

# Options Markets

**Session 7& 8**

# Agenda

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- Overview of Derivative Markets
- Call Option
- Put Option
- Properties of Options
- RBI Recent changes
- Revision
- Factors affecting option Pricing
- Put-Call Parity
- Binomial Option Pricing Model
- Option Strategies

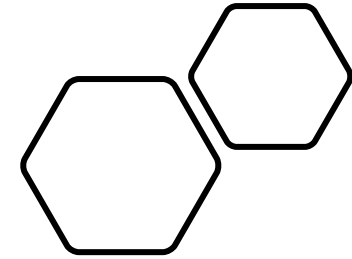
You can't control the  
volatility of the markets



You can control the  
volatility of your actions



@brianferoldi



# Derivatives in India

ETPrime

## Desperate retail investors drive India's options craze

By Andy Mukherjee, Bloomberg • Last Updated: Dec 12, 2023, 10:12:52 AM IST

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### Synopsis

The Securities and Exchange Board of India's crackdown on social-media influencers peddling advice is a losing battle. Although nine out of 10 individual traders are losing money, retail investors can't get enough of derivatives. A smartphone-led gamification of investing is complete.

It is especially worrying in India, where trading in futures and options is now more than 400 times bigger than the underlying cash-market turnover

# Derivatives Markets in India

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## How to trade IHCL, Hindalco and Bharat Forge with F&O.

- The Indian market cheered the five state election results on Monday with both Nifty and Nifty Bank reaching their all-time high levels.

Hindalco stock showing upward movements with limits. The stock decisively crossed this level with good volumes than previous month.

- On the derivative front, huge writing was seen on the put side with significant open interest at the strike prices of 520, 510, and 500.
- Stock can see the level of 550 in the short term.
- Indian Hotels has been on an upward momentum since April 2021 reaching an all-time high of 436. Seeing the option chain, writing was seen on the put side whereas huge buying on the call side

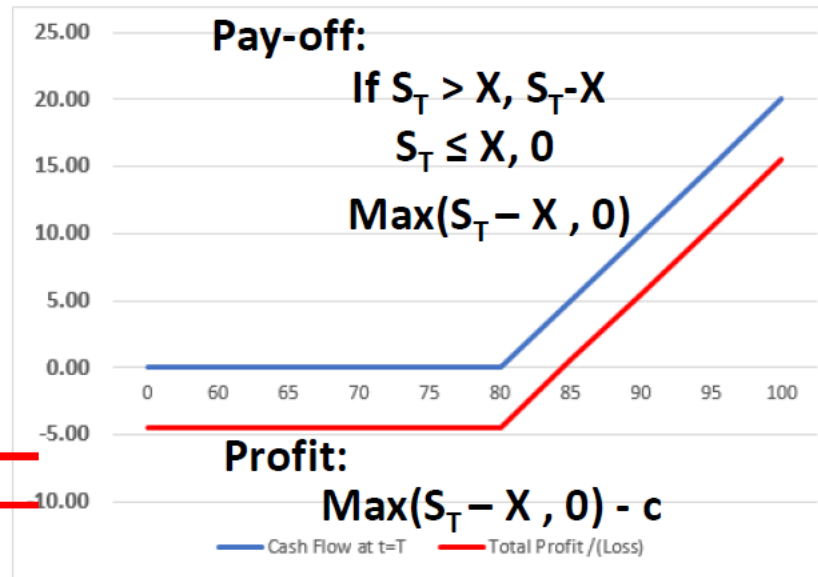
## Trading News in F&O

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Bharat Forge rallied although **huge writing was seen on the put** fresh new sell positions were created on the put side whereas **call writers reduced their position** depicting the conviction of the bulls. So, for a short-term, Bharat Forge can be bought with a target of 1220.

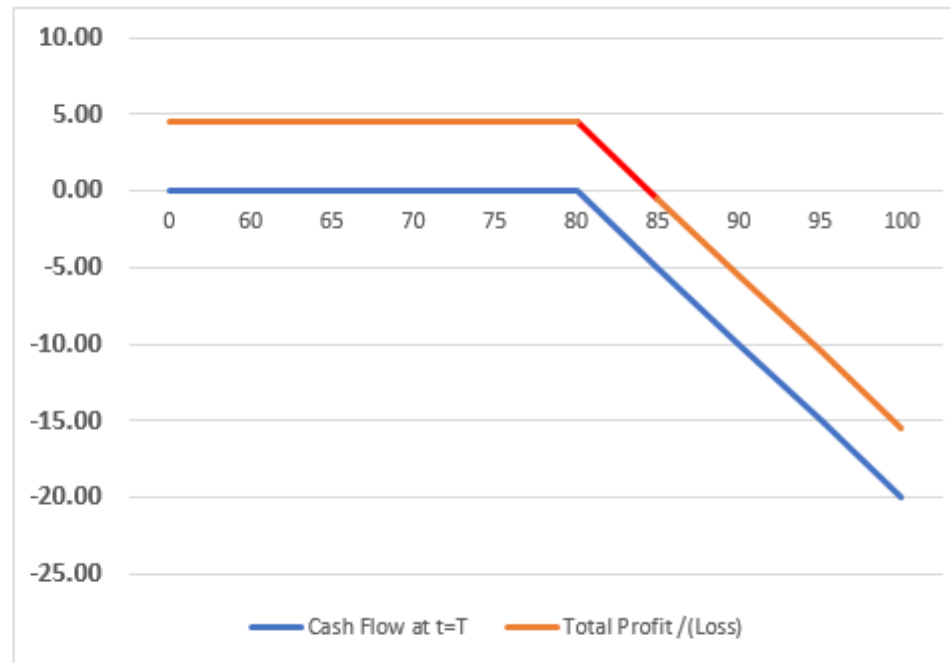
## Pay-off & Profit (Loss) for Call Option Holder

	Stock Price on April 15	Cash Flow at t=0	Will Buyer exercise Call Option?	Cash Flow at t=T	Total Profit/(Loss)
1	Call Price on January 1	4.50			
2	Exercise Price (X)	80.00			
4					
5	0	-4.50	No	0.00	-4.50
6	60	-4.50	No	0.00	-4.50
7	65	-4.50	No	0.00	-4.50
8	70	-4.50	No	0.00	-4.50
9	75	-4.50	No	0.00	-4.50
10	80	-4.50	Indifferent	0.00	-4.50
11	85	-4.50	Yes	5.00	0.50
12	90	-4.50	Yes	10.00	5.50
13	95	-4.50	Yes	15.00	10.50
14	100	-4.50	Yes	20.00	15.50

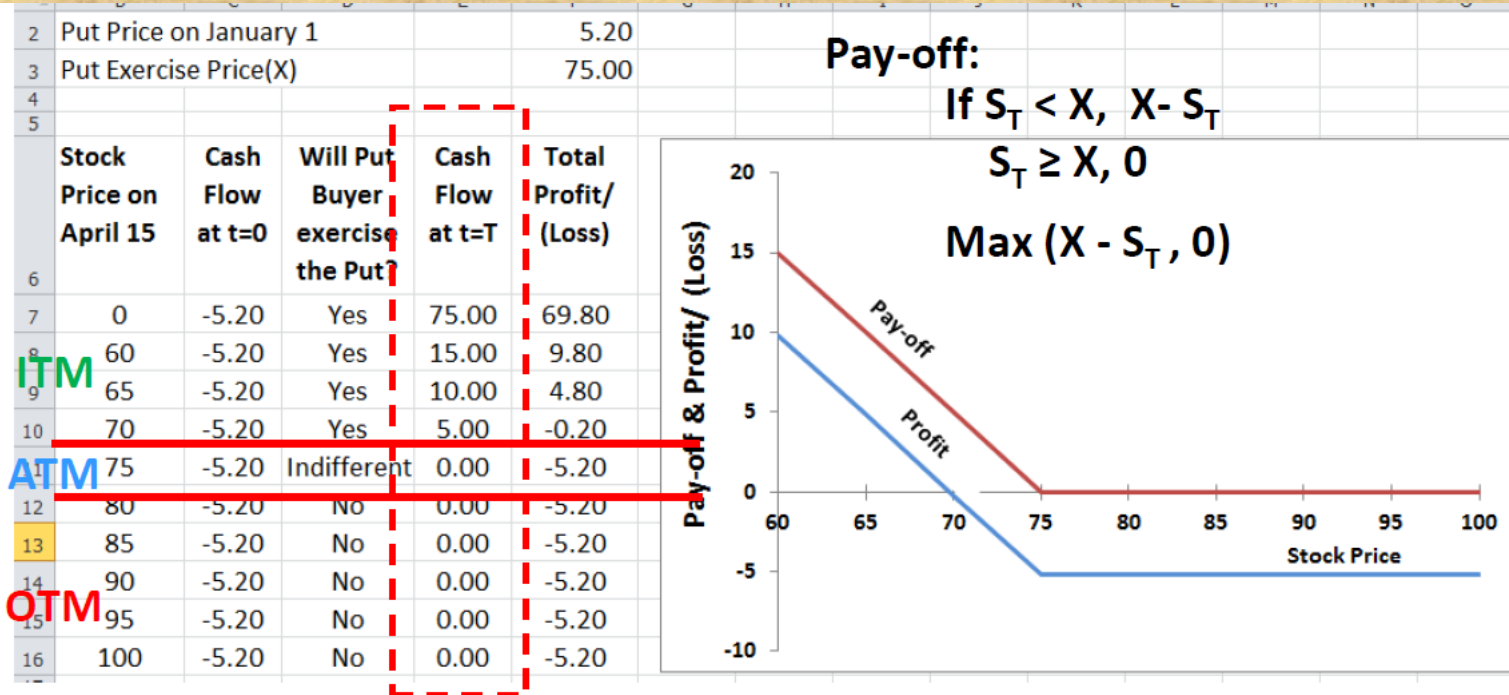


# Pay-off & Profit (Loss) for Call Option Seller

Stock Price on April 15	Cash Flow at t=0	Will Call Buyer exercise Call Option?	Cash Flow at t=T	Total Profit /(Loss)
0	4.50	No	0.00	4.50
60	4.50	No	0.00	4.50
65	4.50	No	0.00	4.50
70	4.50	No	0.00	4.50
75	4.50	No	0.00	4.50
80	4.50	Indifferent	0.00	4.50
85	4.50	Yes	-5.00	-0.50
90	4.50	Yes	-10.00	-5.50
95	4.50	Yes	-15.00	-10.50
100	4.50	Yes	-20.00	-15.50



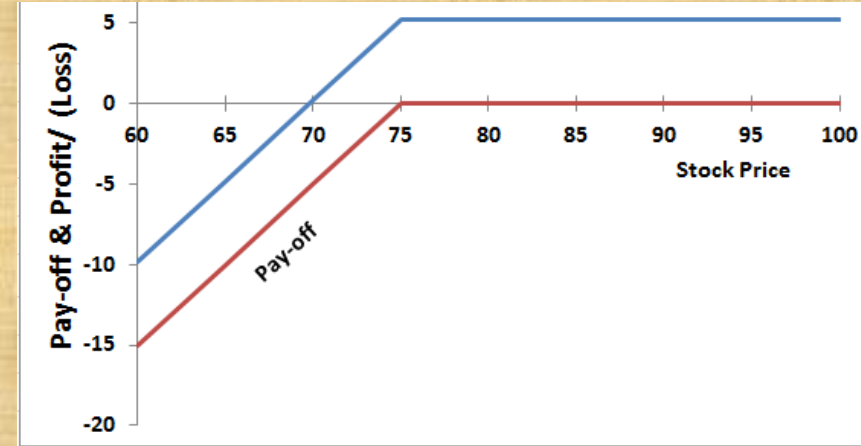
## Profit/(Loss) for Put Option Holder



- When you **Buy a Put Option**, you Buy the right to sell the stock in the future for a pre-determined price, for which you pay the Put premium today.

## Profit/(Loss) for Put Option Writer

Stock Price on April 15	Cash Flow at t=0	Will Put Buyer exercise the Put?	Cash Flow at t=T	Total Profit/(Loss)
0	5.20	Yes	-75.00	-69.80
60	5.20	Yes	-15.00	-9.80
65	5.20	Yes	-10.00	-4.80
70	5.20	Yes	-5.00	0.20
75	5.20	Indifferent	0.00	5.20
80	5.20	No	0.00	5.20
85	5.20	No	0.00	5.20
90	5.20	No	0.00	5.20
95	5.20	No	0.00	5.20
100	5.20	No	0.00	5.20



# Adjustments for Corporate Actions (Stock Options)

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- Corporate actions like dividends, bonus shares or stock splits change the value of underlying stock and hence options of these stock would also change in value.
- Adjustment for Dividends: Exchange traded options do not provide for adjustment for dividends.
- For dividends upto 10% of the market value of underlying stock, no adjustment is made to no. of share or exercise price is made.
- For extra-ordinary dividends (above 10%), amount of dividend is reduced from the all the exercise prices on the stock (w.e.f. ex-dividend date).

# Adjustments for Corporate Actions (Bonus Shares)

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Adjustment for Bonus Shares (Stock Dividend) : Bonus shares do not change the aggregate value of shares but affects the stock price.

- For an 'a:b' bonus issue, No. of shares increase to  $(1 + a/b)$  of its previous value and Exercise price goes down by  $1 / (1 + a/b)$  of its previous value.

