The Short Call Ladder strategy and its application in trading and hedging

***Omer Faraj S. Amaitiek*[1], *Tomáš Bálint*[2], *Marcel Rešovský*[3]**

The paper presents a new approach to the formation of Short Call Ladder (SCL) strategy based on the functions of profit. An optimal algorithm for the use of this strategy in trading is introduced as well. Furthermore, this paper is focused on the application of Short Call Ladder strategy in hedging against a price rise of the underlying asset. In the end, the results are compared with the results of hedging obtained by Short Combo and Vertical Ratio Call Back Spread option strategy.

Keywords: *hedging, option strategies, Short Call Ladder, Short Combo, SPDR Gold Shares, Vertical Ratio Call Back Spread*

Introduction

Increased price volatility on financial markets, especially in the second half of last century, had led to the creation of so-called Financial Derivatives. It is a discipline that is compared by some authors to weapons of mass destruction. However, as is the indisputable fact of the nuclear energy usability, so it is also the indisputable fact financial derivatives usefulness.

In papers (Ambrož 2002), (Jílek 2002), (Kolb 1999), (Šoltés 2002), (Šoltés 2001) and (Vlachynský and Markovič 2001) the authors deal with options and option strategies. In recent years the option strategies are also used to create so-called structured products. There are for example works (Šoltés 2010), (Šoltés and Šoltés 2007) and (Šoltés and Rusnáková 2010).

Appropriate way of option strategies using is hedging, i.e. securing the price of the underlying asset at some future date. For example papers (Amaitiek 2009), (Šoltés 2006), (Šoltés and Šoltés 2005) and (Zmeškal 2004) deal with this issue.

This work describes a Short Call Ladder strategy. In the literature is known one method of its creation.

The first objective of this paper is to propose another way of its creation and suggest an optimal algorithm of its practical usage. Based on this algorithm, achieved theoretical approach is applied to an option trading on SPDR Gold Shares (Yahoo! 2010-10-28).

The second objective is to propose its usage to hedging against a price increase, which is very important in case of future purchase.

Once again, theoretical results are applied to purchase in shares of gold. It also includes a comparison of our proposed hedging strategy results with already known hedging strategies' results given in papers (Amaitiek 2009) and (Šoltés and Šoltés 2005).

Possibilities of a Short Call Ladder option strategy formation

In order to form Short Call Ladder strategy, we have to choose three different options for the same underlying asset with identical expiration date at different strike prices.

I. Let us form Short Call Ladder strategy by:

- selling n call options with a strike price x_1 and option premium p_{1S},
- purchasing n call options with a strike price x_2 and option premium p_{2B},
- purchasing n call options with a strike price x_3 and option premium p_{3B}.

The function of profit from selling n call options with the lowest strike price x_1 and option premuim p_{1S} is

$$P_{CS}(S) = \begin{cases} np_{1S} & \text{if } S < x_1 \\ -n(S - x_1 - p_{1S}) & \text{if } S \geq x_1, \end{cases} \tag{1}$$

[1]*Ing. Omer Faraj S. Amaitiek*, Technical University of Košice, Faculty of Economics, Němcovej 32, 040 01 Košice, ofm64@yahoo.com
[2]*Ing. Tomáš Bálint*, Technical University of Košice, Faculty of Economics, Němcovej 32, 040 01 Košice, tomas.balint@tuke.sk
[3]*Ing. Marcel Rešovský*, Technical University of Košice, Faculty of Economics, Němcovej 32, 040 01 Košice, marcel.resovsky@tuke.sk
(Review and revised version November 30, 2010)

function of profit from purchasing n call options with strike price $x_2 > x_1$ and option premium p_{2B} is

$$P_{CB}(S) = \begin{cases} -np_{2B} & \text{if } S < x_2 \\ \\ n(S - x_2 - p_{2B}) & \text{if } S \geq x_2 \end{cases} \tag{2}$$

and function of profit from purchasing n call options with the highest strike price $x_3 > x_2 > x_1$ and option premium p_{3N} is as follows

$$P_{CB}(S) = \begin{cases} -np_{3B} & \text{if } S < x_3 \\ \\ n(S - x_3 - p_{3B}) & \text{if } S \geq x_3. \end{cases} \tag{3}$$

Function of profit for the whole Short Call Ladder strategy can be obtained by adding individual profit functions and is

$$P_I(S) = \begin{cases} n(p_{1S} - p_{2B} - p_{3B}) & \text{if } S < x_1 \\ -n(S - x_1 - p_{1S} + p_{2B} + p_{3B}) & \text{if } x_1 \leq S < x_2 \\ -n(-x_1 + x_2 - p_{1S} + p_{2B} + p_{3B}) & \text{if } x_2 \leq S < x_3 \\ n(S + x_1 - x_2 - x_3 + p_{1S} - p_{2B} - p_{3B}) & \text{if } S \geq x_3. \end{cases} \tag{4}$$

If the following condition is satisfied

$$p_{1S} - p_{2B} - p_{3B} > 0, \tag{5}$$

then no additional costs are needed for the formation of Short Call Ladder strategy, i.e. it is a zero-cost strategy. Graph of this strategy's function of profit is in Fig. 1.

