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INFORMATION ASYMMETRY AND MASS APPRAISAL[1]

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Abstract: In the article, we propose a new method of valuation based on market value coefficients which we have called the Szczecin algorithm of mass appraisal (SAMWN). This algorithm takes into account the idea that it is possible to measure the effects of both immeasurable and measurable variables which have not been directly included in the valuation. It is therefore a proposal to solve the problem of asymmetry of information in the mass appraisal. The article discusses the procedure of estimating the property value in the process of mass appraisal, in which the attribute related to location and fashion is not included a priori.

Keywords: asymmetry of information, mass appraisal, real estate appraisal algorithms

JEL classification: C10, C51

INTRODUCTION

According to the Real Estate Management Act (Real Estate Management Act 1997), in the process of real estate valuation the following values can be estimated: market, replacement, cadastral and other. The market value is defined as the most likely price that could be obtained for the property at the date of valuation under certain conditions: both parties to the transaction are to be independent of

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each other, determined to enter into the transaction, not acting under constraint and having the same knowledge about the property in question. An additional condition is the passage of appropriate time, which allows for appropriate exposure of the real estate on the market. The market value can only be determined for properties that are or can be traded [Źróbek and Bełej 2000]. Replacement value has been determined as the estimated amount consisting of the cost of land acquisition (its market value) and the cost of production of property components, taking into account the degree of wear and tear, assuming that production costs were incurred at the date of valuation [Hopfer Ed. 1999]. Contrary to the market value, the replacement value applies to properties which are not or cannot be traded (due to the type of property, current use or purpose). The cadastral value is determined during the universal property taxation. Despite the fact that in Poland the methodology for determining this value has been specified, in practice the cadastral value has not yet been estimated. It may even be said that it has not even been defined, as the Act indicates only its purpose (universal taxation).

In practice, real estate valuations can take place in two completely different legal and organisational situations:

1. individual appraisal,
2. mass appraisal.

The cadastral value determination (in practice even for thousands of diverse properties) will require a second approach. Individual appraisal is the case when the object of valuation is a single property or a relatively small group of properties. Valuated properties will differ due to their individual attributes: location, land development, type of market (segment and sub-segment), purpose and scope of valuation, the dates when the property state was inspected and when prices on a local property market were recorded, etc. Individual appraisals are the most frequently performed procedures with the use of the applicable valuation rules provided by law and a number of professional norms, which in Poland include professional standards, basic and specialist appraisal standards and interpretative notes.

Mass appraisal is the case when [e.g. Hozer Ed. 2002; Telega Ed. 2002; Kuryj 2007]:

1. the subject of valuation is a large number of properties of one type,
2. valuation is to be carried out by means of a uniform, objective approach resulting in consistent results,
3. all properties subject to valuation are valued 'at the same time', i.e. the state of the property and the level of prices are recorded on the same day.

From the organisational point of view, the mass appraisal takes place in two stages:

1. collecting all the necessary information and data concerning all the valued properties and the respective market,
2. calculating the value of all properties subject to appraisal with the use of an appropriate (single) algorithm.

The postulate of the necessity to apply one algorithm in the process of mass appraisal means that individual approach to the appraised property is not possible. The list of specific attributes that should be covered by the valuation is defined in advance, either by the valuer (or a valuation team), or even regulated by law.

Pursuant to Article 161(1) of the Real Estate Management Act, the universal taxation is aimed at determining the cadastral value of a property. Cadastral values, as defined in Article 162, paragraph 2 of the Act, are used:

- for determining the taxable base for real estate tax,
- when determining the value of real estate owned by the State Treasury or a relevant local government unit,
- when executing official procedures for the purpose of which it is necessary to specify the individual value of a property.

Depending on the type of land and its components, the specific attributes are defined in the Ordinance on universal real estate taxation of 29 October 2001.

Article 8 of the said Ordinance provides that the specific attributes of land built on or intended to be developed, as well as land intended for purposes other than agricultural and forestry, shall include:

1. location,
2. the function designated in the local land use plan,
3. level of equipment with technical infrastructure facilities,
4. the state of development,
5. plot ratio,
6. the soil class, if it has been defined in the real estate cadastre.

