

THE HEDONIC PRICES CONCEPT OF AGRICULTURAL LAND IN THE EDINET DISTRICT BY USING A SPATIAL AUTOREGRESSIVE MODEL FOR THE SUSTAINABLE RURAL DEVELOPMENT EVALUATION

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Abstract. *The aim of the paper is to identify the regression methodology capable of evaluating land resources in the Republic of Moldova under the aspect of criteria for the consolidation of agricultural land. The value of the plots in the sale-purchase process denotes an autoregressive spatial dependence in which the endogenous value of the market price is mutually influenced depending on the locality, the area, the creditworthiness of the land, the exposure and others. The autocorrelation coefficient is an indicator of the attractiveness of agricultural land in terms of further use for specific purposes (location next to the access road contributes substantially to the market price and adjacent location to rural settlements or economic units intended for storage/processing of agricultural production also considerably affect supply and demand). The fact that the price of parcels in sales-purchase transactions supports a non-stationary behavior according to the Dickey-Fuller test, imposes the hedonic approach in the evaluation of land resources. The spatial econometric model with lag (SAR), which includes the autoregressive component, makes it possible to eliminate the trend with negative effects in the assessment of the market price of agricultural land at the moment represents an appropriate tool in the market analysis of land transactions. The advantages of the SAR implementation in determining the optimal value of agricultural land in the Edineț district allowed the adequate calculation of the price of 8130 plots, in the commune of Zabriceni. The adjacency matrix W in the SAR model is identified by means of the value of sales-purchase contracts registered in the year 2022 in volume of 73 traded parcels. The agricultural land cadastral factors that are included in the spatial autoregressive model are evaluated according to the INGEOCAD maps for the respective year. As a result of the verification of the degree of correspondence of the agricultural land prices evaluated by the SAR method with the offers proposed by professional cadastral appraisers, the significant difference according to the Students' t distribution is lower than 5%. In this way, we can state that the hedonic prices of plots are adequately evaluated and the spatial autoregressive methodology proposed in the paper can be implemented in the practice of land transactions.*

Keywords: *hedonic price, autocorrelation coefficient, spatial econometric model with lag, Edineț district, INGEOCAD*

JEL: C01, C23, E31

1. Introduction

Concerning to 2023 year one may affirm that being endowed with agricultural black earth and a temperate climate, the Republic of Moldova during its history was based in a large measure on the agriculture and it has 2493 thousand of ha agricultural ground. The available total surface of 3384,9 thousand of ha is divided approximatively in 91% of rural environment and 9% urban environment. The utilization of agricultural areas includes approximatively 73,6% from the total surface of the fields of the Republic of Moldova. In accordance with the official statistical data 74,9% from agricultural fields are arable and only 10,8% from these ones are covered by perennial plantations

[1]. The forests cover approximatively 13,8% from the total surface of the fields. In accordance with the local cadastral code the surface of the land resources may be structured in the following way:

- 75% from the territory is covered by the black lands;
- 28,8% of population is occupied in the agricultural sector producing 15 percent from GDP of the country;
- 51,1 % of population lives in villages;
- 69% of the fields are being in private property.

Table 1. The primary information referring to the surface of the agricultural fields and number of transactions of purchasing-selling in the period of the 1999-2023 years

Years	Number of transactions selling purchasing, unities	The surface of the land sold-bought, ,ha		The market price selling-purchasing		The weighting of the surfaces sold-bought, %	The total sum of the transactions Selling-purchasing	
		Total	In calculation at a transaction	Lei MD/ha	Dollars USA/ha		Millions lei MD	Thousands of dollars USA
1999	1931	1454,0	0,75	3323	315,75	0,08	4,83	459,1
2000	9753	7338,0	0,75	3687	296,54	0,40	27,05	2176,0
2005	47382	21825,0	0,46	4778	379,21	1,18	104,28	8276,3
2015	30805	18379,9	0,60	17757,2	943,72	0,99	326,36	17345,5
2016	305514	18201,0	0,59	22556,5	1132,14	0,98	410,55	20606,1
2017	30224	18082,0	0,60	27356	1479,50	0,98	494,65	26752,3
2019	28550	17215,8	0,60	23542,6	1286,50	0,93	405,31	22148,1
2020	27480	16392,1	0,66	19422,8	1121,41	0,88	318,38	18382,3
2021	24362	14490,5	0,59	27434,8	1551,74	0,78	400,16	22633,4
2022	17829	11787,5	0,66	43946,7	2326,45	0,63	518,02	27423,3

Source: elaborated by the author on the basis of collected primary data

In the Republic of Moldova, the contribution of the agricultural sector to GDP recorded an abrupt diminution in the last 20 years from 30-35% in 2000 year until 12-13 % in the present period. Parallel, the weighting of the labor force in agriculture decrease from 40-45% till 30-35% in 2023. This tendency of diminution is much more stressed in comparing with other countries of the region (such as Georgia, Belarus and Azerbaijan). The migration of the population led a real deficit of labor force in the rural environment and the percentage of the rural population remained nearly 40-45 % in comparison with 55-60% in 2000 year. Concerning the revenues, the agricultural sector is being recorderd the smallest middle monthly revenues comparatively with other economic sectors evolving from 500-600 lei in 2004 to 1200-1800 lei in 2011 year. Referring to the 2023 year the smallest values of the profit of monthly middle salary were recorded in the activities of agriculture, forestry and fishing with a value of about 7000 lei. The agricultural sector in the Republic of Moldova is being distinguished as one of the biggest levels of using of agricultural field, the arable grounds

representing 55,1% from the total of these ones. But under the aspect of economic efficiency the land stock with agricultural destination in a large measure is broken up as a result of the reform of land from 1998. In comparison with the countries of the European Union (EU) the Republic of Moldova generally has a more reduced agricultural productivity being influenced by more factors as for example the outdated agricultural infrastructure in certain zones, the limited use of the modern technologies, the brokening of agrarian fields, the limited access to the financing for agricultural investment and climatic fluctuations [2].

