Original Contribution

UNCERTAINTIES SURROUNDING INVESTMENTS IN AGRICULTURAL LAND IN BULGARIA AND SOLUTION USING A REAL OPTIONS APPROACH

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ABSTRACT

The Bulgarian land market has been under development for the past 15 years. Many of the actual owners have got back their land but the problems with land market, land pricing and opportunity to invest in agricultural land still exist. At the moment, sale transactions in Bulgarian land exist only between the Bulgarian citizen and companies. However, Bulgaria's membership of the EU would make it possible for foreigners to buy Bulgarian land. The relevant issue arising from this anticipated change of policy would be the influence this would have on any resulting opportunities for sale or investment in Bulgarian land. All these uncertainties put together formed the purpose of this paper, which is, to demonstrate the utility of the real options approach to agricultural land investment analysis. The main objectives are to calculate option values of some selected real options and to show how these could manage uncertainty in the investment process.

Key words: Investments, Agricultural Land, Real Options Approach

INTRODUCTION

Since the last decades many authors have discussed opportunities for implementation of Real Options Theory in different fields including agricultural land investments[1]. Dixit and Pindyck (1994), Trigeorgis (1995), Pederson and Khitarishvili (2002) suggested the use of real options methodology to solve problems with valuation and uncertainty. In land market under development as in Bulgaria these problems are the most important. The main aim of an application of real options for investments in Bulgarian agricultural land, is to evaluate flexibility and to set decision rules.

As a part of investment decision process, the investments in agricultural land possess three important characteristics formulated by Dixit and Pindyck (1994): irreversibility, uncertainty and timing of investments. Traditional methods of evaluation provide simple rules but they do not include value of flexibility (Pederson and Khitarishvili, 2002, p. 157). In real life project owners of land and potential investors have opportunity to manage the way of use (to switch use) and time of contracting. They have the opportunity to increase their efficiency when they receive new information. An application of real options approach adds value of managerial flexibility to both sides: demand and supply of agricultural land.

There are some good incentives for investment in agricultural land. If the land is used for farming the evaluation of the land should consist of trend of land prices and expected future incomes. The volatility of prices of Bulgarian agricultural land is high (**Figure 1**) as calculated volatility from historical price data is 44,04% per year[2]. In pre-accession period to EU the expectations in Bulgaria are for the land prices to go up. Increase of prices depends on some factors: land prices in European countries, direct payments (according to the Common Agricultural Policy), increase of efficiency of use due to new technologies, etc. Maybe one

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[1] Types of real options and their applications are summarised by Trigeorgis (1995) p. 3.

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[2] The calculated volatility is of weight average national prices. The volatility of land prices by regions is high. For example in year 2004 the price in different regions is from 461 to 2378 Euros/Hectare.

of the most important factors is the possibility of Bulgarian land becoming property of

foreign citizens.

Figure 1. Weight Average Prices of Bulgarian Agricultural Land [3]
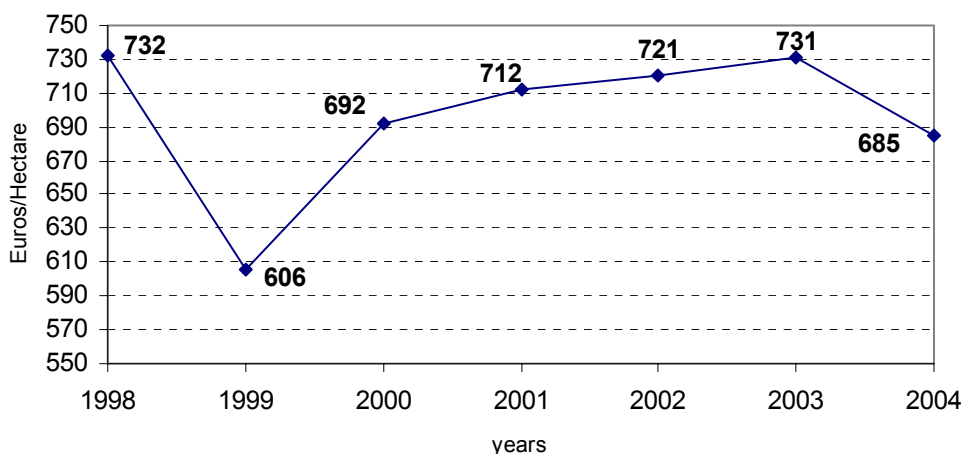
During Socialist times the government ruled Bulgarian land[3] in various ways. After the reforms, the management of land has been restored to its real owners. A lot of problems (huge number of landowners, small separated plots and so on) have not been solved yet but the process has almost finished. According to Bulgarian law, only Bulgarian citizens and companies can own Bulgarian land. Foreign people can establish Bulgarian company and buy land but it is an exception. The expectations for Bulgaria as a member of the EU are to amend this law and in the years 2012-2013 to allow foreign citizens to buy and own Bulgarian land. The questions are how to estimate the option of foreigners to buy Bulgarian land and the value associated with landowners in the waiting period to sell these lands. An application of Real Options Theory can give simple answers.