The specific attributes of agricultural and forestry land include:

1. location,
2. type of land in use,
3. level of equipment with technical infrastructure facilities for agricultural or forestry production,
4. soil class.

The specific attributes of buildings include:

1. location,
2. type of building,
3. equipment with in-building installations,
4. technical data within the meaning of the provisions on cadastre,
5. wear and tear.

The specific attributes of a unit include:

1. position within a building,
2. type of unit,
3. equipment with in-building installations,
4. wear and tear.

Apparently, in the case of determining the cadastral value, the catalogue of property specific attributes to be explicitly included in the valuation is a closed catalogue, although the legislator has stipulated otherwise. The above results from the provision stating that the aforesaid specific attributes of land, buildings and their units may also include other attributes, if they are typical of a given taxation zone. The term „specific" does not solve the problem of the „individual" attributes of a property. At the final stage of determining the cadastral value, maps and tactile tables are constructed, which unambiguously define the attributes that should be explicitly included in the valuation. Therefore, it is not possible to include in the valuation other information (e.g. soil and water conditions) relevant for the value of land designated for development. Soil and water conditions often make investment impossible or make it significantly more expensive. So, we are dealing with an asymmetry of information. For example, almost all investments in the Szczecin seaport require piling prior to any construction works. Water and ground conditions can therefore have a significant impact on the value of many properties. This asymmetry of information in property valuation is the reason why the individual value of the property, determined by means of algorithm-based methods, cannot be compared in any way with the value of a property estimated individually, e.g. by the method of paired comparison. They are two different economic categories.

Decision making processes in the economy should assume the logical and rational nature of decision-makers (managers), and the decisions taken should best serve the interests of the organisation. hen facing a situation that requires a decision, the manager should therefore:

- obtain complete and perfect information,
- eliminate any doubts,
- evaluate everything rationally and logically, and finally make a decision that serves the best interests of the organisation (in the case of the cadastral tax it is the state or a local government).

In the context of mass appraisals, it is pre-supposed that we have incomplete information. Such assumption, however, seems reasonable and logical because limited information reduces the costs of the (mass) appraisal itself. The estimated result of particular real estate valuations will usually differ from the actual market value of properties, but from the point of view of the central or local government policy, it will be neutral, because it is highly probable that the number of overvaluations will be balanced by the number of undervaluations, and the final effect (here: the fiscal one) will be similar [Hozer, Kokot, Kuźmiński 2002].

The asymmetry of information in mass appraisal may cause a plenty of other problems, the most important of which is the conflict between the parties.

Herbert A. Simon was one of the first to note that decisions are not always made according to the principles of rationality and logic [Simon 1983]. In practice, when in the decision-making situation managers:

- use incomplete and imperfect information,

- are limited in their rationality (e.g. because they can acquire and process information),
- tend to be satisfied with the first acceptable solution, and finally make decisions that may or may not serve the interests of the organisation. The quality of their decisions clearly depends on the available information.

Thus, in practice, we are dealing with incomplete and unreliable information, as well as with decision-making in the conditions of conflict between the parties involved. The conflict of the parties in the case of mass appraisal may consist in e.g. the taxpayer's feeling an unfair fiscal burden (cadastral tax is an ad valorem tax, i.e. the higher the value of a property, the higher the amount of tax). The inability to build a building or a structure (e.g. due to unfavourable water and ground conditions) will result in the investor's disapproval of tax amount, if the mass appraisal process has not included in calculations this particular defect of the property in question. This will in all probability result in an appeal by the taxpayer against the decision to charge the mandatory duty. At first glance, the problem seems to be rather minor, but in practice it may paralyse the whole process of a asessing the tax rates, thus causing immense losses for the organisation (the state, a local government). If we assume that the cadastral value is not the same as the market value of a property (as it has already been highlighted by real estate valuation methodologists), almost every administrative decision in this respect may be challenged or appealed by taxpayers. In 2018 in Warsaw, during an international conference „European Valuation Standards and Statistical Valuation Methods - are they legal?" held by the European Group of Valuers' Associations (TEGoVA) and the Polish Federation of Valuers' Associations, Ewa Kucharska-Stasiak (professor at the University of Łódź, PFVA) observed that the subject of discussion should be neither the technical feasibility of using statistical methods in valuation nor the concern to enhance demand for valuers' services, but the answer to two questions: does the property value determined with statistical methods correctly represent the concept of market value and is the result of the estimation carried out by statistical methods understandable for the client. The answers to both questions were negative.