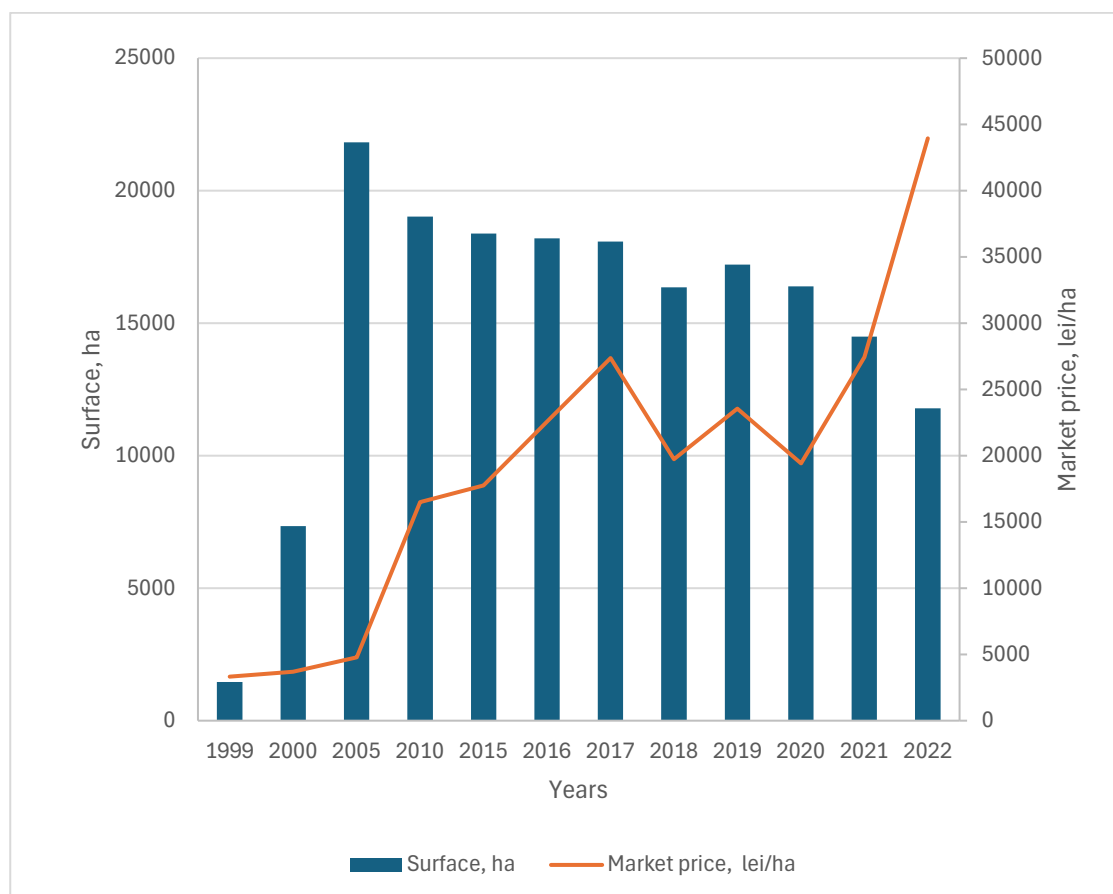


Figure 1. The market price of selling-purchasing depending of the area of the sold-bought land by years

Source: elaborated by the author on the primary collected data

The well-balancing of the agrarian sector in the total of the investments in the fixed means had activity, forestry and fishing constituting 7,7% in 2020 year, 9,3% in 2021 year and 12,5% in 2022 year noticing the tendency of increasing of this indicator. For all that the deficit of financing for the agriculture remains significant (60-70%) but the trade balance records a negative tendency on the fond of a significant increase of the import of the agricultural products in comparison with export. Concerning the export, the Republic of Moldova principally dominates in the sector of alcoholic beverages though the weighting of these ones exports decrease from 45% in 2000 years in 22-23% in 2012. Others important products for export are fruits, nuts, seeds and oleaginous fruits. It is also being noticed that the Republic of Moldova is the unique in the world whose territory is covered by

black soil. The structure of the agricultural grounds by its allowance (grad/ha) the following: the compass of 81-100 represents 26%, the compass of 71-80 represents 20%, the compass of 61-70 represents 15%, the compass of 51-60 represents 15%, the compass of 41-50 represents 11%, the compass of 21-40 represents 6% and the compass of 0-20 represents 7%. Having achieved the land reform in the Republic of Moldova the structure of the land fund (stock) includes in accordance with the destination the following components:

- With agricultural destination – 59%
- Forest -13%
- Emergency (spare) -14%
- Waters -3%
- Industry and transport -2%
- Localities -9% [3].

The land market in the Republic of Moldova is relatively young. During of the period of 20 years of functioning it passed thoroughly changes concerning the structure of scientific reasonable transactions of the calculation of the market prices, the operativity of effecting transactions etc. On the basis of the cadastral systematized is being recorded a dynamic tendency of rising of the prices on the market of the farm fields in the Republic of Moldova. The agricultural farm land market constitutes an important factor in the formation and development of the most competitive of juridical and organizational of the land use by forming of the best surfaces. In the last decade in the Republic of Moldova more and more actively goes the process of farming land markets and particularly of the grounds markets with agrarian destination. In the business environment of our country rises the understanding that the land is not only a principal producing factor but it is also a valuable active that can generate comparable revenues with the investments in the financial instruments. It is evidently that the investments in the farm lands are exposed to great risks as a consequence of the land market badly developed, the absence of a transparent objective information regarding the land value [4].

In a such conditions a very important role below to an adequate evaluation of the lands with agrarian destination. So more important became the land evaluation for the determination of the land tax being an important source of forming the local budget. Analyzing the country situation, we can affirm that the market of the farm land is at a level of development weak enough. This market is being characterized by an absence of a unique base concerning the present prices of transactions with agricultural fields. Every company creates its own data basis. The creation of a data basis with real prices of transactions from the contact of selling-purchasing would present a positive step in developing of a land market but at the moment we have significant differences between the indicated prices in the contracts and real ones [5].

In the result of analysis of land costs, the primary data referring to the number of transactions of selling/purchasing and paying price (in leis and dollars USA) are presented in the table 1. In the context of the market of agrarian lands the direct selling represents only a third of total transactions. The others two thirds consist in legacies, gifts changes, long terms leasing and inclusion in the capital of the enterprises yearly about 17,0 thousand of hectares are sold constituting 1,0% from the total of the private agricultural lands (1701,86 thousand ha), the rest of 2,0% being assigned to other types of transactions. It is a significantly the fact that in accordance with the Agency of Public Services, every 30-35 years (the average being of 33 years) the agricultural grounds change their land owner reflecting the longevity of a generation of active farmers. This information underlines the importance

of transactions diversity in the market of agrarian land and the cyclic implication of the properties change in the economic dynamic of the sector.