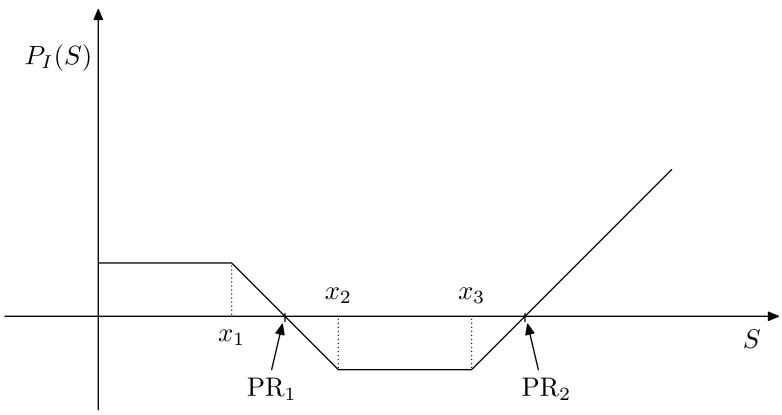

Fig. 1: Function of profit for the Short Call Ladder strategy - variant I

By analyzing the function of profit we can conclude:

- There exists always at least one profitability threshold PR$_2$, which we can calculate from the equation PR$_2$ = $-x_1 + x_2 + x_3 - p_{1S} + p_{2B} + p_{3B}$. The strategy is certainly profitable if $S >$ PR$_2$, when the profit grows linearly according to the spot price development.
- If the condition 5 is satisfied, there exists also another profitability threshold PR$_1 = x_1 + p_{1S} - p_{2B} - p_{3B}$.
- The strategy is loss-making if $S \in$ (PR$_1$,PR$_2$), with the highest loss $L_{max} = -n(-x_1 + x_2 - p_{1S} + p_{2B} + p_{3B})$ if $S \in \langle x_2, x_3 \rangle$.

II. Let us form the Short Call Ladder strategy in another way:

- sell n put options with strike price x_1 and option premium $\overline{p_{1S}}$,
- buy n put options with strike price x_2 and option premium $\overline{p_{2B}}$,
- buy n call options with strike price x_3 and option premium p_{3B}.

The function of profit from selling n put options with the lowest strike price x_1 and option premium $\overline{p_{1S}}$ is

$$P_{PS}(S) = \begin{cases} n(S - x_1 + \overline{p_{1S}}) & \text{if } S < x_1 \\ \\ n\overline{p_{1S}} & \text{if } S \geq x_1, \end{cases} \tag{6}$$

function of profit from buying n put options with strike price $x_2 > x_1$ and option premium $\overline{p_{2B}}$ is

$$P_{PB}(S) = \begin{cases} -n(S - x_2 + \overline{p_{2B}}) & \text{if } S < x_2 \\ \\ -n\overline{p_{2B}} & \text{if } S \geq x_2 \end{cases} \tag{7}$$

and function of profit from buying n call options with the highest strike price $x_3 > x_2 > x_1$ is identical with the function in relation (3).

By adding (3), (6) and (7) we obtain function of profit for this alternative way of Short Call Ladder strategy formation. This relation is as follows

$$P_{II}(S) = \begin{cases} n(-x_1 + x_2 + \overline{p_{1S}} - \overline{p_{2B}} - p_{3B}) & \text{if } S < x_1 \\ -n(S - x_2 - \overline{p_{1S}} + \overline{p_{2B}} + p_{3B}) & \text{if } x_1 \leq S < x_2 \\ -n(-\overline{p_{1S}} + \overline{p_{2B}} + p_{3B}) & \text{if } x_2 \leq S < x_3 \\ n(S - x_3 + \overline{p_{1S}} - \overline{p_{2B}} - p_{3B}) & \text{if } S \geq x_3. \end{cases} \tag{8}$$

From relation (8) we can conclude that the function of profit for this alternative variant is similar to the one presented in (4).

Optimal algotithm of the Short Call Ladder strategy application in trading

In the last section we introduced two different ways of Short Call Ladder strategy formation. To find out which of two presented variants of Short Call Ladder strategy formation si more suitable in particular situation, we have to define decision criteria.

In our analysis the decisions are based on the amount of profit (loss) for any spot price of underlying asset at expiration date. The decision criteria in this situation is a mutual relation between functions of profit $P_I(S)$ and $P_{II}(S)$.

From (4) and (8) we can obtain conditions (9)-(11).

- The first variant is better, if:

$$x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} > 0. \tag{9}$$

- The second one is more suitable, if:

$$x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} < 0. \tag{10}$$

- Both variants are indifferent[4], if:

$$x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} = 0. \tag{11}$$

[4]If the condition (5) is satisfied then the variant I in comparison with the variant II does not need any initial costs for the strategy formation. Therefore in this situation we prefer variant I.

Tab. 1: Call and Put options for SPDR Gold Shares stocks with expiration date on 16/09/2011 (values in USD)

Strike price	Call option		Put option	
	Bid	Ask	Bid	Ask
100	33.56	34.11	1.80	1.96
116	21.50	21.56	5.20	5.45
124	16.15	16.60	8.25	8.50
132	12.70	13.00	12.65	13.10
140	9.25	9.60	17.30	17.61
150	6.65	6.90	24.51	24.91

Source: http://finance.yahoo.com

Example 1. Let us form Short Call Ladder strategy using both variants presented in section . We use data from Tab. 1. Let $n = 100$, $x_1 = 116$, $x_2 = 132$, $x_3 = 150$, $p_{1S} = 21.50$, $\overline{p_{1S}} = 5.20$, $p_{2B} = 13.00$, $\overline{p_{2B}} = 13.10$, $p_{3B} = 6.90$.