The algorithm-based methods of property valuation, the results of which do not allow for determining the market value of a property, should be applied only in specific cases. In all other situations when it is necessary to use market value, traditional methods of individual valuation should be used. When the legislators supplement the Act with the definition of a different type of property value, i.e. the cadastral value, the valuers will be able to apply mass appraisal methods.

A good field to apply mass appraisal are valuations for the purpose of revaluing real estate portfolio, e.g. by banks or investment funds. No direct contact between bank and borrower, fund and investor takes place here, and discrepancies in values for individual properties are of little importance for the entire portfolio. Another application of mass appraisal is to estimate the economic effects of adopting or changing local spatial development plans. The tools and methods of mathematical and statistical modelling are very useful in the real estate market analysis, i.e. at the stage of preliminary property valuation performed in an individualised manner.

LITERATURE REVIEW

In the literature the issue of mass appraisal is often discussed. What is considered are groups of methods rather than individual approaches. Attempts at systematisation can be found e.g. in: [Kauko, d'Amato (Ed.) 2008; Doszyń 2011; Kuźmiński 2004; Hozer 2001; Kokot 2004; Kuryj 2007; Pawlukowicz 2001; Prystupa 2000; Telega et al. 2002]. Most commonly used division distinguishes three groups of methods based on:

1. econometric models of multiple regression and their derivatives,
2. neural networks,
3. Automated Valuation Models (AVM).

Attempts to apply econometric regression models have so far been the most frequently explored, but the results of modelling have not always been satisfactory [Gdakowicz, Putek-Szeląg 2018; Wyatt 1996]. That was mainly due to:

1. unmeasurability of explanatory variables,
2. collinearity of explanatory variables.

Reservations also concerned the occurrence of catalysis and coincidence of attributes, as well as poor fit of models, which strongly limited their practical use, [e.g. Sztaudynger 2003; Dacko 2000; Dacko 2001; Źróbek 2000; Lipieta 2000]. Another reason for the lack of applicability of the models were heterogeneous data. Some of the models used in the simulation also produced negative results [Czaja 1998]. The valuations obtained with the use of neural networks often gave satisfactory results [Lis 2001; Wiśniewski 1998], however, the correlations between variables were not clear.

The automated pricing models (AVMs) have been used in the United States since the early 1980s and in Europe since the 1990s. However, it was not until the 21st century that satisfactory results were achieved with automatic valuation models [Waller 1999] that were initially used to determine the value of individual properties. There are many examples of successful AVM implementations. The paper [Francke 2008] presents a hierarchical time series model of house valuation, called the hierarchical trend model. In the Netherlands, this model has been successfully applied to the valuation of about one million houses for property tax purposes. Property values obtained by means of AVMs find use for other legal purposes, such as water and agricultural taxes or income taxes collected by the Dutch central government.

The paper [Figurska 2017] documents the functioning of over twenty commercial solutions applied in the USA, Australia, Canada, Germany, Great Britain, Switzerland, the Netherlands and Sweden. In many other countries, AVMs are at different stages of development. Success in the implementation of algorithms, however, largely depends on the quality of the data that can be obtained. According to the American standard on AVM [Standard on Automated Valuation Models – AVMs Approved 2003; revised approved 2018]:

1. Transactional data should be sufficient to produce reasonable valuation models. The number of sales should be at least five times (fifteen times is desirable) the number of independent variables explaining the price volatility.
2. Sales transactions should be valid transactions that reflect the market value of a property under valuation.
3. Data should be consistent across the whole population of the properties to be valued.
4. The data on the attributes of properties should be as accurate as possible for use in the model and its application to the property population.
5. Sales data and property attributes should be representative of the underlying population or the subset of properties that may be subject to valuation using the AVM.

