THE PRICE OF AGRICULTURAL LAND IN BULGARIA – SELECTED FACTORS

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ЦЕНАТА НА ЗЕМЕДЕЛСКАТА ЗЕМЯ В БЪЛГАРИЯ – ИЗБРАНИ ФАКТОРИ

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Abstract

The main goal of the report is to build a model to highlight the significant factors affecting the price of agricultural land in Bulgaria. Panel data for 9 years and 25 districts were used. Fixed-effect panel regression and stepwise regression were applied. The empirical results prove that the price of agricultural land in Bulgaria, for the considered period, is influenced by: the relative share of households with access to the Internet, the length of first-class roads and the average annual salary of employed persons. The existing differences in the variables by area also have a strong influence.

Key words: agricultural land price, factors, stepwise regression, panel regression, fixed effect model

JEL: C23, Q11, Q15

1. Introduction

Agricultural land is the main and indispensable factor for agricultural production. Together with its limitations as a natural resource, the issues and problems related to determinants influencing its price are the subject of intensified controversy in the economic literature and do not lose their relevance in the present, and are likely to have a corresponding projection in the future. The main goal of the report is to build a model to highlight the significant factors affecting the price of agricultural land in Bulgaria.

Agricultural land, in addition to its value and irreplaceability, has another important characteristic, namely dispersion. This feature is related to the influence of a set of heterogeneous factors, arising and changing depending on the specific location. For this reason, in order to conduct a worth scientific study, it is necessary to group the data ensuring maximum consideration of any spatial difference. For the territory of Bulgaria, it is expedient for the data to be differentiated by districts, as at the level of geographical areas the aggregation is large. In addition, for the purposes of the present study, at the district level, the geographical features of the

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land parcels can be distinguished well enough. The time scope of the study is limited to nine years (2010–2018), in order to avoid disturbances in the agricultural land market, as a result of the Covid-19 pandemic.

2. Materials and methods

In recent years, agricultural land prices in Bulgaria have risen at record levels (The Price of Agricultural…, 2018). Along with the traditional factors on which the price of the land depends (size of the parcel, location, access to road infrastructure, electricity, water and irrigation opportunities), the influence of the income that the property brings is also mentioned. The highest amount of rent in some places corresponds to the highest price of land there. Higher prices are also associated with the fact that agricultural land in Bulgaria is a limited resource. The forecast is that after 2020, according to the new reform of the Common Agricultural Policy, in case of change in the operation of direct payment schemes, or their replacement with other instruments, the current effect on the land and rent market, for a constant increase in prices, may change.

Feichtinger and Salhofer (Feichtinger & Salhofer, 2011) clarify the approach to hedonic price and the groups of factors that influence price. The hedonic approach[43] is based on the consumption theory, assuming that the price of goods, in the case of agricultural land, can be explained by certain characteristics that describe it (quality of agricultural land).

K. Kocur-Bera (Kocur-Bera, 2016) expresses a similar opinion about the hedonic models of agricultural land pricing. According to her, the main directions of using hedonic price models in the field of agricultural land pricing are rooted in three functional forms: linear, logarithmic and a combination of both. Donosoa, Cancino and Foster (Donosoa et al., 2013) apply a log-linear model, taking into account that logarithmic and linear models, used separately, give similar results, with the main advantage being the smaller relative error.

S. Johansson and P. Nilsson (Johansson & Nilsson, 2013) categorise theoretical and empirical research in the field of agricultural land pricing in two directions. The first direction is characterised by the capitalization of the standard income from agricultural land, where the expected return is capitalized in the land price. The second one focuses on asset pricing and has a hedonic basis, as the different prices of agricultural land cannot be explained only by its production capacity and the resulting income and payments from national agencies to farmers for its use. According to these authors, other factors that are included in the regression equations also influence here, and those taking into account the location of agricultural land

[43] The terms "hedonism" and "hedonistic" are derived from the word hedonic. In the present study, it is preferable to use the term "hedonic".

are among the most significant. In addition, a mix of the two approaches has been observed in recent years.

