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The Greek letters: Scenario analysis with a reverse butterfly spread

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Abstract. The management of risk is the goal of a financial institution that sells an option to a client in the over-the-counter markets. In addition to monitoring risks such as Delta(◎), Gamma (◎) and Vega(v), option traders often also carry out, a scenario analysis. The analysis involves calculating the gain or loss on their portfolio over a specified period under a variety of different scenarios. The time period chosen is likely to depend on the liquidity of the instrument. The scenarios can either be chose by management or generated by a model.
Keywords. Financial institutions, Scenario analysis, Risk management, Portfolio management, Reverse butterfly spread.
JEL. G2, G10, G11, G13, G17, H2.

1. Introduction

The analysis involves calculating the gain or loss on their portfolio over a specified period under a variety of different scenarios. The time period chosen is likely to depend on the liquidity of the instrument.

The scenarios can either be chose by management or generated by a model.

Considering a bank with a portfolio of option on a foreign currency. There are two main variables on which the value of the portfolio depends.

1. The Exchange Rate
2. The Exchange Rate Volatility.

Profit and Loss Realized in two weeks under different scenarios (millions of dollars)							
	Exchange Rate						
Volatility	0.94	0.96	0.98	1	1.02	1.04	1.06
8%	102	55	25	6	-10	-34	-80
10%	80	40	17	2	-14	-38	-85
12%	60	25	9	-2	-18	-42	-90

Suppose the exchange rate is currently 1.0000 and its volatility is 10% per annum. The profit and loss experienced during a two-week period under different scenarios. This table considers seven different exchange rates and three different volatilities. Because a one standard deviation move in the exchange rate during a two-week period is about 0.02, the exchange rate moves considered are approximately one, two, and three standard deviation. In the above table the greatest loss in the Lower right corner of the table. The

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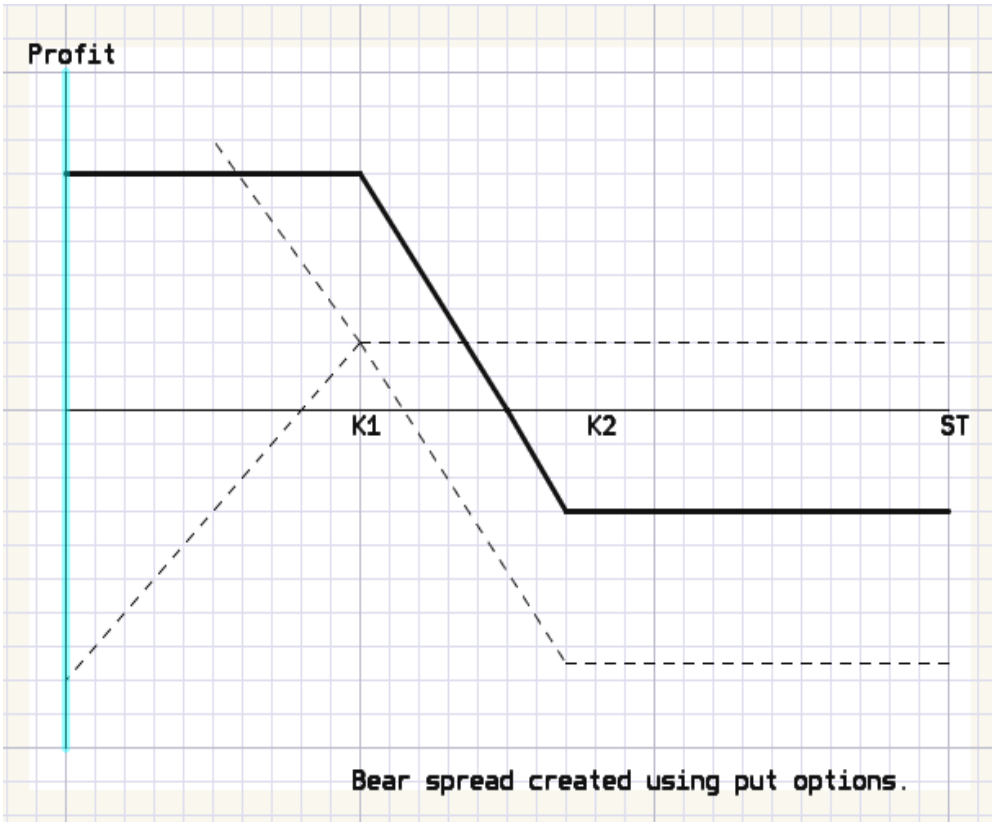
loss corresponds to the volatility increasing 12% and the exchange rate moving up to 1.06%. Usually the greatest loss in a table such as this occurs at one of the corners of the corners, but this is not always so.