METHODOLOGY

The proposal to solve the problem of information asymmetry, as well as of incomplete and unreliable information in the mass appraisal, is a theory based on econometric analysis of relationships and the study of the effect of unmeasurable variables

In the econometric analysis, when using a model to examine the relationships:

$$X_{1t} = f(X_{2t}, X_{3t}, \ldots, X_{kt}, U_t),$$

we can measure, e.g.:

1. the states of variables X_{it},
2. the changes in the states, i.e. $\Delta X_{it} = X_{it} - X_{it-1}$,
3. the effects of variables $X_{2t}, X_{3t}, \ldots, X_{kt}$ na X_{1t} (structural parameters),
4. the outcome of the effects of variables X_{it} , i.e. $X_{1t}(X_{it})$; $i = 2, 3, \ldots, k$.

It appears that even when it is not possible to examine the processes listed in points 1 to 3, we still can examine the effects of non-measurable explanatory variables (attributes) on the explanatory variable [Hozer 2003].

When analysing the real estate market, it becomes clear that the attribute strongly influencing the value of a property is its location. A residential property located in an attractive, fashionable neighbourhood will be valued higher than a similar property[2] located in an unattractive area, far from the city centre. Location is

[2] Similar property means that it is a property with attributes on a similar level, of similar size, finishing standard, technical condition, etc.

a qualitative feature. Experts try to quantify this attribute by describing it as desirable, average or undesirable. But even such a definition of an attribute is very subjective - the state of the location determined for a given property depends on the personal emotion of a person describing the property. So, it is hard examine the effect of a qualitative variable (location) on the value of a property. In the first stage of the study, variables that significantly affect the value of a property were specified. From the collection of variables, these attributes should be selected that have the strongest effect on the value of a property and at the same time there is the possibility to collect them (e.g. size, transport accessibility, neighbourhood, development, utilities, water and ground conditions). It is often impossible to meet both of these conditions, because the question arises how to measure, for example, fashion which undoubtedly affects the value of a property? In the Szczecin land property mass appraisal algorithm (SAMWN) presented below, both deliberate human activity and non-measurable factors are taken into account in the form of market value coefficients (WWR) that eliminate the effect of information assymetry:

$$\widehat{W}_{ji} = WWR_j \cdot pow_i \cdot W_{baz} \cdot \prod_{k=1}^{K}(1 + A_k), \tag{1}$$

where:

$\widehat{W}_{ji}$ – market (or cadastral) value of the i–th property in the j–th elementary area,
WWR_j – market value coefficient in the j–th elementary area $(j = 1, 2, \dots, J)$,
J – number of elementary areas,
pow_i – size of the i–th property,
W_{baz} – price of 1 m^2 of the cheapest land in the valuated area,
A_k – effect of the k–th attribute $(k = 1, 2, \dots, K)$,
K – number of attributes.

Coefficients WWR_j are computed for individual elementary areas[3] as an arithmetical mean of WWR_i (formula 2) computed for individual properties-representatives from each of the elementary areas. These, in turn, are the quotient of the market value of the property (formula 3) determined by the property valuer[4] (in the process of individual valuation) and the hypothetical value of the property determined on the basis of formula 4.

$$WWR_j = \frac{\sum_{i=1}^{l} WWR_i}{l}, \tag{2}$$

[3] Elementary area is defined as an area in which a certain number of valued properties are located that are characterised by the same effect of the location attribute on their value.