Czyżewski, Kułyk and Kryszak (Czyżewski et al., 2019) focus on land prices and its role in the sustainable development of the economy. The sources studied by them help the authors to come to the conclusion that the agricultural land prices cannot be well explained by the models for capitalization of rent and the use of present or future value for their calculation.

Devadoss and Manchu (Devadoss & Manchu, 2007) determine that rising land prices have both positive and negative effects on farmers. For existing farmers, the rising price of land is a positive factor, because in this way the value of their business increases, while for those entering the field of agriculture, this growth has a negative effect, as there is a need for large investments. The main factors influencing the price of land are economic, including the net income of a farmer, the level of production, the total productivity of the factors, government support, macroeconomic factors (land taxes, interest rates, inflation) and the number of population.

Duvivier, Gaspart and de Frahan (Duvivier et al., 2005) performs an analysis based on a hedonic price model and a capitalized rent model, including the price per hectare of land, rent from land sales on the market and rent from government support, population density per square kilometre, price increase of land, density of pigs per hectare of agricultural land, size of the agricultural land market and average size of farms in the surveyed municipality. They studied a panel of 42 municipalities over a period of 22 years from 1980 to 2001. The results of their study show that for the analysed period the sensitivity of the price of agricultural land to compensatory payments increased after 1993. When using a fixed-effect panel regression, it was found that the rent from the sale of agricultural land on the market has a large effect on its price. The price of agricultural land is not sensitive to changes in rents for a short period.

Nickerson and Zhang (Nickerson, Zhang, 2013) advocate the use of a spatial hedonic model to determine the factors influencing the agricultural land value. They examine the different types of hedonic models to study the factors influencing the agricultural land price and bring out the main problems in each of them.

Baylis, Paulson and Piras (Baylis et al., 2011) develop a hedonic panel model explaining the impact of climate change on agricultural land price. After applying a panel regression model, districts-fixed effect model, random effect model with fictitious variables, and a model with a spatially fixed error effect, as well as models for lag effects, the authors reach the following conclusions: a strong spatial effect is observed in the data used; climate change has different effects on the price of land near urban areas and remote areas and the effect of precipitation and temperature change is negligible.

Wang (2018) considers a simplified hedonic model for the formation of agricultural land price. Following four tested models, the authors highlight the following

significant dependencies: there is a strong spatial dependence; the factors reflecting the influence of human resources, temperature, payments made by the state and the distance to the nearest metropolis are among the leading independent variables that strongly influence the land price.

Shin and Kim (Shin & Kim, 2020) consider the impact of direct government payments as a prevention against the abandonment of agricultural land by its owners and link them to sustainable development in rural areas. A similar view is expressed by Levers et al. (2018).

Czyzewski, Przekota and Poczta-Wajd (2017) use a hedonic approach to study the factors influencing the agricultural land price in Poland. This approach is based on the inclusion of variables with qualitative data reflecting the potential significance of agricultural land to buyers in a given region, as a result of their purchase and sale transactions. The main quality indicators influencing the agricultural land price are distance from the town and distance from buildings. The building permit and the type of rural area are among the leading variables.

As a result of the conducted theoretical analysis, some summaries can be formulated on the existing formulations for the determinants of agricultural land price.

In the economic literature there is no single opinion about the influencing factors. This is somewhat understandable, because the agricultural land is not homogeneous and has different characteristics, according to its location, and the determinants are numerous and are grouped according to separate criteria, depending on the natural, production, demographic, social and economic characteristics of the specific objects of research. From this point of view, when analysing the factors influencing the price of agricultural land, a complex approach should be applied, combining separate elements from the indicated groups.

From the review of the literature sources, the conclusion which follows is that in determining the factors influencing the agricultural land price, there are two approaches – that of the capitalized rent and the hedonic approach. In the present paper, the influence of rent is not covered as a factor, because when it is included in the model, a very large part of the explained variation is due to it. The hedonic approach is used to highlight other factors that affect the agricultural land price. It is important that the constructed theoretical model must be adequate and proved empirically, therefore, the choice of variables is extremely significant. Many of the existing studies use many specific factors. The idea of the present study is to limit their number and to make the factors themselves universally valid. By using official statistics, comparability of the results is ensured, and in case of periodic conducting – it allows monitoring of the changes. In the present study, the focus is on the factors characterising the demographic, social and economic development of the districts.

