MÄLARDALEN UNIVERSITY
DEPARTMENT OF MATHEMATICS AND PHYSICS
ANALYTICAL FINANCE I, MT1410
TEACHER: JAN RÖMAN

PROJECT

2003-10-21

STRATEGIES WITH OPTIONS

GROUP 3:
MAGNUS SÖDERHOLTZ
MAZYAR ROSTAMI
SABAHUDIN ZUBEROVIC
XIN MAI

ABSTRACT

This report is aimed at giving a better understanding of the strategies of using different options in different market situations. The authors of this report will go through some of the common strategies, which the investors might need in order to improve their financial standing.

TABLE OF CONTENT

1. INTRODUCTION

In the world of finance, investors trying to improve their financial status are desperately seeking ways for setting up good investment strategies. It is common known that the general publics don't either know or want to engage in, what they think is a risky venture, leading to "sure" loss of entire investments. However, it can be shown that, by putting up a good option strategy, one can actually limit the loss due to unexpected shocks in the market or even in a particular asset. The investors could even set up such a strategy, which could leave to unlimited profits. In this project, authors are going to give a general description of the commonly used option strategies that can be used in the financial market, backed up with relevant and good real-life examples, as well as the follow-up strategies required for a good success.

Section 1 begins with an explanation of the bullish market and how one can spot the typical character of the bullish market, followed by the different strategies involved in this market. Section 2 brings up very interesting strategies, that one can use to profit or minimize one's loss in a downswing-market. This market could be specifically interesting, since the general public have this prejudiced opinion about a bearish market. Neutral markets, described in section 3 of the project, are maybe one of those strategies that are overlooked by the general public, since neither the market nor a particular asset is moving that much up or down. The authors will show how one can potentially profit in this kind of market, even if it is still for the moment. The last strategy, the volatile market in section 4, is a more risky or a more aggressive version of the bullish market, where the price of a particular asset could be very low at one point in time, but in the very near future, it can go up with the same magnitude or even higher. This market is ideal for those financial investors who are considering being risk-takers. The last section involves the conclusion and comments of the authors' project.

2. BULLISH MARKET

Ericsson 2003-04-16 – 2003-10-16

2.1 Overview

A bullish market (Bull market), is a rising market, or a market in which further price increases are expected, due to strong demand (see figure above). Whenever an investor expects the market to be Bullish or in other words; he thinks that the price of the underlying asset will go up; he can as an alternative to buying the stock use strategies described in this section.

In this section strategies are connected to different individual believes in a bullish market. For example:

- If an individual believes that the market or the underlying stock is going to be stable with a small probability of bullish rise he can sell a put option (described on page 4).
- If he instead expects a small upward movement in the share price. He can implement short ratio call spread strategy (described on page 5).
- Or if an individual expects that the share price is more likely to rise then fall he can either construct a bullish call spread or a bullish put spread (described on page 6).
- And finally if this individual expects the share price to rise significantly he can conduct bullish call ladder strategy (described on page 8).

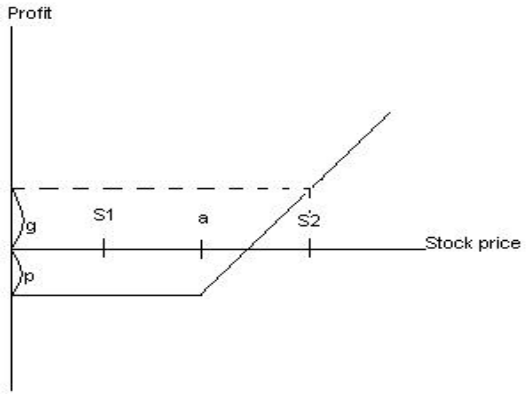
The simpler strategy of buying a call option which is suitable for bullish market will be described primer of all strategies. Together with this strategy I will construct a real life example (on page 3) with follow up actions.

On page 6, I will construct a real life example with bullish call spread strategy which is little more complicated then the first example.

2.2 Buying a call (long call strategy)

The long call strategy provides unlimited profit potential with limited risk. It is best used in a Bullish market where the investor is certain there will be a sharp rise in share price in the near future. Buying a call is equivalent to buying a stock except that the capital outlay and the downside risk both are limited to the premium.

Figure 2. 1:Buying a call option



Review of payoff diagram of bought call option

Bought option for premium price ***p*** with strike price ***a.*** At maturity if stock price is below ***a*** say ***S_1,*** you will not exercise the option and you loose ***p.*** If stock price is above ***a*** say ***S_2*** then the option is in the money and you will exercise it. Since a call option give you the right to buy, you buy the underlying stock at price ***a,*** and you sell it in the market at ***S_2*** and gain ***g.***

2.2.1 Real life example 1: Buying a call option

Since we do not know anything about the future, for simplicity we assume that today is 17th of July 2003. Further, we exclude all transaction costs from our examples.

Since 1st of July, the price of Ericsson (Appendix A) has increased from 8.35kr to a maximum of 9.75kr on 15th of July, and then decreased to 8.75kr today 17th of July. I am an individual who believes that this fall in Ericsson is temporary and that eventually Ericsson will increase. Therefore I read Dagens Industry and find out that one call option with strike 10kr and maturity 3rd of November costs 1.45kr. I call my bank and order 10 contracts. That is 1,450kr ($10 \times 100 \times 1.45$kr). From Table 2.1, we have break-even = call strike price + call premium, which is 10 + 1.45 = 11.45. So when Ericsson is above 11.45, I have made a profit.

Time passing by and eventually on 28th of July, Ericsson is valued at 11.50. At this point I can choose between three follow up strategies:

1. Either I can construct one bullish call spread, which means that I keep my bought call option while I sell one call option at higher strike price. This follow up strategy will be conducted in **REAL LIFE EXAMPLE 2.**

2. The second follow up strategy which can be used in this case is to sell my option, secure the profit and buy another option at higher strike and if wanted with different maturity. If this strategy where to be chosen, I would gain 50kr [$1000 \times (11.50\text{kr} - 11.45\text{kr})$]. Then I have to buy another option at higher strike price. I examine option prices in Dagens Industry date 28th of July and find out that one call option with strike 12kr and maturity 3rd of November costs 1kr. That means a total cost of 1,000kr ($10 \times 100 \times 1$kr). This is not an attractive approach since I end up with – 950kr (50kr – 1,000kr). But at the same time I have decreased my initial investment from 1,450kr to 950kr, and since the risk (maximum loss) associated with bought call option is initial investment, I have with other words decreased my risk (loss).

3. The third and simplest follow up is to simply sell the option and realise the profit. There exists a risk in this matter, in case of further increase in value of underlying asset. Since the second follow up strategy was not suitable for my individual requirements, I can simply sell the option in the market and gain 50kr. This follow up can be conducted if I am an individual who will be satisfied with 50kr. 50kr is not much but at the same time this value is almost 3.5% (50kr ÷ 1450kr) gain in 11days which is much better then interest earned in a risk free market. But any way, I choose to keep my options since I expect further increases.

On 31st of July Ericsson is valued at 11.80 and if I sell the options now my profit has risen to 350kr [1000 × (11.80kr – 11.45kr)]. If I use follow up strategy (2) in this case I gain my 350kr for option sold minus 1,100kr (10 × 100 × 1.10kr) paid for another option with strike 12kr and maturity 3rd of November (all values taken from Dagens Industry 31st August). So I end up with minus 750kr (350kr – 1,100kr) which is not a good choice for my requirements. If third follow up strategy is chosen I end up with 24% (350kr ÷ 1450kr) gain on 14 days and far above what I would gain if I saved the money in a bank. At this point I am satisfied with my 24% gain and I close my positions. If wanted I could continue with my follow ups in eternity. But I leave it to the reader to if wanted follow up with different choice.

Not always market behaves in a way that you expect. If Ericsson would decrease instead of rise what can we do to prevent losses?

One follow up which can be used in this case is to construct a short ratio call spread (described on page 5). You construct a short ratio call spread by keeping your bought option while at the same time you issue two call options with higher strike price.

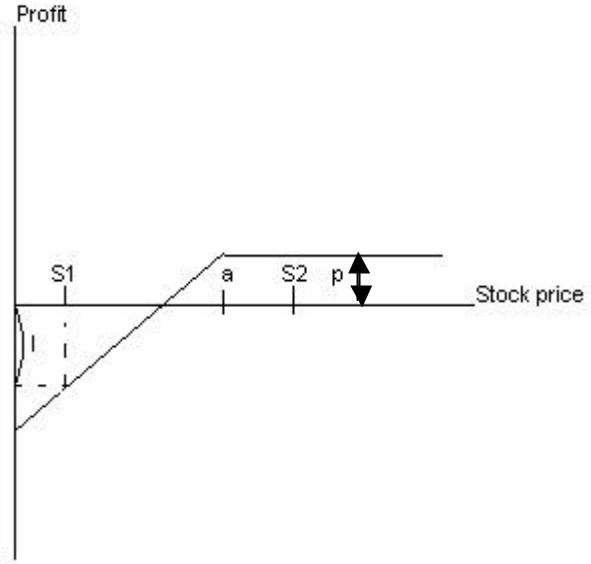
Table 2. 1

LONG CALL STRATEGY REVIEW	
Strategy:	Buy a call option
Market view:	Look for a bullish market where a rise above the breakeven is anticipated
Maximum loss:	Limited to the amount paid for the call
Maximum profit:	Unlimited to the upside beyond the breakeven
Break-even:	Call strike price + call premium
Follow up:	***At rise:*** (1) Construct one bullish call spread (described on page 6). (2) Sell option and buy another one with higher strike price. (3) Sell the option, realise profit but risk taken with continuous rise.
	At decline: Construct a short ratio call spread (described on page 5).

2.3 Selling a put (written put strategy)

This strategy should be employed when an investor is sure price of the share will not fall but not certain whether it will rise or stay stable. When the seller does not own the shares in which the option is sold, this position is called naked. When the seller owns the share the position is termed covered. This strategy has the same payoff as writing a covered call (selling call + buying underlying).

Figure 2. 2:Selling a put option



Review of payoff diagram of written put option

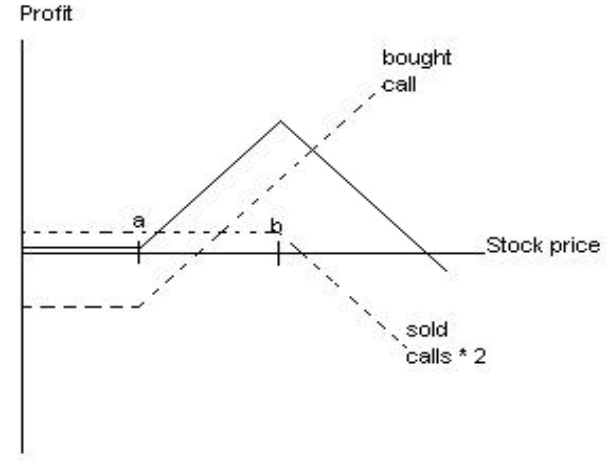
Get ***p*** for sold put option. If stock price at maturity is less then ***a,*** say S_1, the holder of the option will sell the option to you for ***a*** and gain ***l,*** which is your loss, since you could buy the option for S_1 in the market. If stock price at maturity is S_2 the holder will sell the option in the market instead, and you gain ***p.***

Table 2. 2

WRITTEN PUT STRATEGY REVIEW	
Strategy:	Sell a put option
Market view:	Look for a stable market with probability off bullish rise
Maximum loss:	Total value of underlying stock, i.e. very large loss if stock price falls sharply and if the company goes bankrupt
Maximum profit:	Premium
Break-even:	Strike – premium
Follow up:	***At rise:*** Construct a bullish put spread (described on page 6).
	At decline: Sell the option if payoff is still positive (see payoff diagram on Figure 2.2). Otherwise issue a call option.

2.4 Short ratio call spread

Figure 2. 3:Short ratio call spread



Explanation of short ratio call spread

This is a good strategy to use when a small upward movement in the share price is expected. This strategy is implemented by buying a call at ***a*** and selling 2 at ***b.*** Where $a < b$. If it turns out that the investor was wrong about the direction of the movement, losses are limited to the cost at which the position was established. If, however, the investor is right about the direction but wrong about the magnitude of the movement, losses are unlimited. This implies that an increase in the volatility of the underlying share have an adverse effect on the value of this position.

Table 2. 3

SHORT RATIO CALL SPREAD STRATEGY REVIEW	
Strategy:	Buy call at ***a*** and sell 2 calls at ***b,*** where ***a*** < ***b.***
Market view:	The share price will rise slightly
Maximum loss:	Unlimited
Maximum profit:	(***b – a***) + or – Initial cash flow
Break-even:	***Lower:*** If any**,** breakeven exists = ***a*** **+** Initial cash flow
	Higher: 2 × (***b – a)*** **+** Initial cash flow.
Follow up:	***At rise:*** Buy call at higher strike
	At decline: Sell the call option you own or sell and buy back one of the written calls if possible.

