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The real options approach for assessment of business opportunities in spelt processing

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The latest developments in investment analysis offer a number of valuable insights into possible ways of evaluating investment opportunities, encountering the weaknesses of net present value criterion. More specifically, irreversibility, uncertainty and the choice of timing are conditions that Net Present Value does not include but they alter the investment decision in a determinant way. By employing contingent claims analysis in tangible investments better assessment results can be derived. In this paper, an emphasis is made to modify the Net Present criterion by incorporating the real options approach. Its application is demonstrated in an organic spelt production and processing. The Net Present Value indicates that the decision of a spelt processing for animal fodder is unfeasible (NPV_t = - 1.144,84 €) while the real options approach differentiates the results by organic spelt grain production for human nutrition (strategic real option of spelt grain, NPV_{SRO} = 127.96 €). The conclusion is that the real options approach can be proved useful when assessing projects with uncertainty and irreversibility and it can provide a new way of examining agricultural investment decisions.

Key words: real options, Net Present Value Analysis, Black-Scholes model, organic spelt processing

INTRODUCTION

Farmers will decide to invest in a new technologies and implement new practices only if the investment is provided as profitable one. In this respect, defining the most suitable processing of organic spelt and their effectiveness of economical and financial point of view will provide essential information to the farmers. Farmers constantly face questions such as: whether to invest in a new production with more risk or to continue the present production without new types of risks and uncertainties. The most common way to evaluate a new business or an investment opportunity is to use traditional discounted cash flow methods (Gittinger 1986; Turk 2001; Pažek et al. 2006; Rozman et al. 2006). Several researchers argue that Net Present Value (NPV) is not adequate under uncertain conditions. Furthermore, the NPV analysis typically considers projects to be irreversible, i.e. it does not allow for corrective actions to be taken, and only immediate accept-or-reject decisions are allowed (Dixit and Pindyck 1994; Collins and Hanf 1998; Arman and Kulatilaka 1999). To make suitable investment possibilities, investor-farmer need to consider the value of keeping their options open and include the impact of various sources of uncertainty and risk attitudes. For the economic evaluation, contingent claim analysis will be used to define the optimal investment threshold under the major risks and uncertainties that farmers face from the adoption of new business production systems. Real option models, first introduced by Brennan and Schwartz (1985) and McDonald and Siegel (1985) and popularized by Dixit and Pindyck (1994), have been so far mainly normative models of the strategic and operating flexibility in capital budgeting decisions under uncertainty. Real options analysis allows making better investment decisions as the value of flexibility of an investment into the initial evaluation of that investment can be incorporated. Theoretical advances in real options methodology have been rapidly formulated and assimilated in several empirical applications. However, only a few studies implement real options in agriculture. Tzouramani and Mattas (2004) examine the effects of income variability upon the decision on adopting or not environmental friendly production systems in order to evaluate the organic financial incentives to farmers by introducing the real options methodology. Purvis et al. (1996) try to examine the technology adoption of a free-stall dairy housing under irreversibility and uncertainty and its implications in the design of environmental policies. Ekboir (1997) analyzes the investment decisions of an individual farmer under risk in the presence of irreversibility and technical change. Winter-Nelson and Amegbeto (1998) present a model of investment under uncertainty to analyze the effect of variability of prices on the decision to invest in conservation with application to terrace construction. Price and Wetzstein (1999) develop a model for determining optimal entry and exit thresholds for investment in irrigation systems when there is given irreversibility and uncertain returns with price and yield as stochastic variables. Tegene et al. (1999) present a model for the investment decision to convert farmland to urban as an irreversible investment under uncertainty when use of this land is restrict-

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ed by government policies so as to protect the environment. Khanna et al. (2000) analyze the impact of price uncertainty and expectations of declining fixed costs on the optimal timing in site-specific crop management. Musshoff and Odening (2005) explore the potential of the real options approach for analyzing farmers' choice to switch from conventional to organic farming. The appliance of real options evaluation is showed on model of plum and plum brandy as an extension. The research implies that plum plantation has an option value (call value) regarding extension to plum brandy production. This option was determined using the most frequently used option valuation method - Black-Scholes model (Hadelan et al. 2008).

In this paper an emphasis is made to elaborate the decision making process in evaluating investments into organic spelt processing business alternatives using elements of the real options methodology. It is also emphasis to assess the effectiveness of investment on organic farming. Three most frequent investment options have been evaluated, an organic spelt production for the animal fodder versus an organic husked spelt for human nutrition as a spelt grain and spelt flour. This study focuses on the impact of Net Present Value (NPVt) as a decisions parameter by investment decision in the framework of Cost Benefit Analysis (CBA) and real options model (Black-Scholes model).