Solution:
In this case $x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} = 116 - 132 - 5.20 + 21.50 + 13.10 - 13.00 = 0.40 > 0$. This example satisfies condition (9), therefore usage of the first variant is more suitable. Putting the values from this example in relation (4) we get function of profit in the following form

$$P_I(S) = \begin{cases} 160 & \text{if } S < 116 \\ -100(S - 117.60) & \text{if } 116 \leq S < 132 \\ -1440 & \text{if } 132 \leq S < 150 \\ 100(S - 164.40) & \text{if } S \geq 150. \end{cases} \tag{12}$$

Function of profit for the second variant in this case is

$$P_{II}(S) = \begin{cases} 120 & \text{if } S < 116 \\ -100(S - 117.20) & \text{if } 116 \leq S < 132 \\ -1480 & \text{if } 132 \leq S < 150 \\ 100(S - 164.80) & \text{if } S \geq 150. \end{cases} \tag{13}$$

Fig. 2 depicts the function of profit for this strategy. Solid line shows this function created by first variant, variant II is depicted by dashed line. This graph proves that Short Call Ladder strategy formed by first variant is more profitable at any spot price S.

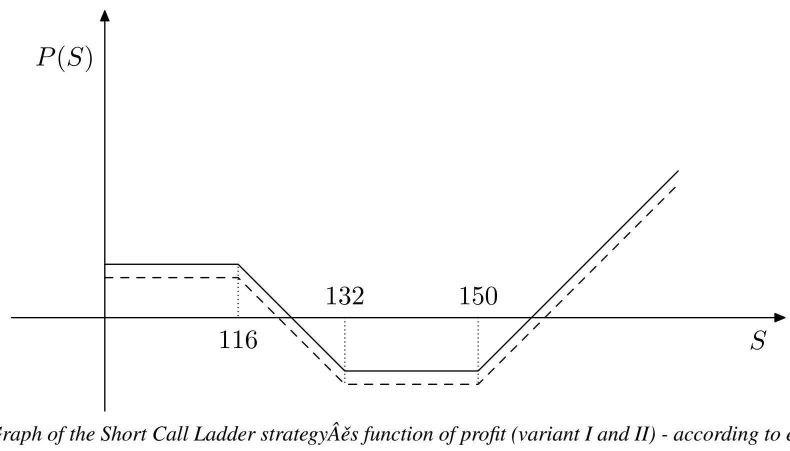

Fig. 2: Graph of the Short Call Ladder strategyÂěs function of profit (variant I and II) - according to example 1

Example 2. Let us form again Short Call Ladder strategy using both variants. Let $n = 100$, $x_1 = 100$, $x_2 = 124$, $x_3 = 140$, $p_{1S} = 33.56$, $\overline{p_{1S}} = 1.80$, $p_{2B} = 16.60$, $\overline{p_{2B}} = 8.50$, $p_{3B} = 9.60$.

Solution:

In this case $x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} = 100 - 124 - 1.80 + 33.56 + 8.50 - 16.60 = -0.34 < 0$. This case satisfies condition (10), therefore the usage of the second variant is more appropriate. We can easily show that function of profit for the second variant is

$$P_{II}(S) = \begin{cases} 770 & \text{if } S < 100 \\ -100(S - 107.70) & \text{if } 100 \leq S < 124 \\ -1630 & \text{if } 124 \leq S < 140 \\ 100(S - 156.30) & \text{if } S \geq 140 \end{cases} \tag{14}$$

and for the first variant is then as follows

$$P_{I}(S) = \begin{cases} 736 & \text{if } S < 100 \\ -100(S - 107.36) & \text{if } 100 \leq S < 124 \\ -1664 & \text{if } 124 \leq S < 140 \\ 100(S - 156.64) & \text{if } S \geq 140. \end{cases} \tag{15}$$

Fig. 3 presents function of profit for this strategy. Solid line shows this function created by first variant, variant II is depicted by dashed line. This graph proves that Short Call Ladder strategy formed by second variant is more profitable at any spot price S.

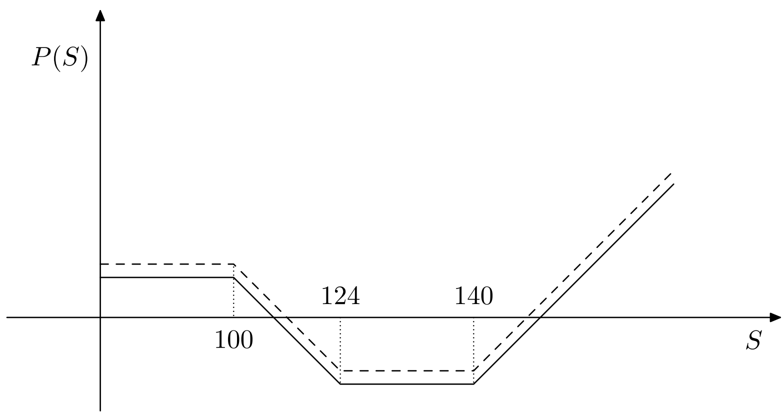

Fig. 3: Graph of the Short Call Ladder strategyÂěs function of profit (variant I and II) - according to example 2

From this example is obvious that our proposal of Short Call Ladder strategy has not only theoretical but also practical importance.

Hedging against the underlying asset price rise using the Short Call Ladder strategy

Let us suppose that at time T in the future we want to buy n pieces of underlying asset, but we are afraid of price rise.