2.5 Bull spreads (bullish call/put spread)

Bull spreads can be created buy buying a call/put option on a stock with a certain strike price and selling a call/put option on the same stock with a higher strike price. Both options have the same expiration date.

Figure 2. 4:Bullish call spread

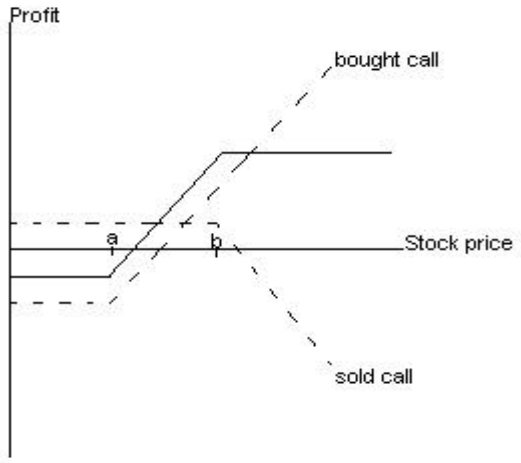
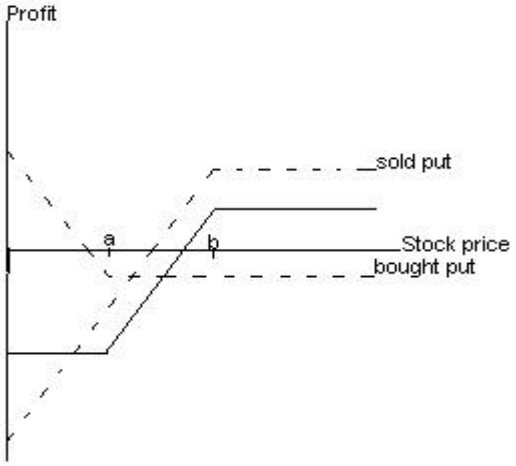


Figure 2. 3:Bullish put spread



The profits from the two option positions taken separately are shown by the dashed line. The profit from the whole strategy is indicated by the solid line. Because a call price always decreases as the strike price increases, the value of the option sold is always less than the value of the often bought. While a put option bought with lower strike price then the put option sold, requires lower initial payment then initial premium received. Therefore, a bull spread, when created from calls, requires an initial investment.

2.5.1 Real life example 2: Bullish call spread

This example is a continuation of **REAL LIFE EXAMPLE 1.**

We begin where we ended in previous example at follow up strategy (1). A reminder: we had 10 option contracts which we paid 1,450kr for with strike 10kr and maturity The 3rd of November. Today it is 28th of July and Ericsson is valued at 11.50kr. Our break-even is 11.45kr. So we have 50kr gain. Now we choose to conduct follow up strategy (1) and

construct a bullish call spread. We do this buy keeping our option but issue one for higher strike price and same maturity. We realize 1,000kr (10 × 100 × 1kr) buy selling 10 call option contracts with same maturity as our bought call option contracts but with an exercise price of 12kr (all values from Dagens Industry 28th of July).

We can gain a maximum profit when share price is 12kr or higher (see Figure 2.3). We follow the market carefully and finally on 18th of August; Ericsson reaches a value of 12.20kr (see Appendix A). At this point we can (1) choose to realise the profit or (2) realise the profit and constructing another bullish call spread with higher strike prices and if wanted with different maturity.

If we choose to realize the profit we sell our options and gain a maximum profit 1,550kr [(12kr – (10kr + 0.45kr)) × 1,000], (see Table 2.4). This is a 344% [1,550kr ÷ (1,450 – 1,000)] return on our initial investment. By constructing a bullish call spread from our previous bought call option we decreased the risk associated with our previous strategy. In the bought call case we began with 1,450kr initial investment and in this case we began with 450kr initial investment. With other words since initial investment in both cases are associated with maximum loss we decreased our maximum loss from 1,450kr to 450kr.

Our second option is to realize the profit and constructing another bullish call spread. This is simply the same as take our 1,550kr and buy a call option with strike ***a*** and sell one with strike ***b*** (see Figure 2.4). By doing so, we have reduced our initial investment further with 1,550kr and probably we end up with positive cash flow from start.

At this point I am more than satisfied with my 344% return on initial investment, but once again it is up to the reader to continue where I stopped.

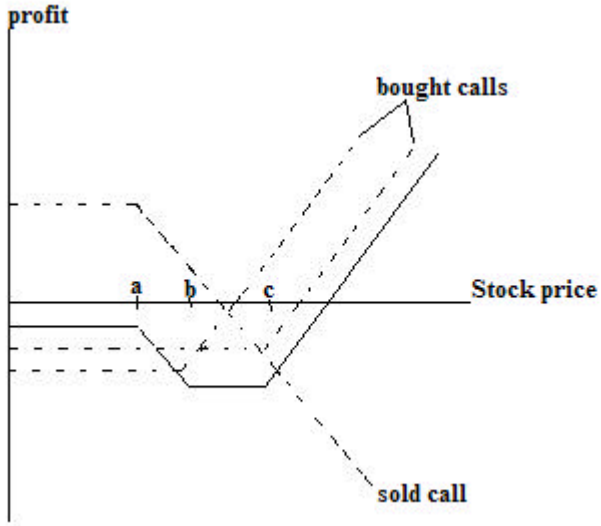
As mentioned before not all markets behave in the manner that we expected. If we were to begin with a bullish call spread and value of underlying suddenly goes down we can protect our self by selling more call option. This is the same as short ratio call spread (described on page 5). By doing so we lower our initial investment or even end up with positive initial cash flow. This situation is illustrated in Figure 2.3.

Table 2. 4

BULLISH CALL/PUT SPREAD STRATEGY REVIEW		
Strategy:	Buy call/put at ***a*** and sell call/put at ***b*** where ***a*** < ***b***	
Market opportunity:	Look for a market where the share price is more likely to rise then fall	
Maximum loss:	***Call:*** initial cash flow	
	Put: (***b*** – ***a***) + Initial cash flow	
Maximum profit:	***Call:*** ***b*** – (***a*** + initial cash flow)	
	Put: initial cash flow	
Break-even:	***Call:*** ***a*** + initial cash flow	
	Put: ***b*** – initial cash flow	
Follow up:	***At rise:*** Realise the profit and form another spread with higher strike prices.	
	At decline: In case of bullish call spread; sell more call options and form a short ratio call spread (described on page 6). In case of bullish put spread Issue put options for compensating for the initial investment.	

2.6 Bullish call ladder

Figure 2. 5:Bullish call ladder



Explanation of bullish call ladder

A more complicated type of spread that can be used when the share price is expected to rise significantly is the bullish call ladder. This strategy involves selling one call and buying two calls at higher exercise prices. It can be seen as an alternative to buying a call as both strategies are implemented in the anticipation of a rally in the underlying share. Important to note, however, is that the maximum loss from the bullish call ladder, which occurs if the share price is between ***b*** and ***c*,** is higher than in the bought call case. As a reward for taking this extra risk, the investor will usually invest less.

Table 2. 5

BULLISH CALL LADDER STRATEGY REVIEW	
Strategy:	Sell call at ***a,*** buy call at ***b*** and buy call at ***c*** where ***a*** < ***b*** < ***c.***
Market view:	The share price will rise significantly
Maximum loss:	(***b*** **–** ***a***) – Initial cash flow
Maximum profit:	Unlimited
Break-even:	***Lower:*** Break-even = ***a*** + Initial cash flow
	Higher: Break-even = ***b*** **–** ***a*** + ***c*** **–** Initial cash flow
Follow up:	***At rise:*** Issue for higher strike price and buy back the issued one if possible
	At decline: Write call options at higher strike price and put options at lower one

3. BEARISH MARKET

3.1 Overview

When dealing with different option strategies one must have a proper and realistic market forecast. The market forecast can be made up by past experience or historical data on different assets. In this part of option strategies we will deal with appropriate strategies when the investor has a bearish view of the market of some particular underlying. A bearish view of the market is the prediction that it will fall.

We will concentrate on two strategies for falling markets, starting with an investor who is quite sure the market will fall, but uncertain how much and therefore constructs an option strategy called bear spread that has limited losses but also limited profits. Finally we will explain a second strategy called negative three-legged option strategy. Investors believing a strong fall in the market apply this strategy but at the same time hedging themselves against rises of the underlying.

It is very important to pin out that forecast are just guesses about future movements in derivates. Of course no one can be sure of the future, so we will lay stress on appropriate follow up actions. The follow up actions will be discussed in different scenarios, depending on the movements of the market. It is of great importance that the investor doesn't stand with his hand tied when dealing with options strategies, no matter the result at the end of the period.

3.2 Bear spread

Bear spread is a strategy used by investors who are bearish on an asset, yet want limited risk. This limited risk is reflected in the limited boundaries for max losses and max profits.

You can construct a bear spread with either put or call options. A bear put spread is constructed by buying a put and selling a call with the same underlying and same maturity but with different strike prices. If X_1 is the strike of the short position and X_2 is the investors long position, then $X_1 < X_2$. This means initial cash outflow for the investor.

Table 3.1 shows the payoff diagram with put options.

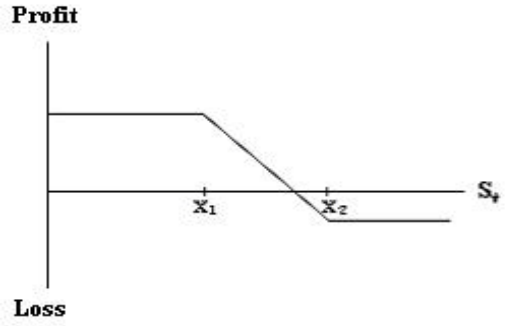
Table 3. 1

	Short position	Long position	Total payoff
$S_t \le X_1$	$S_t - X_1$	$X_2 - S_t$	$-(X_1 - X_2)$
$X_1 \le S_t \le X_2$	0	$X_2 - S_t$	$(X_2 - S_t)$
$S_t \ge X_2$	0	0	0

Max loss: Initial cash outflow
Max profit: $X_2 - X_1$ – cash outflow
Break-even: X_2 – cash outflow

Figure 3.1 shows the payoff graphs for bear put spread.

Figure 3. 1



A bear call spread is constructed by buying a call and selling a call with the same underlying and same maturity but with different strike prices. If X_1 is the strike of the investors short position and X_2 it the strike of the long position, then $X_1 < X_2$, meaning an initial cash inflow for the investor.

Table 3.2 shows the payoff diagram with call options.

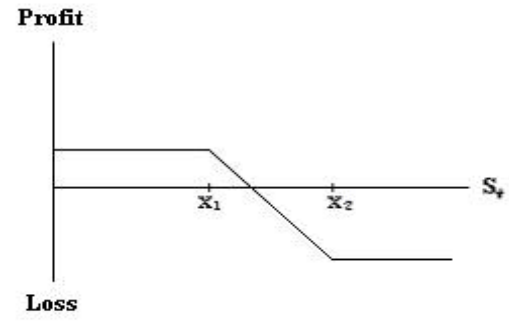
Table 3. 2

	Short position	Long position	Total payoff
$S_t \le X_1$	0	0	0
$X_1 \le S_t \le X_2$	$X_1 - S_t$	0	$-(S_t - X_1)$
$S_t \ge X_2$	$X_1 - S_t$	$S_t - X_2$	$-(X_2 - X_1)$

Max loss: $X_2 - X_1 -$ cash inflow
Max profit: Initial cash outflow
Break-even: $X_2 -$ cash outflow

Figure 3.2 shows the payoff graph for bear call spread.

Figure 3. 2



The most important thing about option strategies is the investors follow up actions. I will explain the follow up actions by examples; this makes things easier to follow. All examples from now on have been constructed by using the Black and Scholes formula with the following parameters:

r = 0.05; s^2 = 0.4 ; T = 1 year ; Time step = 0.1 ; Drift = 0.1. Unless anything else told, this is the parameters that will be used. The only thing that will be changed is the strike prices and these priced will be mentioned for every example.

Consider an investor feeling that the market has risen a bit too much and guessing that the market will have a drop in the coming months. He feels that the stock ABC will drop but will not take the risk by having only a long put position in ABC. So he decides to buy a bear put spread, which means lower cash out flow than the naked put position but also a limited profit. The investor buys one put with strike price 110 and at the same time he writes a put on the same underlying with a strike price of 90. The corresponding premium and cost for the options is calculated by the Black and Scholes formula and shown in Table 3.3.

Table 3. 3

Time	Asset	Put(90)	Put(110)
0	100.00	8.60	18.64

The payoff graph for the bear put strategy of Table 3.3 is shown in Figure 3.3 below.