The paper is organized as follows. In the first part the theoretical background of the applied methodology is presented, followed by presentation of its application in case study. In the second part the results for the individual business alternatives for organic spelt processing are presented and discussed. Ultimately, the paper highlights the importance of incorporating the real options approach in agricultural investment evaluations and further usefulness for policy implications by decision making.

MATERIALS AND METHODTS

The traditional Net Present Value (NPVt) Analysis versus real options approach

The preferred approach to evaluate investments is to use the Net Present Value (NPV) Analysis. For an investment of t periods that is written as:

$$NPV_t = - I + \Sigma\ SP - SS\ /\ (1 + r)^t \qquad (1)$$

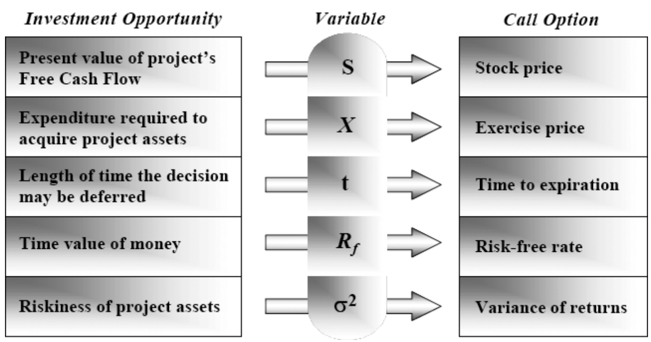
Where:
NPVt - Net Present Value (€)
I - investment costs (€)
SP - total revenue (€)
SS - total costs (€)
r - interest rate (%)
t - time - number of years (Turk and Rozman, 2002).

With isolation of cash costs from enterprise budgets the annual cash flows are estimated, representing a basic input parameter for computation of NPVt. In Equation 1, the aggregate benefits SP and the aggregate costs SS are annually summed and discounted to the present with the selected discount rate r. If the sum is positive, investment generates more benefits than costs to the project manager (in our case the farmer) and vice versa if the sum is negative. If the NPVt of the investment after discounting is positive then this investment is better than the alternative earnings. However, in the continuation the concept of options will be introduced how the real options can be appended to the basic NPVt model.

The real options approach has become an increasingly standard framework for investment timing decisions (Morgan et al. 2007). To illustrate the real options methodology, two examples of developed real options model organic spelt processing output are presented. For this purpose the Black-Scholes model for organic spelt processing business alternatives was developed.

Black-Scholes method (BS)

Real option describes an option to buy or sell an investment in physical or intangible assets rather than in financial assets. Thus any corporate investment in plant, equipment, land, patent, brand name, etc can be the assets on which real options are written. Many investment projects have call and out option features. Also the investments could be evaluated as real options. However, as shown in Figure 1, the investments (real) opportunity could be treated analogically as financial options. The value of real options is described by the best known Black-Scholes option model (BSOPM) (Rovčanin 2005). The BS model is one of the most outstanding models in financial economics. The BSOPM may be used to value real options. Myron Scholes and Robert Merton who developed a similar model independently received the Nobel Prize in economics for the model.



Source: Leuhrman (1998)

Figure 1. The link between investments and Black-Scholes inputs

The BSOPM based on stochastic calculus is as shown below:

$$OV = SN(d_1) – X / e^{-rt} N(d_2) \quad (2)$$

$$d_1 = [\ln(S/X) + (r + ½ σ^2) * t] / σ\sqrt{t} \quad (3)$$

$$d_2 = d_1 - σ \sqrt{t} \quad (4)$$

Where:
- OV - option value (€)
- S - present value of cash flows from optional investment (€)
- d1 - lognormal distribution of d1
- d2 - lognormal distribution of d2
- X - investment expenditure (€)
- r - annual risk free continuously compounded rate (%)
- σ - annualized variance (risk) of the investment's project
- t - period until investment (years)
- e-rt - the exponential term (2,71828)

$$\text{Option value} = SN(d_1) – \text{present value of X times } N(d_2) \quad (5)$$

N(d1) and N(d2) represent the probability distributions. Values of N(d1) and N(d2) are obtained from normal probability distribution tables. They give us the probability that S or X will be below d1 and d2. In the BS model they measure the risk associated with the volatility of the value of S.

