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ATTRIBUTES AFFECTING THE VALUE OF UNDEVELOPED REAL PROPERTY BASED OF COMMUNES OF KOMORNIKI AND MUROWANA GOŚLINA

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ATRYBUTY WPŁYWAJĄCE NA WARTOŚĆ NIERUCHOMOŚCI NIEZABUDOWANYCH NA PRZYKŁADZIE GMIN: KOMORNIKI, MUROWANA GOŚLINA

STRESZCZENIE: Celem pracy było wyodrębnienie czynników wpływających na wartość nieruchomości budowlanych na przykładzie gmin: Komorniki oraz Murowana Goślina, uwzględniając walory środowiskowe i społeczno-ekonomiczne. W opracowaniu przeanalizowano materiały z lat 2010–2013 zawarte w transakcjach kupna-sprzedaży nieruchomości niezabudowanych, pozyskane z PODGiK w Poznaniu. Wyniki analizowano z wykorzystaniem sieci neuronowych. Największy wpływ na kształtowanie się wartości gruntów budowlanych w gminie Komorniki miało występowanie sieci kanalizacyjnej, a w gminie Murowana Goślina – powierzchnia działki.

SŁOWA KLUCZOWE: nieruchomość niezabudowana, metoda cen hedonicznych, sieci neuronowe

Introduction

Land designated for residential development outside the possibility of mounting thanks to their location and surroundings also provide ecosystem services from which you can replace the provision of recreational and aesthetic.

Such benefits include, among others the possibility of walking through the woods and along the shores of lakes or admire the landscape from the window of your own home. Selling the land recognize some of these benefits, taking into account the values in the transaction prices of land sold.

The level of prices recorded on the local real property market in sale-purchase transactions reflects attributes affecting their value. Significant attributes influencing the value of undeveloped real property allocated to single-family housing include nature value as a unique additional income generated by the natural capital.

The process of real property appraisal is complicated, as it requires consideration of many factors. This effect is not uniform, with some factors having a greater effect than others. When estimating real property in the determination of market value of real property we most frequently apply a comparative approach, which in accordance with Art. 153 of the Act on real property economy should include e.g. attributes affecting the value of real property. Determination of weights of market attributes affecting the value of real property is a complex process. According to the National Appraisal Guidelines (Ni1 – application of a comparative approach in real property appraisal) weights of market attributes may be determined in three ways:
- Analysing data bases of prices and attributes of real property previously being objects of market turnover in the period of price analysis,
- Through analogy to local markets of similar type and area,
- Based on studies – observations of preferences of potential real property buyers (data from real property agencies).

Having a relatively large sample (the number of transactions) and certain characteristics attributed to each real property we may apply statistical methods. The application of these methods in analyses of real property markets provides significant information on the behaviour of this market. This information is objective and may be used both to conduct individual and mass-scale appraisals[1]. In developed real property markets statistical methods are acknowledged and frequently used tools in the analysis of real prop-

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[1]   A. Bitner, *O użyteczności metod statystycznych w wycenie nieruchomości,* "Infrastruktura i Ekologia Terenów Wiejskich" 2010 no. 12, p. 145–158.

erty markets[2, 3, 4.] In Polish literature on the subject statistical methods analysing factors affecting the value of real property were applied by[5,1, 6,7,8, 9,10.]

The aim of this study was to identify factors affecting the value of building real property in the communes of Komorniki and Murowana Goślina considering environmental and socio-economic values.

Study area

The study area comprised two communes (figure 1) (Komorniki, Murowana Goślina) located in the Poznań county, distinguished by nature value (vicinity of the Wielkopolska National Park and the Puszcza Zielonka Landscape Park).

The Murowana Goślina commune with the population of 16 thousand inhabitants is located at a distance of 20 km north of the Poznań city centre. This commune neighbours the Puszcza Zielonka Landscape Park. Marked cycling paths are 500 km in length. Around the Park the Trail of Wooden Churches was established, with a beautiful 17th century church in Długa Goślina. Attractive accommodation throughout the year is offered to tourists by 18 hotels and agritourist farms. Avid swimmers may use bathing beaches in Kamińsko, Okoniec and Wojnówko. The Śnieżycowy Jar reserve of spring snowflake, unusual for lowland areas, located in Starczanowo, in the spring is admired by tourists for its white blanket of flowers.

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[2]   R. Bruce, D.J., Sundell, *Multiple regression analysis: history and applications in the apprasial proffesion*, "Real Estate Appraiser" 1977 Jan/Feb, p. 37–44.

[3]   J. K. Eckert (ed.), *Property appraisal and assessment administration*, Chicago 1990.

