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Optional Approach for Investment Projects Valuation and It's Appliance to the Project of Producing Healthy Organic Food

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Opcioni pristup za vrednovanje investicionih projekata i njihova primena na projekte u proizvodnji organske hrane

ABSTRACT – *The aim of this paper is to present the appliance possibilities of optional approach to investment projects valuation, as well as new theoretical and methodological framework of investment analysis, to project of producing and selling healthy organic food.*

Unlike traditional methods of project valuation, this new, contemporary approach provides valuation of management flexibility and possibility of adjustment (correction of previous decisions) in accordance to the market conditions. In light of dramatic changes and increasing risks and uncertainty in investment decision-making, it is necessary to complete the traditional approach by optional, in order to make more rational allocation of resources. The necessity of using optional approach is reflected from the fact that the results of projects valuation according to the traditional and modern approach may be contradictory.

This paper presents the Black-Scholes and binomial option pricing model, and appliance of option valuation is shown on the project of producing and selling healthy organic food and healthy food restaurant as an extension activity. While traditional methods of valuating investment projects valuated the project of producing healthy organic food as unprofitable, the optional approach shows that this project is acceptable, which confirms the importance of this approach

KEY WORDS: *real options, flexibility, risk, uncertainty, project valuation, organic food*

Introduction

Investment project valuation is a specific way of measuring the benefits and costs ratio during defined project lifetime. The purpose of these methods is to quantify arguments about acceptability or unacceptability of the specific project. General classification of investment projects valuation methods is in two groups, traditional and modern methods, whereby the traditional methods of valuation include the standard discount cash flow (DCF) method of analysis, or all those methods of assessment that do not consider the opportunity costs (benefits) based on investment in project. Conventional methods are, therefore, the

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method of net present value (NPV), the internal rate of return method, the annuity method, cost recovery method and the coefficient of profitability. On the other hand, modern methods are based on access to opportunity, which means they take into account not only the gross benefits (costs) of investment, but also missed investment effects (open, "closed down" investment opportunities (options)). By this method, it is possible to evaluate the flexibility of the project, respectively possibility of adjustment (correction of previous decisions), in accordance to the market changes.

According to traditional approach, project value is just a simple difference between the present value of returns and the present value of investment, while the optional approach considered the project value more widely, as a difference of direct costs and benefits of the project (NPV), corrected for the balance of the closed (open) options, after starting the project. Whereas the project with a real option is always worth more, or at least the same as the project without this (these) option(s), it is clear that the traditional approach underestimates the project value, and that the project is considered in a strictly deterministic and static conditions. In conditions of increasing uncertainty, risk and changes, conventional approach is becoming less relevant for the assessment of projects, and in the valuation process must include the value of real options.

There are three main real options that may arise in the process of valuation project as follows:

- Option to abandon
- Option to expend
- Option to contract

Respecting that real options have the following similarities with financial options:

- Represent the right, but not the obligation (as well as financial options);
- Invested funds is the irreversible investment (the price paid for the financial option is non-refundable);
- Can not have a negative value (as well as financial options);

Table 1. Analogy between financial and real options (Rovčanin, 2005, 551)

Financial option		Real option
Stock price	S	Present value of optional project
Exercise price of option	K	Investment expenditure of optional project
Time to expiration of option	t	Rate of return of alternative project
Risk free rate	r	Length of time till optional project
Risk of returns on stock	σ^2	Risk of investment project

In the valuation process they can be equated with the financial, call and put options, and model developed for valuation of financial options can be applied to real options with prior introduction of certain analogies. So the option to abandon is equated with the financial put option, the option to expend is equated with the financial call option, while the option to contract is also a variant of the call option. Models that are commonly used to evaluate the financial and real options are the Black-Scholes and the binomial model, which are presented below. In order to evaluate real options of projects by models mentioned above, it is necessary to previously make further analogy between elements of investment opportunities and elements of European call and put options.