[4] Property valuers who estimated the value of the property in question included the location in the collection of attributes describing the property.

$$WWR_i = \frac{WR_{ri}}{\widehat{W}_{hi}}, \tag{3}$$

$$\widehat{W}_{hi} = pow_i \cdot W_{baz} \cdot \prod_{k=1}^{K}(1 + A_k), \tag{4}$$

where:
WWR_i –ratio of the market value to the hypothetical value of the i-th property,
l – number of properties in the j-th elementary area,
WR_{ri} –market value of the i-th property, as determined by a property valuer,
$\widehat{W}_{hi}$ – hypothetical value of the property calculated on the basis of the model.

In the proposed SAMWN formula (formula 1) the problem is to determine the A_k coefficients measuring the effects of particular attributes (features) on the value of the property. Since the attributes are presented on a qualitative scale, two methods are employed to determine the effects of particular characteristics on the value of real estate: Spearman coefficients (R_{xy}) and standardised β_k coefficients. Beta coefficients are calculated according to the following formula β_k. Beta coefficients are calculated according to the following formula:

$$\hat{\beta}_k = \frac{S_{A_k}}{S_{WR_r}} \cdot \frac{(WR_{ri} - \overline{WR}_r)}{(A_k - \bar{A}_k)}, \tag{5}$$

where:
$\hat{\beta}_k$ – standardised beta coefficients of the k-th attribute,
S_{WR_r} – standard deviation of the value of 1 m^2 of land determined by a property valuer,
$\overline{WR}_r$ – average value of 1 m^2 of land calculated on the basis of values determined by a property valuer,
S_{A_k} – standard deviation of the effect of the k-th attribute,
$\bar{A}_k$ – average value of the effect of the k-th attribute.

Calibration of the attributes of land properties is carried out on the basis of a mathematical formula (correction coefficients (1+A_k) are determined according to the method of distance from extreme values) [Lis 2003]:

$$1 + A_k = \left(1 - \frac{1}{2}\rho\right) + \left[\left(1 + \frac{1}{2}\rho\right) - \left(1 - \frac{1}{2}\rho\right)\right] \cdot \frac{l_{kp}}{k_p - 1} = \left(1 - \frac{1}{2}\rho\right) + \rho\frac{l_{kp}}{k_p - 1}, \tag{6}$$

where:
l_{kp} – the p-th category of the k–th attribute,
ρ – standardised coefficients of the k-th attribute, depending on the method adopted: Spearman coefficient R_{xy} or beta coefficient $\hat{\beta}_k$.

In order to be able to explain the value of the property in 100%, the values of the relevant Spearman coefficients and standardised beta coefficients are adjusted so that the sum of their absolute values is equal to 1.

In the next step of the study, the results of property estimation obtained through individual valuers' valuations are juxtaposed with the results of property value estimation made with SAMWN using:

1. adjusted Spearman coefficients,
2. beta coefficients.

The results obtained are compared using a relative valuation error. The relative error is calculated using the following formula:

$$\partial = \frac{|W_{ji} - WR_{ri}|}{W_{ji}} \cdot 100\%. \quad (7)$$

Additionally, the following variation measures are calculated

$$Se = \sqrt{\frac{\left(WR_{ri} - WR_{ji}\right)^2}{n}}, \quad (8)$$

$$Vs = \frac{Se}{\overline{WR_{ri}}} \cdot 100\%, \quad (9)$$

where:
Se – standard deviation of the value of 1 m^2 land,
Vs – variation coefficient of the value of 1 m^2 of land.

EMPIRICAL EXAMPLE

The study used data on 567 plots of land in Szczecin designated for housing purposes, which were the subject of individual valuation in 2005. The plots were located in 5 elementary areas (Table 1).

Table 1. Quantity of individual elementary areas covered by the study

Elementary area	Quantity
3	187
4	37
5	178
6	62
7	103
Total	567

Source: own study

Plots were described with the following collection of attributes:
y – value of 1 m^2 (in PLN) – a dependent variable;
x_1 – physical traits: 0 – undesirable, 1 – average, 2 – desirable;
x_2 – development: 0 – no, 1 – yes;

x_3 – utilities: 0 – no, 1 – partial, 2 – full;
x_4 – neighbourhood: 0 – undesirable, 1 – desirable;
x_5 – accessibility: 0 – poor, 1 – average, 2 – good;
x_6 – location: 0 – undesirable, 1 – average, 2 – desirable;
x_7 – size: 0 – large, 1 – medium, 2 – small,
x_8 – water and ground conditions: 0 – bad, 1 – undesirable, 2 – average, 3 – desirable.

