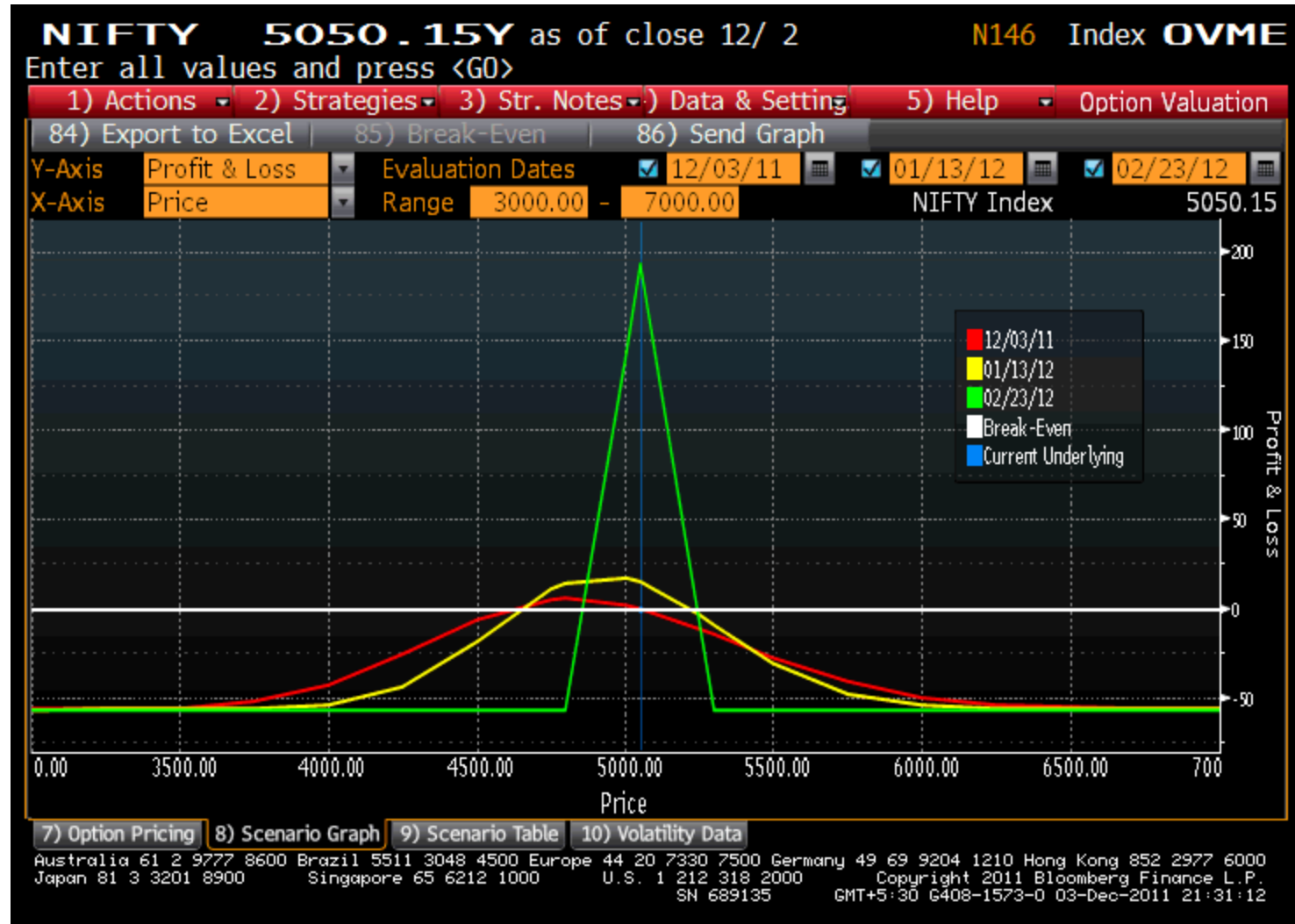
Butterfly Spread	Leg 1	Leg 2	Leg 3
Style	Vanilla		
Exercise	European		
Call/Put	Call		
Direction	Buy		Sell
Strike	5300.00	4800.00	5050.00
Strike % Money	4.95% OTM	4.95% ITM	ATM
Shares	1.00	1.00	2.00
Expiry	02/23/12		16:00
Time to expiry	81		18:32
Model	BS - continuous		
Vol Bloomberg	20.214%	25.092%	21.769%
Forward Carry	5133.54		
INR Rate MMkt	8.535%		