Function of profit from unsecured position is

$$P(S) = -nS, \tag{16}$$

where S is spot price of underlying asset at time T. The higher the spot price is, the higher costs we have to pay for purchase of asset. So the function of profit $P(S)$ will have decreasing trend, hence our loss will be deeper. Therefore we have decided to use hedging against the price rise of underlying asset by our design of Short Call Ladder strategy.

When creating secured position we proceed as follows. We sell n put options with strike price x_1 and option premium $\overline{p_{1S}}$, in the same time we buy n put options with higher strike price x_2 and premium $\overline{p_{2B}}$ and simultaneously we buy n call options with the highest strike price x_3 and option premium p_{3B}.

We can form the function of profit for secured position by adding the function of profit of the Short Call Ladder strategy formed by second variant (8) and function of profit from unsecured position (16). We get

$$SP_{II}(S) = \begin{cases} -n(S + x_1 - x_2 - \overline{p_{1S}} + \overline{p_{2B}} + p_{3B}) & \text{if } S < x_1 \\ -n(2S - x_2 - \overline{p_{1S}} + \overline{p_{2B}} + p_{3B}) & \text{if } x_1 \le S < x_2 \\ -n(S - \overline{p_{1S}} + \overline{p_{2B}} + p_{3B}) & \text{if } x_2 \le S < x_3 \\ n(-x_3 + \overline{p_{1S}} - \overline{p_{2B}} - p_{3B}) & \text{if } S \ge x_3. \end{cases} \tag{17}$$

Fig. 4 depicts the function of profit for unsecured position (dashed line) and for secured position (solid line). From the function of profit for secured position we can conclude:

- If $S < x_1$, then our loss grows linearly, but is smaller than the loss from unsecured position.
- In case, when $x_1 \le S < x_2$, loss from secured position grows faster than the loss from unsecured one.
- In interval $x_2 \le S < x_3$ loss grows equally in case of secured and unsecured position.
- If $S \ge x_3$, then Short Call Ladder option strategy hedges constant amount of loss at level $-x_3 + \overline{p_{1S}} - \overline{p_{2B}} - p_{3B}$ independently from spot price development. In this way we can hedge against the price rise of underlying asset using Short Call Ladder strategy.

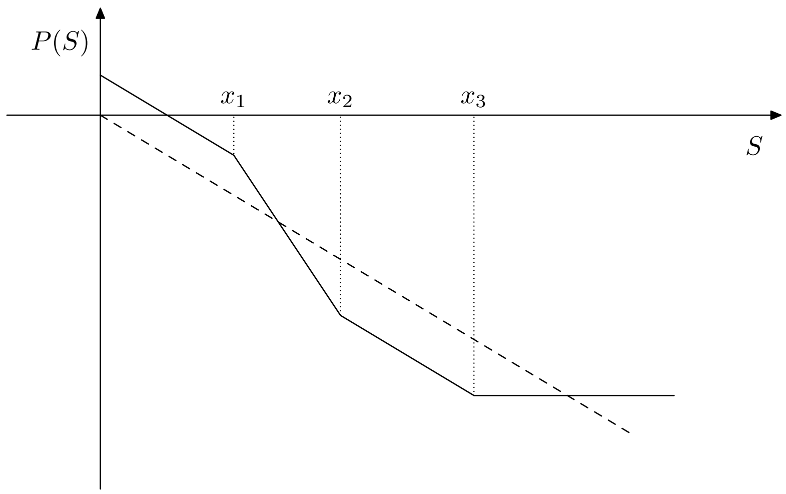

Fig. 4: Function of profit for unsecured and secured position when Short Call Ladder is used

Application of hedging using Short Call Ladder strategy for SPDR Gold Shares stocks

Let assume that we are plannig to create a portfolio consisting of 100 SPDR Gold Shares stocks and we are afraid of price rise in the market. Therefore we want to hedge using our variant of Short Call Ladder strategy. In this section we analyze 3 particular situations which can occur if Short Call Ladder strategy is formed using data from Tab. 1.

1. Let sell 100 put options with strike price $x_1 = 100$ and option premium $\overline{p_{1S}} = 1.80$, in the same time we buy 100 put options with strike price $x_2 = 116$ and premium $\overline{p_{2B}} = 5.45$, and finaly we buy 100 call options with highest strike price $x_3 = 124$ and option premium $p_{3B} = 16.60$ per option. The function of profit for secured position is then as follows

$$SP_1(S) = \begin{cases} -100(S + 4.25) & \text{if } S < 100 \\ -100(2S - 95.75) & \text{if } 100 \le S < 116 \\ -100(S + 20.25) & \text{if } 116 \le S < 124 \\ -14\,425 & \text{if } S \ge 124. \end{cases} \tag{18}$$

When we put the values from Tab. 1 in condition (10), we get: $x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} = 100 - 116 - 1.80 + 33.56 + 5.45 - 21.56 = -0.35 < 0$. We can conclude that the second variant of Short Call Ladder strategy is better.

2. In this situation we sell 100 put options with the lowest strike price $x_1 = 124$ and option premium $\overline{p_{1S}} = 8.25$ per option, in the same time we buy 100 put options with strike price $x_2 = 140$ and option premium $\overline{p_{2B}} = 17.61$. Finally we buy 100 call options of SPDR Gold Shares with the highest strike price $x_3 = 150$ and option premium $p_{3B} = 6.90$. In this case the function of profit is

$$SP_2(S) = \begin{cases} -100(S+8.26) & \text{if } S < 124 \\ -100(2S-123.74) & \text{if } 124 \leq S < 140 \\ -100(S+16.26) & \text{if } 140 \leq S < 150 \\ -16\,626 & \text{if } S \geq 150. \end{cases} \tag{19}$$

In this situation the usage of second variant is better because $x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} = 124 - 140 - 8.25 + 16.15 + 17.61 - 9.60 = -0.09 < 0$.