From a methodological point of view, due to the specifics of the data, it is appropriate to use fixed-effects panel regression. In addition, because presumably the

influencing factors are many, it is necessary to reduce their number in an appropriate way. For this purpose, stepwise regression should be applied (Magnus et al., 2004).

It is important to justify how the number of factors influencing the dependent variable (the price of agricultural land) is reduced and only the significant ones remain in the model. To simplify the regression equation, it is appropriate to apply stepwise regression by the sequential elimination method (Makridakis et al., 1983). This means that all independent variables are initially included in the model, after which the one with the highest value of the F-criterion (or F>0,10) is removed. The process is repeated until only significant variables remain in the model (with F<0,10).

Due to the fact that the present study focuses on the factors influencing the price of agricultural land by geographical area, it is necessary that the data analysed be comparable and grouped appropriately. The National Statistical Institute (NSI) has a section "Regional Statistics", which provides data on key indicators by district and a sample of them is used here. Of these, eight variables were selected for the period 2010–2018 (NSI), for 25 districts (see Table 1).

Table 1. Variables for hedonic model

Group	Variable	Definition and Unit
Demographics	P^{total}	Population as of 31 December – Total (number)
Labour market	$AANELC$	Average Annual Number of Employees under Labour Contract (number)
	$AAWSELC$	Average Annual Wages and Salaries of the Employees under Labour Contract (BGN)
	EAR	Economic Activity Rate – 15 – 64 completed years (%)
	UR	Unemployment Rate (%)
Non-financial corporations	O	Output (million BGN)
Transport	$LCIR$	Length of Category I Roads (km)
Information society	$RSHIA$	Relative Share of Households with Internet Access (%)

The first variable characterises the demographic development by districts. Its inclusion is justified, as it is present in most of the studies in which a hedonic approach is applied. The other seven variables express the socio-economic development of the districts. Particular attention should be paid to the last two variables – Length of Category I Roads and Relative Share of Households with Internet Access. In the Strategy for the digitalisation of agriculture and rural areas of the Republic

of Bulgaria (Strategy for the digitalisation of agriculture and rural areas of the Republic of Bulgaria, 2019) it is stated that at EU level the gap between broadband internet coverage in rural and urban areas is large. With regard to Bulgaria, the European Commission reports that the total coverage with fixed broadband networks covers 95% of households, which is below the EU average. Another official document (Digital transformation of Bulgaria for the period 2020-2030, 2020) states that broadband internet access is one of the cornerstones of the digital revolution. Therefore, the transition to fourth-generation agriculture faces a serious challenge and the indicator by which its trends are observed (Relative Share of Households with Internet Access) must be present in the models, taking into account the impact on the main factors of production, such as agricultural land.

In the statement above, one of the main characteristics of agricultural land was mentioned – dispersion. In order to avoid its negative effect, the hedonic models include a factor related to the localisation of agricultural land. In this sense, through the variable "Length of Category I Roads", it is possible to take into account the growing need for transport connectivity in all districts of the country (Integrated transport strategy for the period until 2030).

The data on the price of agricultural land by districts are also extracted from the NSI, under the heading "Agricultural land market and rent in agriculture". The information on prices for individual years and districts, for the nine-year period of the survey (2010–2018), is marked as confidential. For this reason, three districts are dropped from the list of 28 districts: district Sofia-city, Kardzhali district and Smolyan district, as they are dominated by missing data. In order to obtain a balanced data panel, for three districts (Blagoevgrad, Kyustendil and Pernik districts) only for some years, missing values have been added (same as those from the previous or next period). As a result of combining the data, about 25 districts and for 9 years, a panel with a matrix containing 225 cases is obtained, which increases the possibility of conducting a better study.