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000
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Butterfly Spread Payoff



Option Strategy : Condor

- Strategy Condor
- Implementation Purchase call and put, each equally out of the money, and write a call and a put, each further out of the money than the call and put that were purchased. All options have the same time to expiration.
- Delta Neutral
- Gamma Positive
- Theta Negative

Condor Details

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Settings ▾ 5) Help ▾ Option Valuation

84) FI Leg ▾ 85) Solve For ▾ 86) Refresh ▾ 7) Add to Portfolio ▾ 8) Matrix Pricing ▾ 89) Trade ▾

Underlying	NIFTY Index		NSE S&P CNX NIFTY INDEX	Trade	12/03/11	21:37
Price	5050.15	INR		Settle	12/05/11	

Net Option Values

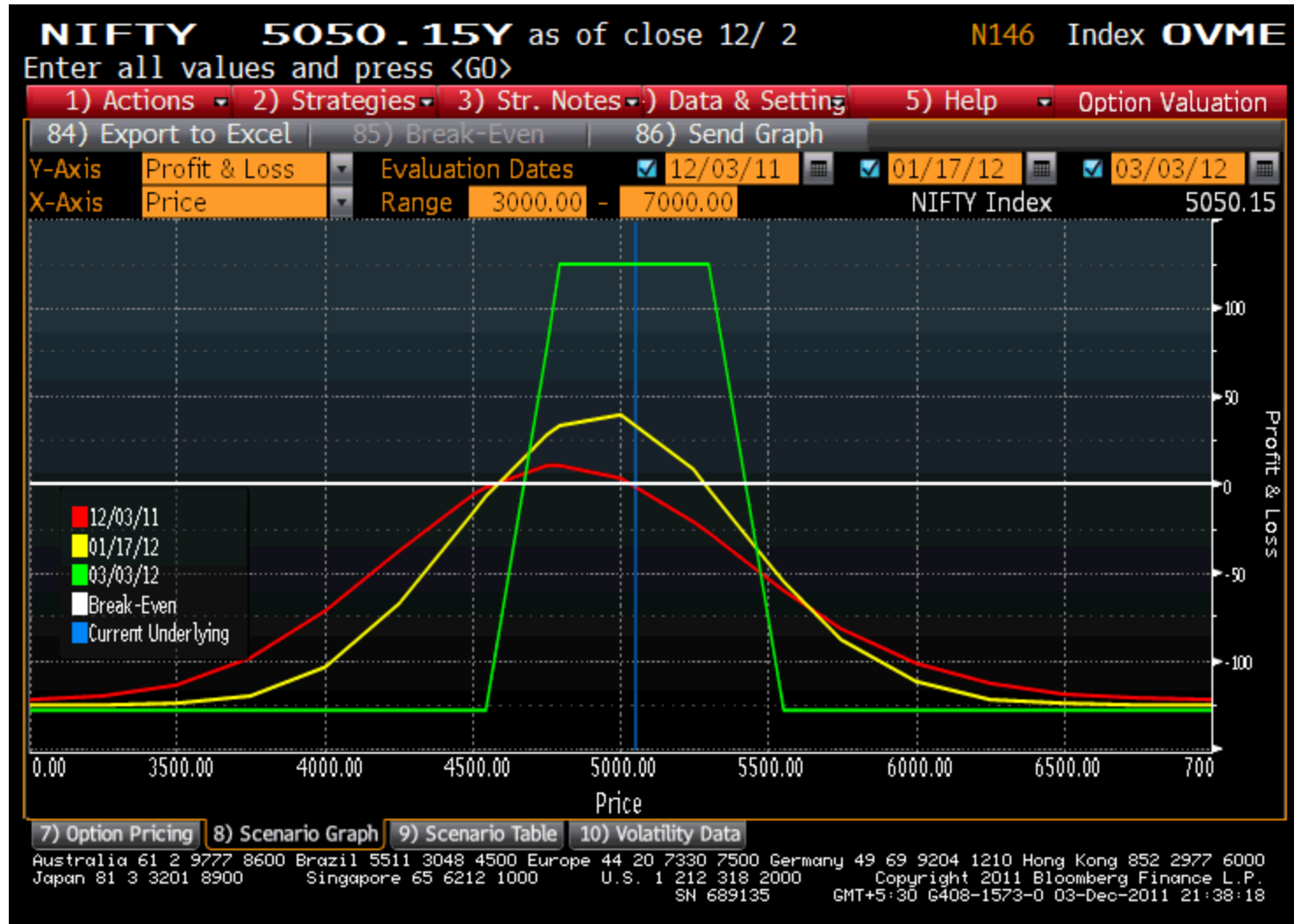
Price (Total)	-104.60	Currency	INR	Vega	-3.71	Time value	-104.60
Price (Share)	-104.6021	Delta (%)	-5.36	Theta	0.49		
Price (%)	-2.0713	Gamma (%)	-1.4901	Rho	-0.38		