Figure 3. 3

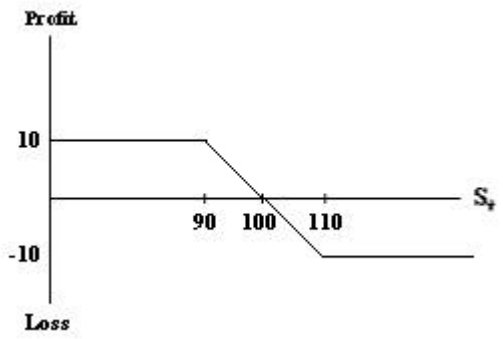
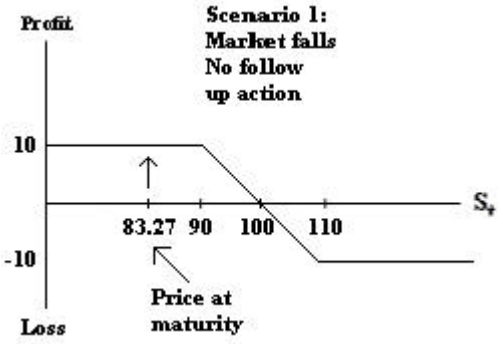


Figure 3. 4



3.2.1 Scenario 1 – market fall

Consider the development of the market as in Figure 3.4 above. The development of the stock is shown in Table 3.4.

Table 3. 4

Time	Asset	Put(90)	Put(110)
0	100.00	8.60	18.64
0.1	89.24	11.65	23.92
0.2	82.83	13.93	27.75
0.3	72.43	19.34	35.61
0.4	87.29	10.77	24.08
0.5	89.31	9.21	22.27
0.6	78.94	13.84	30.10
0.7	73.58	17.02	35.09
0.8	83.01	9.66	26.37
0.9	88.39	5.09	21.30
1	83.27	6.73	26.73

Let us assume that this investor is idle and has little experience of dealing with options. He thinks that because his strategy is in the money, he can relax and wait until maturity and then realize his gain of 9.96 dollars as shown in Table 3.5.

Table 3. 5

S_T	Put 90	Put(110)	Total profit
83.27	1.87	8.09	9.96

A better way to act, as investor in the situation of Table 3.4, is to have a good follow up action. One good action is to obtain a new short put position at a lower strike price. This should be done when the investor's spread is in the money. From Table 3.4 he can for example act at time 0.1. At this time the underlying stock is priced at 89.24 and the premium of a put has increased to 11.65 dollars. To change his short position he must first sell of his initial position, this will cost him 8.6 – 11.65 = –3.05 dollars. After this he wants a new short put position with a lower strike price than before. Table 3.6 shows the premium received of a put with strike price of 80 at time 0.1.

Table 3. 6

Time	Asset	Put(80)
0.1	89.24	7.09

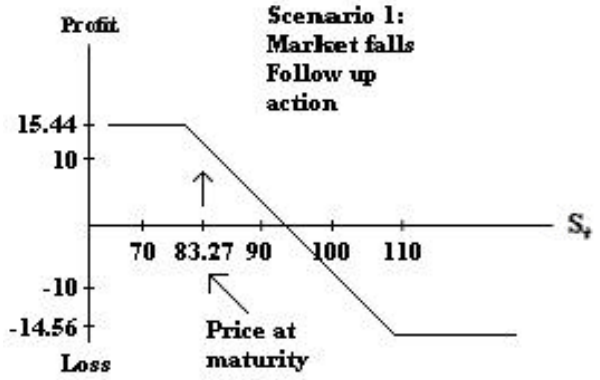
At maturity this investor will have the following profit of his bear put spread:

Table 3. 7

S_T	Put(80)	Put(110)	Loss of revised put position at time 0.1	Total profit
83.27	7.09	8.09	-3.05	12.13

Comparing Table 3.7 and Table 3.5 we can draw the conclusion that an investor who acts with appropriate follow up actions can earn more money on the spread than an investor standing with his hands tied and watching the result of his spread. The corresponding profit graph is showed in Figure 3.5. One can see that the break-even point has moved to a lower price than in Figure 3.4, this is due to the action done by the investor at time 0.1.

Figure 3. 5



3.2.2 Scenario 2 – market rise

Consider a rise in the market as in the Table 3.8.

Table 3. 8

Time	Asset	Put(90)	Put(110)	Bear spread
0	100.00	8.60	18.64	10.04
0,1	96.09	9.25	20.10	10.85
0,2	99.49	7.68	17.87	10.19
0,3	107.81	5.04	13.44	8.39
0,4	129.60	1.57	5.85	4.28
0,5	130.24	1.11	4.87	3.75
0,6	134.06	0.56	3.26	2.70
0,7	112.74	1.51	7.61	6.10
0,8	113.07	0.76	6.00	5.24
0,9	110.22	0.26	5.16	4.90
1	122.13	0.00	0.00	0.00

If the market ends up this way the investor must make good follow up actions to moderate his loss. Actions the investor can undertake are to form a ratio spread or create latter's. First I will show how the result of the investors spread will be if he doesn't apply any follow up action before the maturity. I assume the price of the asset moves like the data in Table 3.8, so the price of the underlying asset is priced at 122.13 at maturity. In Figure 3.6 one can see that at this price at maturity the investor will have a loss of 9.96 dollars. Consider an investor standing at time 0.3 and feeling that the rise in the market must be compensated by some follow up action. The investor has several opportunities at this stage depending on his believe of the market the next months. One good action is to write put options and create a ratio spread that is applied by investors depicting the market will fall, but only moderate. Say that the investor writes two more put options with corresponding strike price of 105 dollars. Table 3.9 shows the premium collected by this action.

Table 3. 9

Time	Asset	Put(105)
0.3	107.81	10.92

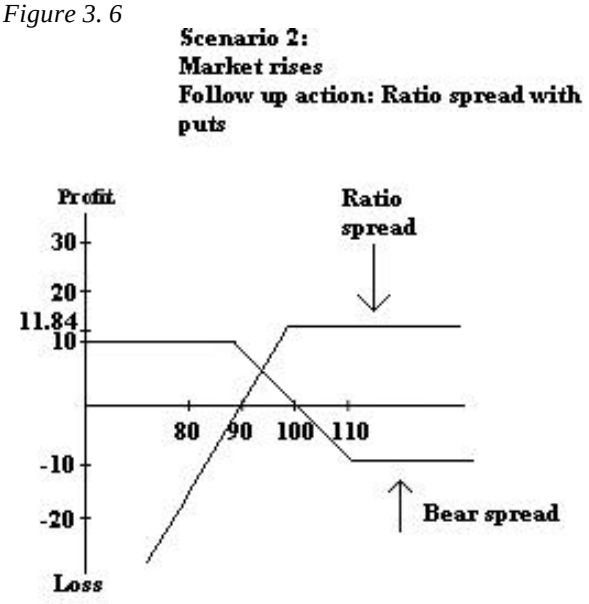
At time 0.3 the investor writes two more put options with a strike price of 105. This means a premium of 10.92 for each option. At maturity, if the underlying asset follows Table 3.8, the investor will have the following profit:

Table 3. 10

S_T	Short Put(90)	Short 2 x Put(105)	Long Put(110)	Total profit
122.13	8.6	21.84	-18.6	11.84

The result of this follow up action is actually a profit! This might seem strange when the market has risen; a scenario the investor definitely didn't think would happen. But because of a good follow up action applied by the investor (and a little bit luck!) he had turned the loss into profit. It is worth mentioning that it is not risk less to construct a ratio spread as follow up action. Consider a drop in the underlying after time 0.1 to maturity. Figure 3.6 shows the graph of the new ratio spread constructed as a follow up action by the investor.

Figure 3. 6



3.3 Negative three leg

This strategy is used by investors believing the market will drop heavily, but also wants a good secure if the market rises. The strategy gives an unlimited profit but limited loss; limited loss is calculated by taking the difference between the exercise prices on the call options plus an initial premium or a initial cash outflow. The strategy is constructed by writing call options with a lower strike price, buying call options with a higher price and using the cash to buy put options.
After a period of rises in the market, the investor believes that it is time for a drop in the market. ABC share has risen to 100 dollars and the investor believes that the share will drop heavily in the future. The investor decides to use a negative three leg as his option strategy and motivates this by the fact that it is cheaper to buy than a naked call position and also, as we will see in this example, if the market goes up the investor will lose less money on this strategy than if he goes naked in a long position in calls (for this data).

He constructs his negative three leg by writing a call with strike price 90, buying a call with strike 100 and uses the leftover cash to buy two put options with strike price of 80. To see the appropriate option prices he uses the Black and Scholes formula seen in Table 3.11.

Table 3. 11

Time	Asset	Call(90)	Call(100)	Put(80)
0	100.00	22.98	18.02	5.07

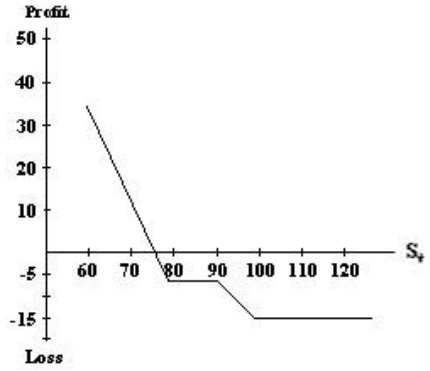
If the investor applies the three leg strategy, he will obtain profits written in Table 3.12.

Table 3. 12

Underlying	Call(90)	Call(100)	2 Put (80)	Total profit
50	23.98	-18.02	49.86	55.82
60	23.98	-18.02	29.86	35.82
70	23.98	-18.02	9.86	15.82
80	23.98	-18.02	-10.14	-4.18
90	23.98	-18.02	-10.14	-4.18
100	12.98	-18.02	-10.14	-15.18
110	2.98	-8.02	-10.14	-15.18
120	-7.02	1.98	-10.14	-15.18
130	-17.02	11.98	-10.14	-15.18

The negative three leg graph looks like below.

Figure 3. 7



3.3.1 Scenario 1 – market fall

Consider the development of the stock market for ABC share predicted in Table 3.13.

Table 3. 13

Time	Asset	Call(90)	Call(100)	Put(80)
0.00	100.00	22.98	18.02	5.07
0.10	103.73	24.79	19.40	4.00
0.20	85.27	11.60	8.17	7.78
0.30	82.59	9.23	6.18	8.16
0.40	62.80	1.67	0.87	17.99
0.50	67.91	2.15	1.09	14.22
0.60	54.19	0.18	0.06	24.75
0.70	70.93	1.39	0.54	11.21
0.80	77.71	1.90	0.63	6.37
0.90	70.14	0.10	0.01	10.25
1.00	63.00	0.00	0.00	17.00

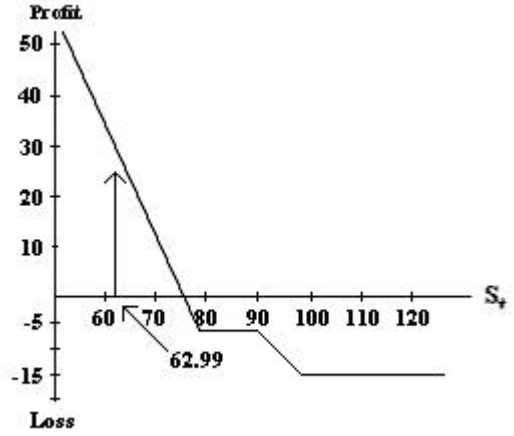
Table 3.13 show asset priced and corresponding option priced of the ABC share from time 0 to maturity. We can see that in this case the market has been bearish, just the way the investor predicted at time 0. If the investor is satisfied with this situation and doesn't act, then the investor will have the following profit at maturity:

Table 3. 14

S_T	Call (90)	Call(100)	2 * Put(80)	Total profit
62.99	22.98	–18.02	23.88	28.84

Profit graph will then look like in Figure 3.8:

Figure 3. 8



When the market falls there is a couple of actions the investor can apply. I will explain one action the investor can apply at time 0.6 when the stock is worth 54.19 dollars. One opportunity the investor has is to write a put option with a strike lower than the present underlying value. The investor then receives a premium and can use this premium to close the initial cash outflow of the strategy. Suppose the investor writes a put option at time 0.6 at a strike price of 60 dollars, Table 3.15 shows the put premium received.