Binomial option pricing model

Binomial tree

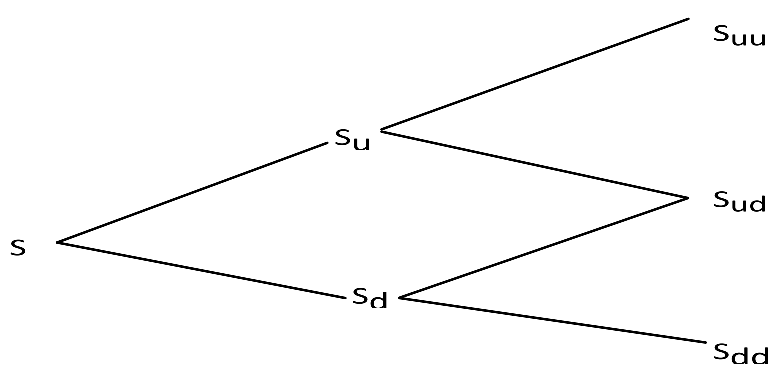
Binomial option pricing model finds its starting point in short time intervals in which the stock price or some other related assets can take two values. Given that recognizes only two possible results, it has called the binomial model. The model observes the trend in the stock price and other related assets over short time intervals throughout the life of the option.

The process of the binomial option pricing model consists of several stages, as follows:

1. making the pricing binomial trees;
2. calculating the options value in each final node of binomial tree;
3. progressively calculating the options value in each previous node. The value in the first node represents the value of the option.

The model is based on several assumptions. It assumes the existence of perfect financial markets, without disruptions and transaction costs. Risk free interest rate is constant, and stocks pay no dividends. Binomial model is based on the binomial tree which represents price movements' model of stocks or other related assets in the future. At the end of each interval, possible future stock prices are being determined. This price evolution forms the basis for options valuation. Each node in the tree represents a possible price of a stock or other forms of related assets in a specific time point.

Figure 1. Binomial tree



The price tree is formed by going forward from valuation date to the date of expiry, or maturity.

Assumption is that the price of related assets is going to grow *u (up)* times or decrease *d (down)* times for each step along the tree, where by definition is $u \geq 1$ and $0 \leq d \leq 1$. If the symbol of the current price is S, then the price in the next period will be $S_u = S \cdot u$ or $S_d = S \cdot d$, where the probability that the price S is going to rise to S_u is p, and that is going to decrease to S_d, *1-p*. Following the shown tree, the expected stock price for one time interval can be calculated as a weighted average of two prices which are the result of movement of current stock price to up or down. It can be shown by following formula:

$$p \cdot S_u + (1-p) \cdot S_d \qquad (1)$$

The value of call options in the final nodes of the tree is calculated as the difference between spot prices of related assets and the executive price of option. If the difference is negative, the value of the option is 0. In one period binomial model, the value of call option is equal to: $Max = (S_u - K, 0)$ in first final node, and $Max = (S_d - K, 0)$ in second final node. The value of put option is: *Max (K-*S_u*, O)* on the first final node, and *Max (K-*S_d*, O)* at the second final node of binomial tree, where the K is exercise price, while S is the spot price of related assets.

After completing the evaluation of options at each final node, we access to the valuation of options on each previous node, starting from the final to the first node of the tree, where the final result is value of the option.

Replicating portfolio

Binomial model is based on the principle of arbitration, claiming that the price of options should match the cost of creating alternative portfolio position, which will have identical effects on the financial investors. The model is based on the idea of creating risk free synthetic portfolio that is consisted of, in the case of call options on stocks, short positions in call option and long in stocks on the basis of which it is made, whereby the first fully covered by another.(Šoškić, 2001, 319). In the case of put options, the synthetic portfolio is made of short positions in put options and short positions in related assets. [1]

Mathematically it can be written, for call option:

$$V = H \cdot S - C \qquad (2)$$

Where is:

$$H = \frac{C_u - C_d}{S_u - S_d} \qquad (3)$$

And C is value of the call option at the time t_0, while C_u and C_d are values of corresponding call option price associated by the shift of property to the up and down. Expression (2) represents a risk-free portfolio, which rejects the risk-free yield, and is composed of H-related assets and the amount of call options issued to the related assets. In this sense, H is the number that shows how many units of property must be hold for each issued call option to date projections of growth and falling prices of related assets, if we want to have a risk-free portfolio. Starting from the probability of growth or decline of related assets prices, it is necessary to determine the risk-free portfolio that will produce the same outcome, regardless of whether it will happen the first or second situation.