No. of Shares in 1 Options Contract      500       $(1 + \text{Bonus ratio})$

$$500 * (1 + 2/5) = 700$$

Exercise Price    140       $1 / (1 + \text{Bonus ratio})$        $140 * 1 / (1 + 2/5) = 100$

# Closure of Options

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For Buyer of an Option:

✓ By Exercising the Option

✓ By letting the Option to expire

• For Seller of an Option:

✓ By entering an offsetting trade

• An *obligation* to sell/buy stands nullified by a *right* to buy/sell and not by creating another obligation to buy/sell.

If Means To Nullify Sold Call Obligation to Sell → Buy Call

Sold Put Obligation to → Buy Put

# Factors Affecting Option Prices

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The following factors have a bearing on the price of a Stock Option:

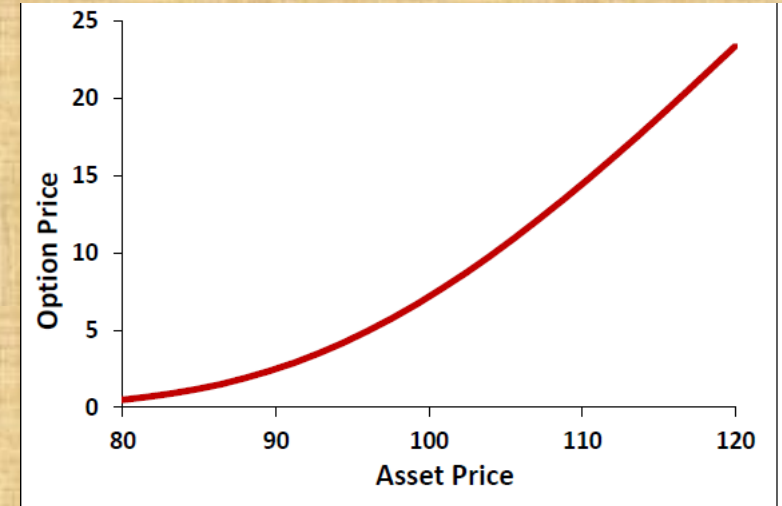
1. Current Stock Price ( $S_0$ )
2. Strike Price ( $X$ )
3. Time to expiration ( $t$ )
4. Volatility of the Stock Price
5. Risk-free interest rate ( $r_f$ )
6. Dividends expected during the life of the option.

# Stock Prices

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Call Option:

- Call option is exercised, if Stock Price(S) > Exercise Price(X).
- Hence, call option becomes more valuable, if the Stock Price (S) increases.

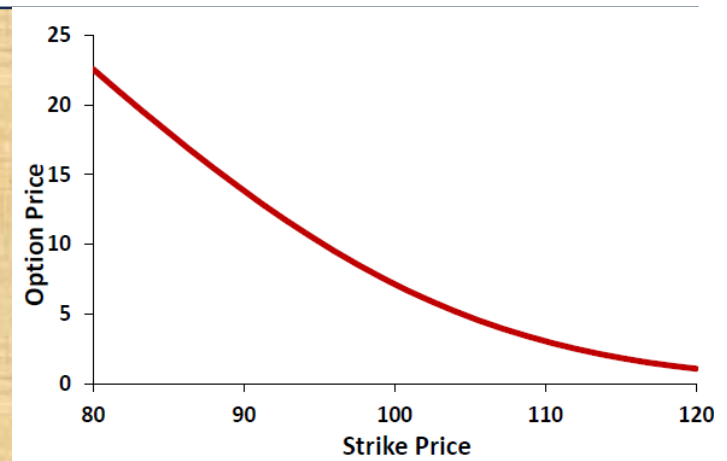


# Exercise/Strike Price

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Call Option:

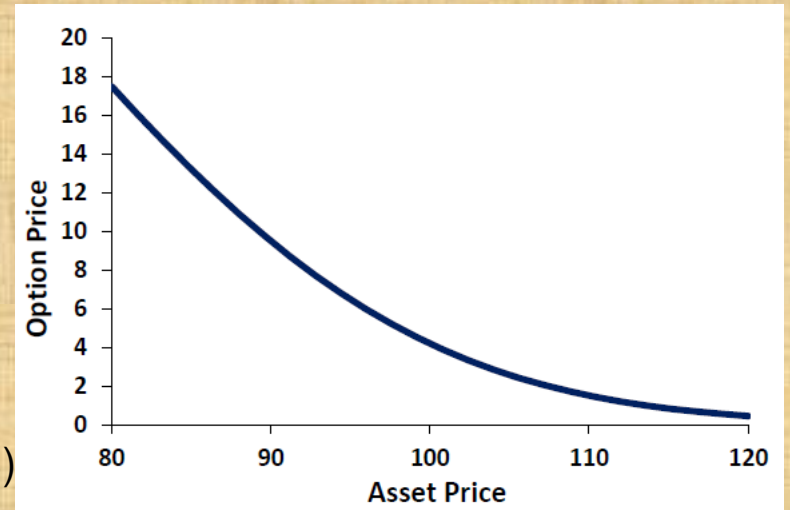
- Again, call option is exercised, if Stock Price(S) > Exercise Price(X).
- So, for higher exercise prices, call option would become cheaper.



# PUT Options

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- Put Option:
- Put Option is exercised, if Exercise Price ( $X$ ) > Stock Price ( $S$ )
- Put option becomes more valuable, if Stock Price ( $S$ ) decreases.

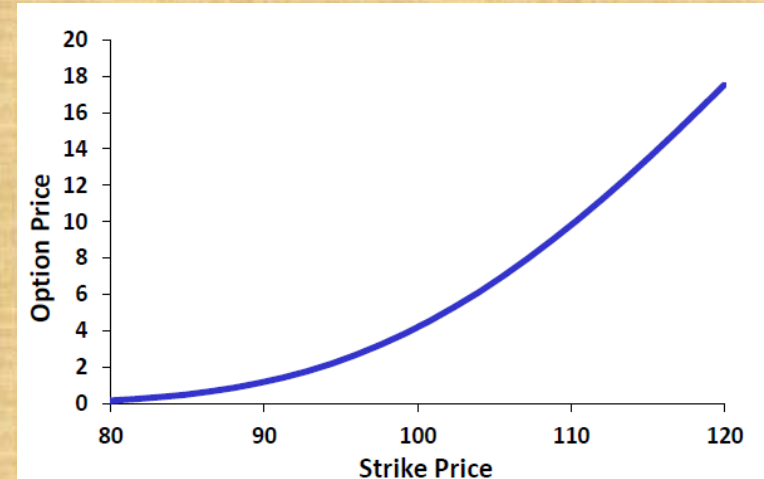


# PUT Option

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## Put Option:

- Put Option is exercised, if **Exercise Price (X) > Stock Price (S)**.
- Put option becomes more expensive for higher Exercise prices(X).



# Time to Expiration

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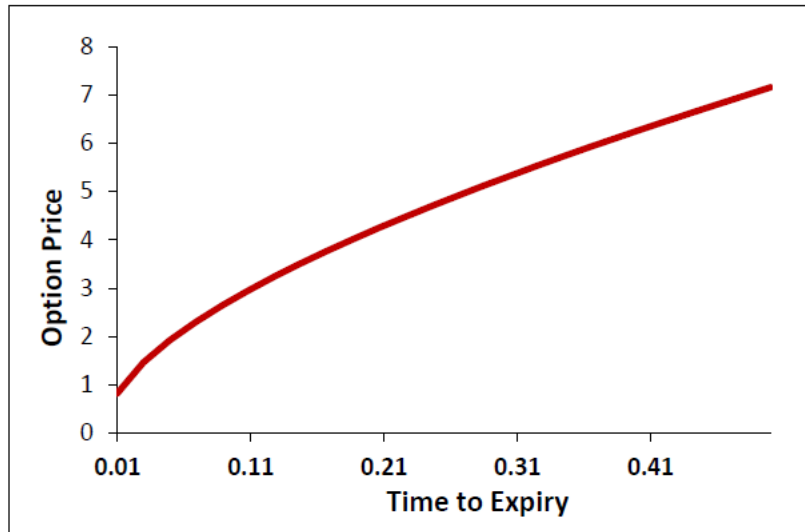
Consider two American Call/Put options which differ only in their time to expiration.

- Owner of the longer-life option not only has all the exercise opportunities as the shorter-life options, but also more.
- Hence, longer life American Options would be worth more than the shorter-life Options.
- **Usually**, European Call & put options also become more valuable as time to expiration increases.
- However, events in the intervening period, may reduce the value of a long-life option, thereby making it less valuable than a short-life option.

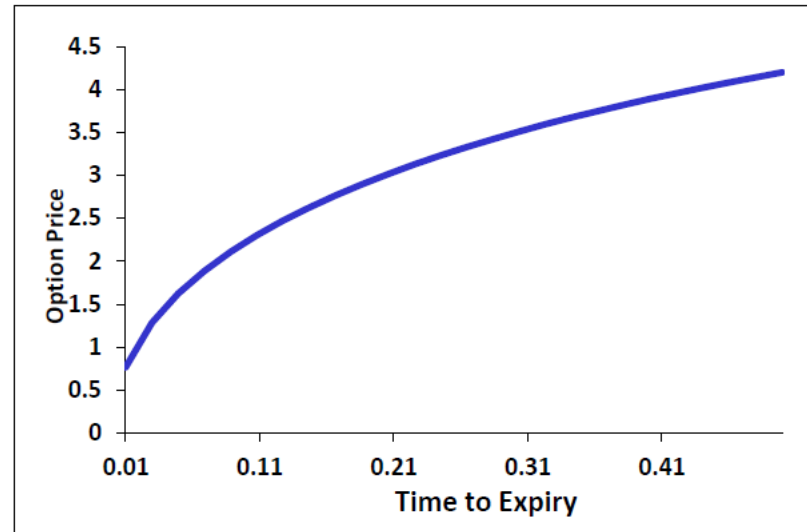
## Time to Expiration

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### Call Option



### Put Option



# Volatility

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Volatility means uncertainty about the prices of the underlying asset.

- Call option holder benefits from price increases but has a limited downside in case the stock price falls.
- Put option holder benefits from decreases in stock prices but have limited downside in case the prices increase.
- Hence, price of both, call & put options increases with increase in Volatility of the underlying asset.

# Risk-free Interest Rate

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- **Impact on Call Options:**

- By paying the Call premium now, a trader saves 'X' till maturity. So higher the interest rate, higher will be his savings.

- Hence, as  $r_f$  increases, Call will become more attractive.

- **Impact on Put Options:**

- When a trader sells the underlying asset (on exercise of put option) he receives 'X' in the future.

- So, the present value of 'X' would reduce, as interest rates increase.

- Hence, as  $r_f$  increases, Put will become less attractive.

# Dividends

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Dividends decrease the stock prices on ex-dividend date.

- Hence, call price decreases with dividends, and put price increases with dividends.

# Summary

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Impact of each factor on Option Price (keeping all other factors fixed)

Factors		Call Option	Put Option
Stock Price	↑	↑	↓
Strike Price	↑	↓	↑
Time to Expiration	↑	↑	↑
<i>(American Options)</i>			
Volatility	↑	↑	↑
Risk-free Interest Rate	↑	↑	↓
Dividends	↑	↓	↑

# Put – Call Parity

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Prices of European Put and Call options on the same underlying with identical exercise price and expiration dates have a special relationship.

- Consider the following portfolios:

- ✓ Portfolio A: One European Call Option and cash of  $Xe^{-rT}$

$(C + Xe^{-rT})$

- ✓ Portfolio B: One European Put Option and One Share

$(P + S_0)$

What is the worth of each portfolio on expiration?

# Put – Call Parity

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Consider the stock of Reliable Industries which is currently trading at Rs.750/-, while the 3-month European call option on it is trading at Rs.67.50 for exercise price of Rs.745/-. If the risk-free interest rate is 6% pa, what should be the price of a put option on the same stock with the same exercise price and expiration date?

$S_0 = \text{Rs. } 750/-$   $CE = \text{Rs. } 67.50$  ;  $X = \text{Rs. } 745/-$ ;  $r_f = 6\% \text{ pa}$ ;

$PE = ?$

$CE + Xe^{-rT} = PE + S_0$

$67.50 + 745e^{-(0.06)3/12} = PE + 750$

$PE = 67.50 + 733.91 - 750.00 = \text{Rs. } 51.41$

# Uses of Put – Call Parity

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To check for arbitrage opportunities resulting from relative mispricing of Call and Put options.

- If  $CE + Xe^{-rT} > PE + S_0$ , then Portfolio 'A' is overvalued relative to Portfolio 'B'. Hence, sell the securities in Portfolio 'A' and buy securities in Portfolio 'B', and make arbitrage profits.
- If  $CE + Xe^{-rT} < PE + S_0$ , then Portfolio 'B' is overvalued relative to Portfolio 'A'. Hence, sell the securities in Portfolio 'B' and buy securities in Portfolio 'A', and make arbitrage profits.

## Uses of Put – Call Parity

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Consider a dividend paying stock trading at Rs.50/-..An ATM1-month European call is available for Rs.3.50. If an ATM put option on the stock is trading at Rs.2.70, is there any arbitrage opportunity? (Assuming risk-free interest rate as 2% p.a). Assume strike price and stock price now as same.