Table 3. 15

Time	Asset	Put(60)
0.6	54.19	8.29

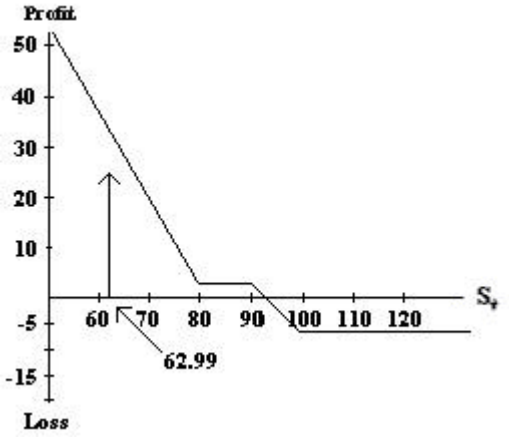
The investor receives a premium of 8.29 dollars when writing the put. If the stock prices follows Table 3.13 then the investor receives a profit of:

Table 3. 16

S_T	Call(90)	Call(100)	Put(60)	2*Put(80)	Total profit
62.99	22.98	-18.02	8.29	23.88	37.13

The graph of this follow up action is shown in Figure 3.9:

Figure 3. 9



Comparing Table 3.14 and Table 3.16 we see that the investor has earned even more profits with this follow up action. But remember even though this action can generate additional profits, this is not always the case. One can easily see that if the underlying at maturity had been below 51.71, then the investor had lost money on this follow up action. So this particular action means taking higher risks.

3.3.2 Scenario 2 – market rise

Another scenario is when the stock market acts in a different way than the investor predicted. Let us assume the asset moves like Table 3.17 through the life of the strategy.

Table 3. 17

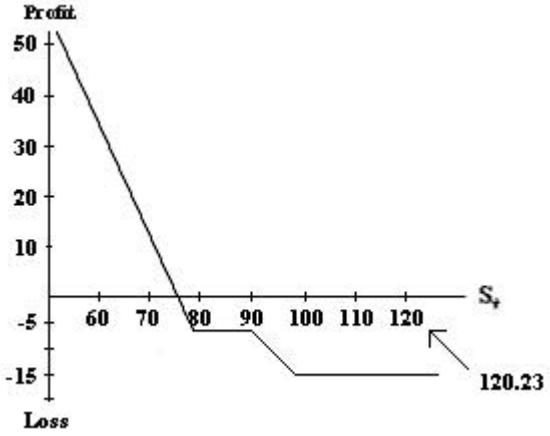
Time	Asset	Call(90)	Call(100)	Put(80)
0	100.00	22.98	18.02	5.07
0.1	106.46	26.88	21.23	3.58
0.2	109.81	28.55	22.48	2.73
0.3	117.64	34.08	27.15	1.58
0.4	125.51	40.09	32.34	0.79
0.5	124.63	38.37	30.41	0.56
0.6	115.30	28.97	21.49	0.66
0.7	106.68	20.38	13.62	0.76
0.8	118.38	29.71	20.99	0.07
0.9	106.20	17.15	9.20	0.05
1	120.24	30.24	20.24	0.00

What should the investor do? Well, as any other option strategy he must act as soon as possible if he wants to reduce his loss or even generate some profit. Before I explain an appropriate follow up action I will show what the result will be in this specific case if the investor had stood with his hands in his pockets. His corresponding loss will then be as Table 3.18 shows.

Table 3. 18

S_T	Call(90)	Call(100)	2 * Put(80)	Total loss
120.24	-7.26	2.22	-10.14	-15.18

Figure 3. 10



One follow up action for the investor to apply is the following: At time 0.2 sell his call 100 option. From Table 3.17 we see that this will generate a cash inflow of 22.49 – 18.02 = 4.46 dollars (1). Next step is to obtain a new short call position at a higher exercise price. From Table 3.17 we see that the premium of the call 90 has increased to 28.55 dollars due to the higher underlying value at time 0.2 and because of this rise we get a cash outflow of: 22.98 – 28.55 = –5.57 dollars (2). Last step is to write a new call option at this time 0.2 of a higher strike price. The investor decides to write a call 115 and receives a premium of 15.3 (Table 3.18).

Table 3. 19

Time	Asset	Call(115)
0.2	109.81	15.30

At maturity the investor then has the following result of his strategy:

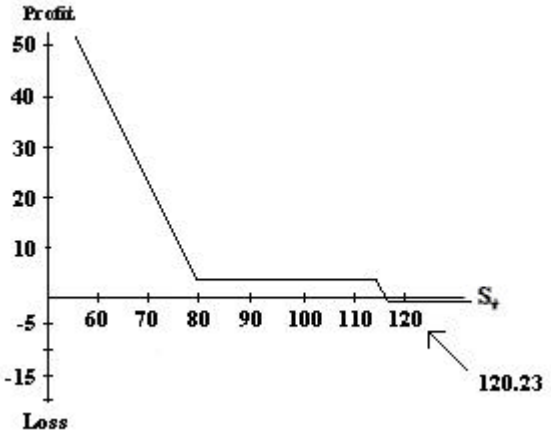
Table 3. 20

S_T	Call(115)	2 * Put(80)	(2) + (1)	Total loss
120.24	10.06	-10.14	-1.11	-1.19

Corresponding graph is constructed below as Figure 3.11

If we compare Table 3.18 and Table 3.19 we make the conclusion that the follow up action has saved the investor from doing a big loss and actually almost put the strategy on the right side of the profit/loss margin.

Figure 3. 11



Summary of follow up actions for a negative three leg strategy:

Market falls

- Write a put option with a low strike price and receive premium. Be careful when setting strike price!

Market rise

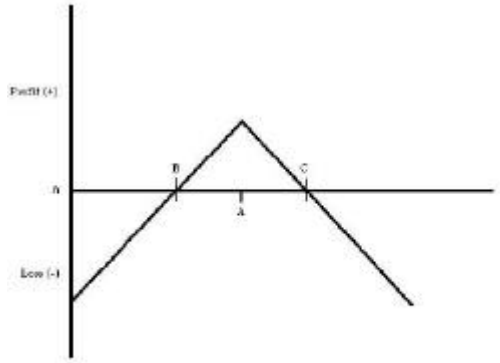
- Sell your call option and obtain a new short call position with higher strike price.

4. NEUTRAL MARKET

4.1 Short Straddle

This position has unlimited risk and limited profit potential, and is therefore only appropriate for the experienced investor with a high tolerance for risk. The short straddle will profit from limited stock movement and will suffer losses if the underlying stock moves substantially in either direction. Both long and short straddles may require higher commissions since they involve buying or selling multiple positions. This strategy will require higher commissions than single series strategies since it involves twice the number of contracts as buying or selling a single series and has a much greater probability of requiring a closing transaction prior to expiration. The investors should use this strategy when they don't expect much short-term volatility, then; the short straddle can be a risky, but profitable strategy. The construction of a short straddle is shown below:

Figure 4. 1: Short Straddle



4.1.1 Basic facts about Short Straddle

It's perfect for a market with small volatility. The construction is done by writing one put option and writing one call option with the same strike price and with the same maturity. Break-even is achieved through the point B, strike price – the premium received and point C, strike price + the premium received. Maximum profit is limited to the received premium if the stock's spot price at maturity is equal to the strike price or option's strike price – stock spot price + total premium received. The potential loss is unlimited if the market goes up or down heavily. Security issues are always required.

4.1.2 Follow-up strategies

Upswing-market (without any possession of the underlying)

- Buy forwards if the stock is rising to the level of break-even upwards
- Buy call options with a lower strike price as a cover

Downswing-market (without any possession of the underlying)

- When the stock is falling to the level of break-even downwards, sell forwards.
- Buy put options with a lower strike price as a cover

Neutral-situation (without any possession of the underlying)

- One will profit, if one can buy call and put options with the same strike price in the next maturity month
- One will profit if the stock is not moving up or down, so that you could buy the call option with a higher strike price and buy the put option with a lower strike price and still, the net revenue will be higher than the differences in the strike prices of the two different options

Profit-situation (with the possession of the underlying)

- Buy as many call options as the underlying, with the same strike price in the next maturity month
- Buy as many call options as the underlying, but with a higher strike price

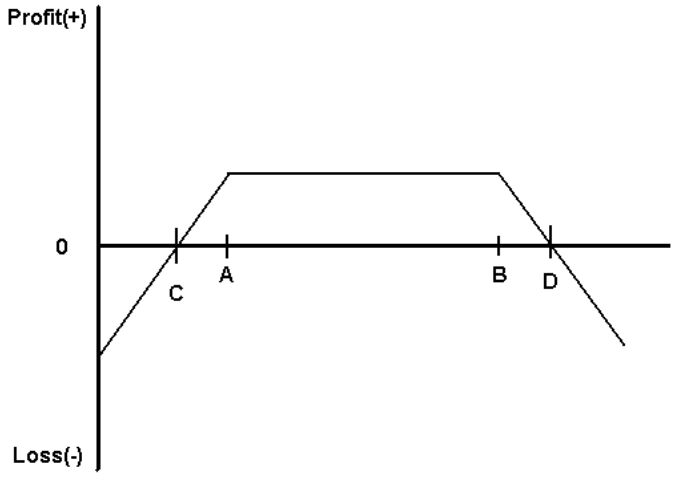
Loss-situation (with the possession of the underlying)

- Downswing-market: Move the written call options to a lower strike price.
- Downswing-market: Use previously acquired revenues to buy new put options.
- Upswing-market: Buy more forwards or stocks.
- Upswing-market: Buy call option with a higher strike price.

4.2 Short Strangle

The short strangle strategy have similar characteristics as the short strangle above, but here is the big difference that the investor believes in a market condition with a relatively small volatility, i.e. small price changes in wider perspective. Still, this position has unlimited risk and limited profit potential, and is therefore only appropriate for the experienced investor with a high tolerance for risk, as well. Since this also involves twice the number of contracts as buying or selling a single series, higher commissions will be required. A figure of the short strangle is shown below:

Figure 4. 2: Short strangle



4.2.1 Basic facts about Short Strangle

This is ideal for a market with relatively small volatility, so that one could profit in a wider price perspective. It is constructed by writing a put option with the strike price A and writing a call option with the strike price B. Break-even occurs at point C (lower strike price – entire premium received) and at point D (higher strike price + entire premium received). Maximum profit is limited to the entire premium received on the both options. Potential loss occurs if the market fluctuates up or down very much. Security issues are also required on this one.

4.2.2 Follow-up-strategies

Upswing-market:

- If the stock is rising to the level of break-even upwards, buy forwards.
- As a cover in the up trend, buy call options with a lower strike price.

Downswing-market:

- If the stock is falling to the level of break-even downwards, sell the forward.
- As a cover in the downtrend, buy put options with a lower strike price.

Neutral-situation:

- One will profit, if one could buy call and put options at the same strike prices in the following maturity month.
- One will profit, if the observed stock is not moving up or down, by buying a call options with a higher strike price and buying put options with a lower strike price and still, the net revenue will be higher than the difference in the strike prices.

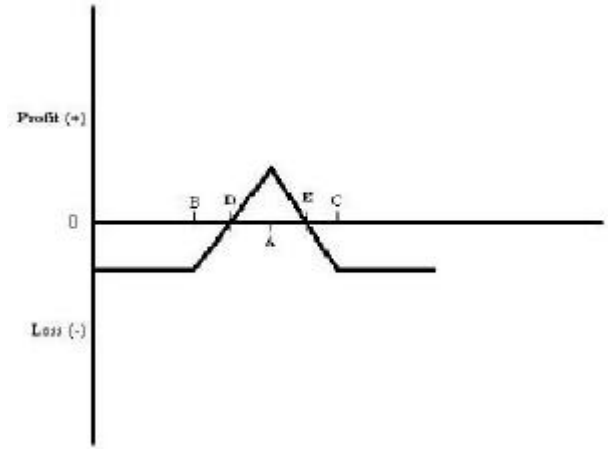
4.3 Long Butterfly

A butterfly is an option strategy in which one contract in each of two outside strikes are purchased and two contracts on the middle strike are sold. In general, buying a butterfly is a way of profiting from decreases in volatility while trying to limit the loss. Since by definition a butterfly must be contract-neutral, (the position is short the same number of contracts it is long) the maximum loss possible is the net amount paid for the butterfly. The construction of a butterfly diagram is shown below:

4.3.1 Basic facts about Long Butterfly

This market is traded with a small volatility, but offers at the same time the chance to reduce the risk of loss. To construct this one, you need to buy a call option with a low strike price B, write two call options with a medium high strike price A and buy a call option with a high strike price C. Break-even points are D and E. Maximum profit is limited (the difference between the low and medium high strike price minus the entire premium received). Loss is limited to the initial cost, which represents the lower straight lines forming the butterfly. In this case, the demand for security issues could be cancelled out.