METHODOLOGY

The application of real options approach for investments evaluation of agricultural land comprises two steps. The first step is identifying and defining real options. The second step includes establishment of mathematical representation, selection of solution method and option calculator (Amram and Kulatilaka, 1999, pp. 108-122). This paper considered two widespread methods for option valuation: Binomial tree and Black & Scholes equation.

Binomial Tree Solution

This model is based on a representation of the evolution of the price of underlying asset until exercising of option. For each period, there are two possible moves of the price of underlying asset (A): to move up (u) with probability p and to move down (d) with probability (1-p) **(Figure 2).**

Expected rate of return (e) obtaining risk-free rate of interest (r) with market volatility (σ) is[5]:

$$\frac{pAu + (1-p)Ad}{A} = e^r$$

To observe normal distribution, the equation of the variance of return is:

$$pu^2 + (1-p)d^2 - [pu + (1-p)d^2] = \sigma^2$$

The movements up and down are symmetrical:

$$u = e^\sigma; \ d = e^{-\sigma}$$

$$p = (e^r - d) / (u - d)$$

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[3] The used data do not include the years before 1998 because of huge inflation in 1997 and supervened currency denomination and currency board. After it, Bulgarian currency (BGN) has been fixed to the Euro, as currency exchange rate has been 1,95583.

[4] The forms of management were changeable during the years (Agro-Industrial Complexes (AICs), Labour agricultural cooperatives (TKZSs), State agricultural farms (SAFs), and so on) but in the origin were public.

[5] The methodology follows Amram and Kulatilaka, 1999, pp. 108-122.

Black&Scholes Solution

Black and Scholes formula was developed to evaluate European call option (Black and Scholes, 1973). The equation is:
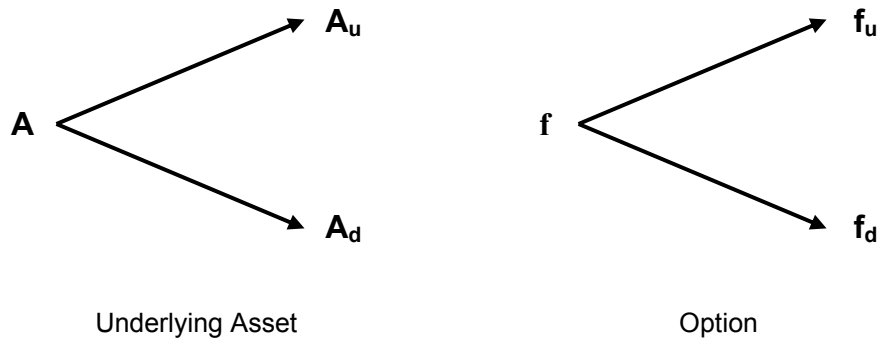
$$C = SN(d_1) - Ke^{-r_fT}N(d_2)$$