# Put – Call Parity

$S_0 = X = \text{Rs. } 50/-$  ;  $C_E = \text{Rs. } 3.50$ ;  $P_E = 2.70$  ;  $r_f = 2\%$  pa (cc) ;  $t = 1/12$  yrs

- Portfolio A:  $C_E + Xe^{-rT} = 3.50 + 50e^{-(0.02)1/12} = 3.50 + 49.92 = 53.42$
- Portfolio B:  $P_E + S_0 = 2.70 + 50 = 52.70$
- Portfolio A > Portfolio B.

➤ Today: Buy Put, Buy Stock, Sell Call and sell Bond (Borrow)

Cash Flow (at  $t=0$ ) :  $- 2.70 - 50.00 + 3.50 + 49.92 = 0.72$

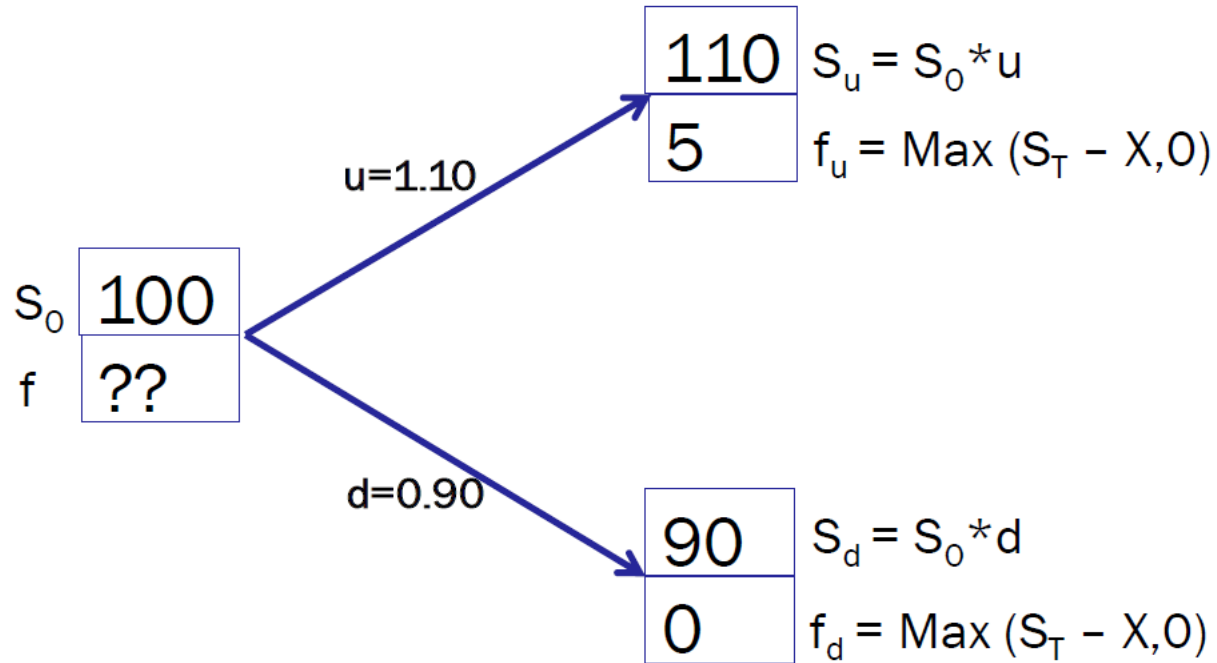
➤ After 1-month:

If $S_T < X$	If $S_T > X$
1. Put : ITM : Sell the stock for $X = 50$	1. Put : OTM : No action
2. Call : OTM : No action	2. Call : ITM : Sell stock at $X = 50$
3. Stock: Deliver the Put option.	3. Stock: Deliver under Call option.
4. Borrowings: Repay with interest $49.92e^{(0.02)1/12} = 50$	4. Borrowings: Repay with interest $49.92e^{(0.02)1/12} = 50$
Net Cash Flow = $50 - 50 = \text{Nil}$	Net Cash Flow = $50 - 50 = \text{Nil}$

# Binomial Option Pricing Model

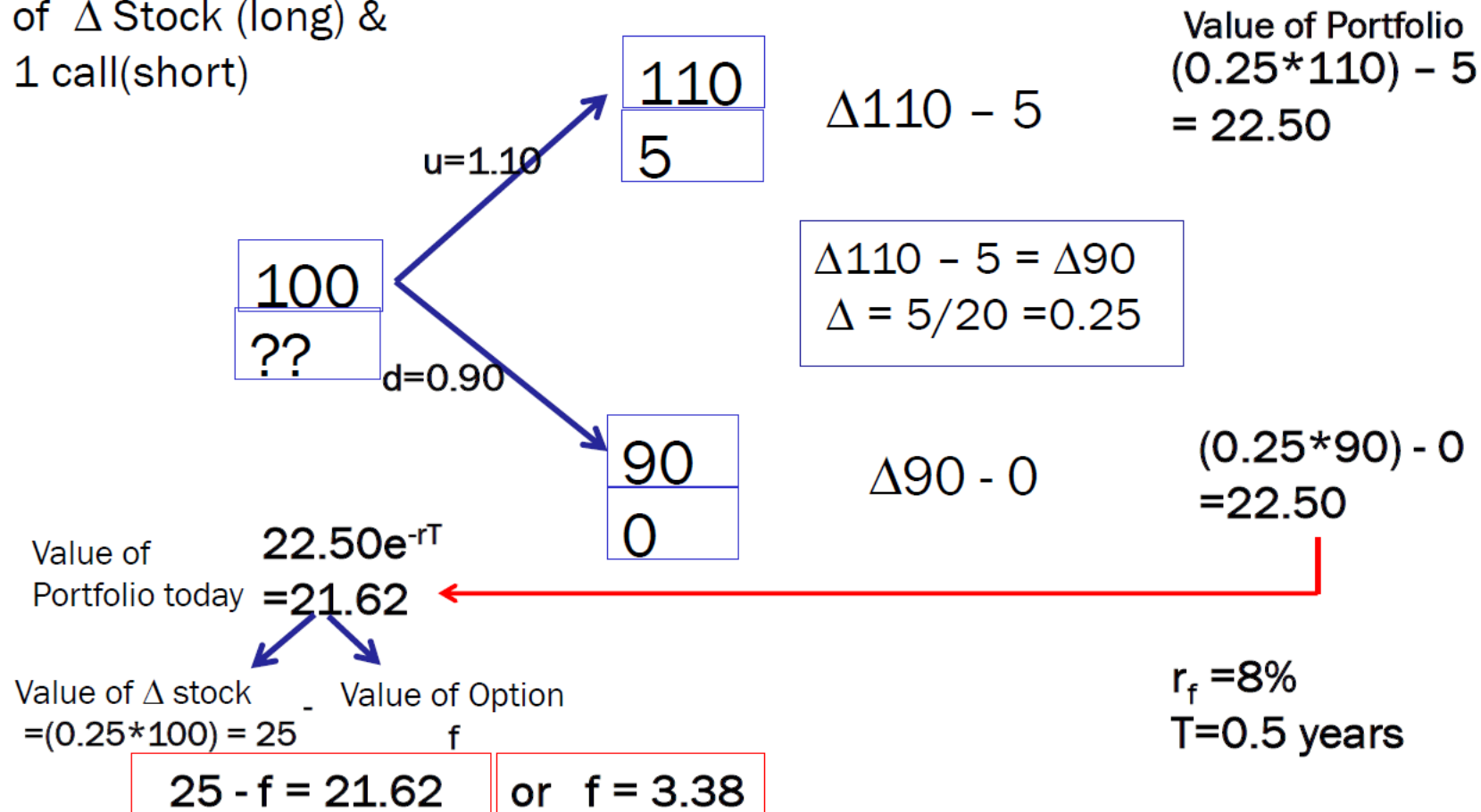
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$$X = 105$$



# Binomial Option Pricing Model

Construct a risk-less portfolio  
of  $\Delta$  Stock (long) &  
1 call(short)



# Binomial Option Pricing Model

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$$S * e^{rt} = S_u * p + S_d * (1 - p)$$

$$p = \frac{S * e^{rt} - S_d}{S_u - S_d}$$

Where, S= current Stock price

r = risk free rate

t= time period

S<sub>u</sub>= when stock price moves up

p = probability

S<sub>d</sub> = when stock price moves down

# Binomial Option Pricing Model

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To find the price of Call option, using the above formula:

$$p = \frac{e^{rT} - d}{u - d} = \frac{e^{0.08 \times 0.5} - 0.90}{1.10 - 0.90} = 0.70405$$

$$f = e^{-rT} \{ p f_u + (1-p) f_d \}$$

$$f = e^{-0.08 \times 0.5} \{ 0.70405 \times 5 + (1 - 0.70405) \times 0 \}$$

$$f = 3.38224 = \text{Rs.3.38}$$

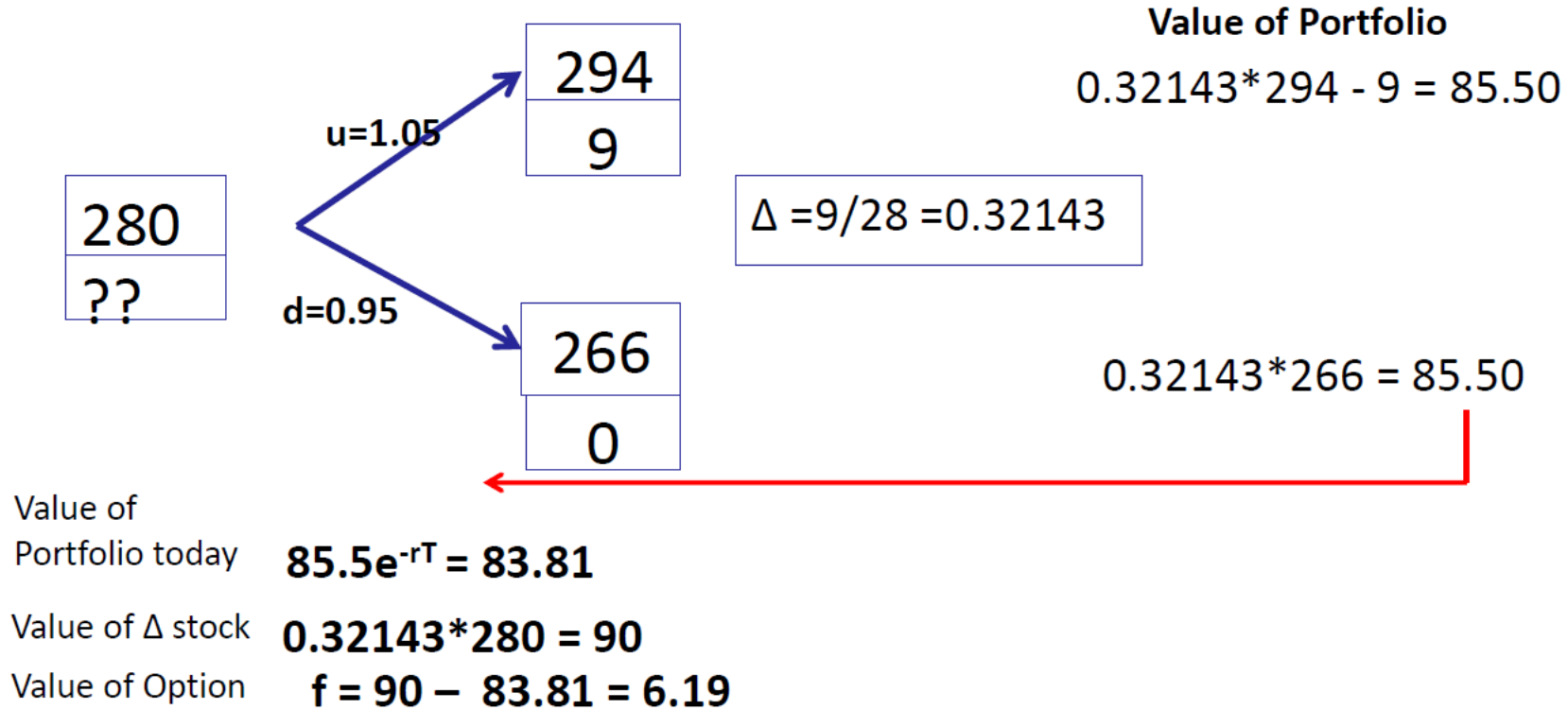
# Binomial Option Pricing Model

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$S_0 = \text{Rs}280/-$ ;  $X = \text{Rs. } 285/-$ ;  $T = 3/12$  years;  $u = 1.05$  ;  $d = 0.95$ ;  $r_f = 8\%$ , Find the value of Call option, using 1 stage Binomial Pricing model.