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[1] Damodaran, A. *Real options: Facts and fantasy*, http://pages.stern.nyu.edu/~adamodar/pdfiles/execval/optval.pdf , (accessed 03 June 2010)

$$V \cdot (1+r) = V_u = V_d = HS_u - C_u = HS_d - C_d \qquad (4)$$

Solving system of equations for V, using expressions (3) and (4) and inserting in formula (2) and expressing C, formula for calculating the value of call options is:

$$C = \frac{C_u - C_d}{S_u - S_d} S + \frac{S_u C_d - S_d C_u}{S_u - S_d} (1+r)^{-1} \qquad (5)$$

The same logic can be applied to the valuation of put options. Specifically, the difference is reflected in the opposite position of the holder of the option by the related assets, in relation to the position of the holder of the call option, so the differences arise only in signs, i.e. $V=H\cdot S+H$, and still is:

$$X = \frac{S_d C_u - S_u C_d}{S_u - S_d} \cdot (1+r)^{-1} - \frac{C_u - C_d}{S_u - S_d} \cdot S \qquad (6)$$

where X – is value of put option at time t_0.

Probability of price movements of related assets

It has already been pointed out that the binomial model is based on only two possible prices outcomes of related assets in the next specific time point, while the probability that the price of related assets is going to the increase on S_u, is p, and is going to fall on the S_d, 1-p.

Starting from the expected return r, expected stock price can be calculated through a specified time interval. If we assume that:

$$S \cdot (1+r) = p \cdot S_u + (1-p) \cdot S_d \qquad (7)$$

Here is:

$$p = \frac{S \cdot (1+r) - S_d}{S_u - S_d} = \frac{1+r-d}{u-d} \qquad (8)$$

If we express S over S_u, S_d, r, p, from the form (7), and insert in the form (5), by rearranging it is obtained formula for calculating the value of call option (9).

$$C = \frac{1}{1+r}\left[p \cdot C_u + (1-p) \cdot C_d\right] \qquad (9)$$

Or, on the basis of the form (7), (8) i (9):

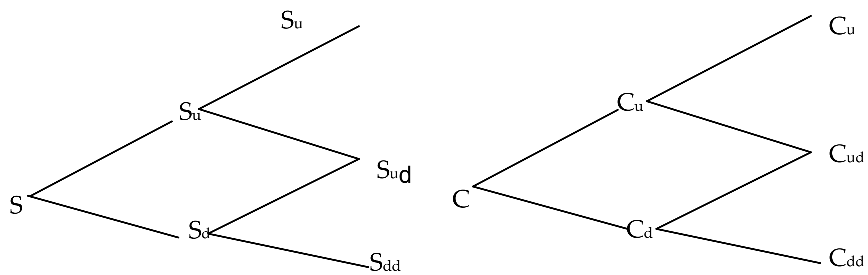
$$C = \left(\frac{1+r-d}{u-d}\right) \cdot \left(\frac{C_u}{1+r}\right) + \left(\frac{u-1-r}{u-d}\right) \cdot \left(\frac{C_d}{1+r}\right) \qquad (10)$$

Multioperiodic model

If one interval is divided into several smaller intervals, binomial model is going to extend. In the case that binomial tree has only two time intervals, initial price of related asset

S will match the value of call option C. After the first time interval, expected prices of related assets are S_u i S_d with corresponding values of call and put options C_d i C_u, and X_u i X_d.

Figure 2. Multiperiodic binomial model – price of related asssets and value of call option



Possible price of related assets, after the second interval, are: S_{uu} and S_{ud}, which are achievable in the case that after the first interval price of related assets has grown, and S_{du} and S_{dd}, which are achievable in the case that the price of related assets after the first interval has fallen, and corresponding values of option are C_{uu}, C_{ud}, C_{du} and C_{dd}.