C – current value of call option
S – current value of underlying asset
K – cost of investment
r – risk-free rate of return
T – time to expiration

σ – volatility of underlying asset
N (d_1) and N (d_2) are the value of normal distribution at d_1 and d_2

$$d_1 = \frac{ln\left(\frac{S}{K}\right) + \left(r_f + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Figure 2. Possible Moves of Price of the Underlying Asset and the Option

Underlying Asset   Option

RESULTS AND DISCUSSION

Bulgarian landowners have some opportunities: "Sell now" or "Wait for n years". The value of waiting can be evaluated as American put option. Data inputs are: current price 685 Euro, Exercise price 1000 Euro, Time to expiration 8 years, volatility 44,04%, risk-free interest rate 5%. The movement of the land prices is shown in **Figure 3**. The value of option follows price of underlying asset (**Figure 4**).
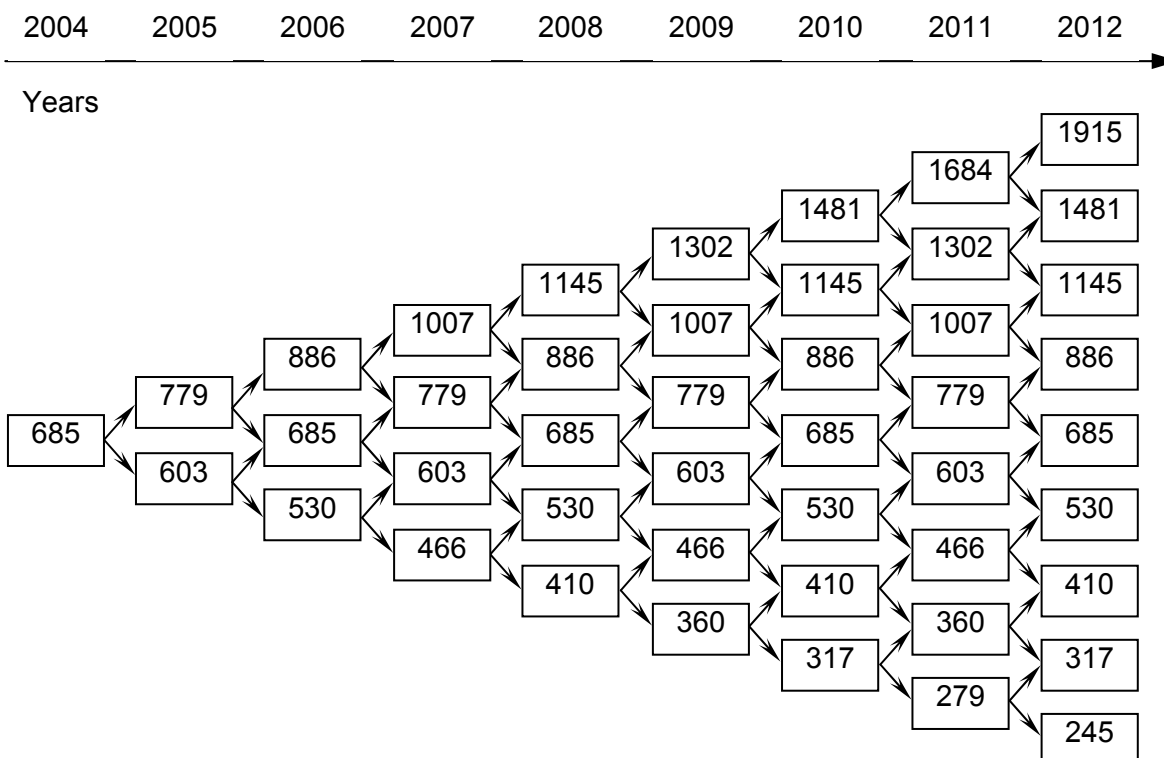
Figure 3. Possible Distribution of Land Prices
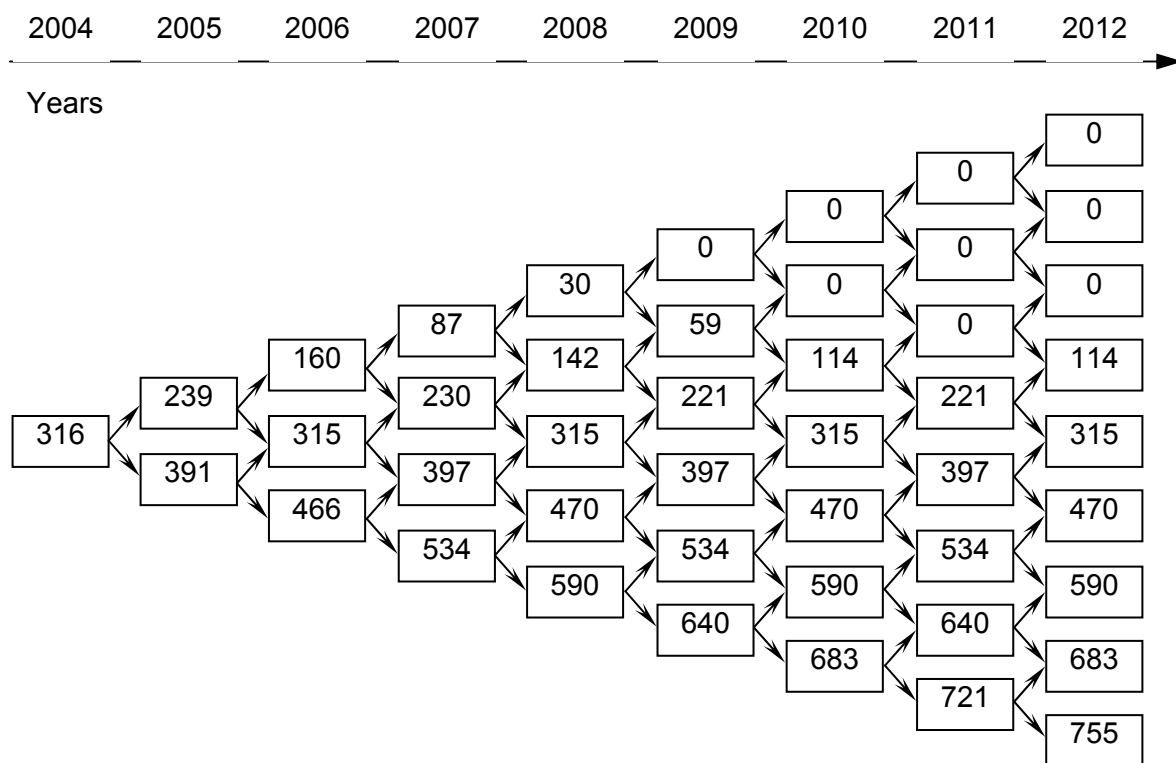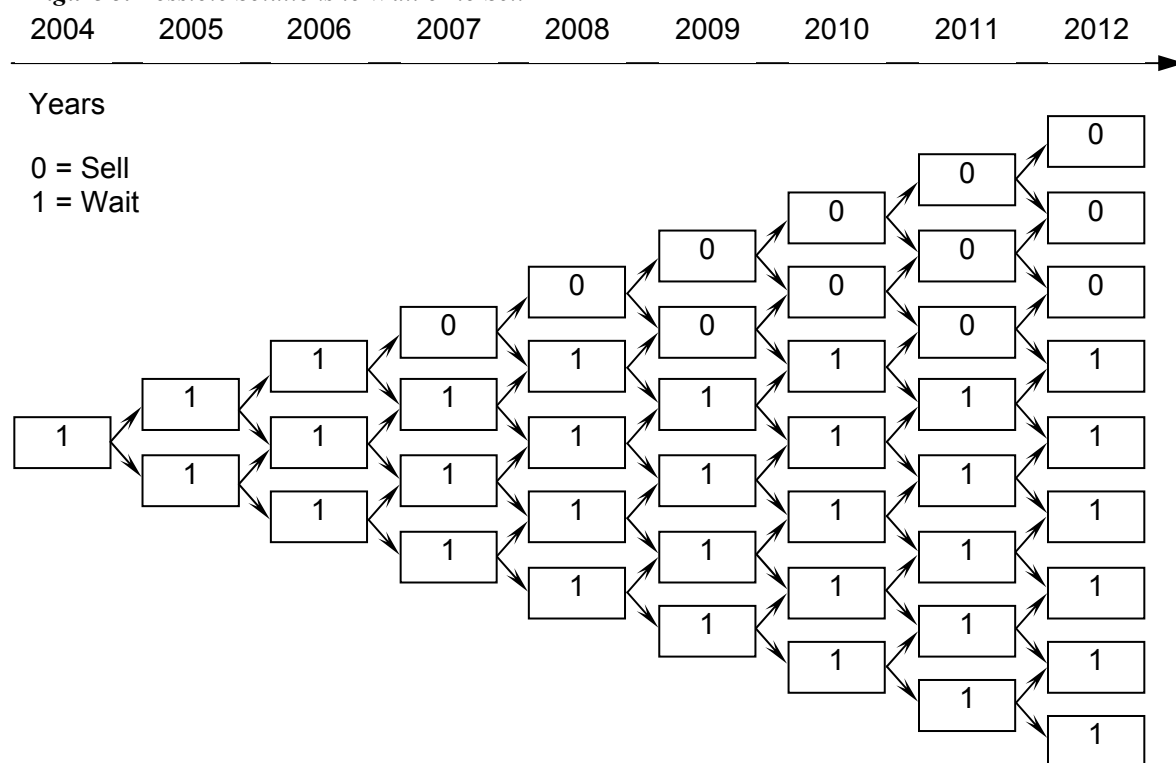
Figure 4. *Values of Option to Wait*

