Analysis of Nova 1 strategy formed by barrier options and its application in hedging against a price drop in oil market

Michal Šoltés[1] *and* ***Monika Harčariková[2]***

This paper investigates hedging analysis against an underlying price drop by using the Nova 1 strategy formed by standard vanilla and barrier options. There are used European down and knock-in put options together with barrier call options. Derived income functions from the secured positions in analytical expressions are presented. Based on the theoretical results, the hedged portfolio is applied to SPDR S&P Oil & Gas Exploration & Production ETF. The proposed hedging variants are analysed and compared with the recommendation of the best possibilities for investors.

Keywords: *option strategy, hedging, barrier option, SPDR S&P Oil & Gas Exploration & Production ETF*

Introduction

Financial markets are still exposed to increased volatility. Therefore, financial institutions and institutional investors have to face a big market risk, which relates to their business activities. Today, methods and mainly instruments used to manage the market risk are constantly developing. One of the possibilities how to manage the risk is the hedging. We can find a lot of scientific studies dealing with the hedging. For example Brown (2001), Guay and Kothari (2003) studied the managing of risk through derivatives. Hankins (2011) investigates how firms manage a risk by examining the interactions between financial and operational hedging, and Loss (2012) studied the optimal hedging strategies. Theoretical results of our analysis will be useful for all institutions.

The aim of the hedging is to reduce a particular risk. It is achieved by adding a new asset or assets, usually derivatives, to the risky asset (shares, commodities, interest rates, currencies, etc.) in order to create a hedged portfolio. In our case, we intend to sell an underlying asset in the future. Therefore, we should hedge against a price drop. With the hedging, we do not want to avoid a price drop, but ensure a minimum acceptable income from the selling of an underlying asset in the future time.

In our analysis, we present the method of the hedging with using options strategies. Options strategies are presented in the papers (Hull 2012, Kolb 1995, Šoltés 2002). In this paper, we utilize the barrier options to the Nova 1 strategy creation with a focus on the hedging. The Nova 1 strategy using only standard vanilla options was designed by Šoltés (2011). Barrier options belong to the one of the most widely traded derivatives in the financial market, which has special characteristics, distinguished them from the ordinary vanilla options. The payoff of the barrier options depends on the path of the underlying asset price with the possibility of activation/deactivation (IN/OUT) of the option according to reaching or not reaching the specified barrier (UP/DOWN) before expiration. There are four types of the barrier options, i.e. UI, UO, DI, DO call/put options. These options are preferred because they are cheaper than standard vanilla options. For hedging against a price drop, there is the best used DI put options with a combination of the standard vanilla call options or four types of barrier call options, ensuring the minimum selling price for institutions, as we will see later. More detailed characteristics of barrier options are explained for example by Taleb (1997) and Zhang (1998).

For the purpose of this paper, the analytical expressions of the secured income functions by using the barrier options are found. Our theoretical results of the hedged portfolios against a price drop are applied to SPDR S&P Oil & Gas Exploration & Production ETF, but this application is robust for various underlying assets. The hedging variants for these shares are designed and compared each other together with the unsecured position. Finally, there are given the recommendations for institutions, which variant is the best in different underlying price development.

[1] *assoc. prof. Michal Šoltés, PhD.*, Technical University of Košice, Faculty of Economics, Department of Banking and Investment, B. Němcovej 32, 040 01 Košice, Slovak Republic, michal.soltes@tuke.sk

[2] *Ing. Monika Harčariková, PhD.*, Technical University of Košice, Faculty of Economics, Department of Finance, B. Němcovej 32, 040 01 Košice, Slovak Republic, monika.harcarikova@tuke.sk

Research methodology and data

In this part, we firstly describe the construction of the Nova 1 strategy. Then we introduce the backgrounds and specify the methods, which are used in our analysis. Finally, there data used in our analysis presented.

The Nova 1 strategy is formed by buying a higher number n_1 of put options with a strike price X_1, premium p_{1B} per option and at the same time by selling a smaller number n_2 of call options with the same strike price X_1, premium c_{2S} per option. There is used a European-style of options for the same underlying asset and with the same expiration time.