Given that current price of call option from binomial tree with one interval is equal to:

$$C = \frac{1}{1+r}\left[p \cdot C_u + (1-p) \cdot C_d\right] \tag{11}$$

Expected valued of call options, in the end of first interval for expecting movement of price to upwards, is going to be:

$$C_u = \frac{1}{1+r} \cdot \left[p \cdot C_{uu} + (1-p) \cdot C_{ud}\right] \tag{12}$$

And for expecting movement to down:

$$C_d = \frac{1}{1+r} \cdot \left[pC \cdot_{du} + (1-p) \cdot C_{dd}\right] \tag{13}$$

If the previous expressions (12) and (13) are inserted in model of present value of call option, form (11), it is obtained the value of call option for binomial model with two intervals.

$$C = \frac{1}{(1+r)^2} \cdot \left[p^2 \cdot C_{uu} + 2p \cdot (1-p) \cdot C_{ud} + (1-p)^2 \cdot C_{dd}\right] \tag{14}$$

If model is being spread, from the number of periods with observed periods one to n, option pricing formula will take the form[2]:

$$C = \frac{1}{(1+r)^n} \sum_{k=0}^{n} \binom{n}{k} p^k (1-p)^{n-k} \max\left[Su^k d^{n-k} - K, 0\right] \tag{15}$$

[2] Benninga, S. et al. **The *Binomial Option Pricing Model***, http://finance.wharton.upenn.edu/~benninga/mma/MiER63.pdf, (accessed 03 June 2010)

This formula is recursive, it works backwards, starting from financial result of option on day of maturity.

Black-scholes model

The Black-Scholes Model is one of the most important concepts in modern financial theory. It was developed in 1973 by Fisher Black, Robert Merton and Myron Scholes and is still widely used today, and regarded as one of the best ways of determining fair prices of options.[3] Since the binomial model for pricing options converges on the Black-Scholes model, it is considered to be a special case of binomial model when the price process is continuous and the number of iteration is infinitive.[4] Still, the Black-Scholes model has not been derived from binomial. The model was established before the binomial.

The Assumptions of the Black-Scholes Model

There are several assumptions underlying the model:

- No dividends are paid out during the stocks life[5]
- Option can only be exercised on the expiration date (Therefore, it can only be used in valuing the European options, but not American)
- Markets are efficient which suggests that market movements cannot be predicted
- No commissions are charged while buying or selling options
- Interest rates remain constant and known (The model uses the risk-free rate in its calculations)
- Stock returns follow a lognormal distribution (The lognormal distribution is often used to summarize the probability of different price changes)

The Black-Scholes formula

The idea behind the Black-Scholes Model is hedging against the written call option with a risk-free portfolio. This portfolio is a replicating portfolio. If it is dynamically rebalanced it will always match the pay off on the call option that was written. Therefore, the present value of this portfolio equals the present value of the call option.

$$Value\,of\;call\,option = [delta \cdot share\;price] - [bank\;loan] \tag{16}$$

$$Value\,of\;call\,option = \Delta S_0 - bond_{zero,T} \tag{17}$$

ΔS_0 is the long position in stock. It is not an entire share of stock but a fractional share of stock signified by delta. This long position is combined with a short position in a zero-coupon bond maturing in the future on time T which is the same time when the call option that we wrote will be presumably exercised. The short positions quantity equals the strike price of the option K. But since the strike price is a price on the significant date in the future,

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[3] http://www.investopedia.com/terms/b/blackscholes.asp (accessed 1 Septmeber 2010)

[4] Calculating option value using binomial with an indefinite number of subperiods is too complicated.