The basic hedonic model, taking into account the influence of the selected eight factors on agricultural land price, has the following form:

$$P_{it} = \beta_0 + \beta_1 P_{it}^{total} + \beta_2 AANELC_{it} + \beta_3 AAWSELC_{it} + \beta_4 EAR_{it} + \beta_5 UR_{it} + \\ + \beta_6 O_{it} + \beta_7 LCIR_{it} + \beta_8 RSHIA_{it} + \varepsilon_{it}. \quad (1)$$

The variables measured in value (dependent P_{it} and independent $AAWSELC_{it}$ and O_{it}), were deflated by Consumer Price Indices (CPI) and adjusted to 2010 by own calculations.

3. Results and discussion

In Table 2, the results of building a hedonic model for the factors influencing the agricultural land price in Bulgaria for the period 2010–2018 are presented.

Table 2. Estimates for variables and statistics of the models

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
$RSHIA$	10,09728 (0.0000)	10,02065 (0.0000)	10,04960 (0.0000)	9,960535 (0.0000)	9,789806 (0.0000)	5,613290 (0.0000)	5,884823 (0.0000)
EAR	-0.440927 (0.9125)						
$AANELC$	-0.002979 (0.2289)	-0.003047 (0.2025)	-0.003495 (0.1180)	-0.000335 (0.3605)			
p^{total}	0.001039 (0.1731)	0.001056 (0.1558)	0.001065 (0.1517)				
O	-0.007936 (0.5892)	-0.007700 (0.5955)					
$LCIR$	-1,332689 (0.0002)	-1,343460 (0.0001)	-1,463904 (0.0000)	-1,403303 (0.0000)	-1,477028 (0.0000)	3,883787 (0.0850)	4,066013 (0.0716)
$AAWSELC$	0.048640 (0.0040)	0.048908 (0.0034)	0.046535 (0.0037)	0.041614 (0.0079)	0.041583 (0.0079)	0.075833 (0.0000)	0.065223 (0.0000)
UR	10,28716 (0.0004)	10,25358 (0.0004)	10,24706 (0.0004)	10,89635 (0.0002)	11,21808 (0.0001)	3,443115 (0.1763)	
β_0	-309,0228 (0,2651)	-335,6794 (0,0123)	-306,1936 (0,0118)	– 226,9887 (0,0360)	– 233,1427 (0,0309)	-815,0213 (0,0045)	-730,5163 (0,0091)
R-squared	0.430785	0.430753	0.430012	0.424600	0.422394	0.796788	0.794878
Adjusted R-squared	0.409703	0.412390	0.414324	0.411463	0.411892	0.767757	0.766765
F-statistic *Prob (F-statistic)*	20,43373 (0.000000)	23,45790 (0.000000)	27,41065 (0.000000)	32,32100 (0.000000)	40,22060 (0.000000)	27,44675 (0.000000)	28,27428 (0.000000)
Durbin-Watson stat	0.707475	0.704456	0.705006	0.701922	0.697050	1,587726	1,571089
S.E. of regression	220,9187	220,4153	220,0523	220,5890	220,5087	138,5696	138,8653
Sum squared resid	10541898	10542488	10556219	10656436	10697299	3763502	3798865
Akaike info criterion	13,67264	13,66381	13,65622	13,65678	13,65172	12,82041	12,82088

Source: own calculations (The calculations were made with the program GRETL).

As it can be seen from Table 2, Model 1 includes all eight factors. Although the model as a whole is significant (Fisher's criterion is 20.43373 with a significance of 0.000000), it is noticed that the coefficients for four of the variables are insignificant. These are: EAR, $AANELC$, P^{total} and O. For this reason, they need to be consistently excluded from the equation. At the first stage, the variable for the economic activity ratio (Model 2) is dropped, because its significance in Model 1 is the highest (0.9125). In the next step (Model 3), the variable for the output is dropped. In Model 4, the variable for the population is also excluded, and in Model 5 the last insignificant at this stage variable – average list number of employees under labour contract, is excluded.