In the papers (Amaitiek et al. 2010, Rusnáková and Šoltés 2012, Rusnáková 2015, Šoltés and Rusnákova 2012, 2013) authors deal with the hedging against a price drop or increase by means of different options strategies using vanilla and barrier options. Following the mentioned studies, we analyse all possible ways of Nova 1 strategy creation using barrier options with the aim to hedge against a price drop.

Based on the obtained theoretical results, our analysis is applied to SPDR S&P Oil & Gas Exploration & Production ETF (XOP). We propose the hedging variants designed for the drop, which meet the assumptions of the zero costs, i.e. a combination of two or more options of positions with the same amount of paid and received options of premiums. Then we evaluate the profitability of the hedging variants for particular intervals of an underlying spot price at the maturity date followed by the comparative analysis of the proposed variants with the recommendation of the best variants for investors.

For the purpose of our analysis, European vanilla and barrier options on SPDR S&P Oil & Gas Exploration & Production ETF with various strike prices and the barrier levels are used. The vanilla options are real data gained from www.finance.yahoo.com. Because of the lack of the barrier market options, the values of the position in the European style of barrier options are calculated. The basic model, i.e. Black-Scholes (1973), is generally used for option pricing. However, this model is not designed for the barrier options. Merton (1973) modified the classic version of this model for European down and knock-out call option. Later, Rubinstein and Reiner (1991) applied the formulas for eight types of the barrier options and Haug (1997) for all sixteen types of the European style of the barrier options. Among other things, the barrier options can be priced by lattice techniques such as binomial (Cox et al. 1979) and trinomial trees (Ritchen 1995) or Monte Carlo simulation (Boyle 1977).

Our approach will consider analytical formulas under Black-Scholes-Merton framework provided by Haug. This model is based on the parameters such as a type of option (DI/DO/UI/UO call/put), the actual underlying spot price S_0, the strike price X, the barrier level H, the time to maturity T, the dividend yield d (valid for XOP), the risk-free interest rate r (derived from government bonds yields – U.S. Treasury rate, source: www.bloomberg.com) and the implied volatility σ (used historical volatility for the barrier options). All calculations will be implemented in the statistical program R.

The dataset of our analysis consists of 13 vanilla call options, 91 DI put options, 156 UI and UO call options, 182 DI and DO call options. The currency of an underlying asset and the option premiums is USD. Strike prices are in the range of 10 – 70, lower barrier levels of DI/DO options are in the range of 10 – 40 and higher barrier levels of UI/UO options are in the range of 45 – 70, all in the multiples of 5. All data used in our analysis can be provided upon a request.

Proposal of hedging analysis formed by barrier options

Let us suppose that we will sell *n* pieces of the underlying asset from our portfolio at the time T in the future, but we are afraid of its price drop in the market. Our income from the sale of the unsecured position at the time T is:

$$I(S_T) = n \cdot S_T \ , \qquad (1)$$

where S_T is the underlying spot price at the time T.

Let us assume that we want to hedge the minimum selling price of our portfolio through the Nova 1 strategy using barrier options. There is a total of sixteen possibilities to create this strategy only with the barrier options. However, in our analysis, we have selected only the best suitable variants of its formation for hedging the minimum selling price. Other possibilities are not suitable because the price is secured only partially in the case of the drop.

1. Let us construct the Nova 1 strategy by buying a higher number n_1 of down and knock-in put options with a strike price X_1, the premium p_{1BDI} per option, the barrier level D_1 and at the same time by selling a smaller number n_2 of call options with the same strike price X_1, the premium c_{2S} per option. We assume that $D_1 < X_1$ for DI (DO) put option because otherwise there are correspondent classical vanilla put options and the barrier level D_1 is below the actual underlying spot price at the time of issue S_0. We select the number of options in a way that enable conditions $n = n_1$ and $n_2 < n_1$. The profit function from buying n_1 of down and knock-in put options is:

$$P_1(S_T)=\begin{cases}-n_1\cdot p_{1BDI} & if \ \min\limits_{0\le t\le T}(S_t)>D_1\wedge S_T<X_1,\\ -n_1\cdot(S_T-X_1+p_{1BDI}) & if \ \min\limits_{0\le t\le T}(S_t)\le D_1\wedge S_T<X_1,\\ -n_1\cdot p_{1BDI} & if \ S_T\ge X_1.\end{cases} \quad (2)$$