| 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |

Years

```
                                                                        0
                                                                0
                                                        0               0
                                                59              0        0
                                        30              114     0
                                87              221             221      114
                        160             142     315            315       315
                239             230     315     397    470     397       470
        316             315     397    397     315     470    534        534
                391             470    221     590     315    640        590
                        466     534    397     534     470             683
                                590    640     590                     721
                                               683                      755
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Figure 5. *Possible Solutions to Wait or to Sell*

| 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |

Years

0 = Sell
1 = Wait

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                                                                        0
                                                                0
                                                        0               0
                                                0               0        0
                                        0               1       0
                                1               1       1       1        1
                        1               1       1               1        1
                1               1       1       1       1       1        1
        1               1       1       1       1       1       1        1
                1               1       1       1       1       1        1
                        1               1       1       1               1
                                1       1       1                       1
                                               1                        1
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Possible solutions to Wait or to Sell are shown in **Figure 5**. It shows that Bulgarian landowners can exercise the option before the year 2012 (for example in 2008 or later). Possibility of foreign citizens to buy Bulgarian agricultural land is European call option. Black and Scholes equation is an easy way to evaluate this real option. The data inputs are the same as in Binomial tree solution: current price 685 Euro, exercise price 1000 Euro, time to expiration 8 years, volatility 44,04%, risk-free interest rate 5%. The calculated parameter d_1 and d_2 are: 0,64 and -0,61. The value of option to buy Bulgarian land in 2012 is 324 Euros.

CONCLUSIONS

Increase of price of Bulgarian agricultural land depends on the following factors: land prices in European countries, direct payments (according to Common Agricultural Policy), increase of efficiency due to new technologies and probably the possibility for Bulgarian land to be owned by foreign citizens.

Bulgarian landowners could sell at higher prices before amendments in the Land Act. Foreign citizens could buy land in two different ways: to establish their own company in Bulgaria or to wait for the law to be amended.

The value of waiting for sale or buy agricultural land can be estimated by real options methodology. It gives clear rules and evaluates managerial flexibility.

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