REMV
REAL ESTATE MANAGEMENT AND VALUATION

Journal homepage:
www.remv-journal.com

WHAT INFLUENCES LAND PRICES? ECONOMETRIC ANALYSIS FOR SZCZECIN

Mariusz Doszyń[1]*

University of Szczecin, Aleja Papieża Jana Pawła II 22A, 70-453 Szczecin, Poland, e-mail: mariusz.doszyn@gmail.com, ORCID: 0000-0002-3710-1177

** Corresponding author*

ARTICLE INFO

Keywords:

econometric models of land prices, real estate features, location, real estate databases

JEL Classification:

C31, C51, R31

ABSTRACT

The aim of the article is to construct an econometric model that will enable the estimation of the impact of real estate features on their unit price. For the purposes of the study, a database of transaction prices of undeveloped land properties for residential purposes was built (Szczecin, analysis period: 2020 – 2022). This database contains 428 transactions. Real estate features and their states were defined. The study also proposed an econometric method of determining the impact of location, which is based on adding 0 – 1 variables for individual housing estates to an appropriately specified model. The proposed approach can support property appraisers in the valuation process (e.g. in market analysis or when determining the weights of real estate features). The presented results and the proposed approach can also be used by analysts and real estate agents.

Citation: Doszyń, M. (2026). What influences land prices? Econometric analysis for Szczecin. *Real Estate Management and Valuation*, *34*(2), 1-9. https://doi.org/10.2478/remav-2026-0011

1. Introduction

Currently, there are many discussions taking place to explain what real estate unit prices depend on. Usually, they regard the development of apartment prices against the background of the general macroeconomic, political and, more recently, geopolitical situation. Econometric time series models are often used in this type of research, e.g. (Cellmer et al., 2019).

Generally, it is difficult to clearly indicate what influences real estate unit prices from the macroeconomic point of view. Local real estate markets have their own specificity and are often inefficient, which results in strong inertia of real estate unit prices. Property unit prices depend, to a very large extent, on their previous values, exhibiting their own "inner law of motion".

This article adopts a different perspective. An attempt was made to explain the unit prices of undeveloped land for residential purposes. Therefore, it is not about the impact of socio – economic factors on the real estate unit price. The unit prices are explained by the characteristics of the property (plot area, transport accessibility, surroundings, physical features of the plot, utilities). The impact of location was taken into account by introducing dummy variables for individual housing estates in the analyzed city. The impact of real estate features on their unit price was determined on the basis of an appropriately specified econometric model for cross-sectional data.

There are many applications of econometric models in explaining real estate prices, e.g. Dell (2017), including urban land prices. For example, Barańska and Michalik (2014) determined real estate market value on the basis of a multidimensional function model for different databases, which is analogous to econometric modeling.

Spatial hedonic econometric models might be useful in explaining land prices. General methodology is presented. e.g., in Anselin and Lozano – Garcia (2009). These models explicitly incorporate the locational attributes and their estimation entails the application of spatial econometrics. These methodologies address two types of spatial effects in econometric models (spatial dependence and spatial heterogeneity). The treatment of spatial dependence, including considerations of space – time dynamics, and spatial heterogeneity are discussed, drawing on selective examples from empirical studies in the literature.

Land prices from the valuation perspective are considered in Krause and Bitter (2012). Three significant trends within the realm of real estate valuation research are indicated: (1) the increasing adoption of spatial

econometrics; (2) the acknowledgement of distinctions between land values and improvement values; and (3) recognition of value premiums associated with environmentally sustainable development practices.

In Nam et al. (2023), an attempt was made to determine factors influencing residential land prices. The research investigated 241 officials, real estate investors, appraisers, and real estate brokers. Research has shown 13 groups with 45 factors affecting the residential land price. The impact rates of the factor groups ranged from 1.43% to 23.65%. The COVID – 19 pandemic, upgrading administrative units, formulation and implementation of the planning, the real estate market, economic factors, credit, real estate brokerage, infrastructure, location of the land parcel, particular or juridical factors, environment and social security have the strongest impact on land prices.

Pham et al. (2022) tried to identify the impact of various factors on land prices in urban zones, aiming to establish land pricing standards. Through a survey encompassing 362 land users and an analysis of 200 successfully transacted properties within the study area, this study employs multivariate regression techniques to construct a model for residential land prices and ascertain their market value. Furthermore, the authors devise a map delineating areas of differing land values, facilitating the adept regulation of land prices by governmental bodies.