And the profit function from selling n_2 call options is:

$$P_2(S_T)=\begin{cases}n_2\cdot c_{2S} & if \ S_T<X_1,\\ -n_2\cdot(S_T-X_1-c_{2S}) & if \ S_T\ge X_1.\end{cases} \quad (3)$$

In the context of previous conditions, the income function from a secured position using the Nova 1 strategy (4) is a sum of individual profit operations (1), (2) and (3).

$$SI_1(S_T)=\begin{cases}n_1X_1+n_2c_{2S}-n_1p_{1BDI} & if \ \min\limits_{0\le t\le T}(S_t)\le D_1\wedge S_T<X_1,\\ nS_T+n_2c_{2S}-n_1p_{1BDI} & if \ \min\limits_{0\le t\le T}(S_t)>D_1\wedge S_T<X_1,\\ (n-n_2)S_T+n_2X_1+n_2c_{2S}-n_1p_{1BDI} & if \ S_T\ge X_1.\end{cases} \quad (4)$$

It is valid that the barrier options of premiums are always cheaper in a comparison to the vanilla options due to the uncertainty of the barrier options price at the future time T. Therefore, this Nova 1 strategy is always created without any initial costs, i.e. the zero-cost strategy as it is shown by the following condition

$$n_2\cdot c_{2S}\ge n_1\cdot p_{1BDI}\,. \quad (5)$$

According to condition (5), there is possible to specify the minimum number of call options (6) for this hedging strategy.

$$n_2\ge\frac{n_1\cdot p_{1BDI}}{c_{2S}} \quad (6)$$

This hedging variant is the best due to a higher call option premium. From the income function of the secured position (4) compared with the unsecured position (1), we can conclude:

- For hedging purposes, the interval $S_T<X_1$ is interesting. If $S_T<X_1$ and the underlying asset price reaches the lower barrier D_1 during the time to maturity, then the incomes of selling the underlying asset are still constant, which are equal $n_1X_1+n_2c_{2S}-n_1p_{1BDI}$. By comparing with the unsecured function, the incomes will be higher with a hedging strategy if $S_T\le n_1X_1+n_2c_{2S}-n_1p_{1BDI}$.
- If the price $S_T<X_1$, but the barrier D_1 is not reached during the time to maturity, the incomes of selling an underlying asset are $nS_T+n_2c_{2S}-n_1p_{1BDI}$ and we have hedged a constant profit $n_2c_{2S}-n_1p_{1BDI}$.
- If the price $S_T\ge X_1$, then the incomes of the hedged strategy will be $(n-n_2)S_T+n_2X_1+n_2c_{2S}-n_1p_{1BDI}$, it means that our profit will not be lower than it would be without hedging.

2. Now, let us look at hedging through the Nova 1 strategy using only barrier options. Let us hedge this option strategy by buying a higher number n_1 of DI put options with a strike price X_1, premium p_{1BDI} per option, barrier level D_1, relation (2) and at the same time by selling a smaller number n_2 of call barrier options with the same strike price X_1, where the call barrier option can be:
   a) up and knock-in call options with the barrier level U, i.e. $U>X_1$, premium c_{2SUI} per option and the profit function:

$$P_{2A}(S_T)=\begin{cases}n_2\cdot c_{2SUI} & if \ S_T<X_1,\\ -n_2\cdot(S_T-X_1-c_{2SUI}) & if \ \max\limits_{0\le t\le T}(S_t)\ge U\wedge S_T\ge X_1,\\ n_2\cdot c_{2SUI} & if \ \max\limits_{0\le t\le T}(S_t)<U\wedge S_T\ge X_1.\end{cases} \quad (7)$$

   b) up and knock-out call options with the barrier level U, i.e. $U>X_1$, premium c_{2SUO} per option and the profit function:

$$P_{2B}(S_T)=\begin{cases} n_2 \cdot c_{2SUO} & \text{if } S_T < X_1, \\ -n_2 \cdot (S_T - X_1 - c_{2SUO}) & \text{if } \max\limits_{0\le t\le T}(S_t)<U \wedge S_T \ge X_1, \\ n_2 \cdot c_{2SUO} & \text{if } \max\limits_{0\le t\le T}(S_t)\ge U \wedge S_T \ge X_1. \end{cases} \qquad (8)$$