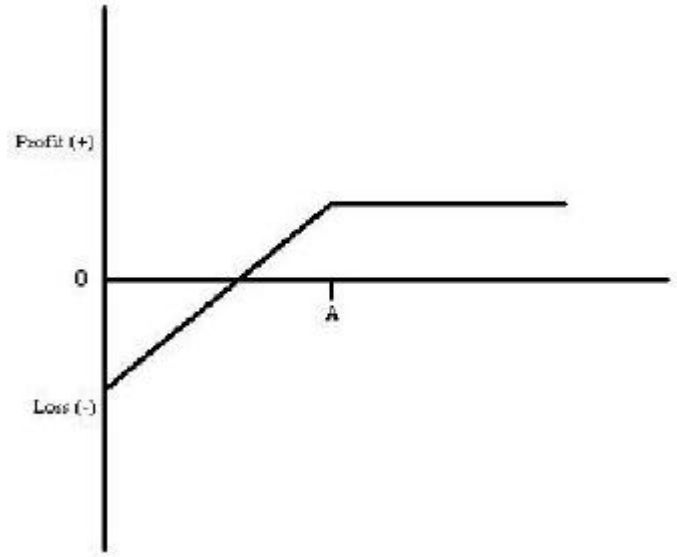
Figure 4. 3: Long butterfly



4.4 Covered Call

Covered call is one of the most popular strategies for investors that own stock. A call option is sold short against a long stock position. It is an excellent strategy for bullish traders who want a nice low risk, limited return strategy. However the subtle twist with this strategy is that it exactly the same strategy as selling naked puts. Investors should use this strategy, when they are mildly bullish or neutral towards a stock. The perfect result for this type of strategy is when the stock rises to the short call strike on expiration. The figure is shown below:

Figure 4. 4: Covered call



4.4.1 Basic facts about Covered Call

It's ideal if you believe that the stock market will go up or stay constant in the short run, assuming that you already own the underlying stock. To create this strategy, one must write as many call options with a strike price A as there are underlying in the portfolio. Break-even is the purchase-price of the covered share – the premium received for the short call option. Profit is limited, though to the fact that the investor is disclaiming any profits from a potential

bullish market, by writing call options. Therefore, the maximum profit is given by: strike price – stock spot price + premium received on the call options. Loss is limited because the stock can't go below zero. Also if the stock rises considerably, then the loss on the short call will be offset by the profit gained on the long stock. Security issues are always required.

4.4.2 Follow-up-strategies

Profit-situation:

- Buy more forwards or shares.
- Move the call option to a higher strike price.
- Move the call option, in the following maturity month, to a higher strike price.

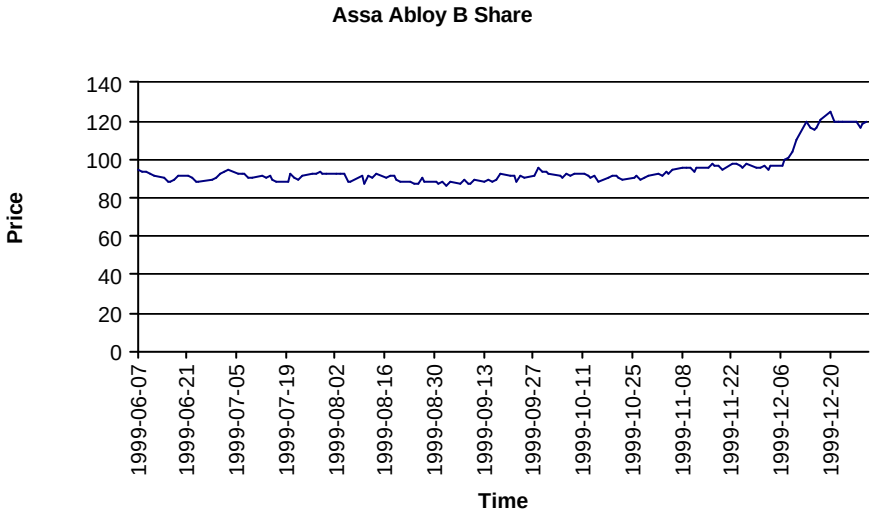
Loss-situation:

- Buy a put option by using the money incurred from the call option premium.
- You should move the call option to a lower strike price, since this will reduce the profit, but this strategy could potentially raise profit in a downtrend.
- Move the call option to a lower strike price in the following maturity month.

4.5 Example

Consider the following price movement's data of the Assa Abloy B share, from 7th of June, 1999 to 31st of December, 1999:

Figure 4. 5



We will consider two of the four different neutral market strategies, from where we will use one follow-up-strategy, respectively. More exactly, we will consider the follow-up-strategy "buying a call option with a lower strike price at an up trend"-scenario for the short strangle market, and will also consider "buying one more share"-scenario for the covered call market.

4.5.1 Short Strangle

From the price oscillations above, suppose that we stand at 27th of September, 1999 and we assume that the market will continue to be quite neutral for the next three months. We can then write one European put option and one European call option, with different strike prices. It will expire at 27th of December, 1999:

European Short Call Option:

S = 91.5 K = 100 $s = 0.25$ r = 0.04 $t = 3/12 = 0.25$

By using Black-Scholes formula, we have:

$$C_E = S \cdot N(d_1) - Ke^{-rt} \cdot N(d_2) \qquad d_2 = d_1 - s\sqrt{t}$$
$$d_1 = \frac{\ln(S/K) + (r + s^2/2)t}{s\sqrt{t}} \qquad N(x) = \int_{-\infty}^{x} e^{-\frac{s^2}{2}} \Big/ \sqrt{2p}\, ds$$

We get that:

$d_1 \approx -0.5681$ $N(d_1) \approx 0.2850$
$d_2 = -0.6931$ $N(d_2) \approx 0.2441$
$C_E \approx 1.9$ SEK

European Short Put Option:

S = 91.5 K = 80 $s = 0.25$ r = 0.04 $t = 3/12 = 0.25$

By using again the Black-Scholes formula, but this time for put option, we get:

$P_E = Ke^{-rt} \cdot N(-d_2) - S \cdot N(-d_1)$ $d_1 \approx 1.2170$? $N(-1.217) \approx 0.1118$
$d_2 \approx 1.092$? $N(-1.092) \approx 0.1374$
$P_E \approx 0.65$ SEK

In order to plot the payoff for this, we need some table data, as shown below. Put and call cells shows their values, respectively, with respect to the stock price data (a.k.a. spot price). Total is the sum of put and call values. Observe that the stock price data are just some arbitrary points. We then plot the data for 'Total' to get:

Table 4. 1

Spot price	Short Put	Short Call	Total
60	-19.35	1.9	-17.45
65	-14.35	1.9	-12.45
70	-9.35	1.9	-7.45
75	-4.35	1.9	-2.45
80	0.65	1.9	2.55
85	0.65	1.9	2.55
90	0.65	1.9	2.55
95	0.65	1.9	2.55
100	0.65	1.9	2.55
105	0.65	-3.1	-2.45
110	0.65	-8.1	-7.45
115	0.65	-13.1	-12.45
120	0.65	-18.1	-17.45

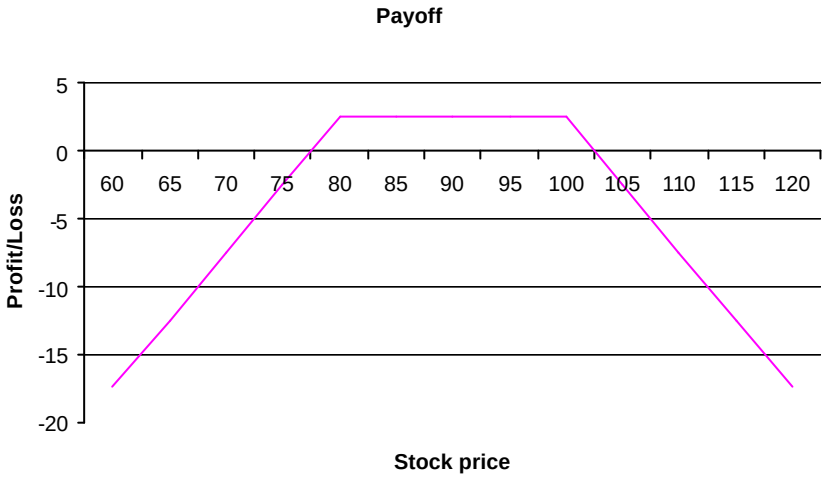
Lower break-even:

80 – 2.55 = 77.45 SEK

Upper break-even:

100 + 2.55 = 102.55 SEK

Figure 4. 6



According to the Assa Abloy B Share-diagram, the stock will cross the upper barrier of 100 SEK at date 6th of December, 1999 (not shown on in the figure), which is the value of the strike price of our short call option. This means that the value of our market portfolio will start to decrease, eventually. By using the follow-up-strategy "buying a call option with a lower strike price at an up trend", we can then reduce our loss due to the unexpected up trend. Suppose we buy one call option when S = 104 at 9th of December, 1999, i.e. 11 days before expiry. We calculate then the value of the long call option, with a lower strike price, say 85 SEK:

European Long Call Option:

$S = 104 \quad K = 85 \qquad s = 0.25 \qquad r = 0.04 \qquad t = 11/360$

$d_1 \approx 4.6662 \qquad N(d_1) \approx 1$

$d_2 \approx 4.6225 \qquad N(d_2) \approx 1$

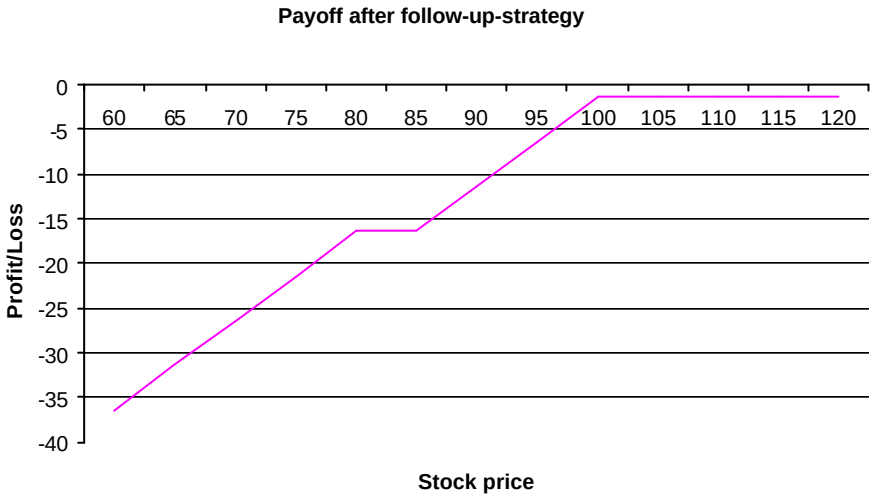
$C_E \approx 19\,\text{SEK}$

Like the table described above, we will have a similar here, but different labels. We then plot the data for 'Total' to get:

Table 4. 2

Spot price	Short Put	Short Call	Long Call	Total
60	-19.35	1.9	-19	-36.45
65	-14.35	1.9	-19	-31.45
70	-9.35	1.9	-19	-26.45
75	-4.35	1.9	-19	-21.45
80	0.65	1.9	-19	-16.45
85	0.65	1.9	-19	-16.45
90	0.65	1.9	-14	-11.45
95	0.65	1.9	-9	-6.45
100	0.65	1.9	-4	-1.45
105	0.65	-3.1	1	-1.45
110	0.65	-8.1	6	-1.45
115	0.65	-13.1	11	-1.45
120	0.65	-18.1	16	-1.45

Figure 4. 7



From the table data and from the modified payoff diagram, we can see that we have reduced our loss with the help of the follow-up-strategy. Our maximum loss is now -1.45 SEK in an up trend.