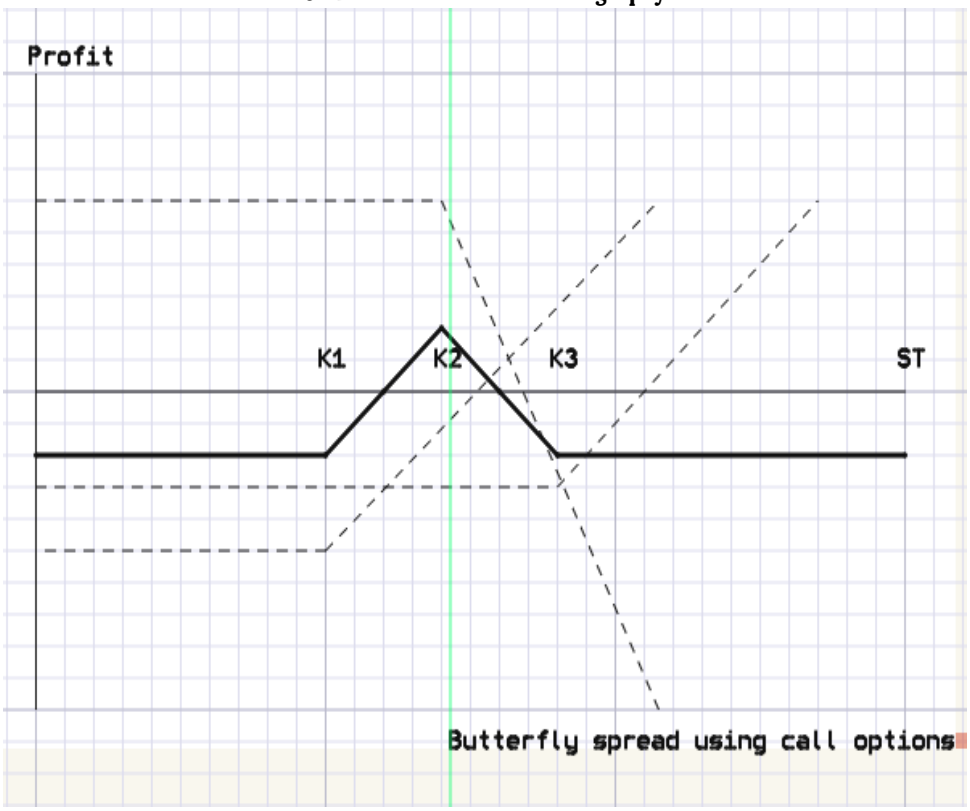
2. Reverse butterfly spread

Hence, we consider an example where the situation where a bank's portfolio consists of a reverse butterfly spread.

A butterfly involves positions with three different strike prices. It can be created by;

- K1: buying a call option with a relatively low strike price,
- K3: buying a call option with a with a relatively high strike price,
- K2: selling two call options with a strike price halfway between K1 and K3.