c) down and knock-in call options with the barrier level D_2, premium c_{2SDI} per option and the profit function:

$$P_{2C}(S_T)=\begin{cases} n_2 \cdot c_{2SDI} & \text{if } S_T < X_1, \\ -n_2 \cdot (S_T - X_1 - c_{2SDI}) & \text{if } \min\limits_{0\le t\le T}(S_t)\le D_2 \wedge S_T \ge X_1, \\ n_2 \cdot c_{2SDI} & \text{if } \min\limits_{0\le t\le T}(S_t)\ge D_2 \wedge S_T \ge X_1. \end{cases} \qquad (9)$$

d) down and knock-out call options with the barrier level D_2, premium c_{2SDO} per option and the profit function:

$$P_{2D}(S_T)=\begin{cases} n_2 \cdot c_{2SDO} & \text{if } S_T < X_1, \\ -n_2 \cdot (S_T - X_1 - c_{2SDO}) & \text{if } \min\limits_{0\le t\le T}(S_t)> D_2 \wedge S_T \ge X_1, \\ n_2 \cdot c_{2SDO} & \text{if } \min\limits_{0\le t\le T}(S_t)\le D_2 \wedge S_T \ge X_1. \end{cases} \qquad (10)$$

In the case of DI/DO call options, we can assume different levels of lower barrier $(D_1; D_2)$. When suitable levels of lower (for DI, call options have to be of different levels D) and higher barriers are set, then the zero-cost strategy can be achieved according to the relation (5).

General description of the income function for the secured position as a combination of three individual positions (1), (2) and (7)/(8)/(9)/(10) is defined as:

$$SI_2(S_T)=\begin{cases} n_1X_1 + n_2c_{2S} - n_1p_{1BDI} & \text{if } \min\limits_{0\le t\le T}(S_t)\le D_1 \wedge S_T < X_1, \\ nS_T + n_2c_{2S} - n_1p_{1BDI} & \text{if } \min\limits_{0\le t\le T}(S_t)> D_1 \wedge S_T < X_1, \\ nS_T + n_2c_{2S} - n_1p_{1BDI} & \text{if } C_1 \text{ is fulfilled } \wedge S_T \ge X_1, \\ (n-n_2)S_T + n_2X_1 + n_2c_{2S} - n_1p_{1BDI} & \text{if } C_2 \text{ is fulfilled } \wedge S_T \ge X_1. \end{cases} \qquad (11)$$

Barrier conditions for particular call barrier options with premium c_{2S} are in Table 1. By substituting corresponding barrier conditions in general income function, we get the income function of the selected possibilities for the Nova 1 strategy creation.

Tab. 1. Call barrier options.

Type of call barrier option	C_1	C_2	Barriers
up and knock-in (UI)	$\max\limits_{0\le t\le T}(S_t)<U$	$\max\limits_{0\le t\le T}(S_t)\ge U$	$U > S_0$
up and knock-out (UO)	$\max\limits_{0\le t\le T}(S_t)\ge U$	$\max\limits_{0\le t\le T}(S_t)<U$	
down and knock-in (DI)	$\min\limits_{0\le t\le T}(S_t)> D_2$	$\min\limits_{0\le t\le T}(S_t)\le D_2$	$D_1 = D_2$ or $D_1 \ne D_2$, i.e. $(D_2 < X_1 \vee D_2 = X_1 \vee D_2 > X_1)$, $D_1, D_2 < S_0$
down and knock-out (DO)	$\min\limits_{0\le t\le T}(S_t)\le D_2$	$\min\limits_{0\le t\le T}(S_t)> D_2$	

It is necessary to choose call barrier options (UI, UO, DI, DO) depending on the type of expectations of underlying asset´s development, i.e. if we expect rapid/slowly increase or rapid/slowly drop. The creations of all hedging strategies suitable in price drop are very interesting with the best variant 1. due to a higher call option premiums, which ensure the highest constant profit in comparison to other variants 2A-2D.