Subjectively, the approach of the land market imposes the modality of the grounds change by the decision of the owner. As we have already mentioned one can affirm that about one third from these transactions brings to the selling of the lots, supplementary another third the decision of changing the owner confines himself to the legacy or gifting and the arrears in a volume of a third supposes the modalities of alternative transitioning. According with the table 1 it is evidently the upward trend in the number of transactions of selling-purchasing and the paying cost in national currency is in increasing. The big differences concerning to the unitary price for a hectare for different periods of time are caused of the technological factors of the lots (the distance till the mayoralty of the commune, the distance till the road with a rigid cover, geographical exhibition, preponderantly to southern, height on the slope and bonity as well as of the economic factors (the rate of the profit of the National Bank of the Republic of Moldova, the inflation and the currency course). One may affirm from the data of the table 1 that the average value on the market of a one hectare of agricultural ground in the study period rised from 3,4 thousand lei per hectare in 1999 till 19,7 thousand lei in 2021. The graphic presentation of the upward trend in the dynamic evaluation of the selling-purchasing market price is exposed in the figure 1 with the surface of achieved transaction area in the left part and in the right part of the image is scale concerning the sold-bought total plots of the parcels in ha [6].

During the years the level of the information quality is diverse too. If in 1999 year were recorded in total only 1933 of transactions on a surface of 232 hectares then the calculations of the value estimation for the 2016 year based on 367 thousand of hectares. It is evidently that the level of veracity of the selected information in 2016 is higher. Among the general factors influencing directly on the selling purchasing cost of the forum land are:

- raising of maturity level of the market;
- ration between demand and offer;
- investment policies;
- subvention policies.

At the same time the graphics analysis of the average value of the farm lots shows yearly us that during the study the ground value was exposed to diverse developing stages: increasing, stagnation and even failure. It is reasonable the question under the action of which factors the average value of market of the agricultural grounds are in failure. One of the most foreseeable factors that devaluates the far lot is the high inflation of the national currency yearly, only because of the inflation. Because of inflation, annually the value of the land falls by approximately 10 percent. The high rate of inflation has negative influence on the value of agricultural land [7].

2. Material and methods

The model of evaluation of land with agricultural destination as every economic model reflects certain basic cadastral relationships but cannot escape the economic reality in its entire intricacy the model of evaluation of lands with agricultural destination offers a schematized image of essential feature considered by the researchers from here is the major importance of economic theory for the success of modeling.

The scientific understanding of the economic theory permit the selecting of essential variables, the establishment of interdependence relations. In the process of econometrical modelation it is

necessaire the formalization of the relations between the categories economical definite primary as model of model. In this way is being made up the qualitative model of the process phenomenon the model that is being fixed as diagrams of waves. The interdependence between the phenomenon are being described in the form of equations but the parameters of the variables characterize the structure of the relation between the variables. Conceptually the elaboration of the methodology of achieving econometrical models for evaluation impose the necessity of defining endogen factors (influencing the market price of the lots) and of the exogen factors (causatives characterizing physical and chemical properties or technological of the lots being in the gestion of the owners).



Figure 2. Interface of Database Navigator DBeaver with indication of the bill of fare and portfolios structure with making evident the inserted objects

Source: application interface DBeaver

The determinative factors of the cost of the agricultural lots on the land market from the Republic of Moldova may be characterized from the point of view of the primary cadastral information from the Data Bases of *LC_cadastr.dbf*. The principal instrument for achieving the collection of technologic parameters of the cadastral unities represents the application of DBeaver being universal data basis open-source supporting a wide set of primary data in the format SOL, NoSQL and others. It also allows the utilization of the medium of traditional programming with an interface comfortable for the current work with data basis the drawing up and modification with economic analysis of reference [8].

Database Navigator represents an interface and medium of programming defining the structure and the and the content of database in accordance with the figure 2. For opening of the data base *LC_cadastr.dbf* in the medium Windows we apply the bill of fare *View*, by which is being opened the cadastral structure of data base and the windows afferent to the types of endogen and exogen

variables. Structurally the data base is presented in format of tree of the objects inserted as notions apart consist of the following elements:

-portfolio with cards concerning to the SQL scriptures of primary processing of cadastral data the endogen and exogene variables;

Table 2. The land market analysis for 2018 year in accordance with administrative regions of the Republic of Moldova

Regions		Number of transactions	The surface of the territories sold-bought, ha	The market price selling-purchasing, lei/ha	The total sum of selling-purchasing payments, lei
North region		110775	7146	21196	151472605
1.	Balti	122	78	47530	3708200
2.	Briceni	480	307	14861	4555679
3.	Donduseni	493	368	27350	10063297
4.	Drochia	559	526	20235	10650594
5.	Edinet	1158	829	18652	15456055
6.	Falesti	509	269	23974	6441472
7.	Floresti	220	203	20412	4153682
8.	Glodeni	1040	573	24830	14223581
9.	Ocnita	833	664	25610	16999092
10.	Riscani	1405	915	22991	21033380
11.	Singerei	1365	592	28081	16618673
12.	Soroca	2591	1823	15121	27568900
Center region		10049	5247	20928	109813003
13.	Chisinau	307	165	1011484	16711151
14.	Anenii-Noi	807	777	14094	10947087
15.	Calarasi	701	206	18125	3742578
16.	Criuleni	113	129	25192	3244191
17.	Dubasari	470	253	21287	5379718
18.	Hincesti	832	339	14861	5040827
19.	Ialoveni	1265	549	33130	18186366
20.	Nisporeni	893	362	15474	5599744
21.	Orhei	1750	733	14597	10706173
22.	Rezina	254	225	21739	4882081
23.	Straseni	666	271	15807	4290606
24.	Soldanesti	1064	618	14118	8729603
25.	Telenesti	254	147	23129	3395041
26.	Ungheni	673	473	18927	8957836
South region		5504	3513	14654	51486132
27.	Basarabesca	286	194	21097	4083216
28.	Cahul	699	573	17165	9827720
29.	Cantemir	641	375	17903	6708248
30.	Causeni	731	478	15148	7239536
31.	Cimislia	195	208	25824	5377136
32.	Leova	2272	1244	8747	10878899
33.	Taraclia	172	233	13673	3180601
34.	Stefan Voda	508	210	19951	4190777
Gagauzia		548	443	22110	9789920
Total		26876	16350	19729	322561660

Source: elaborated by the author on the basis of NBS data

-interrogation in the frame of DBeaver tables and other labels of the data basis;

-the DBeaver objects includes application window overview tables, limitations indexes, sequences, triggers.