## Binomial Option Pricing Model

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# Binomial Option Pricing Model

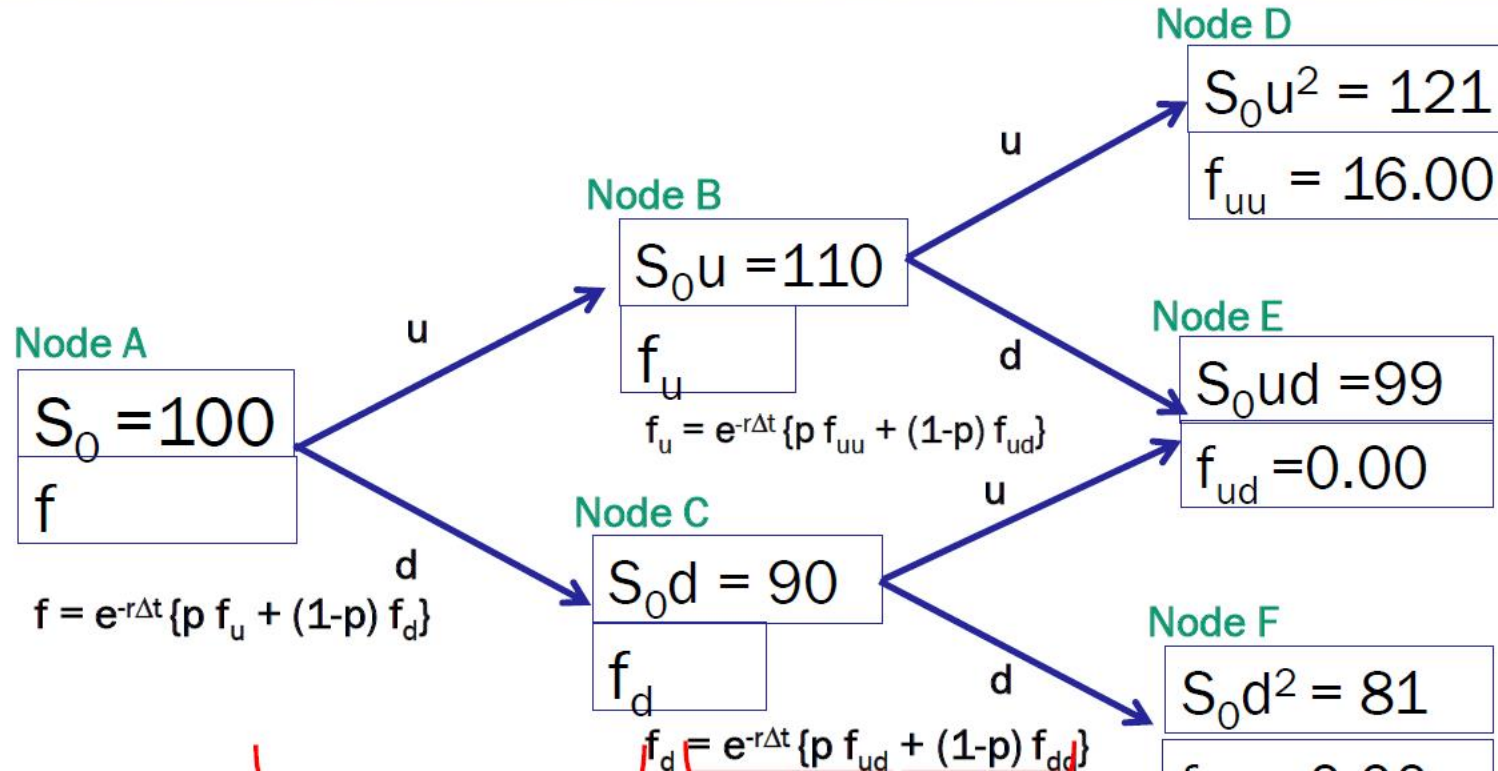
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To find the price of Call option, using the above formula:

$$p = \frac{e^{rT} - d}{u - d} = \frac{e^{0.08 \times 0.25} - 0.95}{1.05 - 0.95} = 0.70201$$

## 2 Stage European Call Option

$S_0 = \text{Rs } 100/-$  ;  $X = \text{Rs. } 105/-$  ;  $T = 0.5$  years ( $\Delta t = 0.25$ );  $u = 1.10$  ;  $d = 0.90$ ;  $r_f = 8\%$ , Find the value of Call option, using 2 stage Binomial Pricing model.



## 2 Stage European Call Option

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$$p = \frac{e^{0.08*0.25} - 0.90}{1.10 - 0.90} = \frac{1.0202 - 0.90}{1.10 - 0.90} = 0.60101$$

Node B

$$f_u = e^{-r\Delta t} \{p f_{uu} + (1-p) f_{ud}\} \quad f_u = e^{-0.08*0.25} \{0.60101*16 + (1-0.60101)*0\}$$
$$f_u = 9.42575 = 9.43$$

Node C

$$f_d = e^{-r\Delta t} \{p f_{ud} + (1-p) f_{dd}\} \quad f_d = e^{-0.08*0.25} \{0.60101*0 + (1-0.60101)*0\}$$
$$f_d = 0.00$$

Node A

$$f = e^{-r\Delta t} \{p f_u + (1-p) f_d\} \quad f = e^{-0.08*0.25} \{0.60101*9.43 + (1-0.60101)*0\}$$
$$f = 5.55530 = 5.55$$

## 2 Stage European PUT Option

$$p = \frac{e^{0.08*0.25} - 0.90}{1.10 - 0.90} = \frac{1.0202 - 0.90}{1.10 - 0.90} = 0.60101$$

Node B

$$f_u = e^{-r\Delta t} \{p f_{uu} + (1-p) f_{ud}\} \quad f_u = e^{-0.08*0.25} \{0.60101*0 + (1-0.60101)*6\}$$
$$f_u = 2.34654 = 2.35$$

Node C

$$f_d = e^{-r\Delta t} \{p f_{ud} + (1-p) f_{dd}\} \quad f_d = e^{-0.08*0.25} \{0.60101*6 + (1-0.60101)*24\}$$
$$f_d = 12.92080 = 12.92$$

Node A

$$f = e^{-r\Delta t} \{p f_u + (1-p) f_d\} \quad f = e^{-0.08*0.25} \{0.60101*2.35 + (1-0.60101)*12.92\}$$
$$f = 6.43728 = 6.44$$

$$f = e^{-2r\Delta t} \{p^2 f_{uu} + 2p(1-p) f_{ud} + (1-p)^2 f_{dd}\}$$

$$f = e^{-2*0.08*0.25} \{(0.60101)^2*0 + 2(0.60101)(1-0.60101)*6 + (1-0.60101)^2*24\}$$
$$f = 6.43555 = 6.44$$

## 2 Stage European PUT Option

$$p = \frac{e^{0.08*0.25} - 0.90}{1.10 - 0.90} = \frac{1.0202 - 0.90}{1.10 - 0.90} = 0.60101$$

Node B

$$f_u = e^{-r\Delta t} \{p f_{uu} + (1-p) f_{ud}\} \quad f_u = e^{-0.08*0.25} \{0.60101*0 + (1-0.60101)*6\}$$
$$f_u = 2.34654 = 2.35$$

Node C

$$f_d = e^{-r\Delta t} \{p f_{ud} + (1-p) f_{dd}\} \quad f_d = e^{-0.08*0.25} \{0.60101*6 + (1-0.60101)*24\}$$
$$f_d = 12.92080 = 12.92$$

Node A

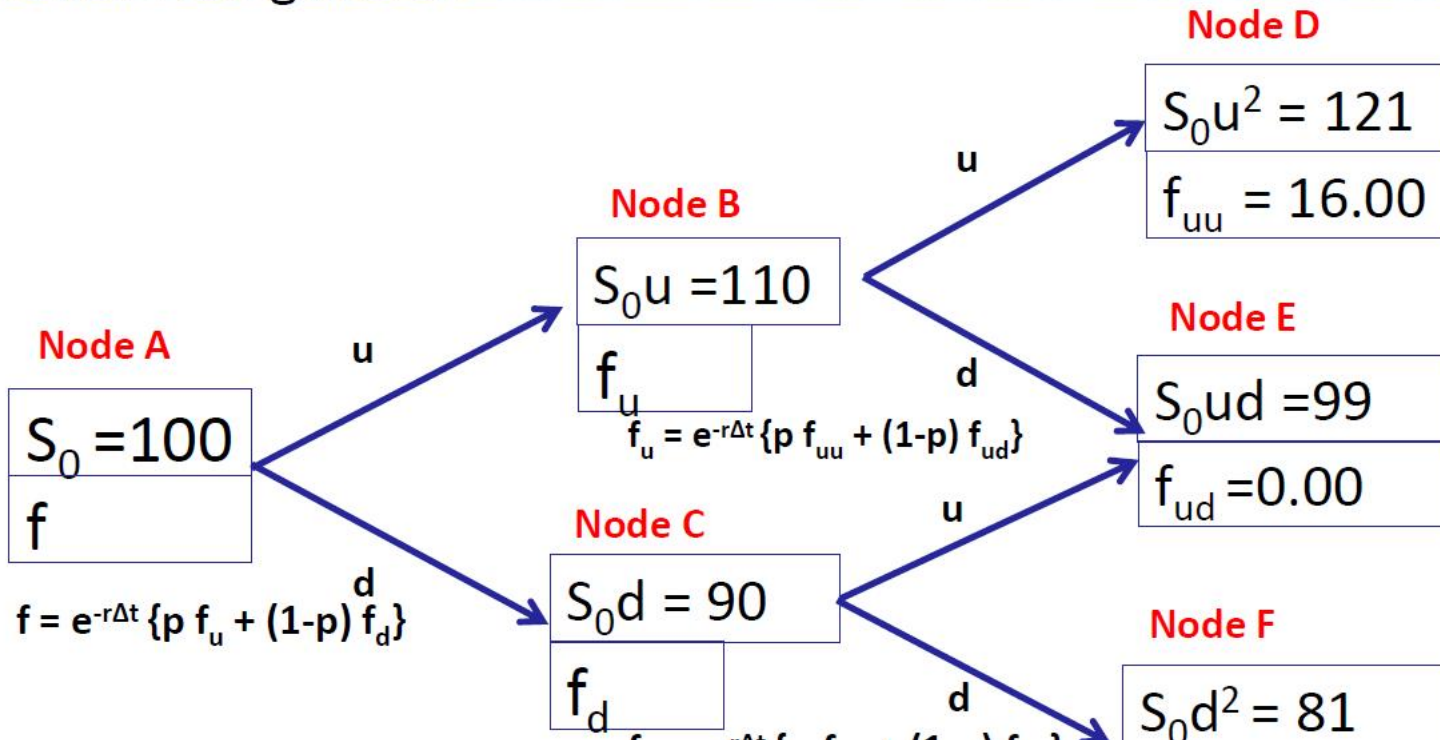
$$f = e^{-r\Delta t} \{p f_u + (1-p) f_d\} \quad f = e^{-0.08*0.25} \{0.60101*2.35 + (1-0.60101)*12.92\}$$
$$f = 6.43728 = 6.44$$

$$f = e^{-2r\Delta t} \{p^2 f_{uu} + 2p(1-p) f_{ud} + (1-p)^2 f_{dd}\}$$

$$f = e^{-2*0.08*0.25} \{(0.60101)^2*0 + 2(0.60101)(1-0.60101)*6 + (1-0.60101)^2*24\}$$
$$f = 6.43555 = 6.44$$

## 2 Stage American Call Option

$S_0 = \text{Rs } 100/-$  ;  $X = \text{Rs. } 105/-$  ;  $T = 0.5$  years ( $\Delta t = 0.25$ );  $u = 1.10$  ;  
 $d = 0.90$ ;  $r_f = 8\%$ , Find the value of American Call option, using 2 stage  
 Binomial Pricing model.



## 2 Stage American Call Option

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### Node B

$$f_u = e^{-r\Delta t} \{p f_{uu} + (1-p) f_{ud}\} \quad f_u = e^{-0.08*0.25} \{0.60101*16 + (1-0.60101)*0\}$$
$$f_u = 9.42575 = \mathbf{9.43}$$
$$f_u = \text{Max}(S_t - X, 0) \quad f_u = \text{Max}(110 - 105, 0) = 5$$

### Node C

$$f_d = e^{-r\Delta t} \{p f_{ud} + (1-p) f_{dd}\} \quad f_d = e^{-0.08*0.25} \{0.60101*0 + (1-0.60101)*0\}$$
$$f_d = \mathbf{0.00}$$
$$f_d = \text{Max}(S_t - X, 0) \quad f_d = \text{Max}(90 - 105, 0) = 0$$

### Node A

$$f = e^{-r\Delta t} \{p f_u + (1-p) f_d\} \quad f = e^{-0.08*0.25} \{0.60101*9.43 + (1-0.60101)*0\}$$
$$f = 5.55530 = \mathbf{5.55}$$

## Trading Strategies using Options

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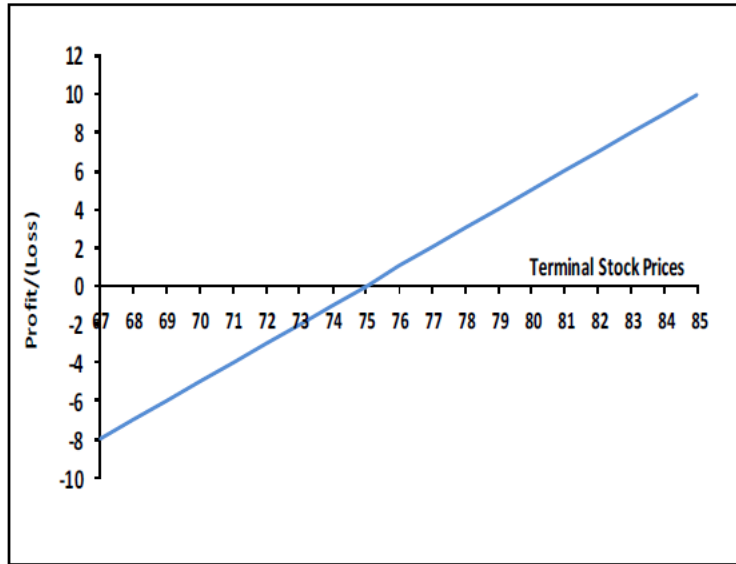
Several strategies involving Options and their underlying assets lead to unusual payoff patterns.