Generally, K2 is close to the current stock price. The patterns of profits from the strategy is shown in the "Butterfly spread using call options"

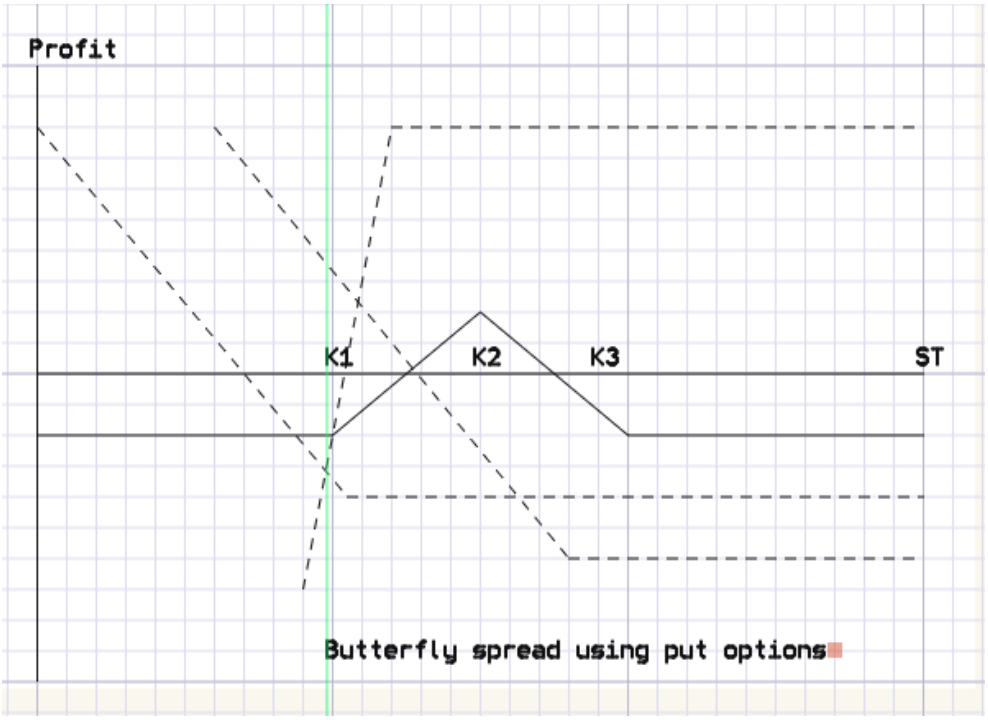
A butterfly spread leads to a profit if the stock price stays close to K2 but gives rise to a small loss if there is significant stock price move in either direction. It is therefore an appropriate strategy for an investor who feels that large stock prices move are unlikely. The strategy requires a small investment initially.

The payoff of the butterfly spread is shown as follows. Suppose that a certain stock is currently worth $61. Consider an investor who feels that a significant price move in the next six months is unlikely. Suppose that the market price of 6-month calls are as follows.

Stirke Price ($)	Call Price ($)
55	10
60	7
65	5

The investor could create a butterfly spread by buying one call with a strike price of $55 strike price. It costs $10+5-(2x$7) =$1 to create the spread. If the stock price in six months is greater than $65 or less than $55 than total payoff is zero and the investor occurs a loss $1. If the stock price is between $56 and $64 a profit is made. The maximum profit, $4 occurs when the stock price in six months is $60.

Payoff of a Butterfly Spread.				
Stock Price Range	Payoff From First Long Call	Payoff From Second Long Call	Payoff From Short Calls	Total Payoff
St < K1	0	0	0	0
K1<ST<K2	ST-K1	0	0	ST-K1
K2<ST<K3	ST-K1	0	neg 2 (ST - K2)	K3-ST
ST>K3	ST-K1	ST-K3	neg 2 (ST - K2)	0
*These payoffs are calculated using the relationshp K2 = 0.5(K1+K3)				



Butterfly spreads can be created using put options. The investors buys a put with a low strike price, buys a put with a high strike price and sells two puts with an intermediate strike price as illustrated above. The butterfly spread in the example just considered would be created by buying a put with a strike price of $55, buying a put with a strike price of $65 and selling two puts with a strike of $60. If all call options are European, the use of put options results exactly the same spread as the use of call options. Put-call parity can be used to show that the initial investment is the same in both cases.

3. Conclusion

A butterfly spread can be sold or shorted by following the reverse strategy. Options are sold with strike prices of K1 and K3 and two options with the middle strike price K2 are purchased. This strategy produces a modest profit if there is a significant movement in the stock price.

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