The utilization of the instrumentary of data base supposes the access defining to the structural information arranged according to the implicit format with the limitation of the possibility of giving away of personal data cadastral [9]. Methodologically the evaluation of agricultural lands in the Republic of Moldova has at the its base the concept of hedonically prices on the land market and the utilized application of space autoregressive model (SAR) represents the basic instrumentary in defining calculation algorithm. The argumentation of approaching of autocorelative of price dependence is based on the space nonstationarity and is a basic condition in the criteria of elaboration of econometric model with the option of geographical ponderability.

$$y = \rho * W * y + X * \beta + \varepsilon$$

$$y = (I_n - \rho * W)^{-1} * X * \beta + (I_n - \rho * W)^{-1} * \varepsilon \quad (1)$$

$$\varepsilon \sim N(0, \sigma^2 * I_n),$$

where:

β – parameters of equation of space regress;

X - the exogen variables included in the model (the surface of the lots, the bonity, perimeter, the distance till the village, till the road, the inclination, exposition and altitude);

y - the cost of the transactions selling purchasing of the agricultural grounds;

ρ - the space component in the regression equation;

W - the adjancency weighted matrix of the sold-bought area;

I_n - the unitary matrix with n dimension;

σ - the standard square deviation of the residue as part of normal distribution (Gauss) with the mean equal zero and the dispersion σ^2 ;

ε – the aleatory regression residuals component.

The principal objective in the frame of the utilization of regression geographically pondered consist in the identification of the type of relations existing between the exogen and endogen variables [10]. It may be achieved by calculation of the statistics or evaluation of the parameters β for calculated values in different lots with a diverse spacing and specific valuable zone. Implicitly it is being supposed that the evaluated statistics of the parameters are constant in the space thought the utilized supposition is in a large measure is disputable and the hedonic composition of the model impose contradictory values. Reasonably we may suppose that in the equation 1 exist autocorelative relations of the level lag AR(1), AR(2)... having a composition intrinsic space which generates unsolved problems concerning the specifying of econometric model with serious consequences for the aleatory component ε (the residues in accordance with the test Jarque Bera does not tolerate a normal distribution with zero mean average and standard deviation σ).

The consequences of this approach (the supposition that $\rho=0$) involves inadequate distribution of equation parameters of regression and the value β is out of the place (bias in approaching BLUE). It is evidently that ponderated geographically regressional model presented in the equation 1 contains elements that give the possibility to remove these impediments by means of the adjancency weighted matrix of the sold-bought area W confirms:

$$W_{ij} = \exp \left[-\frac{1}{2} * \left(\frac{d_{ij}}{h} \right)^2 \right] \quad (2)$$

where:

d_{ij} – represents the distance between the locations i and j ;

h – the bandwidth criterion of high fidelity of the space composition in the econometrical model and in the option of rising of this parameter the evaluated value of the lot adjacent with the price of transaction being definite. In conclusion one can affirm that the geographically weighted regression (GWR) allows the evaluation of the parameters β in the BLUE format and the price values of evaluated agricultural grounds on the basis of the presented model in the equation 1 are adequate to the land market [11].

3. Results and discussions

In the result of the analysis of land market in the Republic of Moldova for 2018 year we may affirm that the hedonic approach of transactions selling-purchasing of the agricultural grounds are being confirmed from data of the table 2. If in some zones the prices offered at selling of one hectare were being raised, the interest of buying dismissed. For all that after a small stagnation the farmers still keep the interest in acquisition of agricultural lots. The principal criteria of establishing the prices are: the bonity, emplacement the access to the irrigation, infrastructure ways of accessing and others. The highest prices for the traditional agriculture ground are offered in the North Zone of the country. The cost of quota reaches till 70-80 thousand lei (45-50 thousand/lei hectares). In the districts of Donduseni, Drochia the price is about 45 thousand/ha. In the district of Briceni the price of a quota of lot is 60-80 thousand or 45-53 thousands lei/ha. In Soroca the price of one ha of lot was about 50-60 thousand lei. The highest prices are offered for the land emplaced hereabouts of Nistru river fact determining the possibilities of irrigation of these ones. The selling price varies 100 and 150 thousand lei/ha. In the zone of the district Floresti the price of a hectare was approximatively 25-35 thousand lei. The price of one hectare of agricultural lot in Ialoveni varies from 60 till 100 thousand lei, but the selling were achieved rarely after a had year. In the district of Telenesti the price offered for a quota equivalent with 2,2 ha was 80 thousand lei. Respectively the price per hectare is a little over 35 thousand lei. In the district of Leova the agrarian lot is being sold of a cost of 15-25 thousand lei. The land for cultivating of wine are being offered the maximum price of 20-30 thousand lei/ha. In the south zone (Basarabeasca, Comrat) is being offered maximum price of 20-30 thousand lei/ha. Let together with the number of transactions were being reduced [12].

The land market in 2018 a little changed comparatively with the previous year. In 2018 there was being achieved a test with agricultural farmers for learning the price offered per hectare of lot agricultural land in different districts of the country. We will present below the average of selling prices this year. The researcher results make evidently the fact that is exists a direct relationship between efficiency and the cost. Thus bigger prices for the agricultural land are being offered in the zones where approaching of the progressive technology in agriculture is more developed and the number of the persons involved in this sector is larger. At the same time on price influences the bonity of the lot and the emplacement of this one with reference to the access ways. The surface of the lot also influences on the price. In the North zone in Briceni there are zones of the biggest prices for the agricultural lands 60-100 thousand leis (approximately 3-5 thousand euro) are offered per quota (1,2 ha) but in Ocnita 60-80 thousand lei (about 3-4 thousand euro). A middle price is offered in the district of Drochia the price of a hectare of land is approximatively 30-35 thousand lei.