Application of hedging results

Let us suppose that in the future (January 2017) we are planning to sell 100 SPDR S&P Oil & Gas Exploration & Production ETF (XOP) and we are afraid of price drop in the market. On 20 July 2015, the shares of XOP were traded at USD 40.31 per share. At this time, we are going to apply the mentioned Nova 1 hedging strategy by using vanilla and barrier options to hedge a minimum selling price at the future date. The numbers of traded options are selected according to condition $n_2 \cdot c_{2S} \geq n_1 \cdot p_{1BDI}$. If this condition is met; the zero-cost strategy is formed. In the next part, we will propose some hedging variants, which meet the above-stated requirements.

1. We will buy $n_1 = 100$ DI put options with the strike price $X_1 = 30$, the barrier level $D_1 = 20$, the premium $p_{1BDI} = 1.52$ per option and at the same time, we will sell $n_2 = 20$ call options with the strike price $X_1 = 30$, the premium $c_{2S} = 11.9$ per option. The hedged income function from the sale of 100 shares is the following function:

$$SI_1(S_T) = \begin{cases} 3086.01 & if \ \min\limits_{0 \leq t \leq T}(S_t) \leq 20 \wedge S_T < 30, \\ 100 \cdot S_T + 86.01 & if \ \min\limits_{0 \leq t \leq T}(S_t) > 20 \wedge S_T < 30, \\ 80 \cdot S_T + 686.01 & if \ S_T \geq 30. \end{cases} \quad (12)$$

The minimum numbers of n_2 call options, according to relation (6), are given by the following condition, i.e. $n_2 \geq \frac{100 \cdot 1.52}{11.9} = 13$ options, in order to remain the zero-cost condition. Otherwise, there is needed some initial costs. Therefore, the options with given parameters should be chosen right.

Let us change the number of n_2 call options, but other parameters remain the same. The results of the income functions are shown in Table 2.

Tab. 2. Comparison of the hedging variants 1.

Scenarios of the spot price during time to maturity t and at the maturity T	**Hedging variant 1A** $n_1 = 100; n_2 = 20$	**Hedging variant 1B** $n_1 = 100; n_2 = 90$
$\min\limits_{0 \leq t \leq T}(S_t) \leq 20 \wedge S_T < 30$	3086.01	3919.01
$\min\limits_{0 \leq t \leq T}(S_t) > 20 \wedge S_T < 30$	$100 \cdot S_T + 86.01$	$100 \cdot S_T + 919.01$
$S_T \geq 30$	$80 \cdot S_T + 686.01$	$10 \cdot S_T + 3619.01$

The comparison of the hedging variants 1A and 1B of shares at various price developments of the share price during the time to maturity and at the maturity date can be found in Figure 1, where a more detailed illustration of these particular hedging variants is provided. It is obvious from Table 2 and Figure 1, that:

- both variants (1A and 1B) fulfil the zero-cost condition and are advantageous against the unsecured position for a drop of shares price, but the hedging variant with higher numbers of n_2 call options (1B) is better,
- it does not matter if the barrier is exceeded or not, because the hedging variant 1B is better in the case of the spot price of shares lower than 41.9 at the maturity with the minimum selling price 39.19 per share, therefore, it is preferred for the drop,
- otherwise, the hedging variant 1A gives better results for scenarios of the spot price of shares above 41.9 at the maturity.

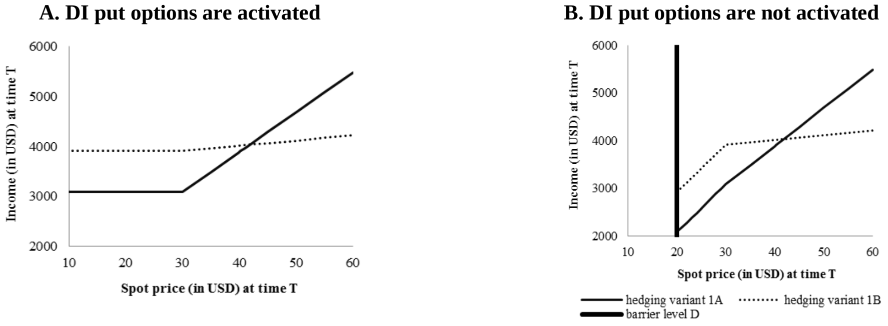

Fig. 1. Comparison of the income functions of the particular hedging variants 1.