3. Let us form the strategy by selling 100 put options with strike price $x_1 = 100$ and option premium $\overline{p_{1S}} = 11.80$, buying 100 put options with higher strike price $x_2 = 132$ and option premium $\overline{p_{2B}} = 13.10$, and in the same time by buying 100 call options with the highest strike price $x_3 = 150$ and premium $p_{3B} = 6.90$ per option. Function of profit is

$$SP_3(S) = \begin{cases} -100(S-13.80) & \text{if } S < 100 \\ -100(2S-113.80) & \text{if } 100 \leq S < 132 \\ -100(S+18.20) & \text{if } 132 \leq S < 150 \\ -16\,820 & \text{if } S \geq 150. \end{cases} \tag{20}$$

Because $x_1 - x_2 - \overline{p_{1S}} + p_{1S} + \overline{p_{2B}} - p_{2B} = 100 - 132 - 1.80 + 33.56 + 13.10 - 13 = -0.14 < 0$, then according to condition 10 is the second variant better also in this case.

By comparing functions of profit (18)-(20) and solving the corresponding inequations we obtain values in Tab. 2. From this data we can deduce following conclusions:

- If the spot price of underlying asset is less than 122.06, then the third situation is the best. In this interval the loss grows linearly.
- If $S \in \langle 122.06, 133.995 \rangle$, then the smallest loss is in the second situation. But the loss still grows linearly.
- If spot price crosses 133.995, we can hedge constant amount of loss equal to -14 425 by option strategy introduced in the first situation, independently from spot price growth.

In interval (113.08,144.25) loss is smaller in unsecured position than in situation presented by us.

Tab. 2: Results of hedging using the Short Call Ladder strategy with selected anticipated spot prices

Situation	Anticipated spot price (USD)									
	100	113.80	116	122.06	124	132	133.995	140	144.25	150
1.	-10 425	-13 185	-13 625	-14 231	-14 425	-14 425	**-14 425**	**-14 425**	**-14 425**	**-14 425**
2.	-10 826	-12 206	-12 426	**-13 032**	**-13 226**	**-14 026**	**-14 425**	-15 626	-16 051	-16 626
3.	**-8 620**	**-11 380**	**-11 820**	**- 13 032**	-13 420	-15 020	-15 220	-15 820	-16 245	-16 820
$-nS$	-10 000	-11 380	-11 406	-11 600	-12 400	-13 200	-13 400	-14 000	-14 425	-15 000

Source: Own design

Comparison of the results of hedging using the Short Call Ladder strategy with the results of hedging using the Short Combo and Vertical Ratio Call Back Spread strategy

Short Combo strategy and its use in hedging against price rise of underlying asset

Option strategy Short Combo (SC) can be formed by selling n put options with strike price x_1 and option premium $\overline{p_{1S}}$ and simultaneously by buying n call options with strike price x_2 and option premium p_{2B}. We assume the use of the same underlying asset with identical expiration date. Function of profit fo secured position obtained with Short Combo option strategy is (see Šoltés (2006))

$$SP_{SC}(S) = \begin{cases} -n(x_1 - \overline{p_{1S}} + p_{2B}) & \text{if } S < x_1 \\ -n(S - \overline{p_{1S}} + p_{2B}) & \text{if } x_1 \leq S < x_2 \\ -n(x_2 - \overline{p_{1S}} + p_{2B}) & \text{if } S \geq x_2. \end{cases} \quad (21)$$

Fig. 5 depicts the function of profit for unsecured (dashed line) and secured position (solid line).

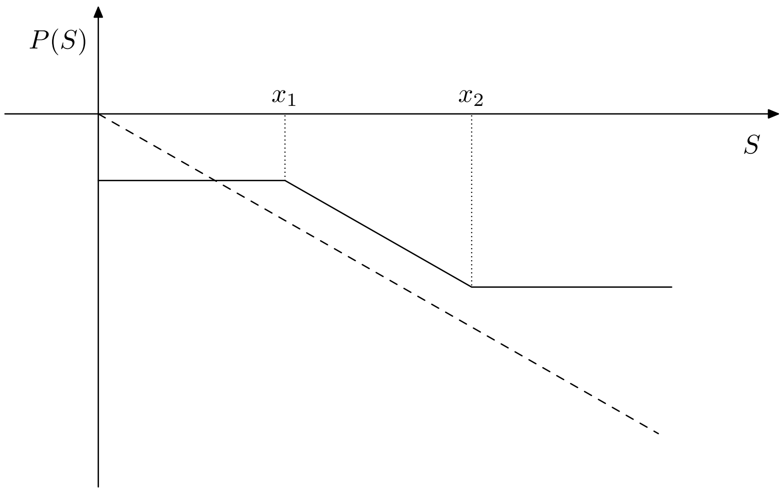

Fig. 5: Function of profit for unsecured and secured position formed by Short Combo strategy

Based on function of profit for secured position we can conclude:

- If the price of underlying asset $S > x_2$, then we can hedge constant price for purchase of underlying asset at $x_2 - \overline{p_{1S}} + p_{2B}$.
- If the price of underlying asset is from interval $S \in \langle x_1, x_2 \rangle$, we can hedge again a better price of underlying asset at $S - \overline{p_{1S}} + p_{2B}$ (if the condition $\overline{p_{1S}} - p_{2B} \geq 0$ is satisfied).
- In the case, when the price of underlying asset decreases below $x_1 - \overline{p_{1S}} + p_{2B}$, then secured position creates bigger loss than unsecured one.