Table 3. The primary data concerning exogene and endogen variables in commune Zabriceni for the district Edinet in 2022 year

N	Cadastral cod	The value of the transaction, lei	Surface, ha	Bonity of the soil, bal	Perimeter of the lot, m	Distance village, m	Distance road, m	Slope, degrees	Exposition, degrees	Altitude, m	Coordinate, X	Coordinate, Y
1	41521070386	5000	0,072	68	209	2016	2	2,16	52	200	116441,7461	323970,1025
2	41521050475	8000	0,131	75	231	2168	1033	6,14	41	139	118638,0586	325511,2126
3	41521050368	5000	0,122	53	141	2100	1114	2,84	59	161	118509,9670	325245,5870
4	41521050372	5000	0,067	52	117	2051	1114	4,26	40	160	118479,0214	325274,1046
5	41524010058	10000	0,150	66	156	1580	1089	2,97	233	198	114445,5518	330384,2946
6	41524010059	10000	0,150	66	156	1586	1123	6,78	200	201	114469,8700	330408,6698
7	41524020017	17000	1,074	66	668	662	635	2,94	203	175	115611,2274	329734,6704
8	41524040002	35000	0,860	66	581	2501	4	3,63	222	199	117309,1754	330696,2778
9	41524040003	45000	0,920	66	585	2465	4	3,05	219	196	117287,0396	330671,0136
10	41524040016	54620	0,860	94	576	1984	9	2,01	170	180	116962,6740	330300,8074
11	41524010055	55000	1,022	66	483	1625	979	5,04	180	206	114306,8002	330572,5962
12	41524010056	45000	0,958	66	421	1635	1032	4,74	190	207	114369,4456	330571,9794
13	41524030080	30000	1,029	82	420	1880	1050	1,21	138	188	116027,2922	330842,7636
14	41524040296	12000	0,788	88	575	4856	743	2,56	195	209	119307,4004	331150,8640
15	41524050161	42311	0,682	94	577	1416	2	4,67	217	202	116774,5944	329091,2808
16	41524020446	2600	0,175	75	707	1025	924	4,86	227	190	115532,6500	330101,8084
17	41521040152	30000	1,160	94	665	1223	444	2,11	106	178	117266,6452	326981,9032
18	41521070554	8000	0,135	68	248	2269	181	1,92	78	213	116310,6608	323630,1432
19	41521020094	48000	1,300	94	745	2578	2	1,57	45	195	118147,5607	328437,0831

Source: Elaborated by the author on the basis of primary collected data

In Soroca the average price of commercialization is of 80-100 thousand lei with access to the irrigation reaches to 150 thousand lei. In Riscani the average price is of 40-45 thousand leis. In Floresti the average price of one hectare of farm land is 30-35 thousand of leis. In Glodeni the average price is 50 thousand of leis per hectare, in Soldanesti 25-40 thousand leis but in Falesti 40-50 thousand leis. In Criuleni the price of one hectare of farm land is approximatively 60-100 thousand leis. In Hancesti the price per hectare varies from 25-45 thousand leis, but in Straseni one hectare costs 25-30 thousand leis.

Table 4. The evaluation results of agriculture lots in the commune Zabriceni of district Edinet in the year of reference 2022

Cadastral code	Surface, ha	The value of transactions from the contract, lei	The value calculated with model SAR, lei
41521050475	0,131	8000	2797
41521050534	0,101	5000	2381
41521050564	0,101	5000	2375
41521050724	0,110	3000	3623
41521050751	0,120	3000	3639
41521050804	0,110	4000	2959
41521060067	1,426	60000	50717
41521060141	1,228	50000	34653
41521060202	1,177	45000	32405
41521070076	0,929	49000	40310
41521070386	0,072	5000	2459
41521070452	0,066	5000	2028
41521070554	0,135	8000	3398
41521070594	0,066	2000	1634
41521090281	0,323	9000	6536
41521090300	0,323	10000	9326
41522010235	0,236	7000	6193
41522010325	0,117	4000	3720
41522010690	0,059	2000	1666
41522020031	0,650	21000	26694

Source: Elaborated by the author on the basis of collected primary data

In Cimislia in average one hectare of agricultural lot may be bought with 40-45 thousand of leis, in some localities reaching till 47 thousand of leis or even more [13]. In Cahul the mean price of commercialization of one hectare of agricultural land is 50 thousand leis. The 2018 year there were analyzed the prices reflected in the contracts of selling purchasing. There were calculated the mean prices excluding preventively the outliers which do not reflect the real market situation. In the frame

of current calculation there were collected the primary data in according with the indicated variables in the space ponderated econometrical model from the equation 1 for the commune Zabriceni for the district Edinet the reference 2022 year. The contracts including multiple transactions with different lots per owner are being excluded from the table 3 as an example of erroneous data which have not to take into consideration for econometrical processing.

The information primary includes the cadastral code of the unique lot (for the owner) with cartographical coordinates (the coordinate X and coordinate Y in the maps format 4026). The value of included transactions in the contract of selling-purchasing is presented in leis at rate of exchange for the respective period that is why the evolution current of the lots in currency (\$ USA) must be adjusted to the tent of the profit rate NBM.

The surface of the agricultural lots is presented in hectares but the transactions with a surface smaller of 10 m² were eliminated from cadastral reasons, the destination of these lots is evidently not agricultural and imposes an errors approaching. The bonity of the soil has a graduation from zero till 100 balls, but some lots are emplaced in places having an inferior quality and have an alternative destination. The indicator of the lot quality reflecting the adequate form of utilization with agrarian purpose (the square variant where the height and width are equal at the adjacent ungle of 90 grades) is perimeter relatively with the surface of the lot [14].