Mostafa (2018) delves into the determinants affecting residential land prices in Kuwait. Recognizing the spatial correlation and diversity inherent in land prices, the research employs a combination of conventional and Bayesian spatial regression methodologies to examine the influence of several factors on residential land prices. These factors include population density, the proportion of Kuwaitis within the population, the quantity of educational facilities, occurrences of traffic accidents, as well as levels of air pollution. The findings suggest a positive correlation between land prices and density, the percentage of Kuwaiti residents, and the availability of educational resources, while indicating a negative impact of air pollution on land prices.

Goffette-Nagot et al. (2010) investigates the geographical diversity of land prices in Belgium. Spatial autocorrelation is taken into consideration. The findings reveal that the linguistic boundary serves as a notable impediment in the spatial distribution of land prices, and that environmental factors do not exhibit significant effects at this geographical level.

Hannonen (2008) examines the forecast accuracy of four distinct hedonic approaches when predicting vacant urban land prices within local markets. The hedonic methods under investigation include: 1) ordinary least squares estimation, 2) robust MM – estimation, 3) structural time series estimation, and 4) robust local regression. Through post – sample predictive testing, it was revealed that utilizing the unconventional methods proposed in this paper leads to more precise predictions compared to conventional least squares estimation. Specifically, employing the unconventional hedonic methods outlined in this study significantly enhances predictive unbiasedness. Additionally, the paper scrutinizes the composition of urban land prices, identifying the permitted building volume, house price index, northing, and easting as the most influential attribute variables in elucidating land prices. Conversely, the impact of parcel size variables and various indicator variables on land prices was comparatively weaker.

Bourassa et al. (2011) quantified the land intensity or leverage of a property by computing the ratio of the land value to the total property value. This computation was based on transaction data for single – family residences in Switzerland, spanning the period from 1978 to 2008. Hedonic models were applied to construct time series data for land prices and land leverage. Error correction models were used to estimate both house prices and land leverage. The importance of incorporating land leverage alongside fundamental factors when evaluating the determinants of house prices was indicated. Changes in house prices were influenced by fluctuations in real construction costs, real GDP per capita, and population growth among individuals aged 30 to 49. Conversely, changes in land leverage are primarily driven by variations in real construction costs and real GDP per capita.

The thorough investigation into modeling undeveloped land prices, particularly from the perspective of mass valuation, is encapsulated within the monograph (Doszyń, 2020). This monograph delineates a framework for assessing the influence of property attributes on urban land value.

Doszyń (2024) investigates whether the inclusion of expert knowledge enhances the accuracy of estimation outcomes for models of urban land value. Six econometric models were assessed: ordinary least squares (OLS), mixed – effects, Bayesian, Inequality Restricted Least Squares (IRLS), ridge regression, and LASSO regression (with regularization). In three of these models (i.e, mixed – effects, Bayesian, and IRLS), prior knowledge was incorporated. In the mixed – effects and Bayesian models, priors were specified as intervals for model parameters, while in the IRLS model,

eISSN: 2300-5289

restrictions in the form of inequalities were imposed. The empirical analysis applied these models to assess the value of undeveloped residential land. Models incorporating prior knowledge demonstrated superior performance in terms of the consistency of estimates with theoretical expectations. Moreover, prediction accuracy was enhanced in models including prior knowledge.

In Doszyń (2022) econometric models of land prices with sample and prior information were estimated. Prices of land property for residential development in Szczecin were modeled. It was shown that the impact of some features cannot be estimated only from the sample data because of the low quality of datasets from local, often small markets. As a solution, econometric models with prior information were proposed. In the simulation experiment, the predictive power of mixed estimation models was compared with OLS models and models with only prior information. It turned out that mixed estimation results are superior.

2. Materials and methods

When trying to explain the factors determining the unit price of real estate, it is important to correctly determine the real estate features and their states. Factors determining unit prices of undeveloped land properties (for residential development) are determined, among others, by property appraisers in the valuation process. The adopted features of the properties and their states are presented in the table below.