These hedging variants created with vanilla and barrier options are the best in comparison to the variants created only with the barrier options. The premiums of the vanilla options are higher than the premiums of the barrier options what is proved by Taleb (1997). Therefore, these variants ensure the highest income at the expected intervals of the spot price at the maturity date T, and we recommend these partial cases with higher numbers of selling n_2 vanilla options for the hedging of the drop.

2. We will buy $n_1 = 100$ DI put options with the strike price $X_1 = 30$, the barrier level $D_1 = 20$, the premium $p_{1BDI} = 1.52$ per option and at the same time, we will sell $n_2 = 90$
A. UI call options
B. UO call options
with the strike price $X_1 = 30$, the barrier level $U = 60$, the premium $c_{2SUI} = 7.91$ for UI ($c_{2SUO} = 3.77$ for UO) per option. The income functions from both of the secured positions are shown in Table 3.

Tab. 3. Comparison of the hedging variants 2A and 2B.

Scenarios of the spot price during time to maturity t and at the maturity T	**Hedging variant 2A** $n_1 = 100; n_2 = 90$	**Hedging variant 2B** $n_1 = 100; n_2 = 90$
$\min_{0\le t\le T}(S_t) \le 20 \wedge S_T < 30$	3559.81	3187.72
$\min_{0\le t\le T}(S_t) > 20 \wedge S_T < 30$	$100 \cdot S_T + 559.81$	$100 \cdot S_T + 187.72$
$\max_{0\le t\le T}(S_t) < 60 \wedge S_T \ge 30$	$100 \cdot S_T + 559.81$	$10 \cdot S_T + 2887.72$
$\max_{0\le t\le T}(S_t) \ge 60 \wedge S_T \ge 30$	$10 \cdot S_T + 3259.81$	$100 \cdot S_T + 187.72$

Based on above mentioned requirements, we can specify the minimum number of n_2 UI call options in numbers of 19 options, i.e. $n_2 \ge \frac{100 \cdot 1.52}{7.91} = 19$ and for UO call 41 options, i.e. $n_2 \ge \frac{100 \cdot 1.52}{3.77} = 41$.

The results of the comparative analysis of the hedging variants 2A and 2B:

- if the spot price of the shares during the time to maturity drops under lower barrier $D_1 = 20$ or not, and does not grow above the upper barrier $U = 60$, then the hedging variant 2A is still better with the minimal hedged price equal 35.598 per share. Therefore, we recommend this variant for hedging against a price drop,
- otherwise, only in the case if the spot price of the shares during the time to maturity grows above the upper barrier $U = 60$ and is above than 34.13 at the maturity date, the income of the hedging variant 2B is higher,
- the choice between UI and UO call options depends on investor´s expectations, but the variant 2A, which generates the higher income from the sale, is the best for hedging against a price drop.

3. For the next hedging variant, we will buy $n_1 = 100$ DI put options with the strike price $X_1 = 30$, the barrier level $D_1 = 20$, the premium $p_{1BDI} = 1.52$ per option and at the same time, we will sell $n_2 = 90$ DI call options with the strike price $X_1 = 30$, the barrier level $D_2 = 35$, the premium $c_{2SDI} = 5.79$ per option. The income function from the secured portfolio is expressed by the formula:

$$SI_{2C}(S_T) = \begin{cases} 3368.97 & \text{if } \min_{0\le t\le T}(S_t) \le 20 \wedge S_T < 30, \\ 100 \cdot S_T + 368.97 & \text{if } \min_{0\le t\le T}(S_t) > 20 \wedge S_T < 30, \\ 10 \cdot S_T + 3068.97 & \text{if } \min_{0\le t\le T}(S_t) < 35 \wedge S_T \ge 30, \\ 100 \cdot S_T + 368.97 & \text{if } \min_{0\le t\le T}(S_t) \ge 35 \wedge S_T \ge 30. \end{cases} \quad (13)$$

We can specify the minimum number of n_2 DI call options in the amount of 27 options, i.e. $n_2 \ge \frac{100 \cdot 1.52}{5.79} = 27$. If DI call options are used, the same lower barriers D_1 and D_2 cannot be used, so we ensure the hedging strategy without initial costs. There can be specified barriers in the relation

$D_1 < X_1 \le D_2$. However, in our case we consider the barrier level $D_2 > X_1$, what is the best hedging variant using DI call options.