We present below 3 situations, where we use Short Combo strategy in hedging against price rise of 100 SPDR Gold Shares stocks. The data for analysis are from Tab. 1.

1. Let sell 100 put options wtih strike price $x_1 = 100$ and option premium $\overline{p_{1S}} = 1.80$ and in the same time we buy 100 call options with strike price $x_2 = 124$ and premium $p_{2B} = 16.60$. Function of profit for secured position is

$$SP_{SC_1}(S) = \begin{cases} -11\,480 & \text{if } S < 100 \\ -100(S + 14.80) & \text{if } 100 \leq S < 124 \\ -13\,880 & \text{if } S \geq 124. \end{cases} \quad (22)$$

2. In this situation we sell 100 put options with strike price $x_1 = 124$ and option premium $\overline{p_{1S}} = 8.25$ and we buy 100 call options with strike price $x_2 = 150$ and premium $p_{2B} = 6.90$. Function of profit for secured position in this situation is

$$SP_{SC_2}(S) = \begin{cases} -12\,265 & \text{if } S < 124 \\ -100(S - 1.35) & \text{if } 124 \leq S < 150 \\ -14\,865 & \text{if } S \geq 150. \end{cases} \quad (23)$$

3. In the last situation we sell 100 put options with strike price $x_1 = 100$ and premium $\overline{p_{1S}} = 1.80$ per option and simultaneously we buy 100 call options with strike price $x_2 = 150$ and premium $p_{2B} = 6.90$. Function of profit for secured position is then

$$SP_{SC_3}(S) = \begin{cases} -10\,510 & \text{if } S < 100 \\ -100(S+5.10) & \text{if } 100 \leq S < 150 \\ -15\,510 & \text{if } S \geq 150. \end{cases} \tag{24}$$

Vertical Ratio Call Back Spread strategy and its use in hedging against price rise of underlying asset

Option strategy Vertical Ratio Call Back Spread (VRCBS) can be created by selling n_1 call options with strike price x_1 and option premium p_{1S} and by buying n_2 call options with higher strike price x_2 and option premium p_{2B}. The conditions $n_2 > n_1$ and $n_2 - n_1 = n$ have to be satisfied (see Amaitiek (2009)). Function of profit for secured position is

$$SP_{VRCBS}(S) = \begin{cases} -nS + n_1 p_{1S} - n_2 p_{2B} & \text{if } S < x_1 \\ -(n+n_1)S + n_1 x_1 + n_1 p_{1S} - n_2 p_{2B} & \text{if } x_1 \leq S < x_2 \\ -n_2 x_2 + n_1 x_1 + n_1 p_{1S} - n_2 p_{2B} & \text{if } S \geq x_2. \end{cases} \tag{25}$$

Function of profit for secured (solid line) and unsecured position (dashed line) based on VRCBS option strategy is depicted in Fig. 6 (under assumption $\frac{n_1 p_{1S}}{p_{2B}} > n_2$, which can be always met).

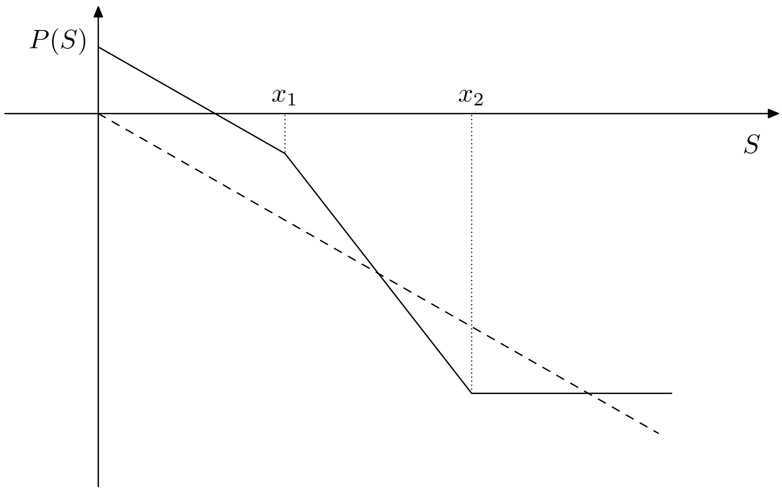

Fig. 6: Function of profit for unsecured and secured position based on Vertical Ratio Call Back Spread strategy

From Fig. 6 and relation (25) we can form following conclusions:

- If in time T the spot price is $S > x_2$, then VRCBS strategy can hedge constant amount of loss at the level $-n_2 x_2 + n_1 x_1 + n_1 p_{1S} - n_2 p_{2B}$.
- If the spot price $S \in \langle x_1, x_2 \rangle$, then our loss from secured position grows faster than the loss from unsecured one.
- If the spot price $S < x_1$, then our costs for the purchase of underlying asset are smaller than in situation where the hedging by VRCBS strategy is used.

We present the usage of Vertical Ratio Call Back Spread strategy in 3 situations. The data for analysis are from Tab. 1.