Condor	Leg 1	Leg 2	Leg 3	Leg 4
Style	Vanilla			
Exercise	European			
Call/Put	Call	Put	Call	Put
Direction	Buy		Sell	
Strike	5500.00	4550.00	5300.00	4800.00
Strike % Money	8.91% OTM	9.90% OTM	4.95% OTM	4.95% OTM
Shares	1.00		1.00	
Expiry	02/23/12 16:00			
Time to expiry	81 18:23			
Model	BS - continuous			
Vol Bloomberg	18.890%	27.911%	20.110%	24.841%
Forward Carry	5133.54			
INR Rate MMkt	8.535%			

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2011 Bloomberg Finance L.P.
 SN 689135 GMT+5:30 G408-1573-0 03-Dec-2011 21:37:45

Condor Payoff



Condor Spread Details

NIFTY 5050.15Y as of close 12/ 2 Index **OVME**

1) Actions ▾ 2) Strategies ▾ 3) Str. Notes ▾ 4) Data & Settings 5) Help ▾ Option Valuation
 84) FI Leg ▾ 85) Solve For ▾ 86) Refresh 7) Add to Portfolio 8) Matrix Pricing 89) Trade ▾

Underlying **NIFTY Index** NSE S&P CNX NIFTY INDEX Trade **12/03/11** 21:38
 Price **5050.15** INR Settle **12/05/11**

Net Option Values
 Price (Total) **122.38** Currency **INR** Vega **-4.02** Time value **-130.13**
 Price (Share) **122.3780** Delta (%) **-8.31** Theta **0.58**
 Price (%) **2.4233** Gamma (%) **-1.3817** Rho **-1.34**

Condor Spread	Leg 1	Leg 2	Leg 3	Leg 4
Style	Vanilla			
Exercise	European			
Call/Put	Call			
Direction	Buy		Sell	
Strike	5555.16	4545.13	5302.66	4797.64
Strike % Money	10.00% OTM	10.00% ITM	5.00% OTM	5.00% ITM
Shares	1.00	1.00	1.00	1.00
Expiry	03/03/12			16:00
Time to expiry	90			18:22
Model	BS - continuous			
Vol Bloomberg	19.315%	28.581%	20.886%	25.502%
Forward Carry	5143.75			
INR Rate MMkt	8.502%			

7) Option Pricing 8) Scenario Graph 9) Scenario Table 10) Volatility Data

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
 Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2011 Bloomberg Finance L.P.
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Condor Spread Payoff