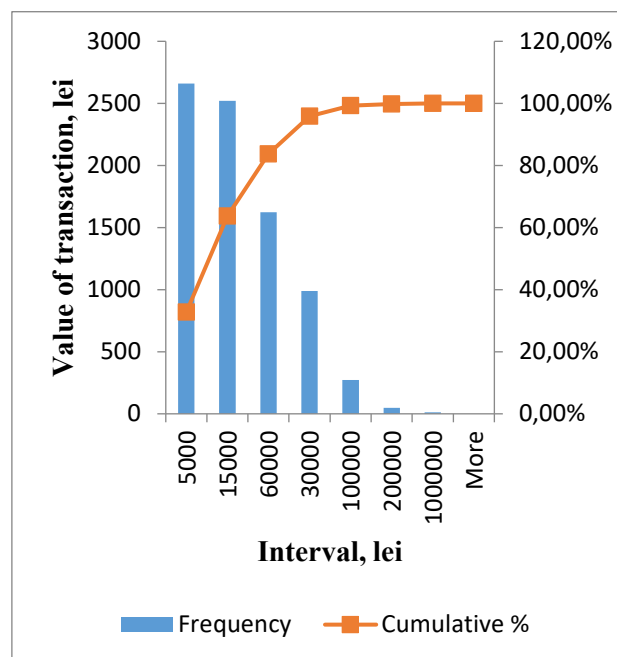
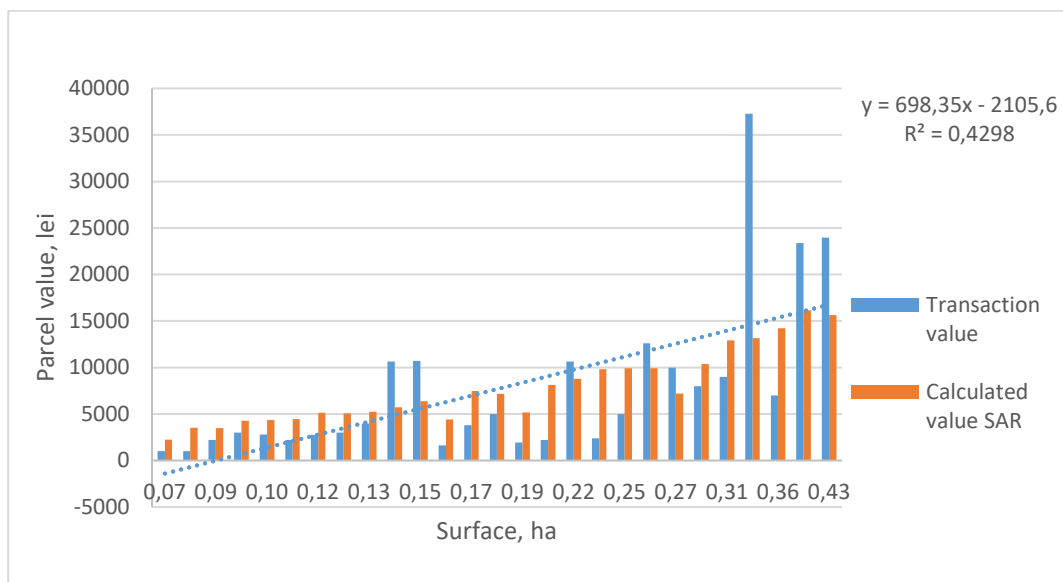


Figure 3 The histogram the of transactions value distribution in the commune Zabriceni according with the cumulative option and relative frequency.

Source: Elaborated by the author on the data basis primarily collected

The distance till the village of the evaluated lot represents an important fact in the space evaluation of the agricultural lots under the aspect of necessity of transportation of the yield to the warehouse or at the house of the owner. Also some lots emplaced directly at proximity of a welling space of the commune a bigger price because that there are legislative premises of transferring of the intravilan in a surface with industrial destination or to the construction of living houses. The measure unity for the

exogene variable the distance till the road is evaluated in meters and represents a significant factor concerning the leger access to the plot of land. The definition of road to access supposes the utilization of a rigid covering with the indication of the coordinates of the transom on the INGEOCAD maps. The fact reflecting the quality of the emplacement of the lot in the agricultural ground is the slope evaluated in degrees and this variable influences significantly the price of transactions of selling purchasing. The exposition of the lot is presented in degrees and maximum value of 180 degrees represents the Southern orientation (the more solicited) but the minimal value zero degree reflects the northern orientation (with a reduced challenging). The last technological indicator included in the econometrical model is the altitude of the emplacement of the lot that is being calculated in meters and the advanced requirement is being referred to the situation in the zone of plain or moderated height of the agricultural lots.



The figure 4. The graphic of the value dependence of transactions of selling-purchasing and the calculated value of the agricultural lots concerning to the surface in the pitch 0÷0,5 ha.

Source: elaborated by the author on the primary collected data

The cadastral approaching in the primary information concerning to 12916 parcels from the land transactions in the Republic of Moldova for 2022 year attest a set of technological data including the lot characteristic in the process of selling-purchasing and the value from contract of this one. In the result of processing of primary data of table 3 by using SAR application to the primary stage by the method of the ordinary least squares (OLS) is calculated with the Cobb-Douglas linear regression in which the technological variables are logarithmed and we have evaluated the partial parameter values of regression equation (elasticity of the exogen cadastral factors). The quality of the econometrical model special being proposed may be appreciated with help of the R^2 , determination coefficient being equal with 0,6813 for the commune Zabriceni with this quota part total variabilities one can affirm that the technological variables have a diverse partial ponderation with the value of 1,42 for surface of agricultural grounds 0,94 for the bonity of the soil where the lot is placed and minority values for the rest factors. The precision of the coefficient evaluation of elasticity according with the student distribution is being framed in the pitch of 95% and we may affirm that the values of the price of

evaluated agricultural lots have the confidential interval acceptable for the land transactions. The test Durbin-Watson of heteroscedasticity of the residues in the special econometric model is equals with 1,033 and attest a normal dispersion (Gauss) with a repartition undeplased at the deviation. The evaluation in concordance with the spacial econometric geographically weighted regression SAR of the primary data for the commune Zabriceni shows a value of the determination coefficient $R^2=0,666$ and confirms the model valability by the quota part of the elasticity of the exogen factors. The direct approaching of the appreciation of agricultural lots price concomitantly with the spatial econometrical indirect evaluation invokes the value of the elasticity surface of the lot equals with 0,854 for direct variant, 0,261 the case the indirect option and 1,116 total option. The Student distribution with the precision of 95% for the parameters of special regression equation confirms a error probability smaller than 0,05 in cadastral calculations.