However, the strategic real options of investments project is calculated using the Black-Scholes methodology and is provided as:

$$NPV_{SRO} = NPV_t + OV \quad (6)$$

Where:
NPV_{SRO} - strategic real option (€)

The strategic real options and Black-Scholes model are less used in agricultural practice. To explicate the applicability of NPV_{SRO} and BSOPM model in agricultural investments and present its results, the case study was performed.

Case study

In the paper we illustrate the application of the presented methodology in the context of organic farming; the spelt production and processing for animal fodder which is a real option to undertake production and marketing of two interested products in human nutrition, husked spelt grain and spelt flour. A small organic part time-farm (4 hectares of arable land) in north eastern Slovenia was considered in order to compare spelt processing investment projects using the presented methodological approach. The farm regularly includes spelt wheat in its crop rotation. The annual area of spelt wheat is, according to crop rotation rules, limited to 1 hectare with average yield of 2500 kg unhusked spelt grain. The service of husking and milling the grain is outsourced by the farmer. He used the spelt for animal fodder, but the alternative option considered in this model is to sell spelt grain and spelt flour to individual customers.

RESULTS AND DISCUSSION

The identified business alternatives are evaluated using a specially developed simulation models in Excel spreadsheet environment. Basic production data and calculated economical parameters for individual business alternatives are presented in Table 1.

Table 1. The simulation model results for the planned spelt processing projects on a sample farm

Business alternative	Products quantity (kg)	Total costs (€)	Total revenue (€)	Coefficient of economics
Husked spelt (animal fodder)	1.470	504	779	1.44
Husked spelt grain (human nutrition)	1.470	1.238	3.675	2.97
Spelt flour	1.176	1.405	3.293	2.34

Based on discounted cash flow methodology, the traditional net present value (NPVt) criterion is used extensively in assessing an investment opportunity for three analyzed spelt products (Table 2). The results are calculated under the assumption of successful product selling at the expected prices. The estimated production levels were calculated on the basis of the annual spelt production area. As shown in Table 2, CBA analysis shows positive net present values for processed spelt for human nutrition (spelt grain and spelt flour). The highest NPVt was observed for husked spelt grain (NPVt = 8.089,69 €). The relatively high estimated NPVt for spelt grain can be explained by high prices, achieved in the market. The lowest NPVt was calculated for spelt grain for animal nutrition and is expected (the price on the market is compared to husked spelt grain for human nutrition lower, but on the other hand the basic production costs are the same as by processed spelt grain). The investment return period is the lowest for husked spelt grain, followed by spelt flour.

Table 2. Financial CBA analysis of the planned spelt processing projects on a sample farm (after 5 years, discount rate = 5%)

Product	Investment costs (€)	Annual cash flow (€)	Net Present Value traditional (€)	Investment return period (years)
Spelt grain (animal nutrition)	2.092,05	237.24	- 1.144,84	16
Spelt grain (human nutrition)	2.092,05	2.550,08	8.089,69	1
Spelt flour	2.092,05	1.989,03	5.849,55	2

However, the results of traditional CBA shows financial feasibility by spelt grain (human nutrition, NPVt = 8.089,69 €) and spelt flour (NPVt = 5.849,55 €). As expected, the investment into spelt grain for animal fodder is financial unfeasible (NPVt = - 1.144,84 €) and investment return period is unsuitable. The results of traditional Net Present Value for spelt grain production (animal fodder, NPVt = - 1.144,84 €) presents the base for calculation of strategic real option of spelt grain (for human nutrition) and spelt flour. However, the results of real options approach show more favorable picture from farmers' perspective. The risk-free rate and variance of the investment's project were defined deterministic. To illustrate the real options methodology, we present two examples of our real options model output. In the first part of Tables 3 and 4 the parameters used in the real options model calculation for the spelt grain and spelt flour production are demonstrated. In the second part of the Table 3 and 4 there are calculated simulation models results for real options calculation.

Table 3. Descriptions and values of parameters for the real options model for spelt grain (human nutrition)

Parameters description	Value
Present Value of cash flows from optional investment	2.550,08 €
Investment expenditure	2.092,05 €
Exponential function	2.71828
Risk-free rate	8%
Period until investment (years)	5
Variance (Risk) of the investment's project	30%
d1	1.226828577
d2	0.556008184
Lognormal distribution of d1	0.890056486
Lognormal distribution of d2	0.71089737
Option value of spelt grain (human nutrition)	1.272,80 €
Strategic real option of spelt grain for animal nutrition (processing of spelt grain for human nutrition)	127.96 €

As seen in Table 3, option value for husked spelt grain, calculated by Black-Scholes methodology, is 1.272,80 €. The strategic real option of spelt grain (animal nutrition) is a positive value, 127.96 €. The results of the application of BS methodology by analyzed farm business alternative showed the interest in investment project (strategic real option = 127.96 €).