4.5.2 Covered Call

Our alternative neutral market strategy involves the follow-up-strategy, where you have to buy one additional share in a profit (or an up trend) situation. We will use similar data as the above, but now, we're only going to write one call option with the same K = 100 SEK at 27th of September, 1999 and whose value we already know: $C_E \approx 1.9$ SEK. On the same date, we also buy one share at S = 91.5 SEK. The following data table and payoff diagram show us the outcome:

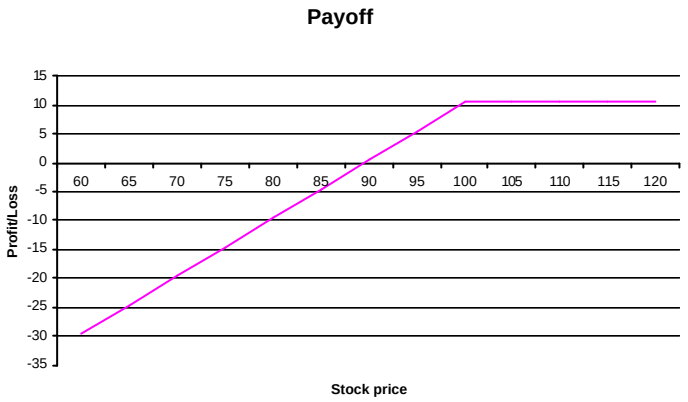
Table 4. 3

Spot price	Short Call	Long Share	Total
60	1.9	-31.5	-29.6
65	1.9	-26.5	-24.6
70	1.9	-21.5	-19.6
75	1.9	-16.5	-14.6
80	1.9	-11.5	-9.6
85	1.9	-6.5	-4.6
90	1.9	-1.5	0.4
95	1.9	3.5	5.4
100	1.9	8.5	10.4
105	-3.1	13.5	10.4
110	-8.1	18.5	10.4
115	-13.1	23.5	10.4
120	-18.1	28.5	10.4

Break-even:

91.5 – 1.9 = 89.6 SEK

Figure 4. 8

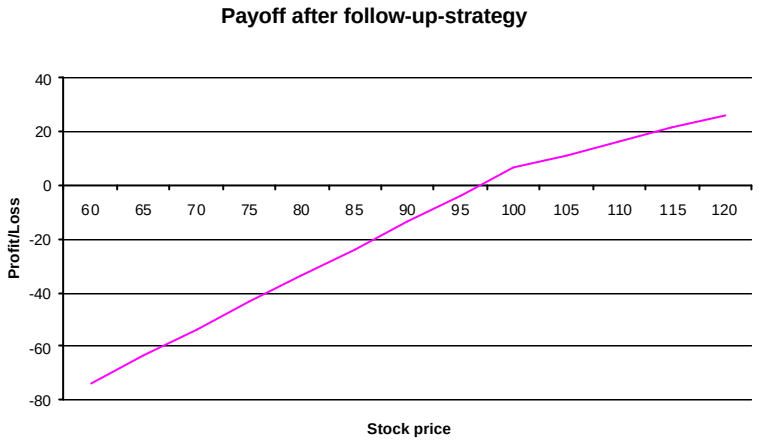


Since we know that on the date 6th of December, 1999, the stock will start to move heavily upwards. Therefore, on 9th of December, 1999, we will buy one additional share for 104 SEK, as required by our follow-up-strategy. The following revised data table and payoff diagram show us the new outcomes of the strategy:

Table 4. 4

Spot price	Short Call	Long Share	Additional share	Total
60	1.9	-31.5	-44	-73.6
65	1.9	-26.5	-39	-63.6
70	1.9	-21.5	-34	-53.6
75	1.9	-16.5	-29	-43.6
80	1.9	-11.5	-24	-33.6
85	1.9	-6.5	-19	-23.6
90	1.9	-1.5	-14	-13.6
95	1.9	3.5	-9	-3.6
100	1.9	8.5	-4	6.4
105	-3.1	13.5	1	11.4
110	-8.1	18.5	6	16.4
115	-13.1	23.5	11	21.4
120	-18.1	28.5	16	26.4

Figure 4. 9



After the modification, we can see now how we can profit from the strong rise in the stock.

5. VOLATILE MARKET

5.1 Overview

Before certain news of a company is to be announced, the market is full of expectations, insiders' information and maybe rumors. The investors may expect and act differently by selling or buying the stock of the company before the news. In such a situation, the market is uncertain. The stock price is expected to rise if the result is positive and meets public expectations or fall, otherwise. One thing to be sure is that the stock price will move sharply but the direction. Facing such an uncertain future, the investors may choose some combinations of options for catching profits. In this part of the paper, three strategies, long straddle, long strangle and short butterfly, will be introduced.

5.2 Long straddle

A long straddle is constructed by purchasing the same amount of call options and put options that have the same maturity times and strike prices. To explain the strategy well, a scenario is constructed. A diagram of long straddle is shown in Figure 5.1 based on such a scenario.

> Scenario:
> The stock of a company is currently selling at $100. The risk-free interest rate is 5%. For some reasons, the stock price is expected to be volatile in the coming future. As estimated, the drift of the stock price is zero, the volatility is 0.4 and the strike prices for both call and put options are set at $100. The maturity of both options is 1 year.

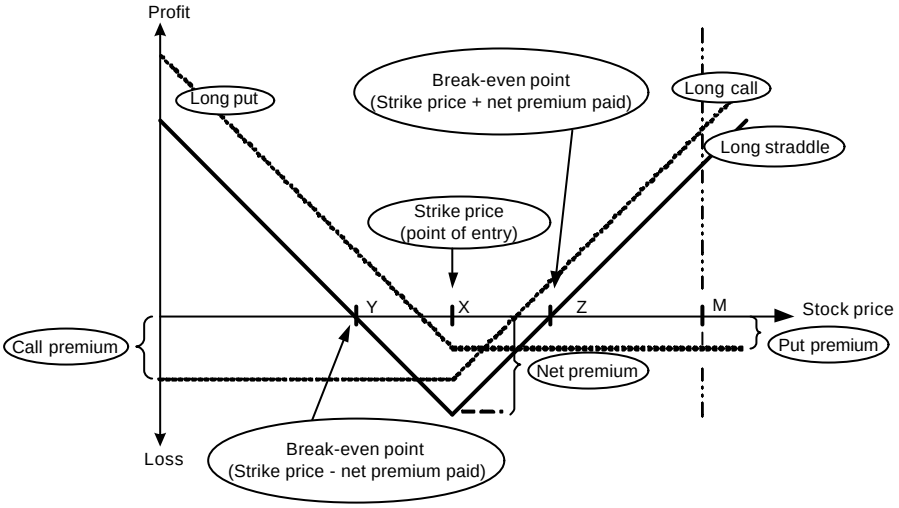
Table 5. 1: The value of long straddle

Time	Spot price ($s = 0.1$)	Call	Put	Long Straddle	Spot price ($s = 0.4$)	Call	Put	Long Straddle
0.0	100.00	6.80	1.93	8.73	100.00	18.02	13.15	31.17
0.1	90.26	1.47	6.81	8.28	102.98	18.92	11.53	30.45
0.2	94.18	2.53	4.43	6.96	113.25	24.97	7.79	32.76
0.3	93.82	1.99	4.73	6.73	120.13	29.11	5.53	34.64
0.4	97.88	3.45	2.61	6.06	125.66	32.46	3.85	36.30
0.5	99.13	3.65	2.05	5.69	151.49	54.84	0.88	55.72
0.6	93.56	0.81	5.28	6.09	151.02	53.55	0.55	54.10
0.7	96.62	1.32	3.21	4.53	166.04	67.61	0.08	67.69
0.8	96.42	0.75	3.33	4.08	182.82	83.82	0.00	83.82
0.9	95.37	0.13	4.26	4.39	204.35	104.85	0.00	104.85
1.0	97.29	0.00	2.71	2.71	151.49	51.49	0.00	51.49

In Table 5.1, as time to maturity, the prices of European call and put options at different time to the maturity of 1 year from now are calculated by using Black and Scholes formula and long straddle prices are summed by call and put option prices. A payoff diagram of long straddle is drawn in Figure 5.1 by the bold curve labeled 'Long straddle'. As the figure shown, the study of the strategy will be around point X, which is called 'the point of entry'. Around this point, if the stock price fluctuates in a narrow interval between point Y and Z, the buyers of the straddle will lose and the maximum loss can't exceed the net premium paid for the long straddle. So, the points Y and Z are the break-even points without more explanations here. The investors will profit from both side of long straddle. If the stock price goes down

left to point Y, the investors will profit at maximum Y or the strike price minus the net premium paid. But if the price goes up right to point Z, the investors will experience an unlimited profit as the price increasing further. As a conclusion, if the stock price moves enough to either direction, the investors will gain.

Figure 5. 1: The construction of long straddle



The idea of long straddle is simple. If the future uncertainty of a stock can be predicted, the long straddle strategy can be applied. When the stock price moves sharply to either direction before the straddle expired, the investors may profit. The most concerned factor of long straddle is time decay. It means that the value of long straddle decreases as the time approaching the maturity. As the figures for the volatility of 0.1 in Table 5.1 shows, the options prices of a low volatile stock decrease fast as time closing to the maturity since long straddle consists of two long options, the longer time the investors wait, the more they experience losing in the straddle position. The Greek Theta for the volatility of 0.1 is calculated in Table 5.2. The Theta for call, put and long straddle are –4.9187, –0.2674 and –5.1861, respectively. It means that as time closer to the maturity time by 0.1 years, the straddle price will be cheaper by \$0.5. The Delta of the long straddle is 0.6544 and Gamma is 0.0453. The long straddle is more time sensitive than stock price or volatility. It implies that if the stock price doesn't move enough to either direction as expected, the buyer will lose the position by holding the current long straddle as time approaching to maturity. Or the same thing happens if the stock price is standing around a certain point for a long time.

It is uncommon that the long straddle to be hold to the maturity. If the movements of stock price strongly enough and a satisfied profit can be caught, the long straddle will be closed before the maturity. For an instance, if the stock price rises above point Z before maturity, at time 0.5 years, at point M. According to the figures in Table 5.1 (volatility = 0.4), the long straddle purchased at time 0 has 0.5 year to maturity. The buyer of the long straddle can liquidate the straddle by selling the call option and gain \$36.82 = \$(54.84 – 18.02) from the right side. On the left side, the put option can be sold and a loss of –\$12.17 = \$(0.88 – 13.15). The net profit by closing the long straddle will be \$24.55. But if the buyer holds the long straddle to maturity and the stock price at the maturity is still at M, both options will be exercised. The net profit will be \$20.32 = \$(M – X – call premium) – put premium. The realized profit will be \$4.23 lower and it is just the difference of the long straddle in value as shown in Table 5.1. It is also an evident to show the effect of time decay. An alternative way

to close the long straddle position in the previous example is that, exercise the call option and gain $36.82 and keeps the put options since the value of the put option is only $0.88 and worthless. The concern is that since it is a volatility market and the direction is unknown, the buyers can hold the put option to wait the market reverse to break point X, then at the maturity or later time the buyer can gain more from the naked put.

Table 5. 2: The Greeks of long straddle

Delta		Theta		Gamma		Vega	
Call	**Put**	**Call**	**Put**	**Call**	**Put**	**Call**	**Put**
0.7088	-0.0544	-4.9187	-0.2674	0.0343	0.0110	34.2944	11.0282

After the long straddle is purchased, the stock price must move at least $(Z – X) upward or $(Y – X) downward. If the stock price won't move as expected or evident shows that the prediction of a future volatility market is wrong, follow-up action is necessary to protect buyer's position, before the time decay causes more loss on the position of long straddle. Let's assume that after the long straddle is purchased, the market is running between points X and Z and such a situation seems to last till the maturity of options. If the volatility won't be rise enough as expected, the buyer of straddle will lose. In such a case, the purchased long straddle should be closed. A follow-up in such a case is to sell the put option and write a call option at a higher strike price. To test it, we re-calculate Table 5.1 by comparing the strike price of $100 and $131 in the same market with the volatility of 0.4 and the result is shown in Table 5.3. We assume that at time 0.4, the spot stock price is N = $114.45, the buyer decides to close the long straddle by follow-up action. The put option will be sold at $6.1 which was purchased at $13.15, a loss of $7.05 will occur on the left side. Then a call option at a higher strike price of $131 should be written. By writing the call option, a cash inflow is $9.37. Take into account the first call option purchased, the net position is at – $15.7 = $(9.37 – 7.05 – 18.02). As shown in Figure 5.2, if the stock price is at point N at maturity, the net profit of the buyer will be –$1.25 = $(114.45 – 100) – $15.7 which is better than losing all the long straddle value of – $18.78 = $(12.39 – 31.71).

In summary, to implement long straddle, the strike price should be chosen carefully since both call and put options will at-the-money. The buyer should give the stock time to realize the expected volatility. But if the expected result is sure not to happen, the buyer should close the position before time decay makes the value of long straddle vanished.