Table 1

Real estate features and their states

Feature	Category	Eligibility criteria
Area	Large	>1200 m^2
	Average	500 – 1200 m^2
	Small	<500 m^2
Utilities	Lack	Lack of energy, water, sewage, gas, system heat
	Incomplete	Possibility of connecting to at least one medium
	Full	Possibility of connecting to electricity, water, sewage and gas or district heating
Surroundings	Burdensome	Industrial areas, bases, warehouses, yards
	Unfavorable	Commercial buildings in the immediate vicinity
	Average	Residential, recreational, garage, public and commercial purposes in the further vicinity
	Favorable	Green areas and agricultural areas
Transport availability	Unfavorable	Access via an unpaved road or the nearest bus stop at a distance of more than 1000 m
	Average	Access via a paved road of poor quality (slabs, asphalt with holes) or the nearest stop at a distance of more than 500 m
	Favorable	Access via a good quality paved road and a stop at a distance of up to 500 m
Physical features	Unfavorable	The shape of the plot is average or unfavurable, and the terrain is uneven
	Average	The shape of the plot is favorable or average, but the terrain is uneven, or the shape of the plot is unfavorable, but the terrain is equal
	Favorable	The shape of the plot is favorable and the terrain is equal

Source: Doszyń (2020).

All features are qualitative. Area is a quantitative feature, but, according to the property appraiser's suggestion, it was expressed in three levels (large, medium and small area). According to the appraiser's opinion, this is how the area is treated by participants of the local real estate market.

For all features (except the environment), there are three states: unfavorable, average and favorable. In the case of the environment, there are four feature states. Utilities also have three states: lack, incomplete, full.

The qualitative nature of features means that a certain amount of subjectivity in determining feature states is inevitable. Therefore, it is important that each feature state is clearly defined. It is also advisable that the states of the features be determined by the same team of experts, preferably property appraisers. This is a condition for the coherent and unambiguous determination of the states of each feature.

An important, if not the most important, feature of real estate is its location. The impact of location will be determined by adding dummy variables for individual housing estates in the city.

The transaction data covers the years 2020 – 2022. The spatial scope is Szczecin. Information on 428 transactions was collected. Only plots designated for residential purposes, with an area between 200 – 3000 m^2, were considered.

The explained variable is the unit price of undeveloped land properties for residential purposes. Unit prices ranged from PLN 11.6 to PLN 1050, with an average of PLN 279.44 and a median of PLN 210.58. The unit price distribution is presented below. As we can

see, distribution is positively skewed.

The distributions of qualitative features are presented in the table 2.

Most properties (59.6%) had an average area, unfavorable transport accessibility (41.8%), favorable physical features (79.2%) and full utilities (50.2%). Transactions were distributed relatively evenly in individual years. The most transactions were in 2021 year (38.3%).

All presented real estate features are defined in such a way that the relationships between the unit price and the individual features should be positive. These types of relationships are presented in the charts below. We can see that this is in fact the case. Correlograms of the unit price of real estate against individual features of the property indicate positive relationships between features and price. In the last figure, unit price distributions are presented for each year. Due to the fact that the data comes from three years (2020 – 2022), in order to take into account the possibility of price changes, individual years will be taken into account by adding dummy variables to the econometric model.

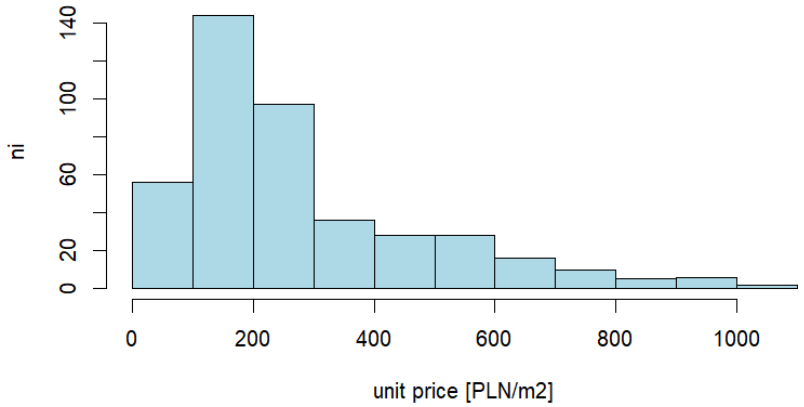

Fig. 1. Distribution of unit land prices in Szczecin in the years 2020 – 2022. *Source*: own study.