[5] Merton altereted the standard Black-Scholes model to incorporate an annual dividend yield in the formula which made the model usefull for dividend paying stocks.

it is necessary to present value that strike price by discounting it with a discount rate r which is risk-free rate. Still the probability that option expiries in the money and will be exercised should also be considered. So the present value of the strike price is multiplied by $N(d_2)$, a cumulative normal distribution function which represents the probability of the option being exercised. So on the right side, beside ΔS_0 is a probability adjusted present value of the strike price:

$$Value\,of\ call\,option = \Delta S_0 - N(d_2)Ke^{-rT} \tag{18}$$

Also ΔS_0 needs adjustments. Just like with the short position, cumulative normal distribution function $N(d_1)$ is used. $N(d_1)$ represents delta (Δ) or how many fractional share of stock should be long.

$$Value\,of\ call\,option = N(d_1)S_0 - N(d_2)\cdot Ke^{-rT} \tag{19}$$

The previous formula is actually the Black-Scholes formula. Value of call option is usually singed by c. So here is complete Black-Scholes formula:

$$C = N(d_1)S_0 - N(d_2)\cdot Ke^{-rT} \tag{20}$$

Where

$$d_1 = \frac{\ln(\frac{S}{K}) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} \tag{21}$$

$$d_2 = d_1 - \sigma\sqrt{T} = \frac{\ln(\frac{S}{K}) + (r - \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} \tag{22}$$

C = value of call option
$N(d)$ = cumulative normal distribution function[6]
K = strike (exercise) price of the option
S_0 = current value of the underlying asset (price of the stock now)
T = life to expiration of the option
r = risk-free interest rate
σ = volatility of stock price and stock return rate (standard deviation)
e = exponential term (2.7183)
ln = natural logarithm

Using the same analogy, the Black-Scholes formula for put option is:

$$X = N(-d_2)Ke^{-rT} - N(-d_1)S_0 \tag{23}$$

Where is X = value of put option.

The value of option value depends upon a number of current stoke price, strike (exercise) price, time until expiration, risk-free interest rate and standard deviation σ .

[6] It is a probability that a normally distributed random variable will be less than or equal to d.

$$C = C(S_0, K, T, r, \sigma) \quad (24)$$

Standard deviation is critical variable in this model. The reason for this is that small changes in standard deviation cause significant changes of the option value.

Variables in the Black-Scholes Model

The call option value depends upon a number of factors:

- current stock price S_0
- strike (exercise) price K
- time until expiration T
- risk-free interest rate r
- standard deviation σ.

$$c = c(S_0, K, T, r, \sigma) \quad (25)$$

Current stock price

Higher the current stock price, higher the value of call option. The measurement of sensitivity of current stock price changes is delta. The Delta is a measure of the relationship between an option price and the underlying stock price.

$$\Delta = \frac{\delta c}{\delta S_0} = N(d_1) \quad (26)$$

Since the $N(d_1)$ is a probability, delta is a value between 0 and 1. For a call option, a Delta of 0.50 means a half-point rise in premium for every dollar that the stock goes up.

Gamma is sensitivity of Delta to unit change in the underlying. Gamma indicates an absolute change in delta.

$$\Gamma = \frac{\delta^2 c}{\delta S_0^2} \quad (27)$$

For example, a Gamma change of 0.150 indicates the delta will increase by 0.150 if the underlying price increases or decreases by 1.0. Results may not be exact due to rounding.

Strike (exercise) price

If the strike price increases, the value of a call option will decrease. However, the exercise price does not change, so this measurement has sense only in aspect of valuing the same option with different strike price for purpose of comparing.

Time until expiration

If the time until expiration is longer, the value of a call option is lower. Theta is sensitivity of option value to change in time. Theta indicates an absolute change in the option value for a 'one unit' reduction in time to expiration.

$$\theta = \frac{\delta c}{\delta T} \quad (28)$$

The Option Calculator assumes 'one unit' of time is 7 days. For example, a theta of -250 indicates the option's theoretical value will change by -.250 if the days to expiration is reduced by 7. Results may not be exact due to rounding.[7]

Risk-free rate

If the risk-free rate increases so will the value of a call option. Rho is sensitivity of option value to change in interest rate. Rho indicates the absolute change in option value for a one percent change in the interest rate.

$$\rho = \frac{\delta c}{\delta r} \tag{29}$$

For example, a Rho of .060 indicates the option's theoretical value will increase by .060 if the interest rate is decreased by 1.0. Results may not be exact due to rounding.