1. We sell $n_1 = 100$ call options with strike price $x_1 = 100$ and option premium $p_{1S} = 33.56$. In the same time we buy $n_2 = 200$ call options with strike price $x_2 = 124$ and option premium $p_{2B} = 16.60$. The variable n is $n = n_2 - n_1 = 200 - 100 = 100$. Function of profit for secured position is

$$SP_{VRCBS_1}(S) = \begin{cases} -100S + 36 & \text{if } S < 100 \\ -200S + 10\,036 & \text{if } 100 \leq S < 124 \\ -14\,764 & \text{if } S \geq 124. \end{cases} \tag{26}$$

2. In this situation we sell $n_1 = 100$ call options with strike price $x_1 = 124$ and option premium $p_{1S} = 16.15$, in the same time we buy $n_2 = 200$ call options with strike price $x_2 = 150$ and premium $p_{2B} = 6.90$. The value of differential variable n is $n = n_2 - n_1 = 100$. Function of profit for secured position in this situation is

$$SP_{VRCBS_2}(S) = \begin{cases} -100S + 235 & \text{if } S < 124 \\ -200S + 12\,635 & \text{if } 124 \leq S < 150 \\ -17\,365 & \text{if } S \geq 150. \end{cases} \quad (27)$$

3. In the last situation we sell $n_1 = 100$ call options with strike price $x_1 = 100$, option premium $p_{1S} = 33.56$ and simultaneously we buy $n_2 = 200$ call options with strike price $x_2 = 150$ and premium $p_{2B} = 6.90$ per option. The differnce n is $n = n_2 - n_1 = 200 - 100 = 100$. Function of profit for secured position is

$$SP_{VRCBS_3}(S) = \begin{cases} -100S + 1\,976 & \text{if } S < 100 \\ -200S + 11\,976 & \text{if } 100 \leq S < 150 \\ -18\,024 & \text{if } S \geq 150. \end{cases} \quad (28)$$

Comparison of analysed strategies in hedging against price rise of underlying asset

We decided to evaluate the suitability of our Short Call Ladder strategy variant in comparison with the Short Combo (section) and Vertical Ratio Call Back Spread strategies (section). For the purposes of comparison we used data for options on SPDR Gold Shares (Tab. 1), which were presented in 3 situations as mentioned in sections , and . The results of analysis are in Tab. 3.

Tab. 3: Comparison of SCL, SC and VRCBS in hedging against a price rise of underlying asset (SPDR Gold Shares) for anticipated spot price

Situation	Anticipated spot price (USD)									
	100	113.80	116	122.06	124	132	133.995	140	144.25	150
1.SCL	-10 425	-13 185	-13 625	-14 231	-14 425	-14 425	-14 425	-14 425	-14 425	-14 425
1.SC	-11 480	-12 860	**-13 080**	**-13 686**	**-13 880**	**-13 880**	**-13 880**	**-13 880**	**-13 880**	**-13 880**
1.VRCBS	**-9 964**	**-12 724**	-13 164	-14 376	-14 764	-14 764	-14 764	-14 764	-14 764	-14 764
2.SCL	-10 826	-12 206	-12 426	-13 032	-13 226	-14 026	-14 425	-15 626	-16 051	-16 626
2.SC	-12 265	-12 265	-12 265	-12 265	-12 265	**-13 065**	**-13 265**	**-13 865**	**-14 290**	**-14 865**
2.VRCBS	**-9 765**	**-11 145**	**-11 365**	**-11 971**	**-12 165**	-13 765	-14 164	-15 365	-16 215	-17 365
3.SCL	-8 620	-11 380	-11 820	-13 032	-13 420	-15 020	-15 220	-15 820	-16 245	-16 820
3.SC	-10 510	-11 890	-12 110	-12 716	-12 910	**-13 710**	**-13 910**	**-14 510**	**-14 935**	**-15 510**
3.VRCBS	**-8 024**	**-10 784**	**-11 224**	**-12 436**	**-12 824**	-14 424	-14 823	-16 024	-16 874	-18 024
$-nS$	-10 000	-11 380	-11 406	-11 600	-12 400	-13 200	-13 400	-14 000	-14 425	-15 000

Source: Own design

By comparing Short Call Ladder, Short Combo and Vertical Ratio Call Back Spread strategies in hedging against price rise of underlying asset we can form following conclusions:

- In the first situation is Vertical Ratio Call Back Spread the best up to $S = 115.16$. For the spot prices below this level is the Short Combo strategy the best. If $S = 115.16$ the amount of loss obtained by SC and VRCBS is identical. This loss is $-12\,996$.
- In the second presented situation is again Vertical Ratio Call Back Spread the best up to spot price $S = 125$. If the spot price is higher then Short Combo is the best. The amount of loss at spot price $S = 125$ is $-12\,365$.
- The last situation is similar than previous two situations. Vertical Ratio Call Back Spread strategy produces the smallest loss up to $S = 124.86$, where the amount of this loss is $-12\,996$. For higher spot prices the usage of Short Combo is the best.
- Our variant of Short Call Ladder strategy was in all three situations the second best possibility but never the best one. On the other hand it should be noted that this strategy was the most balanced without any strong deviations neither downwards nor upwards. This property is illustrated in Fig. 7 (see p. 181).