Table 2

Distribution of qualitative explanatory variables

State	Area	Transport availability	Physical features	State	Utilities	Year
Unfavorable	0.322	0.418	0.084	Lack	0.075	2020: 0.357
Average	0.596	0.388	0.124	Incomplete	0.423	2021: 0.383
Favorable	0.082	0.194	0.792	Full	0.502	2022: 0.259

Source: own study.

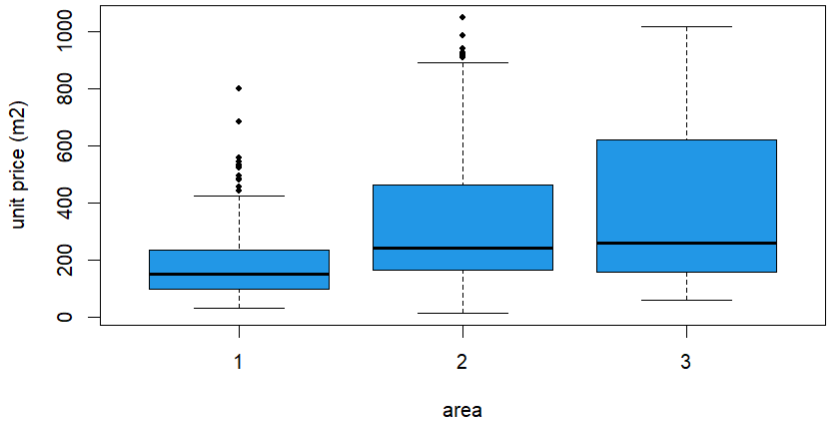

Fig. 2. Relation between unit real estate price and area. *Source*: own study.

eISSN: 2300-5289

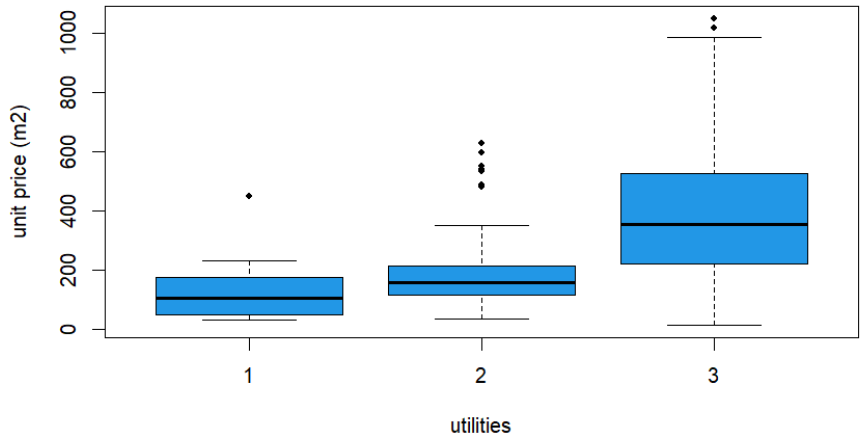

Fig. 3. Relation between unit real estate price and utilities. *Source*: own study.

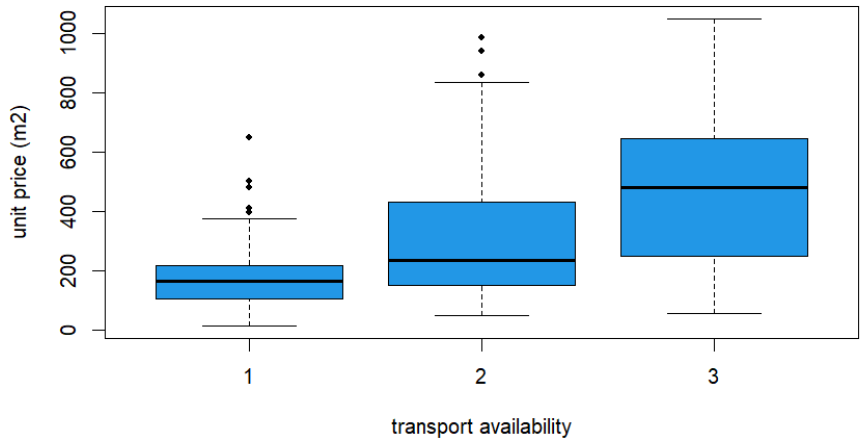

Fig. 4. Relation between unit real estate price and transport availability. *Source*: own study.