Since the main purpose of the article is to present the method of calculating the effect of information asymmetry, when calculating the impact of unmeasurable variables or of measurable variables not included in the appraisal procedure on the property value, the location attribute was omitted in subsequent calculations. The value of this attribute was determined on the basis of a property valuer's opinion and it also contained an opinion on the popularity, or fashion, of the area in question. Spearman correlation coefficients and coefficients $\hat{\beta}_k$ between the value of 1 m^2 of a land property in Szczecin and individual attributes are shown in Table 2.

Table 2. Spearman correlation and $\hat{\beta}_k$ coefficients between value of 1 m^2 and individual attributes of land properties in Szczecin in 2005

Coefficients	x_1	x_2	x_3	x_4	x_5	x_7	x_8
R_{xy}	-0.063	**0.282**	**0.343**	-0.074	**0.175**	-0.081	**0.187**
Adjusted R_{yx}		**0.286**	**0.347**		**0.177**		**0.190**
$\hat{\beta}_k$	0.039	**0.106**	**0.158**	-0.049	**0.092**	**-0.155**	**0.389**
Adjusted $\hat{\beta}_k$		**0.118**	**0.176**		**0.102**	**-0.172**	**0.433**

x_1 – physical traits, x_2 – development, x_3 – utilities, x_4 – neighbourhood, x_5 – accessibility, x_7 – size, x_8 – water and ground conditions.
Relevant coefficients at significance level of 0.05 are in bold.

Source: own study

When determining the impact of attributes using the adjusted Spearman coefficients, the following variables proved to be insignificant: physical traits, neighbourhood and size. When using the standardised beta coefficient, the following attributes also proved to be insignificant: physical traits and neighbourhood. The value of the property was most strongly influenced by utilities (according to the Spearman coefficient). In the case of beta coefficients, the highest correlation was observed between the value of the property and water and ground conditions. All coefficients were characterized by low values. The lines in which the corrected Spearman and beta coefficients are presented were calculated by adjusting the significant values of the coefficients of individual attributes, so that their sum was equal to 1. Only the attributes significantly affecting the value of the property were taken into account.

Table 3 shows the calculation of the effect of each attribute state on the property value.

Table 3. Calculation of values of land property attributes

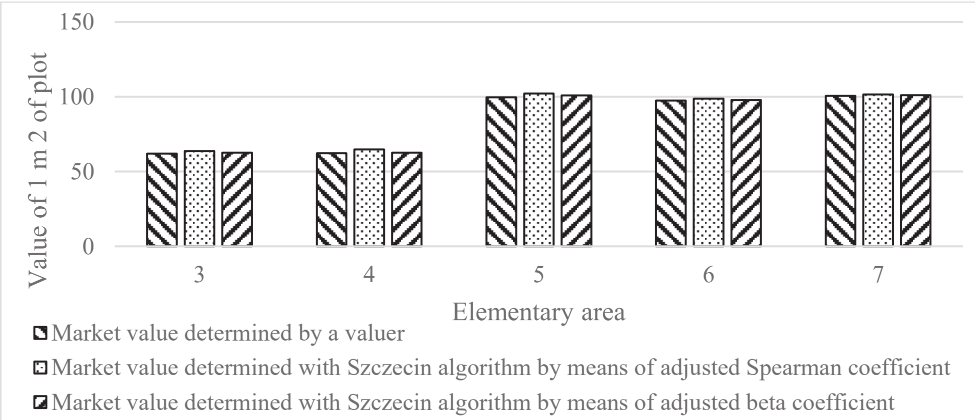
Attribute	Attribute alternative	Adjusted R_{xy}	$1+A_k$	A_k %	Adjusted $\hat{\beta}_k$	$1+A_k$	A_k %
Development	0	0.286	0.8571	-14.29	0.118	0.9410	-5.9
	1		1.1429	14.29		1.0000	0
Utilities	0	0.347	0.8265	-17.35	0.176	0.9121	-8.79
	1		1.0000	0		1.0000	0
	2		1.1735	17.35		1.0879	8.79
Accessibility	0	0.177	0.9114	-8.86	0.102	0.9492	-5.08
	1		1.0000	0		1.0000	0
	2		1.0886	8.86		1.0508	5.08
Size	0	-	-	-	-0.172	1.0860	8.6
	1		-	-		1.0000	0
	2		-	-		0.9140	-8.6
Water and ground conditions	0	0.190	0.9051	-9.49	0.433	0.7837	-21.63
	1		0.9684	-3.16		0.9279	-7.21
	2		1.0316	3.16		1.0721	7.21
	3		1.0949	9.49		1.2163	21.63