Various Strategies:

- Covered Call & Protective Put
- Spreads : Bullish; Bearish; Butterfly; Calendar
- Combinations : Straddles; Strangles; Strips; Straps.
- Others: Collars; Synthetic Stocks

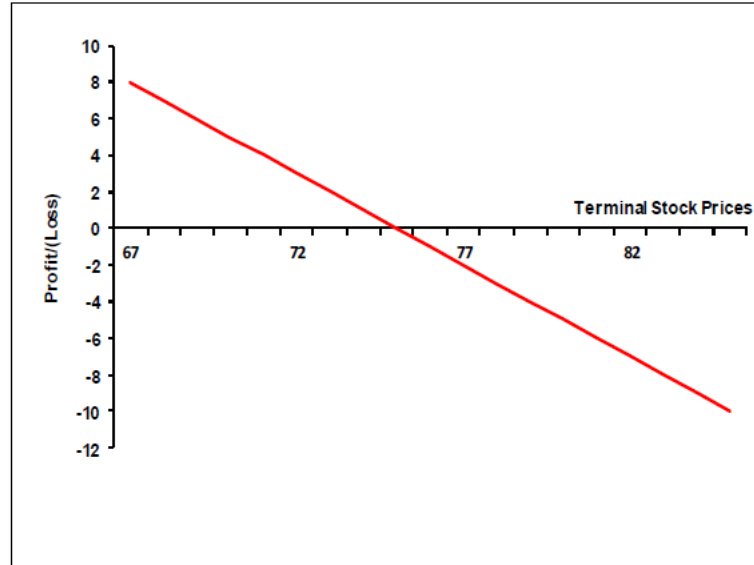
## Stock – Long & Short

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Buyer of Stock is Bullish on the stock.

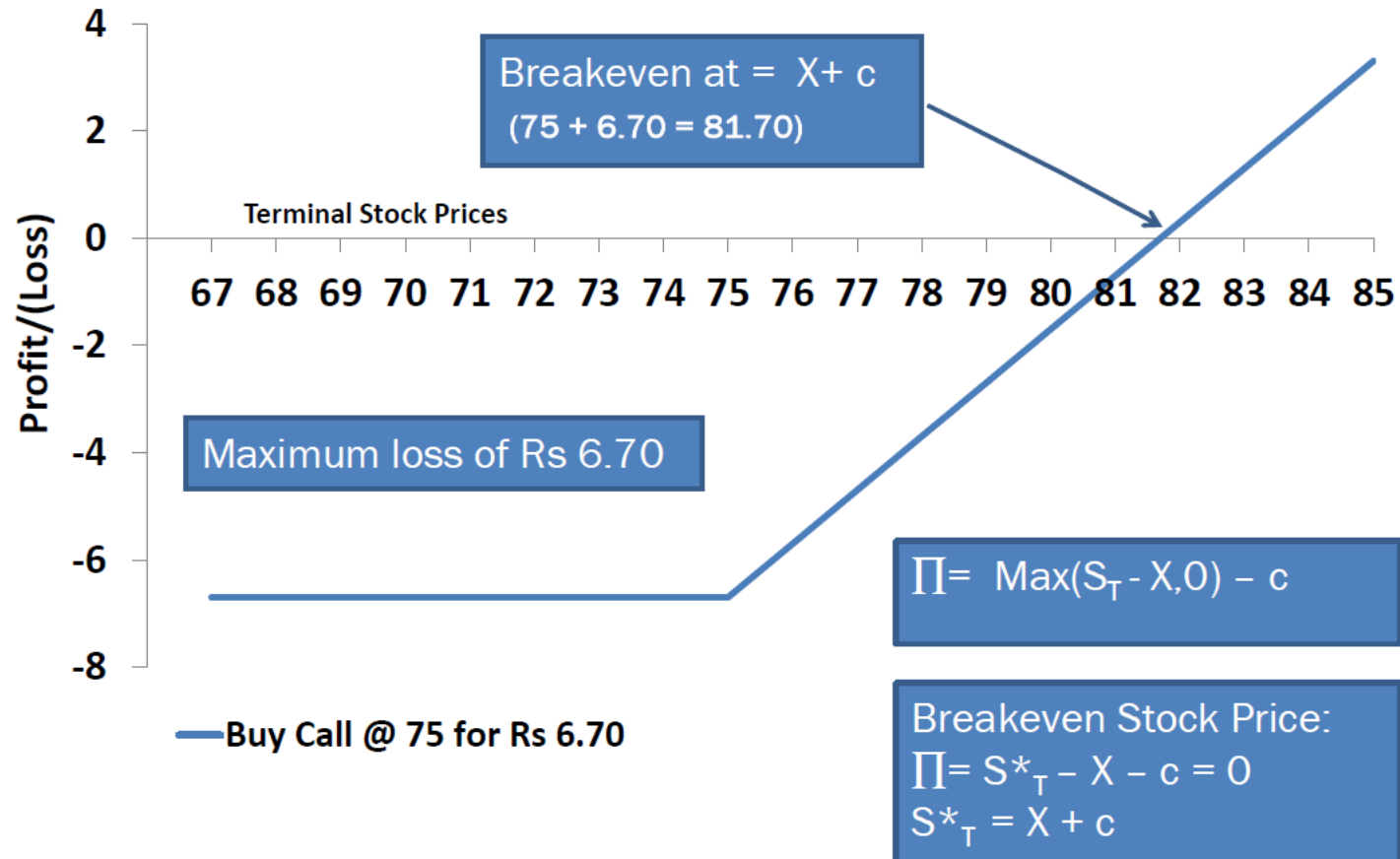
$$\Pi = N_S(S_T - S_0)$$



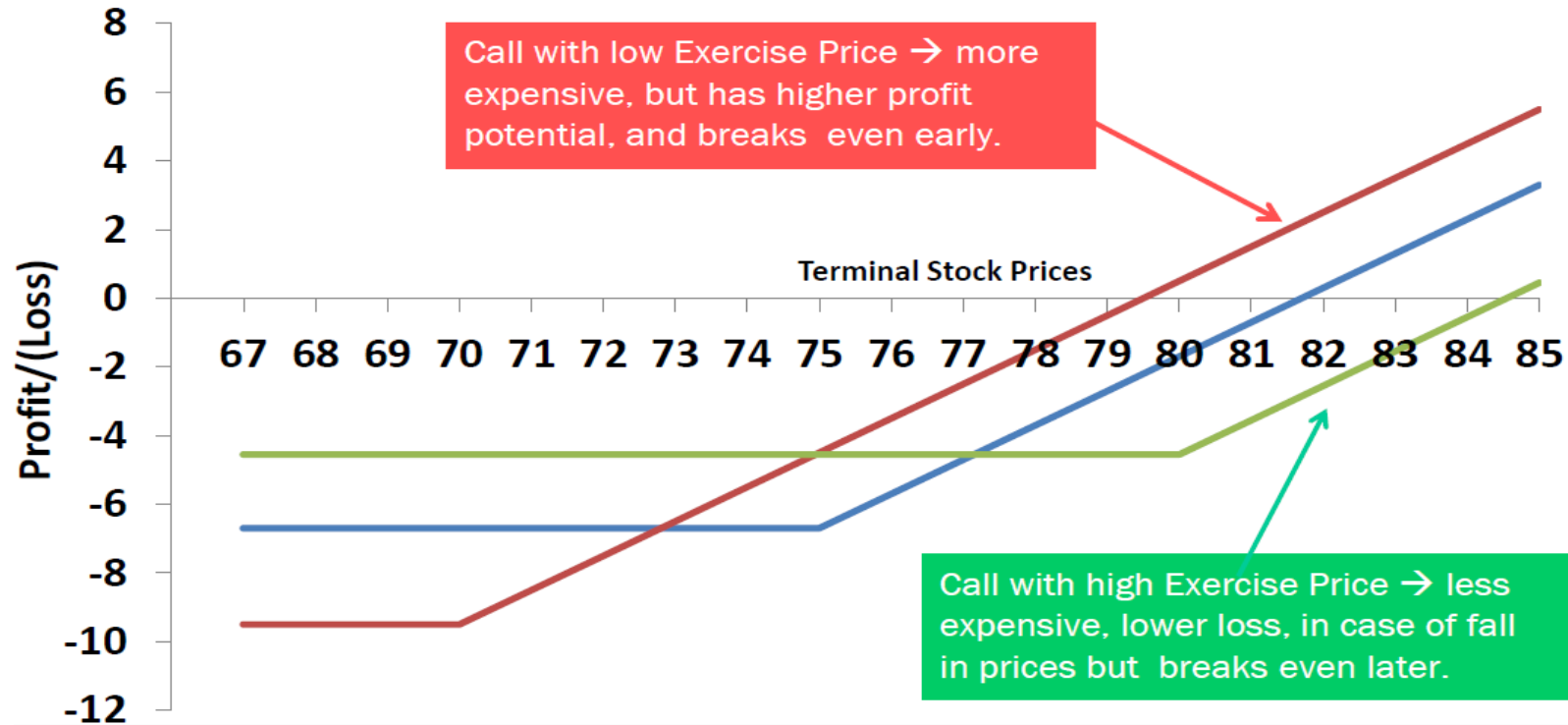
Short seller of Stock is Bearish on the stock.

$$\Pi = -N_S(S_T - S_0)$$

## Long on Call Option (Buy Call Option)



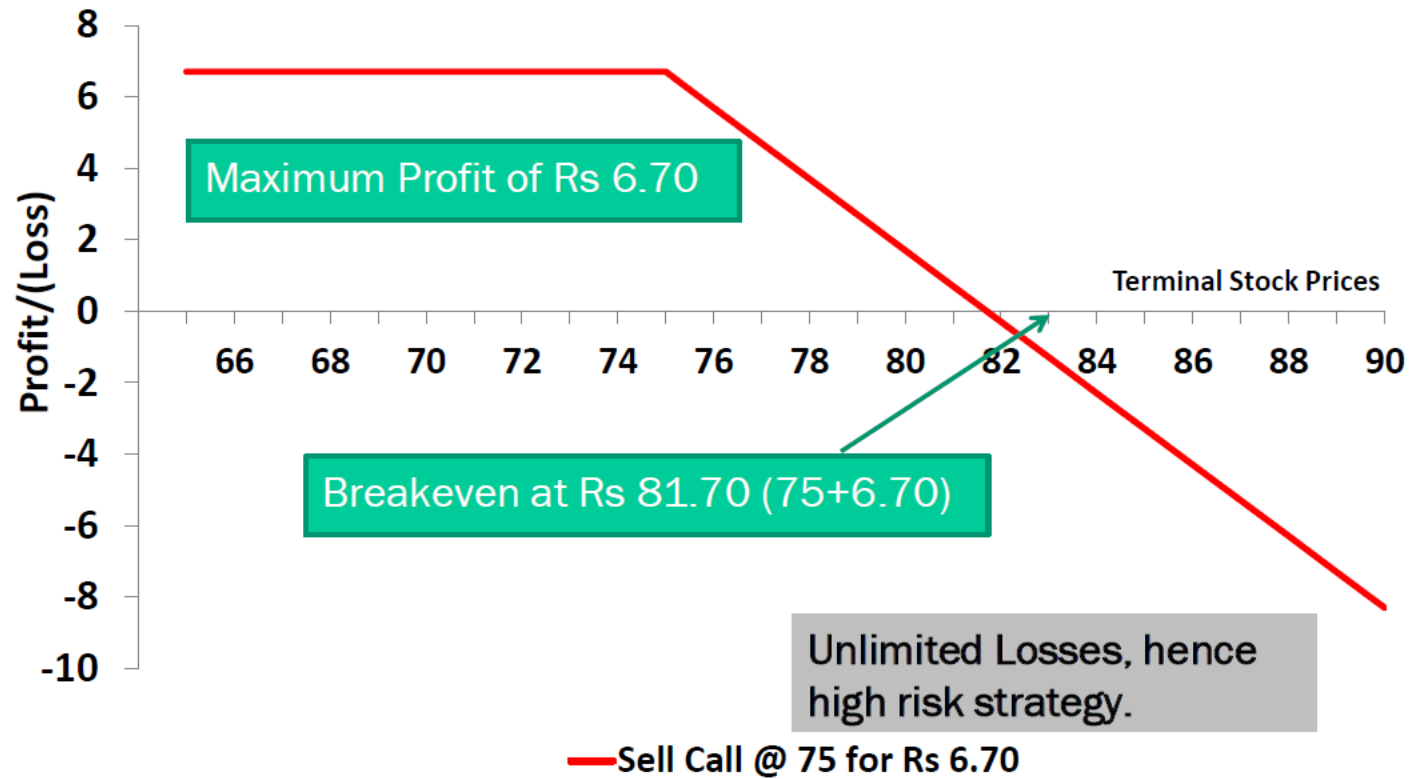
## Long on Call Option (Choice of Exercise Price)