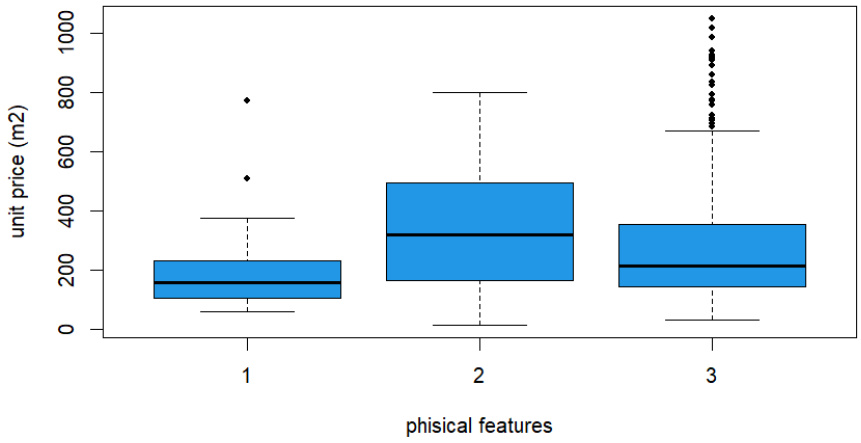

Fig. 5. Relation between unit real estate price and physical features. *Source*: own study.

eISSN: 2300-5289 | Received 2025-05-26 | Revised 2025-10-19 | Accepted 2025-11-25

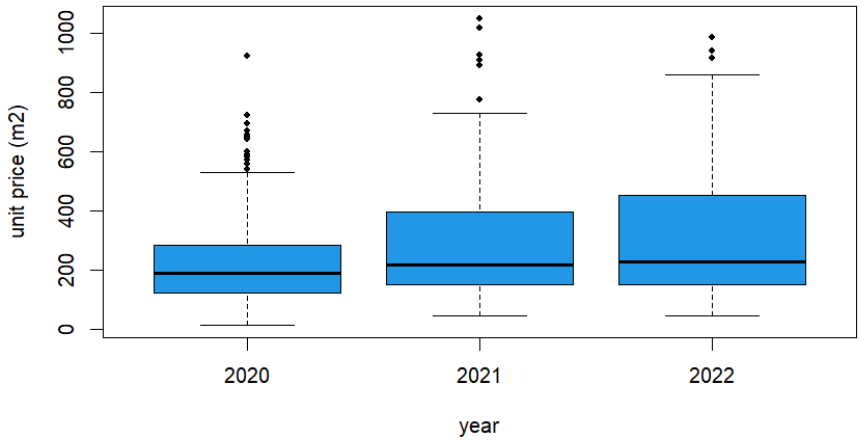

Fig. 6. Unit price distribution in each year. *Source*: own study.

Table 3

Number of transactions in individual housing estates

Housing Estate	n_i	Housing Estate	n_i
Wielgowo – Sławociesze – Zdunowo	95	Podjuchy	10
Skolwin	66	Gumieńce	7
Osów	43	Zdroje	5
Stołczyn	42	Dąbie	4
Płonia – Śmierdnica – Jezierzyce	35	Żydowce – Klucz	4
Bukowe – Klęskowo	27	Żelechowa	4
Warszewo	25	Pomorzany	3
Krzekowo – Bezrzecze	16	Kijewo	2
Pogodno	13	Turzyn	1
Załom – Kasztanowe	13	Arkońskie – Niemierzyn	1
Bukowo	12		

Source: own study.

The feature that has the strongest impact on real estate prices is usually location. The impact of location in econometric models can be taken into account in many ways. We can add another qualitative variable with the following states: unfavorable, average, favorable. In spatial econometric models, the impact of location can be taken into account through spatial autocorrelation. This study used a different approach. The impact of location will be determined by adding dummy variables for individual housing estates in the city.

The number of transactions in individual residential estates is presented in table 3. The number of estates is 21. In 7 estates, there were more than 20 transactions, whereas fewer than 10 transactions were noted in 9 housing estates.