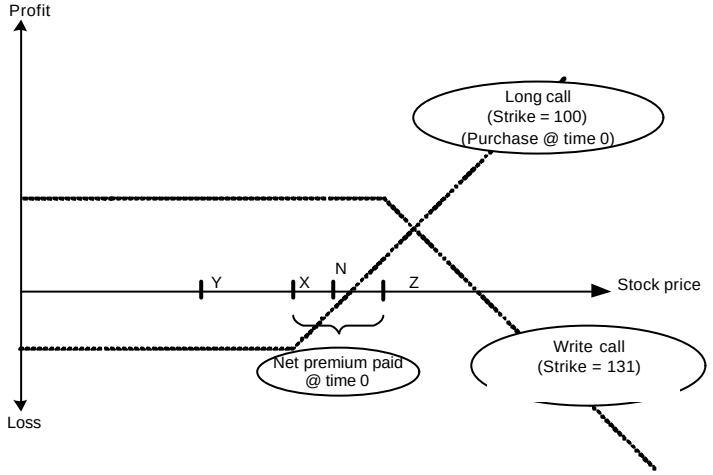
Table 5. 3: The value of long straddle

Time	Spot price (K=100)	Call	Put	Long Straddle	Spot price (K=131)	Call	Put	Long Straddle
0.0	100.00	18.02	13.15	31.17	100.00	8.08	32.69	40.76
0.1	75.71	5.26	25.16	30.42	75.71	1.57	51.10	52.67
0.2	76.71	4.90	24.26	29.16	76.71	1.32	50.47	51.79
0.3	97.57	13.41	12.40	25.81	97.57	4.63	33.55	38.17
0.4	114.45	23.50	6.10	29.60	114.45	9.37	22.05	31.42
0.5	105.44	15.80	7.89	23.68	105.44	4.83	27.16	31.99
0.6	108.35	16.35	6.02	22.37	108.35	4.45	24.51	28.97
0.7	117.11	21.47	2.87	24.34	117.11	5.80	17.74	23.54
0.8	106.91	11.95	4.05	16.00	106.91	1.50	24.29	25.79
0.9	83.17	0.41	16.74	17.14	83.17	0.00	47.18	47.18
1.0	87.61	0.00	12.39	12.39	87.61	0.00	43.39	43.39

The general follow-up actions:

- In up-going market without underlying
  - write call option with a higher strike price and sell the put option
  - short forward and sell the put option
- In down-going market without underlying
  - write put option with a higher strike price and sell the call option
  - buy forward and call option
- In a neutral market
  - write call option with a higher strike price and put option a lower strike price
  - write call and put option with longer maturity

Figure 5. 2: The follow-up of long straddle in up-going market



5.3 Long strangle

The construction of a long strangle is similar to that of a long straddle. The only difference is that the strike price of the call option is higher than put. Table 5.4 is derived from Table 5.1 with the strike price of $110 for the call option and $90 for the put, other things being equal. The net premium paid for buying a long strangle is cheaper than that of long straddle. The reason is that both of the options in long strangle strategy are out-of-the-money. Both working in a volatile market, long strangle has a cost advantage than long straddle. In Figure 5.3, the payoff curve is drawn for a long strangle by calculation shown in Table 5.4.

As shown in Figure 5.3, the point of entry is between the points X and Y that are the strike prices of put and call options, respectively. Similar as the long straddle, the break-even points are L and R. Either the stock price goes higher than R = Y + net premium or lower than L = X – net premium, the buyer of the long strangle will gain. But as the payoff diagram implied, the long strangle needs an even sharper stock price change to be profit than a long straddle.

Time decay will also damage the position of long strangle. Because both the call and put options are out-of-money, the value of strangle will accelerate decreasing when time is approaching the maturity, that is why strangle cannot be hold too close to the maturity, the calculation of Delta for the long strangle in Table 5.4 is shown in Table 5.5.

Table 5. 4: The value of long strangle

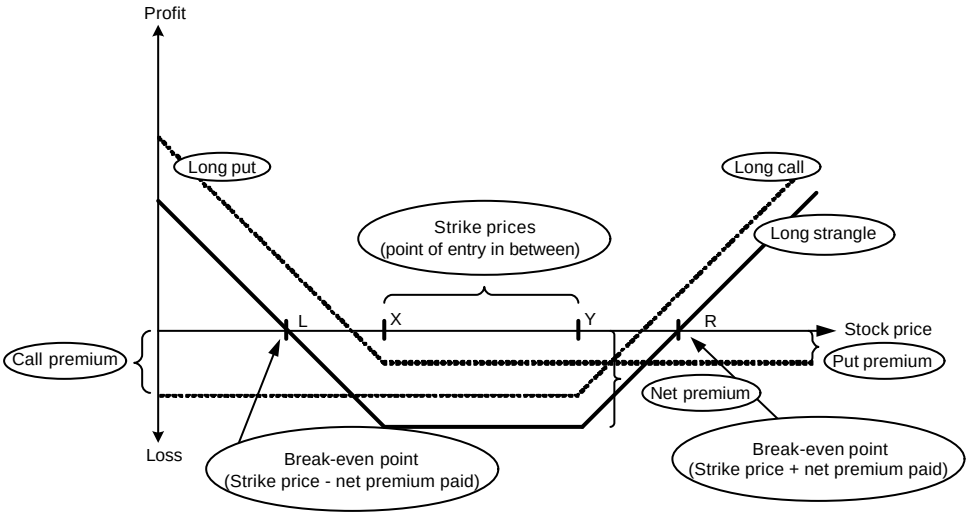
Time	Spot price ($s = 0.1$)	Call	Put	Long Straddle	Spot price ($s = 0.4$)	Call	Put	Long Straddle
0.0	100.00	2.17	0.24	2.41	100.00	14.00	8.60	22.60
0.1	101.66	2.41	0.14	2.55	98.81	12.38	8.43	20.80
0.2	102.97	2.52	0.08	2.60	113.97	20.08	4.44	24.52
0.3	101.19	1.51	0.11	1.62	121.84	24.21	2.79	27.00
0.4	104.10	2.10	0.03	2.13	115.69	18.62	3.06	21.68
0.5	100.23	0.66	0.08	0.73	115.94	17.35	2.44	19.78
0.6	103.17	0.96	0.01	0.97	103.36	8.54	3.89	12.43
0.7	97.71	0.06	0.08	0.14	109.85	10.28	1.87	12.15
0.8	97.49	0.01	0.03	0.04	103.39	5.12	1.95	7.07
0.9	104.35	0.10	0.00	0.10	95.63	0.95	2.25	3.19
1.0	101.11	0.00	0.00	0.00	106.08	0.00	0.00	0.00

Like long straddle, if the stock isn't volatile as expected, the follow-up actions are needed to close long strangle. Since both long straddle and long strangle are composed by long call and long put options, the follow-ups actions are the same.

Table 5. 5: Delta of long strangle

Time	Call	Put	Long strangle
0	-9.9215	-4.8902	-14.8117
0.1	-10.3611	-5.2846	-15.6457
0.2	-10.8699	-5.744	-16.6139
0.3	-11.4694	-6.2883	-17.7577
0.4	-12.1916	-6.9473	-19.1389
0.5	-13.0874	-7.7675	-20.8549
0.6	-14.242	-8.8262	-23.0682
0.7	-15.8116	-10.2617	-26.0733
0.8	-18.1062	-12.336	-30.4422
0.9	-21.6129	-15.3492	-36.9621

Figure 5. 3: The construction of long strangle



5.4 Short butterfly

Short butterfly is constructed by three call or put options with the same maturity date. In this part, we explain based on the short butterfly with call options. As shown in Figure 5.4, a short butterfly is formed by writing a call option with a strike price of X, buying two call options with strike prices of Y and writing another call option with a higher strike price of Z. By replicating the same scenario, the value of short butterfly is calculated as shown in Table 5.6. The 'cost of spread' in Figure 5.4 is the value of short butterfly in Table 5.6. And the point of entry and break-even points are also shown in the figure. In Figure 5.5, short butterfly by three put options is constructed.

Figure 5. 4: The construction of short butterfly by call options

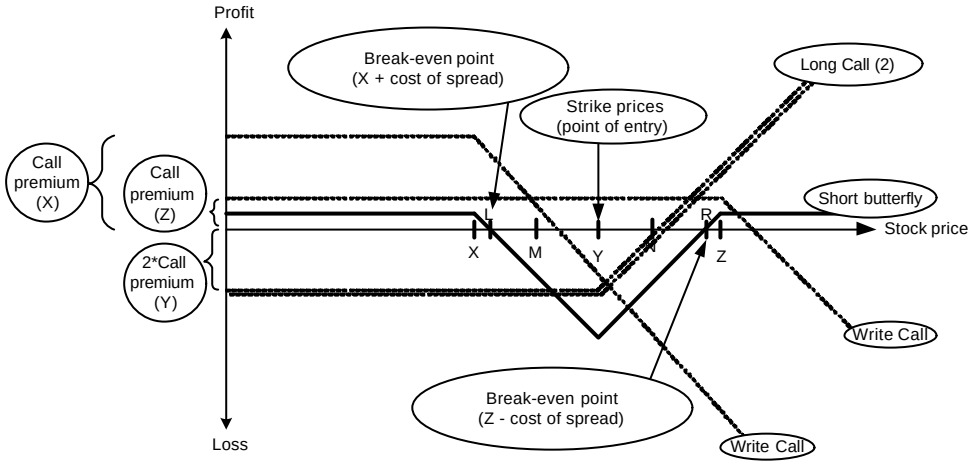
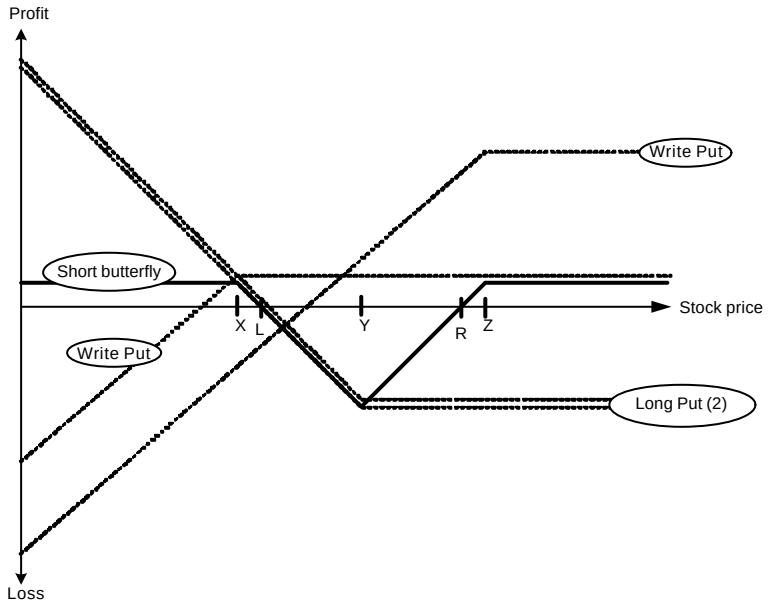


Figure 5. 5: The construction of short butterfly by put options



By reading Table 5.6, first of all, the obviously difference is that in the same market, it costs a lot to form long straddle and long strangle, but profits by forming short butterfly. Secondly, no matter how high the stock price goes up, the maximum profit of short butterfly is limited at the two wings. The maximum profit happens when the stock price break either of the break-even points, L or R, and will be the same as the cost of spread. If the stock price doesn't move

as much as expected, the maximum loss will be \$(Y – X) – cost of spread. In Table 5.7, the Greeks for call options and short butterfly are calculated. Each Greek of short butterfly equals to the two times of the long call minus the sum of two short call options.

Table 5. 6: The value of short butterfly

Time	Spot price ($s = 0.4$)	Call (K=80)	Call (K=100)	Call (K=120)	Short butterfly
0.0	100.00	28.98	18.02	10.81	-3.74
0.1	85.58	17.27	9.19	4.70	-3.58
0.2	98.22	25.87	14.89	8.10	-4.19
0.3	96.47	23.57	12.78	6.44	-4.46
0.4	103.70	28.67	15.97	8.11	-4.84
0.5	103.96	27.99	14.83	6.95	-5.28
0.6	103.16	26.35	12.90	5.33	-5.88
0.7	115.13	36.67	19.88	8.71	-5.63
0.8	110.71	31.70	14.73	4.76	-7.00
0.9	106.41	26.85	9.36	1.40	-9.54
1.0	108.98	28.98	8.98	0.00	-11.02

Table 5. 7: The Greeks of short butterfly (volatility = 0.4)

Greek	Delta	Theta	Gamma	Vega	Rho
K=80	0.8113	-8.0115	0.0068	27.0182	52.1580
K=100	0.6274	-9.8043	0.0095	37.8420	44.7180
K=120	0.4480	-9.6104	0.0099	39.5544	33.9905
Short butterfly	-0.0045	-1.9866	0.0023	9.1113	3.2875

As the figures in Table 5.7 are examined, the Delta and Gamma of short butterfly are almost zeros. It implies that any change of the stock price only slightly decreases the position of the short butterfly. Compared with the Delta and Gamma of long straddle, short butterfly is much insensitive to the stock price. The Theta equals to – 1.9866 which is negative, so the time decay will damage the position of the position. And the large Vega value means that the strategy is sensitive to volatility change. By comparing the Greeks of short butterfly with long straddle, we conclude that the risk of holding a short butterfly is lower than holding long straddle and strangle. As the lower risk taken, the profit from short butterfly is also lower; it is consistent with risk aversion.

The short butterfly looks similar to long straddle that the buyer can profit from both side but the profit are different. If the stock price moves enough as expect, short butterfly can be hold to maturity for the limited profit. But if the stock price doesn't change much as predicted, for short butterfly to profit before maturity, if the stock price fluctuates between points L and R, the buyer could consider liquidating the short butterfly purchased. As in our example, at time 0.7, it is clear that the stock price won't go outside RY before maturity. When the short butterfly was purchased, the buyer got \$3.74, now the short butterfly can be sold out at \$5.63 and the buyer will experience a net loss of \$1.89 = (\$5.63 – \$3.74). If the buyer decided to wait to maturity and the stock price at maturity is \$N = \$108.98 as shown in Figure 5.4, all the options will be exercised and the net loss will be –\$7.27 = Net premium + $2\times$(N – Y) – (N – X). It is better to close the short butterfly by follow-up before the maturity.