[4]   J. Hozer, S. Kokot, W. Kuźmiński, *Metody analizy statystycznej rynku w wycenie nieruchomości*, Warszawa 2002.

[5]   A. Bitner, *Konstrukcja modelu regresji wielorakiej przy wycenie nieruchomości*, "Acta Sci. Pol., Administratio Locorum" 2007 no. 6(4), p. 59–66.

[6]   K. Gawroński, B. Prus, *Lokalny rynek nieruchomości oraz wybrane czynniki kształtujące ceny nieruchomości rolnych i działek budowlanych na przykładzie miasta Niepołomice*, "Infrastruktura i Ekologia Terenów Wiejskich" 2005 no. 4, p. 7–18.

[7]   P. Parzych, *Modelowanie wartości nieruchomości zurbanizowanych*, "Studia i Materiały Towarzystwa Naukowego Nieruchomości" 2007 no. 15(3–4).

[8]   R. Walkowiak, A. Zydroń, *Zastosowanie regresji krokowej do określenia atrybutów wpływających na wartość nieruchomości rolnych na przykładzie gminy Mosina*, "Acta. Sci. Pol., Administratio Locorum" 2012 no. 11(3), p. 239–253.

[9]   A. Zydroń, R. Walkowiak, *Analiza atrybutów wpływających na wartość nieruchomości niezabudowanych przeznaczonych na cele budowlane w gminie Mosina*, "Annual Set The Environment Protection" 2013 no. 15, p. 2911–2924.

[10]   A. Zydroń, D. Kayzer, *Podnoszenie świadomości społeczeństwa o nowych metodach wyceny wartości przyrody – Willingness to Pay oraz Willingness to Accept na przykładzie Wielkopolskiego Parku Narodowego*, Poznań 2015.

The Komorniki commune of almost 24 thousand inhabitants is located in the central part of the Wielkopolskie province. It is one of the most dynamically developing demographically communes in Poland. It results from the fact that it is one of the most developed economically communes in the Poznań conurbation, which to a considerable degree is caused by the advantageous location for transport, i.e. the vicinity of Poznań, a well-developed transport system, particularly the vicinity of the A2 motorway with the exit from this motorway in Komorniki and the commune-operated bus transportation. In the commune of Komorniki there are areas covered by legal nature protection forms, such as the Wielkopolska National Park, the Protected Landscape Area of the Wirynka River Valley and the Natura 2000 areas.

Figure 1.   Location of the study area

Methods

Studies comprised an analysis of sale-purchase transactions for undeveloped land in the communes of Komorniki and Murowana Goślina in the years 2010–2013. In the study we analysed materials concerning sale-purchase transactions, i.e. 385 transactions in the commune of Komorniki and 392 transactions in the Murowana Goślina commune, which were obtained from the the County Geodesy and Cartographic Documentation Centre in Poznań. It was established that the area of a plot for building purposes should be min.

300 m^2 and max. 3000 m^2. Based on the analyses of these land sale-purchase transactions the following variables were identified:

- sewerage network (0 – not present, 1 – present);
- distance from Poznań city limits [km];
- distance from surface waters [km];
- distance from protected forested areas [km];
- plot area [m^2];
- year of study (2010, 2011, 2012 , 2013).

The dependence between the price for 1 m^2 undeveloped real property allocated to building purposes in the selected communes and the analysed characteristics in a given year was determined using artificial neural networks. Automated neural networks available in STATISTICA 10.1 were used for the statistical analyses. As a measure of fit for the model evaluating the price of 1 m^2 undeveloped real property in comparison to the actual value resulting from the sale-purchase transactions we adopted the correlation coefficient.

In order to distinguish important variables from those, which are not informative for the network operation we conducted the analysis of sensitivity. This analysis may be conducted only to learn something on input variables. Analysis of sensitivity does not provide an absolute evaluation of the usefulness of variables. It has to be exercise with caution, which does not undermine its practical usefulness. The primary measure of network sensitivity is the quotient of error obtained when initiating the network for a set of data without one variable and error obtained with a complete set of variables. The greater the error after the rejection of a variable in relation to the original error, the more sensitive the network is to a lack of this variable. If the quotient of the errors is 1 or even smaller, the elimination of the variable does not influence the quality of the network.

In order to indicate whether there is a trend for real property prices connected with individual years, a model was constructed with an additional variable – the year, in which the sale-purchase transaction was executed. Valuation of ecosystem services was made by Hedonic Pricing Method.