Regarding the presented database, it is worth noting that the properties were not randomly selected. This means that the database may not be representative. For example, transaction prices in the presented database differ negatively from prices published by, for example, the National Bank of Poland (NBP). The lack of representativeness of the database used is related to the difficulty in accessing information on transaction prices and property characteristics. Furthermore, the database does not include information on the type of planned development (single-family, semi-detached, or multi-family houses), and such information undoubtedly affects prices. The range of variation for a particular area is also related to the specific nature of transactions in the database used.

The following econometric model of property unit price was estimated:

$$lnp_i = \alpha_0 + \alpha_{11}a_{1i} + \alpha_{12}a_{2i} + \alpha_{21}u_{1i} + \alpha_{22}u_{2i} + \alpha_{31}ta_{1i} + \alpha_{32}ta_{2i} + \alpha_{41}pp_{1i} + \alpha_{42}pp_{2i} + \sum_{j=2}^{21}\beta_j\, l_{ji} + u_i \quad (1)$$

where:
p_i – unit price of i – th property, $i = 1, 2, \ldots, n$, n – number of properties,
area: a_{1i} – average, a_{2i} – small,
utilities: u_{1i} – incomplete, u_{2i} – full,
transport availability: ta_{1i} – average, ta_{2i} – favorable,
physical properties: pp_{1i} – average, pp_{2i} – favorable,
l_{ji} – zero – one variables for residentials, $j = 2, 3. \ldots, 21$
$\alpha_0, \alpha_{11}, \ldots\ldots, \alpha_{42}, \beta_2, \beta_3, \ldots, \beta_{21}$ – parameters,
u_i – error term.

The above model (1) is log – linear. Qualitative feature states were introduced into the econometric model as zero – one variables ("1" indicates the presence of a given state of the feature). Zero – one variables were omitted for the worst feature states and for the "worst" location (Turzyn residential), because there is a constant term in the model. The impact of the worst states is present in the constant term.

Variable l_{ji} stands for location. It is a zero – one variable, equaling one for a given housing estate. The lowest unit prices were in the Turzyn housing estate, and this is the reason why the zero – one variable for this estate was omitted.

Table 4

Estimation results

Variable	Estimate	p – value	Impact [%]
Intercept	2.816	0.000	-
Average area	0.313	0.000	36.8%
Small area	0.246	0.028	27.9%
Incomplete utilities	0.387	0.000	47.3%
Full utilities	0.635	0.000	88.7%
Average transport availability	0.255	0.000	29.0%
Favorable transport availability	0.359	0.000	43.2%
Average physical features	0.293	0.004	34.0%
Favorable physical features	0.369	0.000	44.6%
Arkońskie – Niemierzyn	2.106	0.000	721.5%
Bukowe – Klęskowo	2.087	0.001	706.1%
Bukowo	1.877	0.000	553.4%
Dąbie	1.810	0.000	511.0%
Gumieńce	1.740	0.000	469.7%
Kijewo	1.717	0.000	456.8%
Krzekowo – Bezrzecze	1.642	0.002	416.5%
Osów	1.586	0.001	388.4%
Płonia – Śmierdnica – Jezierzyce	1.490	0.001	343.7%
Podjuchy	1.466	0.001	333.2%
Pogodno	1.404	0.005	307.1%
Pomorzany	1.389	0.002	301.1%
Skolwin	1.344	0.003	283.4%
Stołczyn	1.190	0.010	228.7%
Warszewo	1.165	0.009	220.6%
Wielgowo – Sławociesze – Zdunowo	0.959	0.032	160.9%
Załom – Kasztanowe	0.899	0.042	145.7%
Zdroje	0.866	**0.052**	137.7%
Żelechowa	0.851	**0.081**	134.2%
Żydowce – Klucz	0.145	**0.772**	15.6%
Year 2021	0.247	0.000	28.0%
Year 2022	0.222	0.000	24.9%

P – values higher that 0.05 are written in bold
Source: own study.

3. Research and discussion

Estimation results of Model (1) are in the following table. Parameters with dummy variables for surroundings states were not statistically significant, and therefore this feature was omitted. The significance level of 0.05 was adopted throughout the study.