Source: own calculations

The power of the attributes' effect on the value of a property varies depending on the applied coefficient. When we use the adjusted Spearman coefficient, it is the utilities that have the strongest effect on the value of 1 m^2 of land. Plots equipped with all the required utilities are on average 34.7% more expensive than non-equipped plots. The next most important feature is development. The weakest effect on the value of the property is exerted by water and ground conditions and accessibility.

On the other hand, when applying the adjusted coefficient $\hat{\beta}_k$ the most significant variable was water and ground conditions. A plot of land with favourable water and ground conditions was on average 43.3% more expensive than a plot with poor water and ground conditions. The remaining attributes influencing the value of the plot are: utilities, development and accessibility. In the case of the second method (beta coefficients), the size also proved to be an vital attribute influencing the dependent variable, however, what is questionable is the sign of the correlation - the smaller the plot, the lower the value of 1 m^2 (1 m^2 of a small plot was 17.2% lower than 1 m^2 of a large plot). In economic practice we observe a positive rather than negative correlation on the real estate market - the smaller the plot, the higher the value (price) of 1 m^2 [Foryś, Gdakowicz 2004]. The negative sign of the coefficient may indicate that in the analysed sample small plots of land belonged to natural persons (and the value of the plot was lower), while the sellers of large plots were institutionalised entities, and the value of these properties was higher.

Figure 1. Summary of the average value of 1 m^2 of land estimated by property valuers and calculated using SAMWN with the application of adjusted Spearman coefficients and standardised beta coefficient in individual elementary areas



Source: own calculations

The average value of 1 m^2 of land estimated both by property valuers and using Szczecin mass appraisal algorithm (with the use of both approaches) stood at a comparable level, in each of the elementary areas. According to property valuers, popular and attractive plots (i.e. worth more) were located in elementary areas marked with numbers 5, 6 and 7 - the value of 1 m^2 of the plot was about PLN 100. The application of the Szczecin algorithm of mass appraisal of real estate confirmed the results obtained through individual valuations - plots located in areas 5, 6 and 7 were valued higher than plots located in areas 3 and 4. The application of the SAMWN calculation algorithm and the estimation of WWR_j values for particular elementary areas made it possible to include in calculation the effect of the plot location (fashion) although that variable was not one of the *a priori* attributes.

Table 4 presents values of market value coefficients (WWR_j) estimated for particular elementary areas by means of SAMWN. The results obtained using the algorithm (in both variants: using the adjusted Spearman and beta coefficients) are compared with the values estimated by property valuers. The consecutive columns present measures of agreement between the obtained results, such as the residual deviation, coefficient of variation and relative valuation error.