Results

Modelling of prices for 1 m^2 undeveloped real property for building purposes was performed using artificial neural networks. For each analysed case an original model structure was obtained. In addition, there were differences in the activation functions of hidden neurons (linear, hyperbolic tangent and exponential) and output neurons (exponential and logistic) in each model. These differences result from the essence of the learning process of neural

networks, in which using iterative algorithms the network structure is cleared in order to minimise errors.

The values of the correlation coefficients specifying the quality of models in each year evaluating the level of prices for 1 m² undeveloped real property in the both communes varied from 0.34 to 0.84. The models take into account year research correlation coefficient for Komorniki was 0.49, and for the municipality of Murowana Goślina 0.46.

Results of sensitivity analysis for models with individual years evaluating prices for 1 m² undeveloped real property in the communes of Komorniki and Murowana Goślina are present in table 1, while in table 2 for this communes with an additional variable – the year.

Table 1.   Sensitivity analysis of artificial neural networks for models with individual years

commune	year	sewerage network	distance from Poznań	distance from surface waters	distance from forested areas	plot area
Komorniki	2010	9.689	1.571	1.319	1.020	1.017
	2011	2.918	0.991	1.022	1.215	1.020
	2012	1.069	0.995	1.001	1.019	1.000
	2013	2.508	1.344	1.006	1.214	1.030
Murowana Goślina	2010	1.008	0.997	0.999	1.000	1.250
	2011	1.007	0.999	0.999	1.000	1.001
	2012	5.042	1.022	1.119	1.013	1.099
	2013	1.598	1.240	0.887	1.142	1.760

Table 2.   Sensitivity analysis of artificial neural networks for models with an additional variable – the year

commune	sewerage network	distance from Poznań	distance from surface waters	distance from forested areas	plot area	year of study
Komorniki	3.176	1.036	0.999	1.326	1.007	1.110
Murowana Goślina	1.006	1.063	1.012	1.015	1.496	1.047

When investigating results of sensitivity analysis it was found that the price for 1 m² undeveloped real property for building purposes in the Komorniki commune depends mainly on the existence of the sewerage system. Based on the values of coefficients of 9.689, 2.918, 2.508 it was stated

that in the years 2010, 2011 and 2013 this factor considerably modified the value of sold real property. The effect on variability of plot prices in 2010 and 2013 was additionally connected with the distance from the Poznan city limits and in 2010 with the distance from surface waters. Moreover, it was recorded that the distance from the Wielkopolska National Park in 2011 and 2013 affected changes in prices for 1 m^2 real property. In 2012 based on the results of sensitivity analyses it was not stated that the investigated factors influenced plot prices in executed sale-purchase transactions.

When investigating results of sensitivity analyses for modelling the value of 1 m^2 plots located in the Murowana Goślina commune it was found that in 2010 and 2013 the price was considerably affected by plot area, while in 2012 and 2013 it was the existence of the sewerage network. In contrast to the Komorniki commune, in this commune the prices of plots were not significantly influenced by environmental value (protected forests areas, surface waters).

In addition, it was noted that the effect of the distance from forest protected areas for the price of 1 m^2 of real estate has changed over the years. In the last year of the study noted that the price of land in the municipality greatly influence begins the direct neighborhood of the Forest Zielonka.

When analysing the assessment of coefficients obtained based on the sensitivity analysis it was observed that for modelling including variability connected with the year of sale it was not stated that the years, in which transactions were executed, considerably affected the price of 1 m^2 undeveloped real property for building purposes in the investigated communes. It may be stated that there exists a certain variability connected with years, but it is more adequate to state that prices in the investigated years remained within a certain relative stable range. Additionally it was found that the effect of the attribute of the distance from protected forested areas (in the years of analysis 2011, 2013) for the Komorniki commune on the price of 1 m^2 real property was highly significant, since it implies the effect of this factor for the constructed model including the years, in which the sale-purchase transactions were executed.

Figures 2 presents graphs for the scatter describing the relationships between the observed values of prices for 1 m^2 real property and the corresponding residuals (differences between the actual and modelled prices). On their basis it was found that among the transactions we may find those, for which the price of 1 m^2 seems underestimated in relation to the other transactions. In each of the analysed samples (learning, validation, testing) we may find cases, in which market values are lower by 100 to 200 PLN than the general trend resulting from the executed sale-purchase transactions. These cases to a considerable extent may affect the reduction of quality for