A minimum selling price of the value of 33.6897 per share, which represents an interesting opportunity for the hedging in our expected price scenarios, is proven by the analysis.

4. The best hedging variant using only the barrier options is the following case. In this case, we will buy $n_1 = 100$ DI put options with the strike price $X_1 = 30$, the barrier level $D_1 = 20$, the premium $p_{1BDI} = 1.52$ per option and at the same time, we will sell $n_2 = 90$ DO call options with the strike price $X_1 = 30$, the barrier level $D_2 = 20$, the premium $c_{2SDO} = 11.66$ per option. The following relation expresses the income function from the secured portfolio:

$$SI_{2D}(S_T) = \begin{cases} 3897.64 & if \ \min\limits_{0 \le t \le T}(S_t) \le 20 \wedge S_T < 30, \\ 100 \cdot S_T + 897.64 & if \ \min\limits_{0 \le t \le T}(S_t) > 20 \wedge S_T < 30, \\ 100 \cdot S_T + 897.64 & if \ \min\limits_{0 \le t \le T}(S_t) < 20 \wedge S_T \ge 30, \\ 10 \cdot S_T + 3597.64 & if \ \min\limits_{0 \le t \le T}(S_t) \ge 20 \wedge S_T \ge 30. \end{cases} \quad (14)$$

We can specify the minimum numbers of n_2 DO call options in the amount of 14 options, i.e. $n_2 \ge \frac{100 \cdot 1.52}{11.66} = 14$. A minimum selling price 38.97 per share is secured. We can see that if our assumptions are fulfilled, the hedging variant 2D is the second best possibility of all analysed variants at expected intervals of the spot price of shares at the future time T.

Finally, we can conclude that these hedging variants are suitable for a significant price drop. All possibilities ensure an interesting opportunity for the hedge minimum selling price of shares, but investors should note that if the price at the future time does not meet his/her expectations, he/she could be lossy in comparison to the unsecured position.

Conclusion

Nowadays, companies have to face many challenges. On the one hand, there are new opportunities, but on the other hand, lots of new risks are rising as well. The purpose of the paper was to present the hedging analysis against a price drop of the underlying asset through the Nova 1 strategy creation by using the barrier options.

The paper began by providing an overview of the literature and research methodology. This paper was focused on the derivation of the income function strategy with the use of the hedging for selling an underlying asset. The theoretical part of our approach deals with the hedged portfolio formation by the analytical expression of its elementary components. For our hedging purposes, only down and knock-in put options are appropriate when the hedger wants to secure against a drop. The results of our approach indicate that using barrier options offers more alternatives for hedging and we analysed all these hedging possibilities. It is valid, the barrier options are cheaper hedging instruments compared to the standard vanilla options. Therefore, they are mostly utilized on the hedging. We came to the conclusions that there exists one type using the combination of the barrier option and the standard vanilla option and four types of the Nova 1 strategy formation using only barrier options. Each of the hedging variants has some advantages and disadvantages, which allow to secure only the most likely unfavourable future price movement scenarios. However, the choice of standard call/barrier call options type depends on the hedger's expectations of the underlying price development and the willingness to take a risk.

The main practical benefit of this paper is the application to the SPDR S&P Oil & Gas Exploration & Production ETF. The practical part of our approach was focused on the investigation appropriate hedging variants associated with conditions of the zero initial costs. Following the mentioned assumptions, we found the best variants for hedging against a price drop of the shares and performed its detailed description as well. We can recommend the hedging variant 1B, created with vanilla and barrier options, as the best variant, which ensure the highest income at expected intervals of the spot price at the maturity. Others variant we should not exclude, because they ensure an interesting income too. Finally, there is significant to select the strike prices for the income profile, lower and upper barrier levels, in order to achieve the best income functions.

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