Table 4. Coefficients of market values for particular elementary areas and measures of agreement between SAMWN results and valuers' valuations

Elementary area	Adjusted R_{xy}				Adjusted $\hat{\beta}_k$			
	WWR_j	Se	Vs	∂	WWR_j	Se	Vs	∂
3	0.978	8.377	13.50	13.03	0.983	4.643	7.48	6.05
4	0.987	10.525	16.89	16.96	0.973	3.507	5.63	4.54
5	1.546	13.736	13.79	13.13	1.575	9.226	9.26	6.73
6	1.537	9.641	9.91	7.73	1.431	5.978	6.15	4.33
7	1.449	7.663	7.61	6.12	1.546	5.432	5.40	4.45

Source: own calculations

Notably, the obtained results are similar to those acquired by means of other approaches with regard to all the elementary areas under consideration. On the other hand, the lower both relative and absolute variations in *WWR* estimation justifies the choice of a measure based on the adjusted $\hat{\beta}_k$.

For instance, the coefficient of the market value in the 5. elementary area (for the Spearman coefficients) is 1.546, which means that the value of land in this area as calculated with the use of the SAMWN was on average 54.6% higher than the value of land located in a less attractive elementary area. On the other hand, the coefficient of market value in the 5. elementary area at 1.575 means that the value of land in this area calculated with the SAMWN using the $\hat{\beta}_k$ coefficient was on average 57.5% more expensive than the value of land located in the less fashionable elementary area. When the SAMWN (the adjusted Spearman coefficient) was applied, the value of a plot of land in the 3. elementary area differed on average from the value estimated by the property valuer by +/- PLN 8.38 per 1 m^2, which constituted 13.5% of the average value of land determined by the valuer. However, when applying the adjusted $\hat{\beta}_k$ coefficient for the same elementary area, the value of 1 m^2 of land valued by the valuer differed on average by +/- PLN 4.64 per 1 m^2, which represented 7.48% of the average value of land determined by the valuer.

In all elementary areas the results were characterised by lower values of stochastic structure parameters

CONCLUSION

The problem of asymmetry of information in real estate valuation and the way how the impact of non-measurable variables on the explained variable and the impact of variables omitted in the valuation procedure are approached is particularly close to people professionally dealing with the real estate market analysis, especially to those operating in the fields where hundreds, or even thousands of properties are subject to valuation. Many attributes that influence the value and price of real estate are non-measurable, for example: fashion, attractiveness or popularity. Many properties have their individual, sparse attributes or the ones that are indigenous to a specific area. The paper proposes a procedure of estimating the value of real estate in a mass appraisal, in which one of the above instances takes place. The attribute related to location and fashion is not included *a priori*.

The juxtaposition of the value of real estate estimated with the use of SAMWN and obtained on the basis of individual valuers' appraisals gave similar results. The construction of the algorithm allows - through estimating the WWR_j - to take into account the effect of non-measurable attributes on the value of the property. In the proposed two methods of determining the influence of attributes on the property value, better results were obtained when adjusted beta coefficients were applied.

The proposed procedure for estimating the property value takes on particular importance in the context of mass appraisal of real estate and the method of statistical market analysis. In both cases, the legislator has not defined a detailed procedure, leaving a large margin of discretion to property valuers. The presented research may be an important voice in the debate on the use of econometric and statistical methods in the process of real estate valuation.

Real estate valuation is a process subject to legal regulations. A property valuer is obliged to choose an appropriate approach, method and technique of valuation depending on the purpose of valuation. Within each method and technique, procedures have been agreed to ensure a uniform manner of valuation, taking into consideration the attributes strongly influencing the value of a property. The least regulated method is the statistical analysis of the market. Since algorithms that can be used in this method often require a large set of observations (algorithms are often statistical-econometric tools), they can be applied in the mass appraisal. The application of *WWR*s improves the quality of valuations when information available is incomplete (asymmetry of information between the parties).

The paper proposes a procedure that is conducive to solving the problem, as well as it shows how to include in the process of property valuation the valuation the imperfections in the knowledge about attributes influencing its value, and not known to one party of the procedure. For this purpose we used Szczecin's algorithm of mass property valuation (SAMWN), thus proposing two ways to determine the impact of attributes on the value of real estate: Spearman coefficient and beta factors. The results were compared with the results obtained in the process of individual property valuation performed by property valuers.

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