5.5 Comparison of strategies

In the same scenario as previous, the stock price moves as shown in Table 5.8 and the profit/loss of forming long straddle, long strangle and short butterfly are calculated. In Table 5.8, 'Call(1)' and 'Put(1)' refer to call and put options with the strike price of $80. 'Call(2)' and 'Put(2)' are with the strike price of $100 while the strike price of 'Call(3)' and 'Put(3)' are $120. The long straddle is constructed by purchasing one 'Call(2)' and one 'Put(2)'. The long strangle is constructed by one 'Call(3)' and one 'Put(1)'. And short butterfly is constructed by writing one 'Call(1)', purchasing two 'Call(2)' and writing one 'Call(3)'. In Table 5.9, some key data are calculated and listed for the comparison.

Table 5. 8: Market price of options

Time	Spot price	Call(1)	Call(2)	Call(3)	Put(1)	Put(2)	Put(3)
0.0	100.00	28.98	18.02	10.81	5.07	13.15	24.95
0.1	101.09	29.06	17.70	10.31	4.44	12.21	23.93
0.2	87.32	17.61	9.10	4.45	7.15	17.85	32.43
0.3	94.27	21.84	11.57	5.70	4.82	13.86	27.30
0.4	91.70	18.91	9.14	4.02	4.85	14.48	28.77
0.5	100.61	25.09	12.75	5.72	2.51	9.67	22.15
0.6	112.13	34.56	19.08	9.02	0.84	4.97	14.51
0.7	117.31	38.79	21.63	9.83	0.29	2.84	10.73
0.8	105.69	26.85	11.11	3.09	0.37	4.43	16.21
0.9	91.75	12.85	1.90	0.09	0.71	9.66	27.75
1.0	98.00	18.00	0.00	0.00	0.00	2.00	22.00

Table 5. 9: Comparison of strategies

Strategies	Cost @ time 0	Point of Entry	Maximum profit	Maximum loss
Long straddle	31.17	@100	unlimited	31.17
Long strangle	15.88	Between 80 and 120	unlimited	15.88
Short butterfly	-3.74	@100	3.74	16.26

As figures shown, if the stock price of a company is expected to move sharply in future, to construct options strategies, long straddle cost the most while short butterfly costs the least. Long straddle can take a large profit, but time decay may damage the position of hold long straddle. So long straddle is the one with the highest return and risk among the three strategies introduced here. Long straddle's point of entry is a single point, in a highly active market, altogether with its high cost, it is required a thoroughly follow-up. Time is very import for implementing long straddle. About long strangle, it is relatively cheaper than long straddle, its point of entry is an interval, so after the strategy is constructed, it gives time for buyer to decide the future market trends. Because the accelerated decreasing value to maturity, a decision of closing or holding before maturity is necessary. Compared with long straddle, the only shortage of long strangle is that it requires an even larger movement in stock price. Finally, let's examine short butterfly. By figures in Table 5.9 and Table 5.10, short butterfly takes the lowest profit but costs the least. The value of short butterfly is relatively stable. But for long strangle and long straddle, the loss to cost ratio is 1:1. The same ratio for short butterfly is larger than 1. If the amount of short butterfly purchased is large, the loss should be a big problem. As long strangle, the region for loss is in the middle and larger than that of long straddle, it implies that a sharper movement of stock price is expected. If the stock price won't move as much as expected, because of the loss to cost ratio, short butterfly should be

carefully followed up and liquidated before maturity.

Table 5. 10: The value of strategies

Time	Spot price	Long straddle	Long strangle	Short butterfly
0.0	100.00	31.17	15.88	-3.75
0.1	101.09	29.91	14.75	-3.97
0.2	87.32	26.95	11.60	-3.86
0.3	94.27	25.43	10.52	-4.4
0.4	91.70	23.62	8.87	-4.65
0.5	100.61	22.42	8.23	-5.31
0.6	112.13	24.05	9.86	-5.42
0.7	117.31	24.47	10.12	-5.36
0.8	105.69	15.54	3.46	-7.72
0.9	91.75	11.56	0.80	-9.14
1.0	98.00	2	0	-18

6. CONCLUSION

As shown in the paper, in different market situation, different strategies formed by options can be used for catching profit. The introductions in this paper are basic for reasons like that the transaction fees are ignored when options are traded. In the real financial market, strategies can be formed by different derivatives. Although the forms are varied the basic idea is the same. The shortages of the paper are: (1) all the options are defined and calculated as European options, which means that the options can't be exercised before maturity; (2) the theoretical prices are calculated simply by the Black and Scholes formula. Since the Black and Scholes formula isn't perfect all the time, we can't be sure some critical point were filter out in our calculations.

In this paper, although we define the market as bullish market, bearish market, neutral market and volatile market, they show the unpredictable characters of the market. But these market situations are caused by health reason rather than disasters or any psychologically reasons. In simple words, we can say those market are rational. In irrational markets, extra adjustments should be made for various strategies but these adjustments can be discussed at that point in time.

7. REFERENCE

Books

J. R. M. Röman (2003). *Finansmarknaden; En översikt av Instrument och Värderingsmodeller*. Department of Mathematics and Physics, Mälardelen University. Sweden.

Internet

http://www.stockholmsborsen.se

Newspaper

Dagens Industri

APPENDIX A

Ericsson, Telefonab. L M ser. B, ERIC B, SE0000108656								
Date	**Opening**	**Bid**	**Ask**	**High**	**Low**	**Close**	**Last**	**Volume**
2003-10-10	13.20	13.00	13.10	13.30	13.00	13.10	13.10	100 446 904
2003-10-09	13.10	13.20	13.30	13.30	12.90	13.30	13.30	272 901 248
2003-10-08	12.80	13.00	13.10	13.20	12.70	13.10	13.10	196 149 776
2003-10-07	12.50	12.70	12.80	12.80	12.40	12.80	12.80	187 272 992
2003-10-06	12.40	12.50	12.60	12.60	12.30	12.50	12.50	130 170 240
2003-10-03	11.70	12.20	12.30	12.30	11.50	12.20	12.20	165 866 992
2003-10-02	11.60	11.50	11.60	11.80	11.40	11.50	11.50	222 864 752
2003-10-01	11.30	11.30	11.40	11.50	11.00	11.30	11.30	235 212 528
2003-09-30	11.50	11.20	11.30	11.70	11.10	11.30	11.30	134 648 240
2003-09-29	11.70	11.50	11.60	12.10	11.40	11.50	11.50	173 660 128
2003-09-26	11.50	11.50	11.60	11.70	11.20	11.60	11.60	203 908 768
2003-09-25	11.50	11.40	11.50	11.70	11.30	11.50	11.50	250 671 440
2003-09-24	12.20	11.70	11.80	12.40	11.70	11.70	11.70	221 571 824
2003-09-23	12.20	12.10	12.20	12.40	12.00	12.10	12.10	237 350 464
2003-09-22	12.50	12.30	12.40	12.50	12.10	12.30	12.30	240 911 136
2003-09-19	13.20	12.70	12.80	13.20	12.70	12.70	12.70	184 063 120
2003-09-18	13.30	13.10	13.20	13.40	12.80	13.20	13.20	178 550 832
2003-09-17	13.40	13.20	13.30	13.60	13.20	13.30	13.30	147 973 280
2003-09-16	13.00	13.20	13.30	13.30	12.90	13.20	13.20	130 868 952
2003-09-15	13.40	13.10	13.20	13.70	13.00	13.10	13.10	194 029 392
2003-09-12	13.50	13.30	13.40	13.80	13.30	13.40	13.40	173 509 904
2003-09-11	13.20	13.20	13.30	13.50	12.90	13.20	13.20	226 630 112
2003-09-10	13.80	13.40	13.50	13.90	13.40	13.40	13.40	236 413 136
2003-09-09	14.30	14.00	14.10	14.60	13.90	14.10	14.10	291 217 120
2003-09-08	14.00	14.20	14.30	14.30	13.80	14.30	14.30	154 094 512
2003-09-05	13.90	14.00	14.10	14.10	13.50	14.10	14.10	197 315 312
2003-09-04	13.50	13.70	13.80	13.90	13.40	13.80	13.80	247 559 744
2003-09-03	13.20	13.40	13.50	13.70	13.20	13.40	13.40	239 620 576
2003-09-02	12.90	13.00	13.10	13.10	12.80	13.00	13.00	166 889 008
2003-09-01	13.00	12.90	13.00	13.00	12.70	12.90	12.90	104 878 608
2003-08-29	13.20	12.80	12.90	13.30	12.80	12.80	12.80	149 200 448
2003-08-28	13.10	13.00	13.10	13.20	12.90	13.10	13.10	180 085 808
2003-08-27	12.90	12.90	13.00	13.10	12.80	12.90	12.90	178 829 520
2003-08-26	12.80	12.70	12.80	12.90	12.40	12.70	12.70	205 177 824
2003-08-25	12.90	12.70	12.80	13.00	12.60	12.70	12.70	114 267 624
2003-08-22	13.10	13.00	13.10	13.40	12.70	13.00	13.00	339 025 088

2003-08-21	12.70	13.00	13.10	13.20	12.60	13.00	13.00	206 797 984
2003-08-20	12.90	12.50	12.60	12.90	12.20	12.50	12.50	215 274 112
2003-08-19	12.40	12.70	12.80	12.90	12.30	12.80	12.80	327 348 128
2003-08-18	11.80	12.10	12.20	12.20	11.70	12.20	12.20	132 417 784
2003-08-15	11.80	11.70	11.80	11.90	11.60	11.70	11.70	82 820 312
2003-08-14	11.80	11.80	11.90	11.90	11.60	11.80	11.80	117 203 432
2003-08-13	11.70	11.70	11.80	11.80	11.60	11.80	11.80	95 327 712
2003-08-12	11.30	11.50	11.60	11.60	11.20	11.50	11.50	102 989 944
2003-08-11	11.50	11.20	11.30	11.60	11.10	11.20	11.20	90 908 184
2003-08-08	11.30	11.40	11.50	11.60	11.30	11.40	11.40	77 908 528
2003-08-07	11.30	11.30	11.40	11.40	10.90	11.30	11.30	135 496 448
2003-08-06	11.60	11.20	11.30	11.60	11.20	11.20	11.20	155 159 600
2003-08-05	11.90	11.80	11.90	12.00	11.80	11.90	11.90	131 391 056
2003-08-04	11.50	11.70	11.80	11.90	11.50	11.70	11.70	162 620 608
2003-08-01	11.80	11.50	11.60	11.90	11.50	11.60	11.60	165 331 440
2003-07-31	11.30	11.80	11.90	11.90	11.10	11.80	11.80	138 055 936
2003-07-30	11.20	11.20	11.30	11.40	11.20	11.30	11.30	91 345 840
2003-07-29	11.50	11.10	11.20	11.60	11.10	11.20	11.20	118 166 616
2003-07-28	11.00	11.40	11.50	11.50	11.00	11.50	11.50	245 239 856
2003-07-25	10.50	10.90	11.00	11.00	10.50	10.90	10.90	164 568 048
2003-07-24	10.50	10.70	10.80	10.80	10.40	10.80	10.80	125 030 728
2003-07-23	10.50	10.40	10.50	10.60	10.30	10.40	10.40	129 628 688
2003-07-22	10.50	10.20	10.30	10.70	10.10	10.30	10.30	210 380 112
2003-07-21	10.30	10.50	10.60	10.70	10.20	10.50	10.50	318 646 656
2003-07-18	10.60	10.10	10.20	11.10	10.10	10.10	10.10	1 004 517 696
2003-07-17	9.40	8.75	8.80	9.45	8.70	8.75	8.75	454 660 992
2003-07-16	9.85	9.50	9.55	10.00	9.40	9.50	9.50	242 029 504
2003-07-15	9.25	9.70	9.75	9.75	9.15	9.75	9.75	343 345 312
2003-07-14	8.95	9.15	9.20	9.20	8.90	9.20	9.20	101 780 480
2003-07-11	8.70	8.75	8.80	8.85	8.60	8.80	8.80	106 545 328
2003-07-10	8.95	8.75	8.80	8.95	8.75	8.75	8.75	103 521 672
2003-07-09	9.20	9.00	9.05	9.25	9.00	9.05	9.05	131 511 856
2003-07-08	9.20	9.20	9.25	9.40	9.10	9.20	9.20	174 867 808
2003-07-07	8.80	9.15	9.20	9.20	8.80	9.15	9.15	170 506 528
2003-07-04	8.50	8.70	8.75	8.75	8.50	8.75	8.75	97 839 272
2003-07-03	8.60	8.55	8.60	8.75	8.55	8.60	8.60	166 197 968
2003-07-02	8.55	8.40	8.45	8.60	8.40	8.45	8.45	101 111 808
2003-07-01	8.50	8.35	8.40	8.60	8.35	8.35	8.35	140 785 040