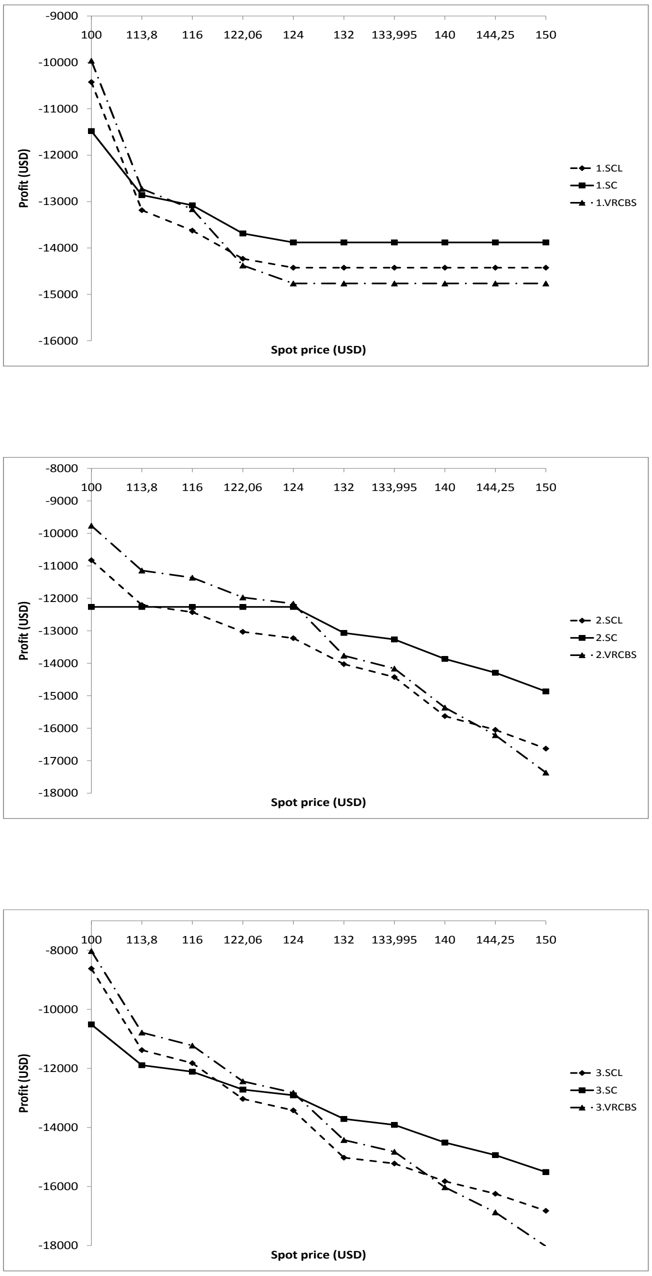

Fig. 7: Comparison of the SCL, SC and VRCBS strategies in hedging against the price rise of SPDR Gold Shares

Source: Own design

Conclusion

The paper pressents two important theoretical results. In the first place a new method of Short Call Ladder option strategy formation is introduced. This strategy can be created by selling n put options with the lowest strike price x_1, buying n put options with strike price $x_2 > x_1$ and buying n call options with the highest strike price x_3. This strategy formation is described by the functions of profit in analytical forms and the optimisation condition for the use of this strategy in trading is defined as well. The second theoretical result of this paper is the proposal of Short Call Ladder application in hedging against the price rise of underlying asset.

The practical part of this work demonstrated the usage of Short Call Ladder option strategy in hedging against the price rise of underlying asset in three model situations. These situations were based on data for SPDR Gold Shares stocks. In comparison with Short Combo and Vertical Ratio Call Back Spread option strategies our variant of SCL has not shown the best results. However, Short Call Ladder produces the most balanced amounts of loss in each analyzed situation.

References

Amaitiek, O.F.S., 2009. Vertical ratio call back spread strategy and its application to hedging. Transactions of the Universities of Košice , 7–10ISSN: 1335-2334.

Ambrož, L., 2002. Oceňovanie opcií. C.H. Beck. ISBN: 80-7179-531-3.

Jílek, J., 2002. Finanční a komoditní deriváty. Grada Publishing. ISBN: 80-247-0342-4.

Kolb, R., 1999. Futures, Option and Swaps. Oxford, Blackwell Publishers. 3 edition. ISBN: 0-63121-499-2.

Šoltés, M., 2006. Hedging proti nárastu ceny podkladového aktíva pomocou opcií a opčných stratégií, in: Nová teórie ekonomiky a managementu organizací, VŠE, Praha. pp. 1519–1527.

Šoltés, M., 2010. Vzťah speed certifikátov a inverznej vertical ratio call back spread opčnej stratégie. E+M Ekonomie a Management 13, 119–124.

Šoltés, M., Šoltés, V., 2007. Analýza garantovaných a airbag certifikátov. Biatec 15, 24–25. ISSN: 1335-0900.

Šoltés, V., 2001. Analýza možnosti vytvorenia stratégie long condor a návrh optimálneho algoritmu pri praktickom investovaní. Ekonomický časopis 49, 306–317. ISSN: 0013-3035.

Šoltés, V., 2002. Finančné deriváty. Košická tlačiarenská, a.s. ISBN: 80-7099-770-2.

Šoltés, V., Rusnáková, M., 2010. Utilization of options in the formation of structured product. Transactions of the Universities of Košice , 65–72ISSN: 1335-2334.

Šoltés, V., Šoltés, M., 2005. Hedging pomocou opčných stratégií long combo a long strangle, in: AIESA - Budovanie spoločnosti založenej na vedomostiach, Bratislava.

Vlachynský, K., Markovič, P., 2001. Finančné inžinierstvo. IURA Edition, spol. s. r.o. ISBN: 80-89047-08-4.

Yahoo!, 2010-10-28. Yahoo! finance homepage. http://finance.yahoo.com.

Zmeškal, Z., 2004. Přístupy k eliminaci finančních rizik na bázi hedgingových strategií. Finance a úvěr - Czech Journal of Economics and Finance 54, 60–63.