It seems that it is not easy to estimate a good econometric model of real estate unit prices. The main obstacle is often low data quality. Transaction databases may contain a few transactions. There might be much missing data or unusual observations resulting from incorrect entries, etc. It is also not easy to determine the factors that determine real estate unit prices. Additionally, in the case of qualitative features, the feature states are not clearly defined and are determined subjectively. Transaction databases are often combined, resulting in a lack of comparability, consistency, etc.

In the context of the above comments, the obtained model should be assessed quite positively. Only the surroundings turned out to be a statistically insignificant feature, and was therefore eliminated from the model. The remaining parameter estimates are statistically significant, with the exception of the dummy variables only for three housing estates (Zdroje, Żelechowa, Żydowce – Klucz).

Most importantly, the parameter estimates are consistent with theoretical expectations, which is not at all common.

The last column of the table above shows the percentage impact of individual variables. In the estimated model, the reference point is the intercept, which can be treated as the theoretical minimum unit price, i.e. the price of the property with the worst condition of all features, located in the worst housing area. Hence, this is a reference point when interpreting the impact of other property features.

Analyzing the impact of individual features (the last column of the table above), it can be seen that the location has the greatest impact on the real estate unit price. Its influence was in the range of 15.6 – 721.5%. In almost all housing estates (except Żydowce – Klucz) the influence of location was greater than 100%. In the case of the Arkońskie – Niemierzyn estate, there was only one transaction, so the impact of the location for this estate should be treated with great caution.

Another feature with high impact on unit prices is utilities, which increases the minimum unit price by 88.7%. Physical features increase the unit price by 44.6%, transport accessibility – by 43.2%, and area – by 36.8%.

All parameter estimates are positive. Moreover, there is a monotonic effect of the property's feature states, which means that a better feature state increases the unit price of the property to a greater extent than the previous state. For example, full utilities increases the unit price, on average, by 88.7%, and incomplete utilities – by merely 43.7%. Favorable transport availability increases the unit price of the property on average by 43.2%, while average transport availability – by 29%. A similar relationship occurs for the physical characteristics of the plot. The exception is the plot area, where an average area increases the unit price by 36.8%, while small area – only by 27.9%. This may indicate that real estate buyers prefer plots of medium rather than small size for development.

The database covers transactions over a period of three years. In order to take into account unit price changes over time, dummy variables were added for 2021 and 2022. The dummy variable for 2020 was omitted and serves as a reference point. Dummy variables for these years (2021, 2022) are statistically significant. It can be stated that, in 2021, unit prices were higher on average by 28% compared to 2020, and in 2022 – by 24.9%.

The model fits the empirical values quite well. The coefficient of determination is 69.8%. The disadvantage of the estimated model is the necessity to reject the hypothesis stating the normality of the residuals distribution. P - value in the Shapiro-Wilk test is less than 0.05. The hypothesis of homoscedasticity of error term should also be rejected. P - vale in the White test was less than 0.05. These types of defects are common when modeling real estate unit prices based on many observations, which often involve very diverse transactions.

4. Conclusions

Nowadays, there are many methodological proposals, including the field of real estate unit price modeling. Very advanced quantitative methods are often proposed. In many models, the unit price level is explained using, e.g, economic, social, and geographic variables. These are usually time series models. The problem may be that, nowadays, the set of variables influencing real estate unit prices may change from period to period. This is related to the very dynamically changing economic, political and even geopolitical environment.

The presented study proposes a hedonic regression model in which the unit price level is explained by real estate features. This is a model for cross-sectional data. The basic problem in constructing this type of models

eISSN: 2300-5289

for local real estate markets is to construct a database of transactions containing reliable information. The data was taken from the Real Estate Price Register. However, it required many actions related to incorrect entries, lack of clear descriptions, etc. The next stage was to define the characteristics of the properties and their states. There are no clear indications in this regard in the literature, which results from the diversity and specificity of local real estate markets. Correctly defining property features, their states, and then assigning them to individual properties has a decisive impact on the modeling results. It is important to use a uniform and consistent approach when assigning individual feature states. Constructing a database of transaction prices of appropriate quality was an important part of the study. One of the premises of this study was that the quality of statistical data is crucial. If data quality is low, even advanced quantitative methods will not lead to satisfactory results.