Standard deviation

Standard deviation is critical variable in this model. The reason for this is that small changes in standard deviation cause significant changes of the call option value. If standard deviation increases the value of call option will decrease. Vega is sensitivity of option value to change in volatility. Vega indicates an absolute change in option value for a one percent change in volatility.

$$Vega = \frac{\delta c}{\delta \sigma} \tag{30}$$

For example, a Vega of 0.090 indicates an absolute change in the option's theoretical value will increase by 0.090 if the volatility percentage is increased by 1.0 or decreased by 0.090 if the volatility percentage is decreased by 1.0. Results may not be exact due to rounding.

Advantages and limitations of the Black-Scholes Model

The main advantage of the Black-Scholes model is speed - it lets you calculate a very large number of option prices in a very short time.[8] Although understanding the model seems hard and complicated, using it is more than simple. Just a couple of mathematical and statistic operations and the value of call option has been calculated. The Black-Scholes model was designed to value options that can be exercised only at maturity and on underlying assets that do not pay dividends. However, in practice, assets do pay dividends, options sometimes get exercised early and exercising option can affect the value of the underlying asset. Adjustments exist. While they are not perfect, adjustments provide partial correction to the Black-Scholes model.[9]

Also, option prices are very sensitive to changes in volatility. Volatility however cannot be directly observed and must be estimated. Estimating volatility is a problem which is often solved by using historical data or already estimated volatilities for specific industries or even

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[7] http://www.optionseducation.org/advanced/volatility_greeks.jsp (accessed 1 September 2010)
[8] http://www.hoadley.net/options/BS.htm (accessed 5 September, 2010)
[9] http://pages.stern.nyu.edu/~adamodar/ (accessed 5 September, 2010)

companies. These last estimations are usually done by organizations and companies themselves mostly by using previous price behavior, in other word historical data.

Relation between binomial and Black-Schloes models

Inputs for Black-Scholes model, as a special variant of binomial model, can be used for approximation of factors u and d, using following equations:

$$u = e^{(r-\frac{1}{2}\sigma^2)\cdot\Delta t+\sigma\cdot\sqrt{\Delta t}} \tag{31}$$

$$d = e^{(r-\frac{1}{2}\sigma^2)\cdot\Delta t-\sigma\cdot\sqrt{\Delta t}} \tag{32}$$

Where Δt is one of N intervals during the period T in which price of related assets has been changed, while ohter symbols from edited equations are explained previously. By this approximation, probability of moving asset price to upward is determined by following expression:

$$p = \frac{e^{r\cdot\Delta t} - d}{u - d} \tag{33}$$

The project of producing healthy organic food

This part of the paper illustrates the appliance of presented methodology to the Project of Producing Healthy Organic Food. To show this methods practically, the project has to have an option of some kind. This project can be expanded by opening an organic restaurant which represents our call option. In this way organic food production has added optional value of restaurant which increases the value of the project. The net present value (NPV) of the project is calculated for the next five years.[10] The calculation includes only net cash flow per year and present cash flow per year using 12% discount rate and it is given in table

As seen in the table, the projects net present value is negative (NPV=-3.641,22 BAM). Using only traditional valuation methods this project would be considered unprofitable and would not be accepted. But as said before, traditional methods ignore the possibility of options. Now we will see the results of option based valuating methods. Opening an organic restaurant is an extension of the primary project of producing healthy organic food. The decision to vertically integrate and invest in a restaurant should be made 3 years after the start of producing healthy organic food.

[10] The five year calculation is given because this is agricultural project, and it is common for this kind of project NPV to be calculated for five years.

Table 2. Net Present Value calculation of healthy organic food production (in BAM[11])

Year of project	0	1	2	3	4	5
Net cash flow	-112.500	13.062,5	21.972,5	31.640,95	42.137,48	53.538,1
Present net cash flow (12%)	-112.500	11.662,946	17.516,342	22.521,404	26.779,131	30.378,958
Net present value (NVP)	**-3.641,22**					

Source: Authors' calculation

Total investment costs will be 250.000 BAMs, of which 150.000 will be provided by own funds and 100.000 by credit funds. These funds will be used for the object itself, construction and interior, equipments and craft resources. This calculation is given for 10 years, during which the income raises by 3% mostly because the potential customers number is expected to grow by 5-10%.[12] Also, the goal is to double the sales of first year in the third year. This will enlarge the material costs which will be rising by the year. Costs such as payroll, marketing, sales and other expenses are rather constant.