As a result of the stepwise regression performed by the successive elimination method, the hedonic model of the factors influencing the agricultural land price in Bulgaria for the period 2010 – 2018 has the form (Model 5):

$$P_{it} = -233{,}1427 + 0{,}041583AAWSELC_{it} + \\ + 11{,}21808UR_{it} - 1{,}477028LCIR_{it} + 9{,}789806RSHIA_{it} + \varepsilon_{it},$$

i.e. with error probability of less than 5%. It can be argued that the influencing factors are: Average Annual Wages and Salaries of the Employees under Labour Contract, Unemployment Rate, Length of Category I Roads and Relative Share of Households with Internet Access. The statistics for the model show that 42% of the influencing factors are covered.

The next stage of the analysis is to take into account the spatial structure of the data. Model 6 is a panel regression with fixed effect included by districts. From the statistics of the model, Table 2 shows that the coefficient of determination increases, compared to the models not reporting a fixed effect, by 37% and is ≈80%. This shows that the spatial structure of the data has almost the same influence as the impact of other factors combined. At the same time, there is an increase in the significance of the coefficient for the variable "Unemployment rate" (0.1763), which requires it to be excluded from the model. In its final form, the hedonic model acquires the form (Model 7):

$$P_{it} = -730{,}5163 + 0{,}065223AAWSELC_{it} + 4{,}066013LCIR_{it} + \\ + 5{,}884823RSHIA_{it} + \varepsilon_{it}.$$

Interpreting the calculated coefficients, it can be summarised that the relative share of households with Internet access has the strongest impact on the agricultural land price, followed by the length of category I roads and the average annual number of employees under labour contract has a relatively smaller influence. The empirically proven results fully correspond to the modern development of agriculture and the agricultural land market in Bulgaria. The introduction of innovations related to the transition to "fourth generation" agriculture is unconceivable without internet access and a developed road infrastructure. Naturally, the higher amount of the average salary is associated with an increase in consumer attitudes to purchase various assets, incl. agricultural land, which reflects on the rise in its price.

The value of the Durbin-Watson Criterion for Model 7 indicates that there is no autocorrelation of the residues, i.e. the established regression is not false. The value of the Akaike information criterion indicates that Model 7 describes well the change in the studied variables.

The last stage of the analysis includes checking the appropriateness of including a fixed effect by districts in Model 7. The values of the parameters (F-statistic = 16,583765 (0.0000), Cross-section Chi-square = 248,709393 (0.0000)) show that they are significant and therefore the inclusion of a fixed effect in the model is justified.

In the Table 3, the results for the districts-fixed effect for Model 7 are presented.

The values confirm the presence of large spatial differences in the studied variables and once again prove that their consideration is necessary.

Table 3. Districts-fixed effect (Model 7)

District	Fixed effect	District	Fixed effect
Vidin	272,7711	Shumen	– 275,6287
Vratsa	182,3816	Burgas	-712,2919
Lovech	– 2,546358	Sliven	195,1512
Montana	372,2211	St. Zagora	-419,2894
Pleven	220,4169	Yambol	107,3425
V. Tarnovo	-88,96823	Blagoevgrad	333,3805
Gabrovo	– 212,5001	Kyustendil	42,21093
Razgrad	365,7987	Pernik	-118,2921
Ruse	139,7054	Sofia district	-1437,986
Silistra	520,6288	Pazardzhik	111,1154
Varna	-103,7033	Plovdiv	– 266,1975
Dobrich	801,9682	Haskovo	-312,7542
Targovishte	285,0654		

Source: own calculations (The calculations were made with the program GRETL).

4. Conclusion

In the present study, through a complex theoretical approach and application of stepwise regression by the elimination method and panel data regression, a model has been built that proves empirically that from a pre-selected group of eight factors, on the price of agricultural land in Bulgaria for the period 2010–2018, three factors have a significant impact: the relative share of households with internet access, the length of category I roads and the average annual wages and salaries of the employees under labour contract. Another important result is that the model for including a districts-fixed effect leads to an increase in the percentage of covered factors almost twice, which in turn confirms that its consideration in such studies is mandatory. The proposed methodology can be successfully adapted for other similar studies using panel data, and the basic hedonic model can serve as a starting point in searching for the factors determining the agricultural land price at different levels.

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