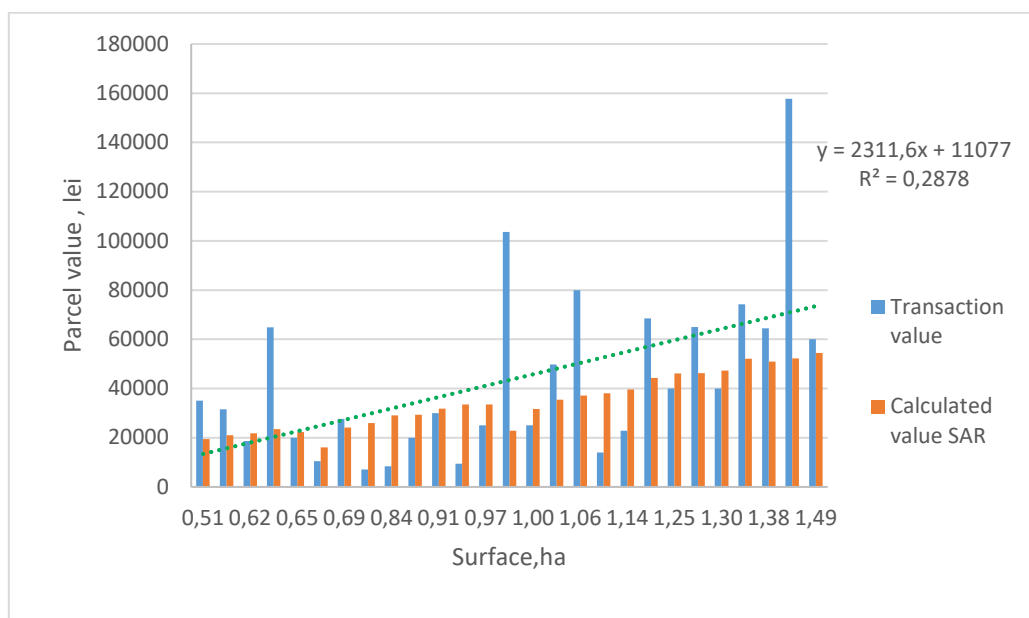


Figure 5. The graphic of the dependence of transaction value of selling-purchasing and the calculated value of agricultural grounds concerning to the surface of the lot in the diapason of 0,5÷1,5 ha

Source: Elaborated by the author in the basis data primary collected

In the table 4 there are presented the results of prices calculation of the agricultural lots from the commune Zabriceni, the district of Edinet for the 2022 year with the indication of the afferent cadastral code, the surface of the lot and the value of selling-purchasing transactions according to the contract. The exogen factors included in the frame of econometrical model may be characterized in the following approach:

- the average value of agricultural surface of the lots is of 0,54 ha with reliable interval from 0,52 up 0,56 with mean squary deviation of 0,752. This technological indicator correlates massively $r = 0,97$ with the value of the contract transaction value in leis with a precision of evaluation net superior to $p = 0,05$. The minimum value of the lot surface in sample is of 0,015 and the maximum value represents 26,91 ha with the indicator Standard Skewness equals with 398 and Standard

Kurtosis – 5228. In the figure 3 there is presented the resulted information of the distribution of the surface of the lots in sample;

- the arithmetic average of the soil bonity of included lots in sample is equaled with 59,5 balls and the scuary average of deviations represents 27 with the interval reliable in option of distribution student 95% from 58,9 up to 60,1. The variation coefficient concerning the bonity represents 45% and this one confirms the homogeneity of the primary data with values Skewness -25 and Kurtosis -12 in accordance with the test of normality Jarque-Bera. The soil bonity in sample varies between the minimum value 6,0 and maximum value 94,0 that attests a relatively high quality of agricultural lots concerning the productivity. The coefficient of correlation of the soil quality has maximum value with the altitude of the lot emplacement of the lot $r = 0,25$ represents a considerable value in reference with the geographical exposition of the slope of the ground $r = 0,12$ and is only negative with the exogen factor the slope $r = -0,014$ and the evaluation precision is satisfactory with a error probability smaller than $p = 0,05$;

- the form of the lot that in the primary data is expressed by perimeter has a middle arithmetical value of 481 meters and the scuary average deviation of 302 m is being framed in the reliable interval according with the distribution student 95% from 298 up 307 m. The maximum perimeter in sample is 6723 m and with the minimum value of 6 m generates a distribution of primary data in accordance with the test of normality Jarque-Bera in a value of 111 for Skewness and 670 concerning Kurtosis. The repartition of the data in sample concerning the homogeneity is characterized by the coefficient of variation equals with 51% and represents an acceptable value from the point of view of dispersional analysis. The intensity of the relation between the exogen factors of the econometrical model is evaluated with the help of the coefficient of correlation and perimeter has a maximum affinity in comparison with the surface of the lot with a maximum value of $r = 0,643$.

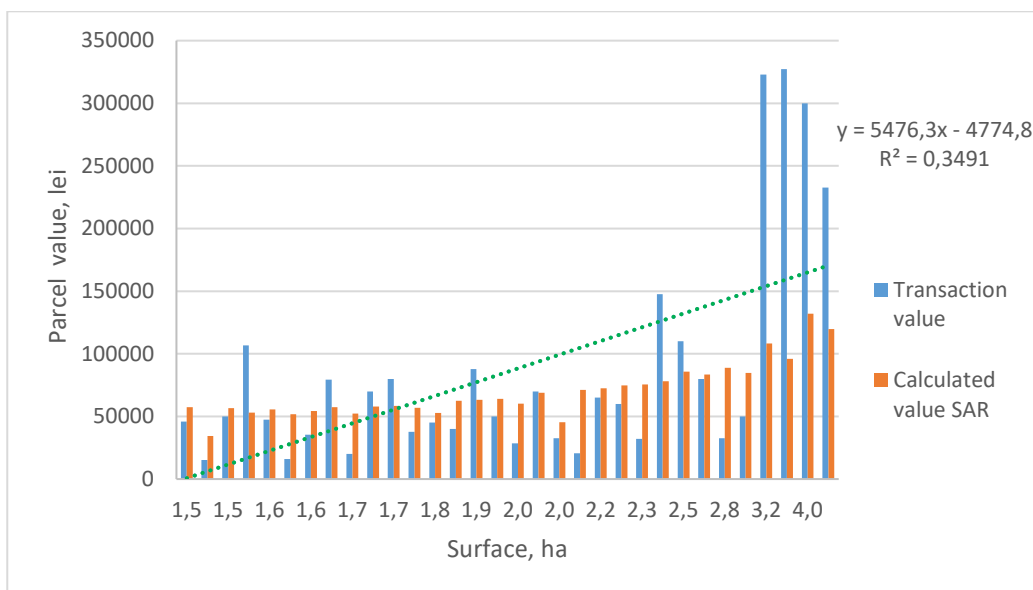


Figure 6. The graphic of dependence of transaction value of purchasing-selling and the calculated value of agricultural lots concerning the surface of the lot in the diapason 1,5÷4,0 ha

Source: Elaborated by the author on the basis of primary collected data

In the figure 4 there is presented the linear dependence of the value of agricultural lots (from the contract or calculated with the indication of the trend) for different diapasons of the lot surface. The buyers of agricultural lots psychologically they have an intuitive preference referring the large surfaces and in the presented graphics (Figure 4-6) the trend OLS is maximum for the diapason 0,5-1,5 ha, with the value of the coefficient regression 698. It is evidently that the values of agricultural lots evaluated under the model econometric ponderated geographically SAR are net inferior to evaluated values by means of OLS because of the linear regression is sensitively inadequate under the aspect concerning the nonstationarity of the primary data reflecting by the hedonically price of lots (bigger than 3 ha) certify an overlapping of the calculated values OLS a fact that is being confirmed from the distribution Pareto of the behavior of the consumers (buyers) from the economic theory.