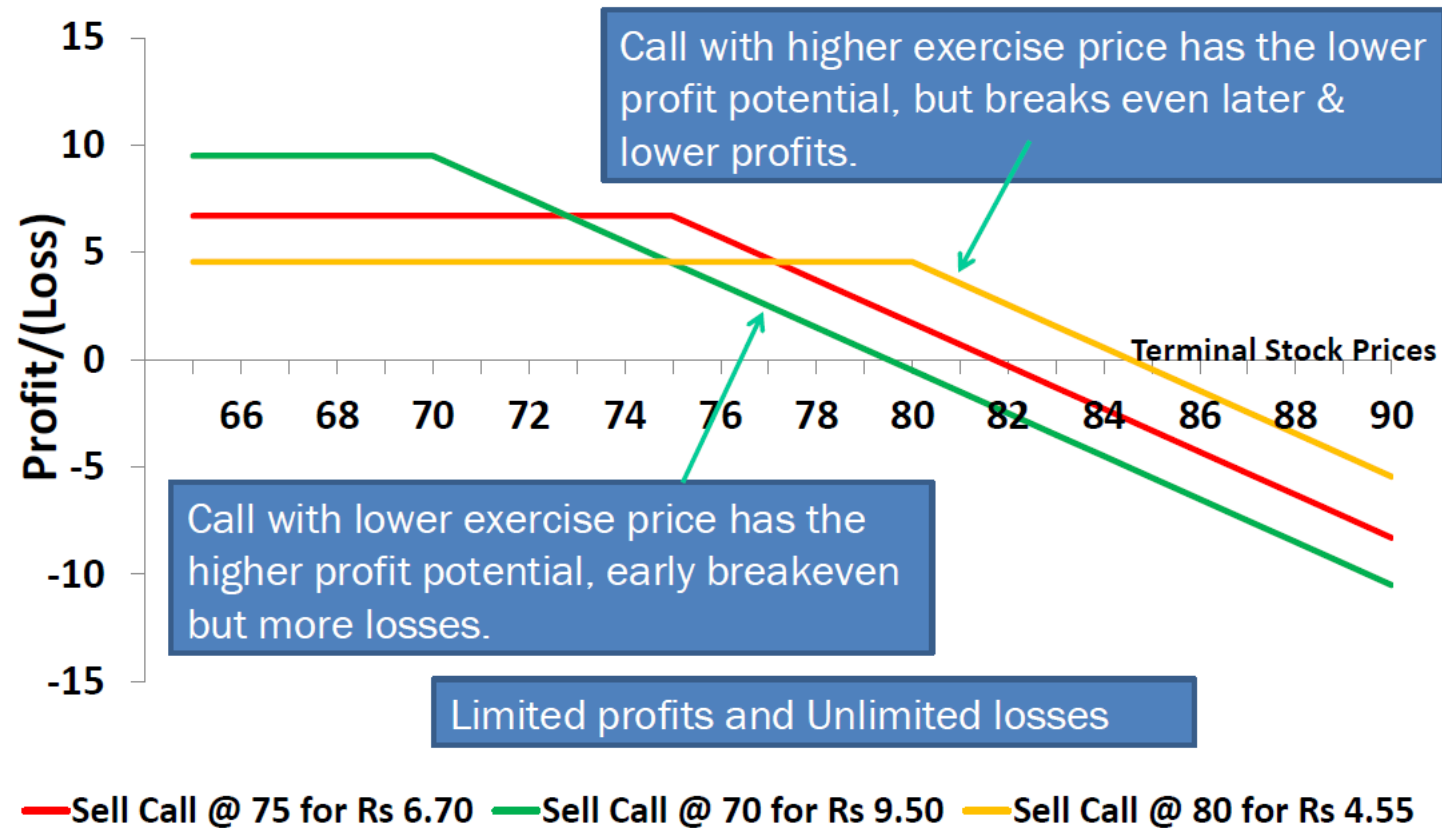
Choice of Call option depends upon call buyer's outlook of market.  
If strongly Bullish, then Call with lower exercise price, otherwise Call with higher exercise price.

— Buy Call @ 75 for Rs 6.70 — Buy Call @ 70 for Rs 9.50 — Buy Call @ 80 for Rs 4.55

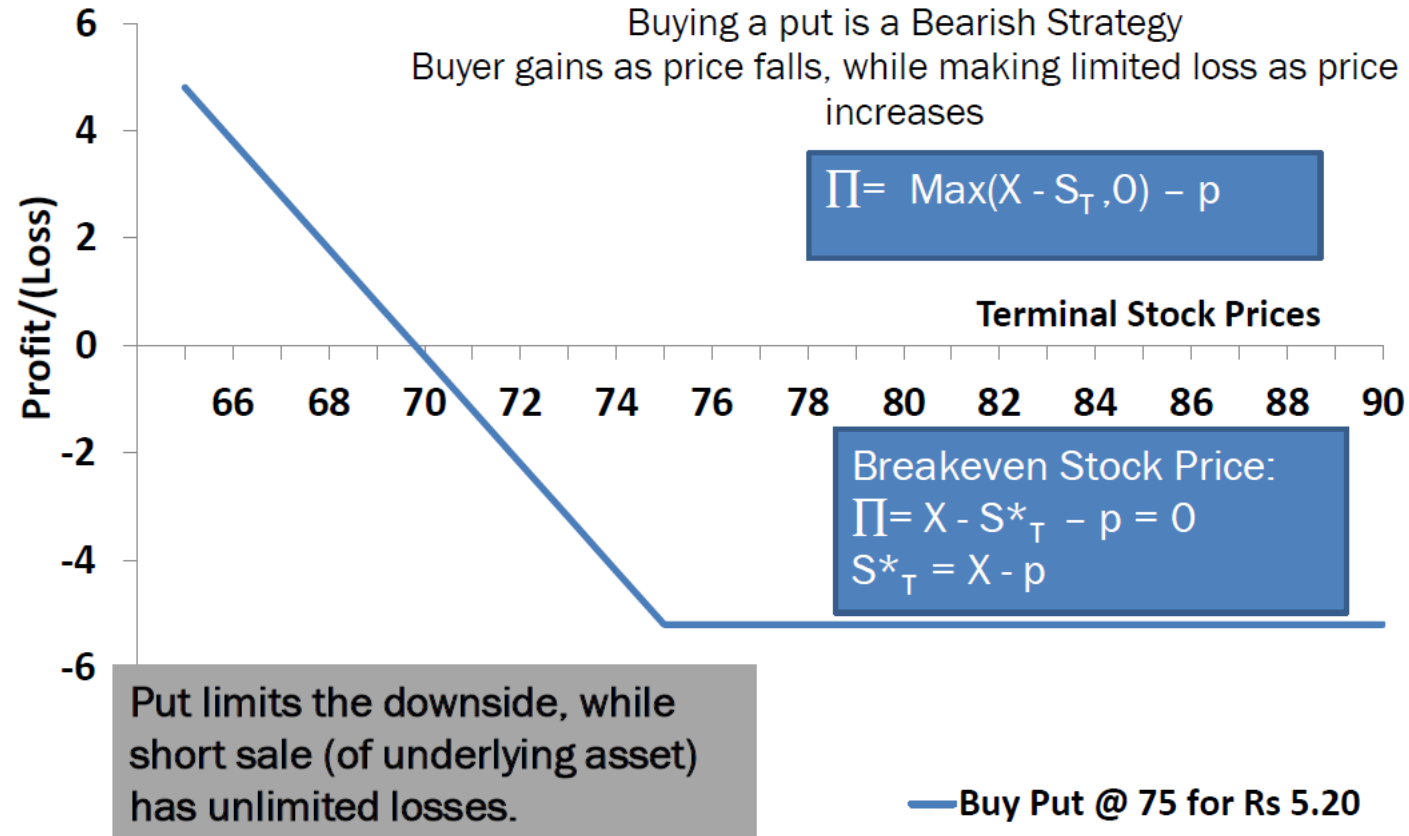
## Short on Call Option (Sell Call Option)



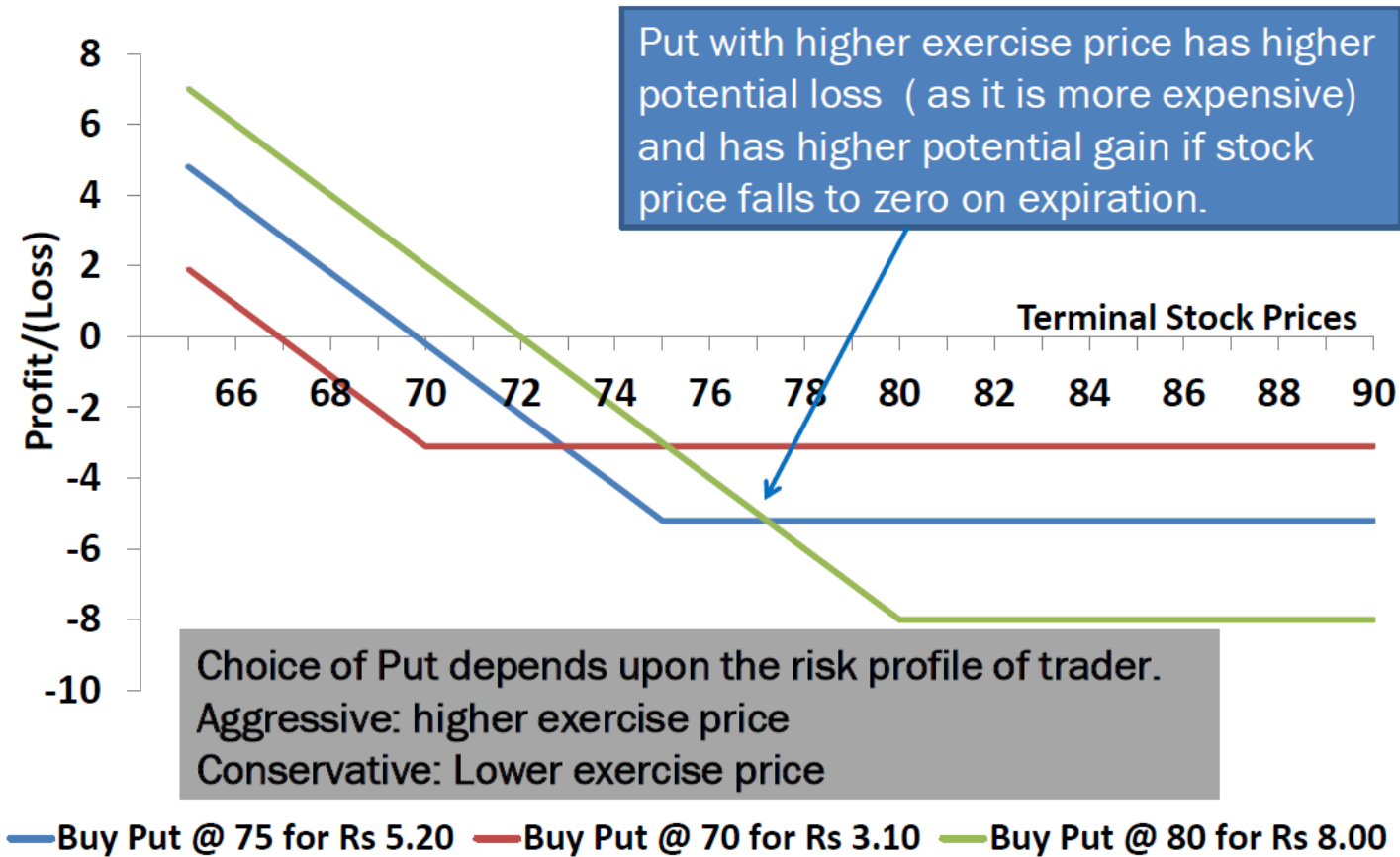
## Short on Call Option (Choice of Exercise Price)