the conducted modelling. Frequent occurrence of these observations in the analysed sale-purchase transactions influence the value of square errors, which significantly complicates the establishment of market value of real property taking into consideration the comparative approach.
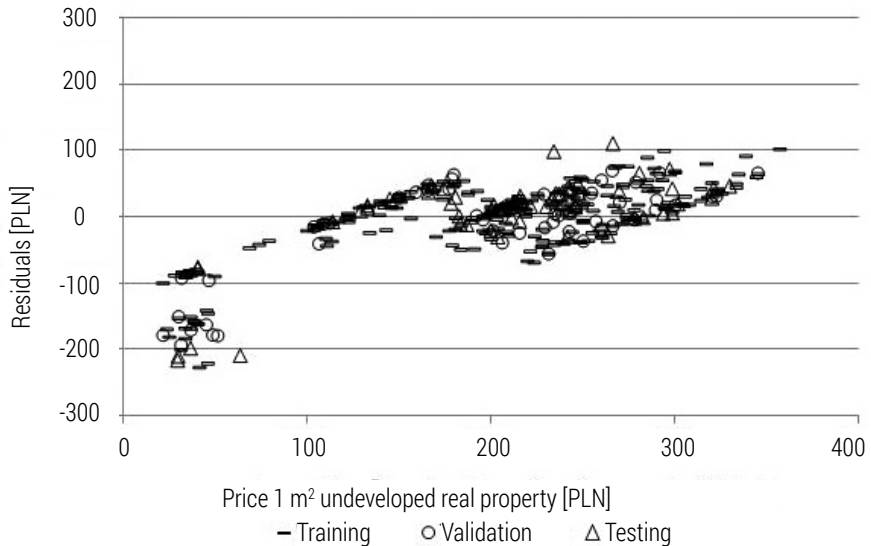

Figure 2.   Comparison of the modelled and residual values

Discussion

Based on the analyses it was found that the value of undeveloped real property depending on the year of study and on the selected commune was influenced by various factors. These results are consistent with those reported by other authors[11]. It was also observed in this study that there is a dependence between plot size and the transaction price (the larger the plot, the unit price decreases). This problem was discussed in studies by[12,13,1], where a more marked relationship was obtained between these variables. The difference in the results between individual authors resulted among

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[11]   K. Gawroński, B. Prus, *Lokalny rynek nieruchomości oraz wybrane czynniki kształtujące ceny nieruchomości rolnych i działek budowlanych na przykładzie miasta Niepołomice*, "Infrastruktura i Ekologia Terenów Wiejskich" 2005 no. 4, p. 7–18.

[12]   S. Źróbek, M. Bełej, *Podejście porównawcze w szacowaniu nieruchomości*, Olsztyn 2000.

[13]   M. Prystupa, *Wycena nieruchomości przy zastosowaniu podejścia porównawczego*, Warszawa 2001.

other things from the adopted assumptions when selecting variables applied in modelling, trends in specific years of study and attractiveness of plots related to their location. It is frequently assumed that the analysed real property have to differ in only one characteristic, which is uncommon in reality. Practically it is impossible to find around a dozen real property differing in only one characteristic, for which sale-purchase transactions were recorded[1]. Both in this study and in a study by[1] the analyses included all sale-purchase transactions on the market using all available information on dependencies between the price of a plot and its attributes. In view of analyses based on multiple regression we may agree with[1] that the application of linear models in the estimation of real property value is advisable thanks to the objective and simple method to determine the effect of attributes on the value of real property. This approach has another drawback, as it is assumed that explaining variables are continuous variables. These assumptions are not met in the case of such attributes as the location of high voltage grid lines or the access to the sewerage network. For this reason it is recommended to use other methods, taking into consideration attributes presented in the form of a discreet variable. One of such methods is modeling of prices of 1 m2 using neural networks. This may lead to differences in the application of these methods. In turn, one of the drawbacks of the application of neural networks is connected with a lack of objective criteria, which specify from what figure the quotient of the error obtained when initiating the network for a set of data without one attribute and the error obtained with a set of variables show the significance of this attribute.

Conclusions

1. The greatest effect on the fluctuations in the value of building land in the Komorniki commune was observed for the access to the sewerage network, while in the Murowana Goślina commune it was plot area.
2. It was noted that in the municipality of Komorniki significantly the price of 1 m^2 of undeveloped property received direct vicinity of the Wielkopolska National Park. However in the municipality of Murowana Goślina it noted that the neighborhood of the Forest Zielonka year increasingly affects the price of 1 m^2 plot.
3. It was observed that in the Murowana Goślina commune only in the years 2012–2013 the price of 1 m^2 undeveloped real property was influenced by access to the sewerage network.
4. It was not stated that the price of 1 m^2 real property was significantly influenced by the year, in which the transaction was concluded.

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Dariusz Kayzer, Ph.D – 30%
Krzysztof Adamowicz, Ph.D Eng – 20%

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