The net cash flow, present net cash flow, and net present value of the restaurant project are given in Table 3. Used discount rate is also 12%.

Table 3. Net Present Value calculation of organic restaurant project (in BAM[13])

Year of project	0	1	2	3	4	5	6	7	8	9	10
Net cash flow	-250.000	47.750	56.750	65.977	75.437	85.138	95.087	105.291	115.758	126.496	137.513
Present net cash flow (12%)	-250.000	41.522	42.911	43.381	43.131	42.329	41.109	39.583	37.842	35.958	33.991
Net present value (NPV)	**151.756**										

Source: Authors' calculation

Net present value of this project is positive, therefore the project is acceptable. Net Present Value is 151756 BAMs, which is a very high NPV since it represents 60,7% of initial investment. Traditional methods can only calculates NPV of these projects, but fail to show correlation between them. The next part of this paper will show the value of organic food production project, but with an existing option of organic food restaurant project.

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[11] BAM is international code for Bosnia and Herzegovina convertible mark, 1€=1,95583BAM.

[12] http://www.bplans.com/organic_restaurant_business_plan/market_analysis_summary_fc.cfm (accessed 5 September, 2010)

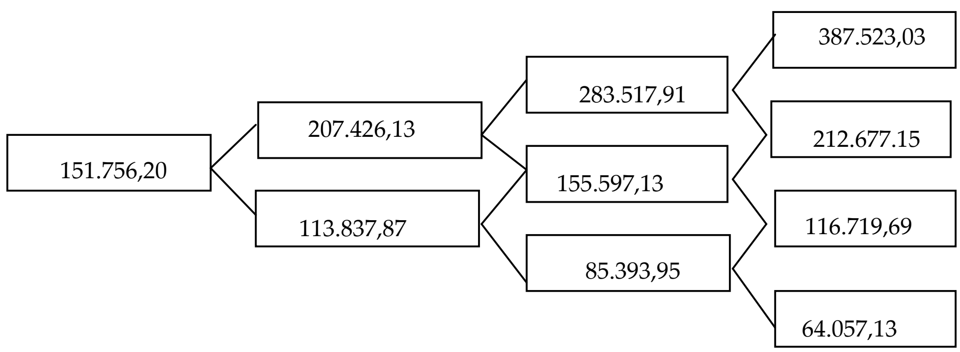
[13] BAM is international code for Bosnia and Herzegovina convertible mark, 1€=1,95583BAM.

Values of variables for Black-Scholes calculation are strike price $K = 250.000$ BAMs, current stock price $S_0 = 151.756$ BAMs and time to expiration $T = 3$ years. Estimated risk-free rate in Bosnia and Herzegovina is 6%. The variable which has the most influence on the result is the one which is also the hardest to predict – standard deviation. Based on world calculation of volatility for different kind of industry, standard deviation for food industry is 30%.[14] Inserting the above data in formulas (21) and (22), we calculate the values of d_1 and d_2 and based on that the values of $N(d_1)$ and $N(d_2)$:

$$d_1 = -0{,}3582761$$
$$d_2 = -0{,}8778914$$
$$N(d_1) = 0{,}360068311$$
$$N(d_2) = 0{,}190001322$$