## Long on Put Option (Buy Put Option)

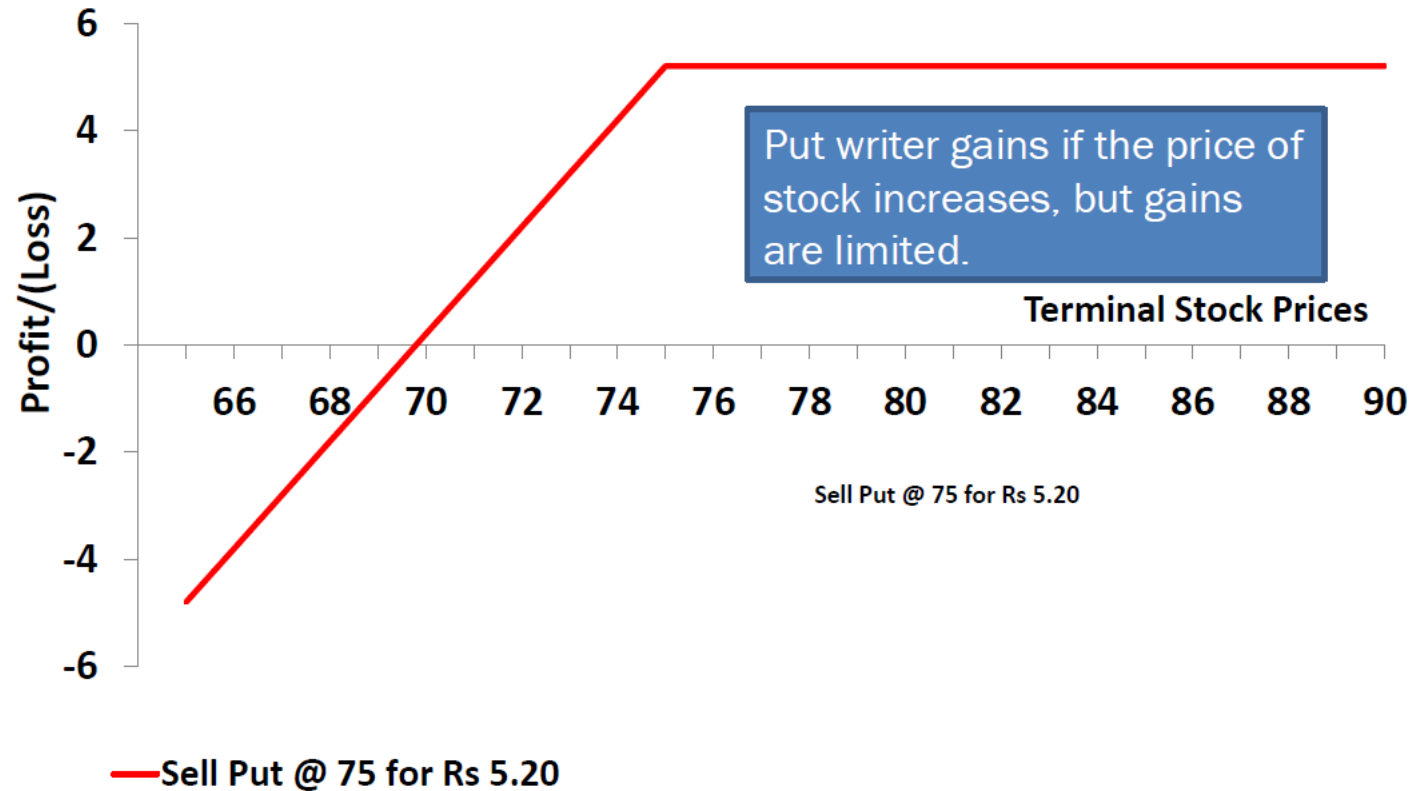


## Long on Put Option (Choice of Exercise Price)



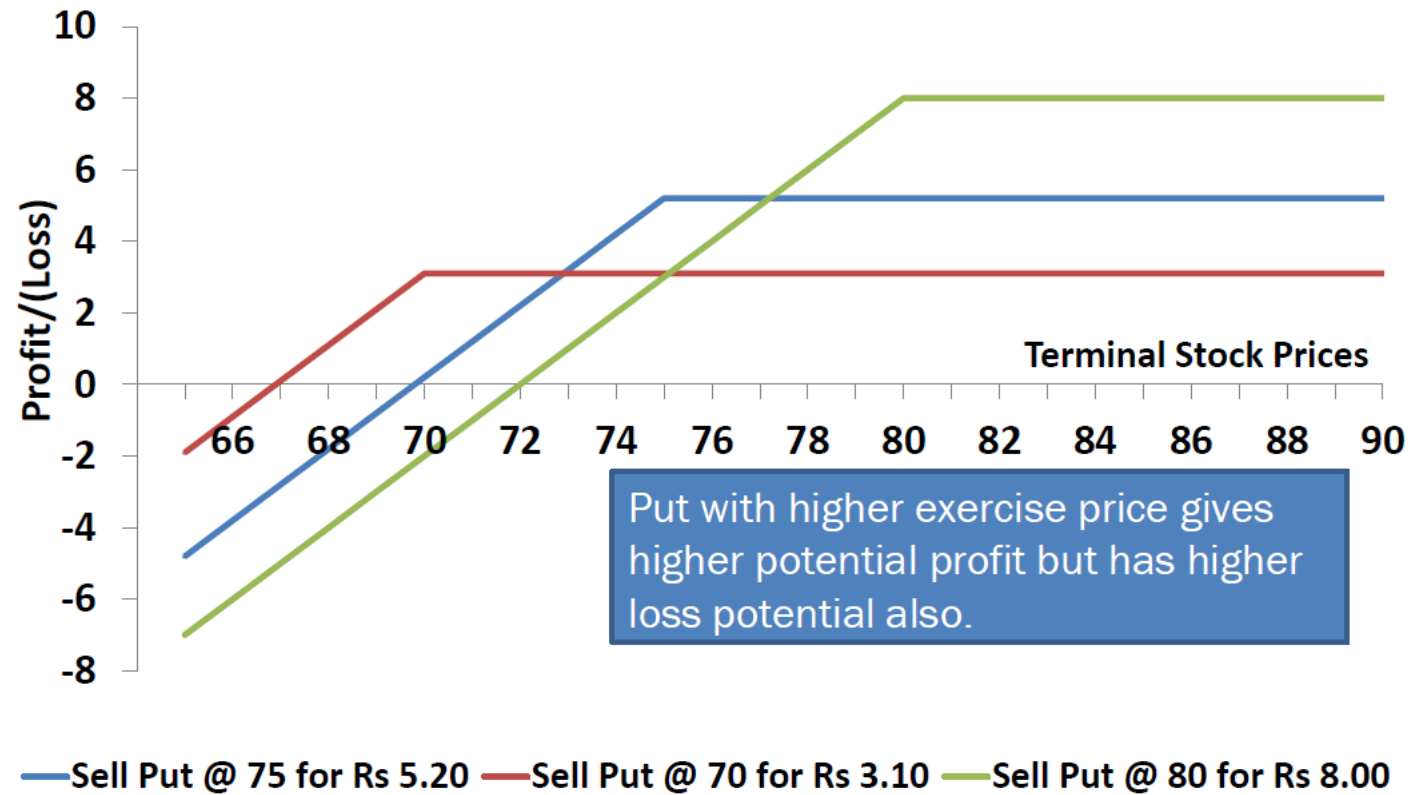
## Short on Put Option (Sell a Put Option)

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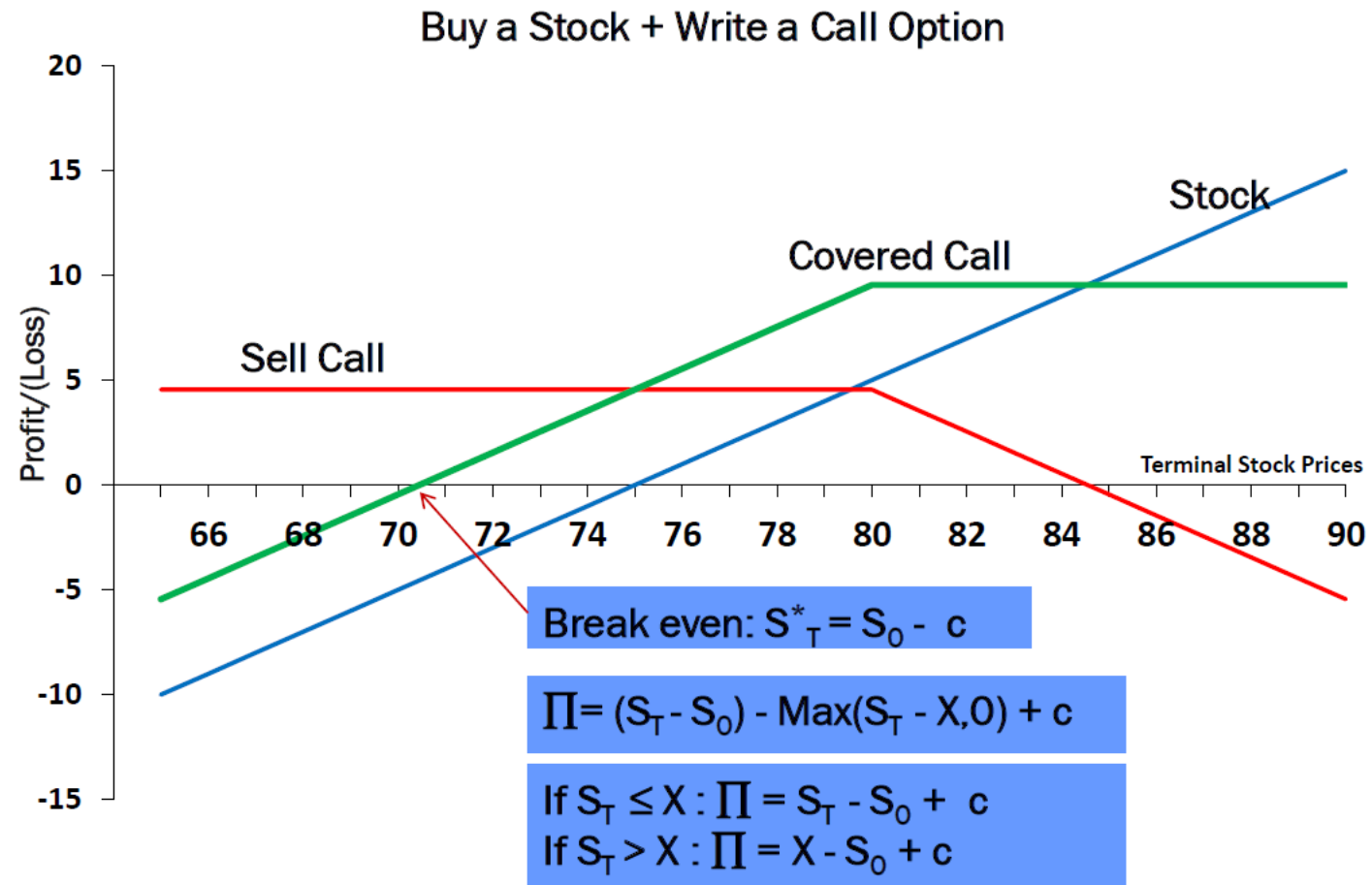


## Short on Put Option (Choice of Exercise Price )

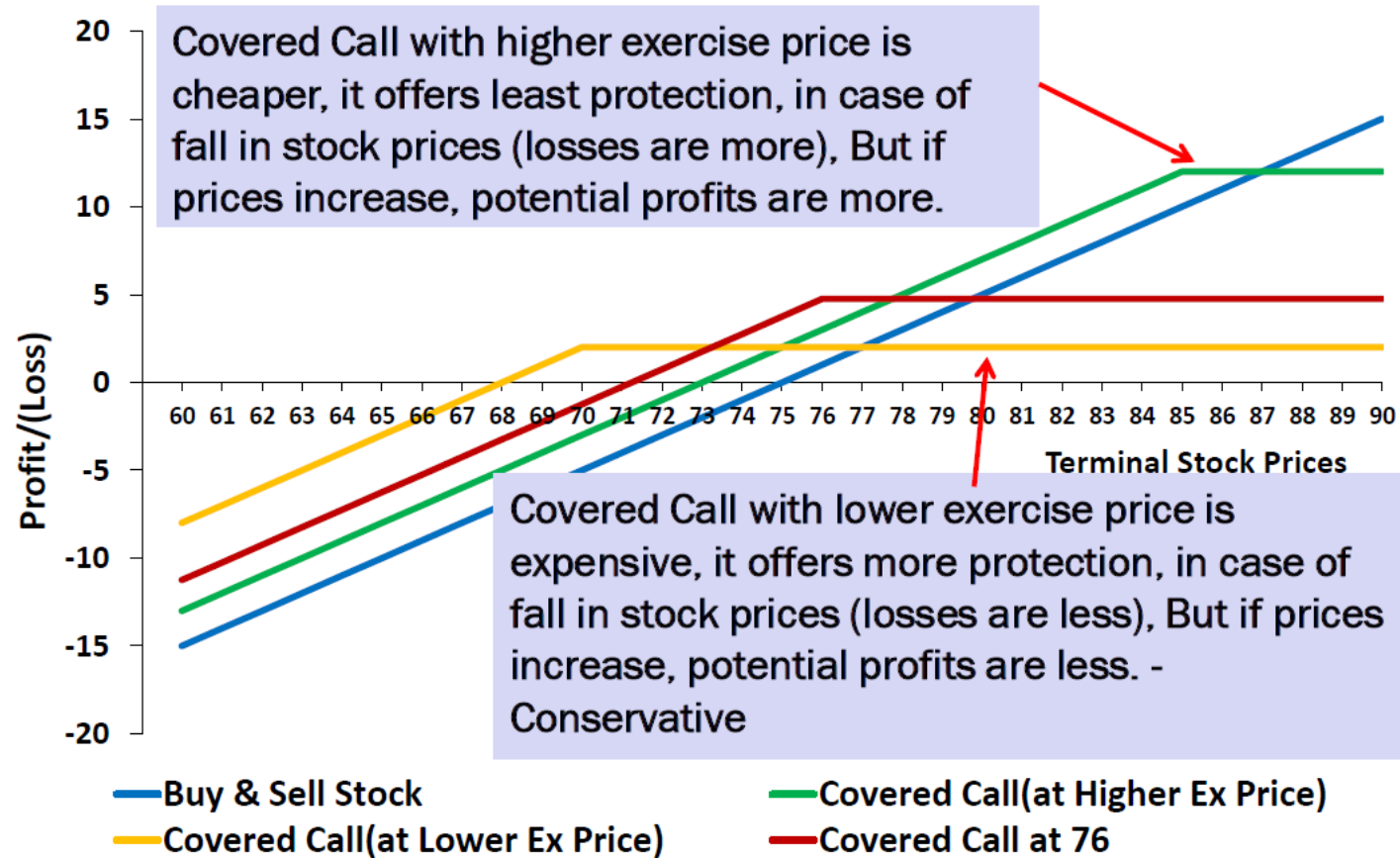
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## Writing a Covered Call