The average value of the transactions concerning to the data of the Republic of Moldova in 2022 represents 85584 leis from the contract selling-purchasing and equals with 69814 leis for the lots values of calculated lots according to the model econometrical SAR. The deviation of the square average of 86944 leis concerning the transactions from the contracts is net superior to the afferent statistic indicator 21519 leis calculated with the help of the space econometrical model confirming the visible difference in the dispersion of the primary data in the presented graphics. The minimum value of transactions from contracts is 15111 leis and the maximum value 327323 leis but the diapason concerning the estimated value of the lots is being definded from 34286 leis minimum up 132079 leis. The reliance interval according with the distribution student 95% for the transactions registered in contracts are found in the diapason from 31346 till the maximum value 80883 leis and respectively the calculated values of the lots are in the interval from 7758 leis till 491235 leis. The coefficient of correlation of the transaction from the contracts with the surface of the lots represent financial relation with a strong intensity $r=0,97$ and respectively the value of the afferent statistic indicator between the surface of agricultural lots and the data the space econometrical model presents a relation near linear with high intensity $r=0,98$

4. Conclusions

The durable development of the rural space in the Republic of Moldova is an objective of major importance taking into account of offered conditions of the perspectives to adhere to the European Union. The basis make-up in increasing of efficiency of utilization of financial resources in the agricultural sector of the country represents the adequate evaluation of the land lots with agricultural destination that is not achieved at this moment in the massive variant for those approximatively four million of lots identified by the cadastral code.

The essential objective in the present work under aspect of methodological argumentation of the hedonic price in the transactions of selling-purchasing of the agricultural lots imposes the necessity of utilization of the space econometric model. It was achieved the complete set of calculations for the commune Zabriceni district of Edinet with the presentation concerning 8130 lots with the calculated values of integral agricultural lots of the village. Graphically is presented the comparative analysis of the calculation results by means of space econometric model SAR the values the transactions of selling-purchasing and the linear trend from three specific pitches distincted under the aspect of distribution of the lot price on the market land.

For the minor values 0-0,5 ha the calculated values by the regression method ponderated geographically are net inferior to the values of linear trend (OLS) and vice-versa the major values transactional surfaces:1,5-4,0 ha, the linear trend OLS is net inferior to the calculated values by the space econometrical method. The respective aspect requires a specific approaching in agricultural politics of the decision factors in the agricultural sector concerning the behavior of the consumer (buyers) on the land market. The proposed model for evaluating of agricultural lots is adequate to put problem for achieving and may serve as a working instrument in practical implementation.

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5. Bibliographical references.

1. Anselin, L., Rey, S.. *Modern Spatial Econometrics in Practice: A Guide to GeoDa, GeoDaSpace and PySAL*. Chicago, IL, USA: GeoDa Press, 2014.
2. Brasington, D.M., Hite, D. *Demand for Environmental Quality: A Spatial Hedonic Analysis*. *Regional Science and Urban Economics*, 2005, 35, 57–82.
3. Brueckner, J.K. *Strategic Interaction Among Governments: An Overview of Empirical Studies*. *International Science Review*, 2003, 26(2), 175–88.
4. Brunson, C., A.S. Fotheringham, and M. Charlton. *Geographically Weighted Regression Modelling Spatial Non-stationarity*. *The Statistician*, 1998, 47, part 3, 431–43.
5. Bidanset, P.E., Lombard, J.R.. *Evaluating Spatial Model Accuracy in Mass Real Estate Appraisal: A Comparison of Geographically Weighted Regression and the Spatial Lag Model*. *A Journal of Policy Development and Research*. 2014, 16(3), 169-182.
6. Bidanset, P.E., Lombard, J.R. *The Effect of Kernel and Bandwidth Specification in Geographically Weighted Regression Models on the Accuracy and Uniformity of Mass Real Estate Appraisal*. *Journal of Property Tax Assessment & Administration*. 2014, 11(3), 5–14.
7. Huang, B., Wu, B., Barry, M.. *Geographically and Temporally Weighted Regression for Modeling Spatio-Temporal Variation in House Prices*. *International Journal of Geographical Information Science*. 2010, 24(3), 383–401.
8. Lockwood, T., Rossini, P. *Efficacy in Modelling Location within the Mass Appraisal Process*. *Pacific Rim Property Research Journal*. 2011, 17(3), 418–442.
9. McCluskey, W.J., McCord, M., Davis, P.T., Haran, M., McIlhatton, D. *Prediction Accuracy in Mass Appraisal: A Comparison of Modern Approaches*. *Journal of Property Research*. 2013, 30(4): 239–265.
10. McMillen, D.P. *One Hundred Fifty Years of Land Values in Chicago: A Nonparametric Approach*. *Journal of Urban Economics*. 1996, 40(1), 100–124.
11. Moore, J.W., and J. Myers. *Using Geographic Attribute Weighted Regression for CAMA Modelling*. *Journal of Property Tax Assessment & Administration*. 2010, 7(3), 5–28.
12. Pace, R.K., LeSage J.P. *Spatial Autoregressive Local Estimation*. In A. Getis, J. Mur and H.G. Zoller (eds.), *Spatial Econometrics and Spatial Statistics*. Palgrave Macmillan, 2004.
13. Pace, R.K. LeSage, J.P. *Introduction to Spatial Econometrics*. CRC Press, 2009.
14. Tiefelsdorf, M. *Modelling Spatial Processes. The Identification and Analysis of Spatial Relationships in Regression Residuals by Means of Moran’s I*. Springer, 2000.