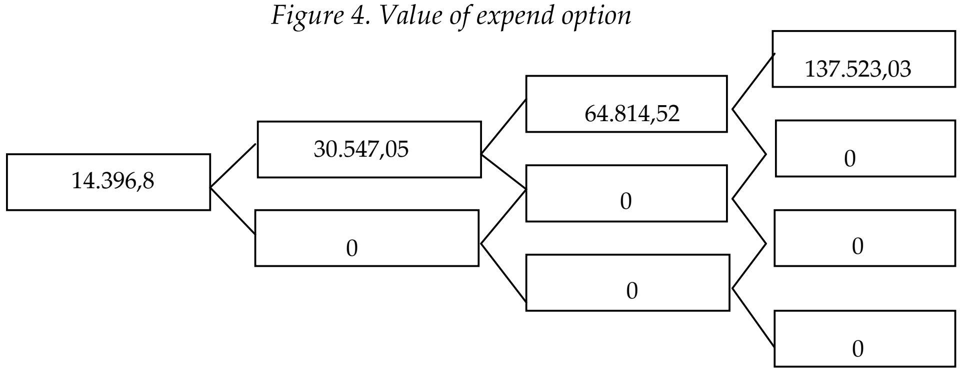
Using known inputs, calculated inputs and formula (20), the value of call option, according to Black-Scholes is 14.967,13 BAMs. Binomial model gives similar results. According to the equations (31) and (32), we have calculated u and d factor for binomial model and they are 1,37 and 0,75 respectively.[15] Next figure presents possible value of optional project in next three years.

Figure 3. Possible value of healthy organic restaurant project



In the next phase, according to described methodology, value of expend options is calculated. Value on first node is value of option and it is 14.396,8 BAMs.

Figure 4. Value of expend option



[14] www.business-spreadsheets.com

[15] We assumed that $\Delta t = 1$, it means that there is only one period each year.

Strategic value of the Project of Producing Healthy Organic Food by traditional, Black-Scholes and binomial model is presented in next table:

Table 4. Value of project of producing healthy organic food

	Traditional approach	**Modern approach**	
		Black-Scholes model	**Binomial model**
Value of the project	-3.641,22	11.325,91	10.755,53
Investment decision	Not accepted	Accepted	Accepted

Source: Authors' calculation

Conclusion

Evaluation efficiency of capital investment without optional approach, i.e. without taking into account real options, is not realistic and realiable basis for making investment decisions. Presented project of producing healthy organic food is the example which can serve for better understanding of real options and their valuation, but also it points out to necessity of using an optional approach to the evaluation of investment projects, as an additional tool to conventional valuation methods. Indeed, these traditional methods evaluated the project of producing healthy organic food as unacceptable, with a net present value of -3641.22 BAMs. The option of extending of this project to projects of healthy food restaurant is evaluated by modern methods, by Black-Scholes and binomial model. According to Black-Scholes model, value of project is 11.325,91 BAMs, and according to binomial is 10.755,53 BAMs.

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APSTRAKT *– Cilj ovog rada je da prikaže mogućnosti primene opcionog pristupa prilikom vrednovanja investicionih projekata, kao i novi teorijski i metodološki okvir analize investicija za proizvodnju i prodaju zdrave organske hrane.*

Za razliku od tradicionalnih metoda procene, ovaj novi, kompleksni pristup obezbeđuje fleksibilno upravljanje i mogućnost prilagođavanja (korigovanja prethodnih odluka) u skladu sa okolnostima na tržištu. U svetlu dramatičnih promena i narastajućih rizika i neizvesnosti prilikom investicionog odlučivanja, neophodno je dopuniti tradicionalni pristup opcionim, u cilju racionalnije alokacije resursa. Neophodnost korišćenja opcionog pristupa ogleda se u činjenici da rezultati procene vrednosti projekata u skladu sa tradicionalnim i modernim pristupom mogu biti kontradiktorni.

Ovaj rad predstavlja Black-Scholes i binomni model model vrednovanja opcija, i primenu opcionog vrednovanja ilustrovanu na proizvodnji i prodaji zdrave organske hrane i restorana zdrave hrane kao dodatne delatnosti. Dok su tradicionalni pristupi vrednovanja investicionih projekata procenili projekat za proizvodnju zdrave organske hrane neprofitabilnim, opcioni pristup pokazuje da je ovaj projekat prihvatljiv, što potvrđuje značaj ovog pristupa.

KLJUČNE REČI: *realne opcije, fleksibilnost, rizik, neizvesnost, vrednovanje projekata, organska hrana*

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