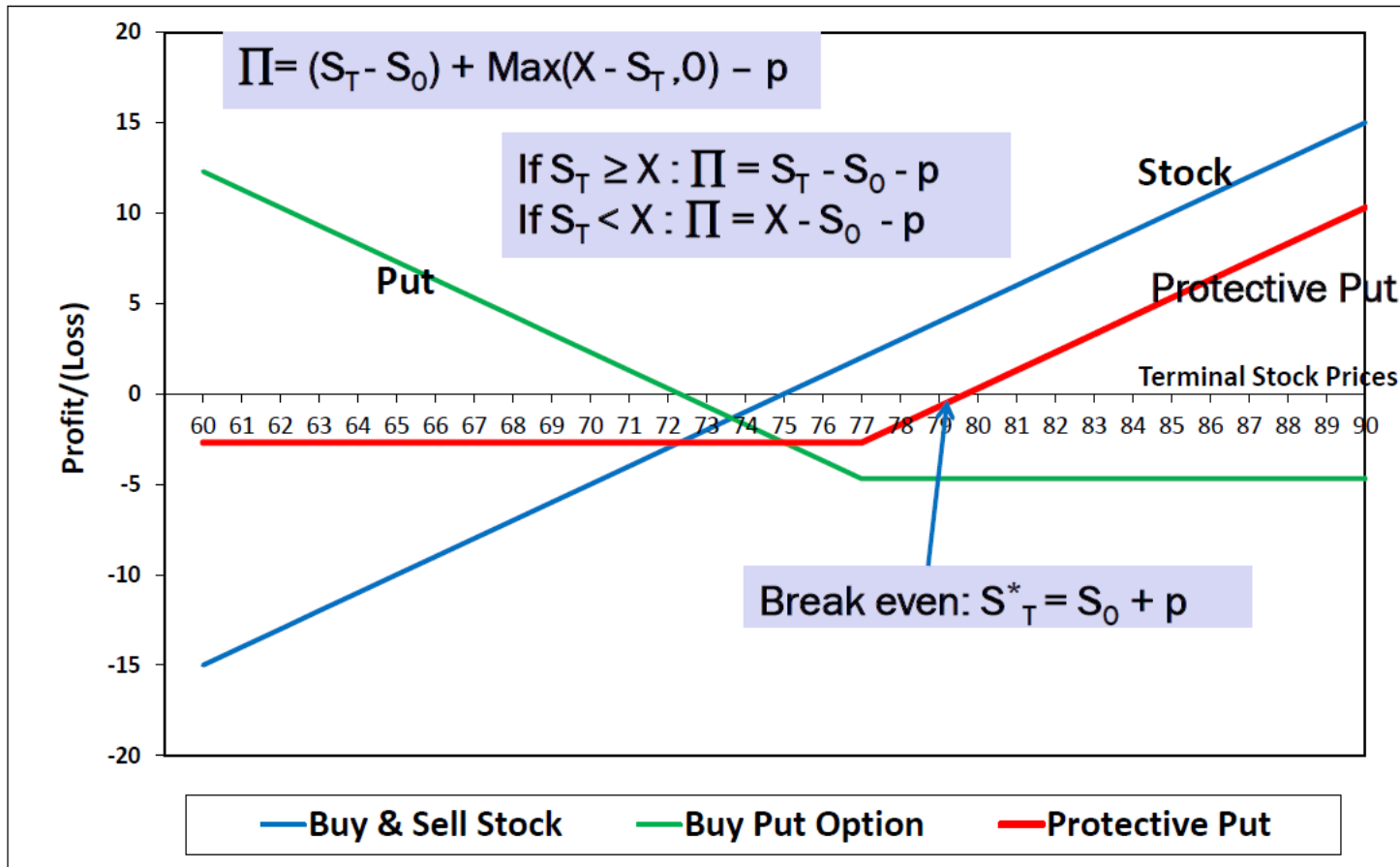


## Covered Call -Choice of Exercise price

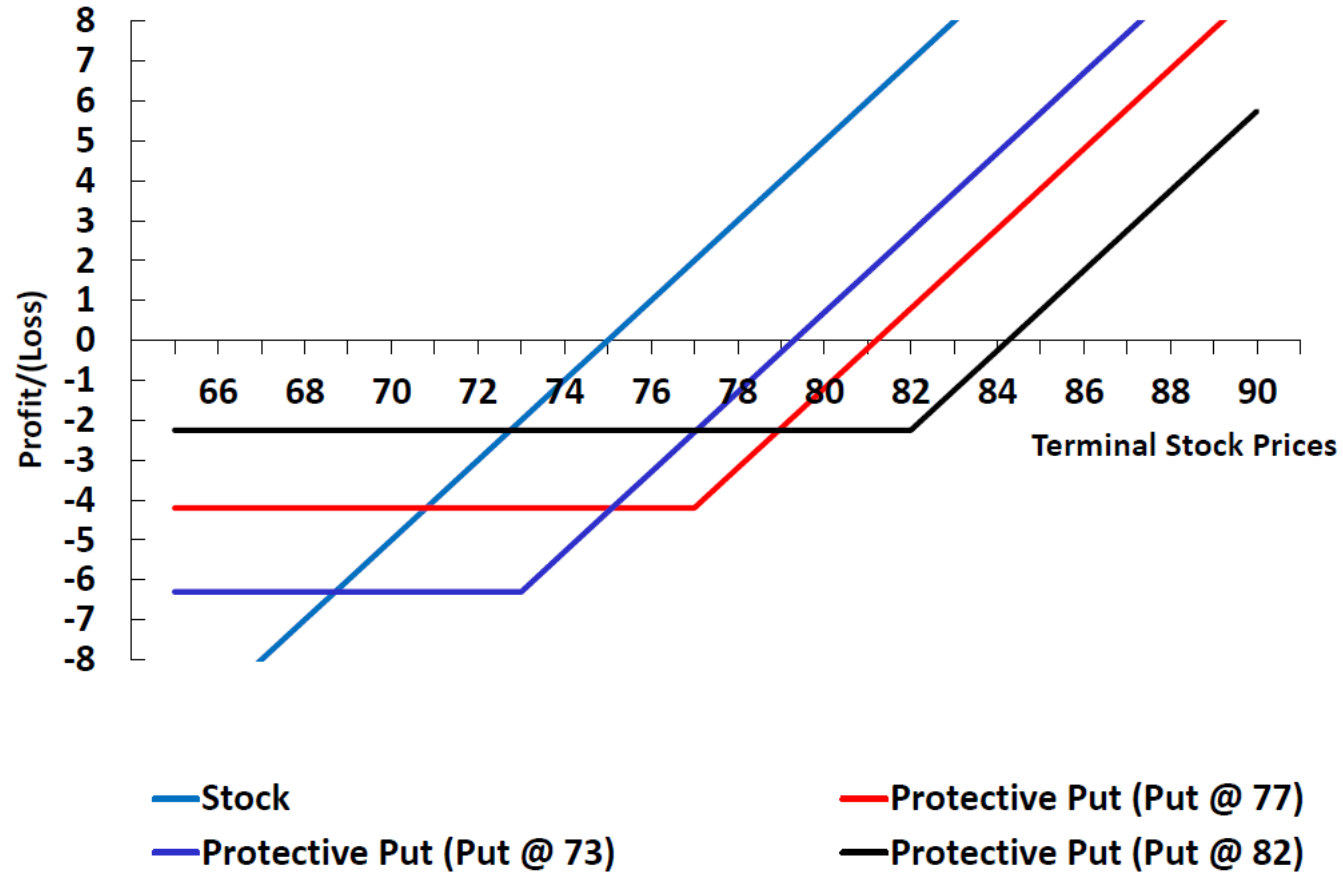


# Protective Put

## Buy a Stock + Buy a Put



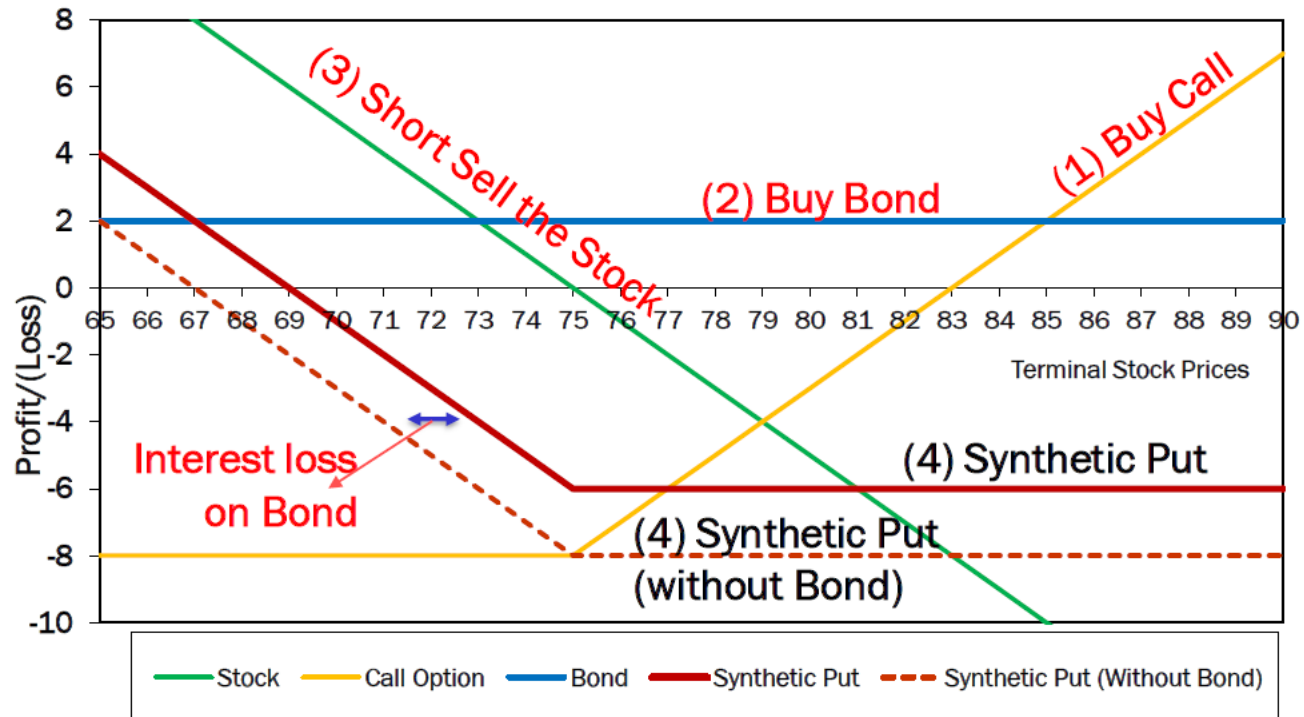
## Protective Put- with different Exercise Prices



## Synthetic Options

Using the Put Call Parity, we may create synthetic Options.

- Synthetic Put =  $c + Xe^{-rT} - S_0$  (Buy Call, Buy Bond & Sell Short the stock)
- But traders simply Buy Call & Short sell the stock.



## Why create Synthetic Put

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By creating a Synthetic put, we may take advantage of any mispricing in Puts & Calls.

# Swaps

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- ❖ Literal meaning : “to exchange”.
- ❖ **Swap** is a transaction which transforms one stream of future cash flows into another stream of future cash flows with different features.
- ❖ Does not involve legal swapping of actual debt but an agreement is made to meet certain cash flows.
- ❖ **Basic types:**
  - ✓ Interest rate Swap
  - ✓ Fixed to Floating Rate or
  - ✓ Floating to Fixed Rate
  - ✓ Basis Swap

# Interest Rate Swaps

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Why do these spreads exist in fixed and floating rates????

Why some companies need fixed and some need floating.

# Swaps

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Company A and B have been offered the following rates per annum on a 20 Mn 5-year loan.

Company	Fixed Rate	Floating rate
Company A	5%	LIBOR +0.1%
Company B	6.4%	LIBOR +0.6%
Differential	1.4%	0.5%

A require loan at floating. Company B require at Fixed rate. Commission is 0.1%

According to comparative advance( Swapping) = LIBOR+ 0.6%+5% = LIBOR +5.6

If they would have taken according to their Will = LIBOR +6.4+0.1 = LIBOR +6.5

# Interest Rate Swaps

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- Fixed rate differential = 1.4%
- Floating rate = 0.5%
- Saving through swap = 0.9%(1.4%-0.5%)
- Commission to swap bank = 0.1%
- Net saving through swap = 0.8% ( It needs to be equally distributed between both the parties)
- A saving = 0.4%
- B saving = 0.4%
- Hence floating rate that A will be willing to pay = LIBOR-0.3%

# Swaps

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