The Figure 1 presents all calculated NPV values for husked spelt grain production. As shown in Figure 1, option value and strategic real option of husked spelt grain for human nutrition based on calculation of Cost Benefit Analysis and traditional NPV Value (NPVt = - 1.144,84 €).

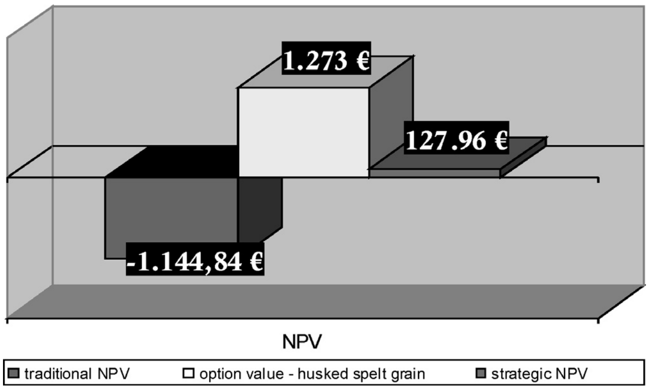


Figure 1. The comparison between traditional NPV, option value and strategic NPV for husked spelt grain

Table 4. Descriptions and values of parameters for the real options model for spelt flour

Parameters description	Value
Present Value of cash flows from optional investment	1.989,03 €
Investment expenditure	2.092,05 €
Exponential function	2.71828
Risk-free rate	8%
Period until investment (years)	5
Variance (Risk) of the investment's project	30%
d1	0.856414774
d2	0.185594381
Lognormal distribution of d1	0.804115802
Lognormal distribution of d2	0.57361857
Option value of spelt flour (human nutrition)	795.00 €
Strategic real option of spelt grain for animal nutrition (processing in spelt flour)	- 349.84 €

The results of analyzed farm business alternative (spelt flour) indicate that the calculated option value is 795.00 €. According to the option value calculation, the strategic real option of spelt grain for animal nutrition and further processing into spelt flour is a lower value, in analyzed case a negative value (- 349.84 €). Under the model assumptions, the spelt flour production option is unsuitable for the farmer.

However, in Figure 2 all calculated NPV values are clearly presented. On the basis of calculated data with BS methodology it can be concluded, that the second business alternative (spelt flour) for the farmer is not the most appropriate option.

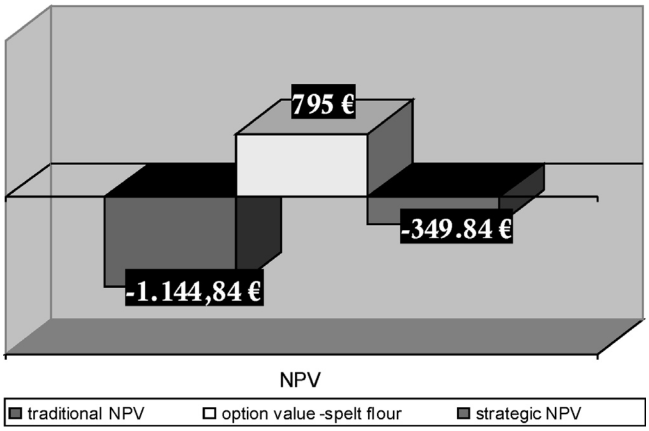


Figure 2. The comparison between traditional NPV, option value and strategic NPV for spelt flour

CONCLUSIONS

The application of discount cash flow approach in agriculture is not always the appropriate way to decide if an investment project is feasible or not. In this work, an attempt was made to employ a real options approach to evaluate the spelt processing business alternatives on an organic farm. The general implication from this empirical analysis is that risk and uncertainty play an important role in farmers' decision to adopt a new organic spelt processing business alternative that is more appropriate and feasible for the farm. Empirical results reveal that the production of spelt flour versus spelt grain (for human nutrition) is not advisable for the analyzed farm. However, Black-Scholes methodology is widely used in practice, since it is easy to calculate and it explicitly models the relationship of all the variables. The model results are often useful in practice and helpful in setting up hedges in the correct proportions to minimize risk. Even when the results are not completely accurate, they serve as a first approximation to which adjustments can be made.

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