The estimated econometric model gave quite satisfactory results. The model parameter estimates were consistent with theoretical expectations. The signs of the parameter estimates were positive, which resulted from the definition of the features and their states. Moreover, the impact of the features met the monotonicity criterion, which means that the impact of a better state of a given feature on the unit price was greater than the impact of the previous state. The location had the greatest impact on the unit price, followed by the plot utilities. The influence of transport accessibility, physical features and plot area was smaller.

The article proposes taking into account the influence of location using dummy variables for individual housing estates. This approach seems quite promising. Often, the effect of location is taken into account through spatial autocorrelations. However, this type of approach requires a lot of data from similar locations, which is difficult, especially in small local markets.

The estimated model also has some drawbacks. The distribution of the error term is not normal. Moreover, the error term is not homoscedastic. In subsequent research, an attempt will be made to improve the model specification, which may result in eliminating these shortcomings.

Acknowledgements

The database used in the study was prepared mainly by M. Frej, with the help of M. Bas, both of whom are property appraisers working at the Department of Econometrics and Statistics of the University of Szczecin.

References

Anselin, L., & Lozano-Garcia, N. (2009). Spatial hedonic models. In T. C. Mills & K. Patterson (Eds.), *Palgrave Handbook of Econometrics*, vol. 2, 1213 – 1250.

Barańska, A., & Michalik, S. (2014). Variants of modeling dwelling market value. *Real Estate Management and Valuation, 22*(3), 28–35. https://doi.org/10.2478/remav-2014-0024

Bourassa, S. C., Hoesli, M., Scognamiglio, D., & Zhang, S. (2011). Land leverage and house prices. *Regional Science and Urban Economics, 41*(2), 134–144. https://doi.org/10.1016/j.regsciurbeco.2010.11.002

Cellmer, R., Bełej, M., & Cichulska, A. (2019). Identification of cause - and - Effect relationships in the real estate market using the VAR model and the Granger test. *Real Estate Management and Valuation, 27*(4), 85–95. https://doi.org/10.2478/remav-2019-0038

Dell, G. (2017). Regression, critical thinking, and the valuation problem today. *The Appraisal Journal, 85*(3), 217–230.

Doszyń, M. (2022). Econometric models of real estate prices with prior information. Mixed estimation. *Real Estate Management and Valuation, 30*(3), 61–72. https://doi.org/10.2478/remav-2022-0021

Doszyń, M. (2024). Might expert knowledge improve econometric real estate mass appraisal? *The Journal of Real Estate Finance and Economics*, *69*, 719–740. https://doi.org/10.1007/s11146-022-09891-3

Doszyń, M. (red. n.) (2020). *System kalibracji macierzy wpływu atrybutów w szczecińskim algorytmie masowej wyceny nieruchomości.* WNUS. Szczecin [Doszyń, M. (red. n.) (2020). *Calibration system of attributes influence matrix in Szczecin mass real estate valuation algorithm*. WNUS. Szczecin]

Goffette-Nagot, F., Reginster, I., & Thomas, I. (2010). Spatial analysis of residential land prices in Belgium: Accessibility, linguistic border, and environmental amenities. *Regional Studies*, *45*(9), 1253–1268. https://doi.org/10.1080/00343404.2010.484417

Hannonen, M. (2008). Predicting urban land prices: A comparison of four approaches. *International Journal of Strategic Property Management, 12,* 217–236. https://doi.org/10.3846/1648-715X.2008.12.217-236

Krause, A. L., & Bitter, C. (2012). Spatial econometrics, land values and sustainability: Trends in real estate valuation research. *Cities (London, England), 29*(Supplement 2), 19–25. https://doi.org/10.1016/j.cities.2012.06.006

Mostafa, M. M. (2018). A spatial econometric analysis of residential land prices in Kuwait. *Regional Studies, Regional Science, 5*(1), 290–311. https://doi.org/10.1080/21681376.2018.1518154

Nam, P. P., Hue, N. T., & Huyen, P. T. T. (2023). The impact of factors on residential land prices: A case study in Tu Son city, Vietnam. *Real Estate Management and Valuation, 31*(2), 66–81. https://doi.org/10.2478/remav-2023-0014

Pham, H. T., Nguyen, T. T., Nguyen, Q. V., & Nguyen, T. V. (2022). Land price regression model and land value region map to support residential land price management: A study in Nghe An Province, Vietnam. *Real Estate Management and Valuation, 30*(1), 71–83. https://doi.org/10.2478/remav-2022-0007