Routledge
Taylor & Francis Group

INTERNATIONAL JOURNAL OF STRATEGIC PROPERTY MANAGEMENT
ISSN 1648-715X / eISSN 1648-9179

2017 Volume 21(3): 307–317
doi:10.3846/1648715X.2016.1270235

RATING ATTRIBUTES TOOLKIT FOR THE RESIDENTIAL PROPERTY MARKET

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Received 5 June 2015; accepted 14 October 2016

ABSTRACT. The growing significance of the real estate market prompts investors to search for factors and variables which support cohesive analyses of real estate markets, market comparisons based on diverse criteria and determination of market potential. The specificity of the real estate market is determined by the unique attributes of property. The authors assumed that developing real estate market ratings identifies the types of information and factors which affect decision-making on real estate markets. The main objective of real estate market ratings is to create a universal and standardized classification system for evaluating the real estate market. One from the most important problem in this area is collection of appropriate features of real estate market and development dataset. The main problem involves the selection and application of appropriate features, which would be relevant to the specificity of information related to the real estate market and create a kind of coherent system aiding the decision-making process. The main aim of this study is to elaboration set of variables (knowledge platform) that were used to elaborate the real estate market ratings. The results lead to obtain the necessary set of features that constitute essential information which describes the situation on the local real estate market.

KEYWORDS: Real estate market ratings; Knowledge database; Rating attributes toolkit

SUPPLEMENTARY MATERIAL associated with this article can be found, in the online version, at https://doi.org/10.3846/1648715X.2016.1270235

1. INTRODUCTION

It is obvious that real estates are a very important aspect of our life. The need to have a place to live is one of the basic human needs. Man experiences many varied needs related primarily and acquired needs (Smyczek, Sowa 2005). Satisfying these needs takes place according to a natural sequence. Satisfaction of needs may be put in order, according to Maslow's theory, in line with importance criteria (Kotler *et al.* 1993): physiological needs (hunger, thirst, shelter, sleep), safety needs (safety, care, order, stability), social needs (feeling of affiliation and love), need of recognition and respect (prestige, accomplishments, social position), self-fulfilment needs (spiritual life, putting ideas into practice). According to such ranking, the need of shelter is on the first and foremost place. Property is a part of the system that can be called a real property market (Wiśniewski 2007). The necessity of determining classifications of real property markets results from various needs related to the sphere of becoming acquainted with and analysing market mechanisms. They refer to the needs resulting from the legal aspect related to evaluation of real property, the scientific and cognitive aspect related to establishment of theories and premises for determining classifications, the consulting aspect with respect to performance of various types of calculations and analyses related to location of an investment, and also to the context of analysis of economic and social risks. This gives rise to a broad scope of utility of analyses of this type, related to manners and procedures of designating classifications of real property markets and real properties as such.

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It was necessary to make a precise definition of the subject within the scope of the study. The authors assumed that the real estate market was a certain subsystem, which consisted of specific set of factors, features whose relationships affect the residents quality of life (QOL). The quality of life should be widely considered in many aspects expressed on the basis of endo- and exogenous phenomena. They indicate the probability of improvement or deterioration in the quality of life in the near and distant future. Endogenous phenomena account for a more direct and instant impact on the QOL. They may be expressed by: salary, unemployment rate or amenities of the residential location etc., whereas exogenous phenomena account for the impact that is felt indirectly, with influence extended in time. They may be expressed by: the number of businesses, GDP, macro moods on the capital markets, etc.

The "endo" and "exo" concepts in this work are considered in statistical terms (considering the analysis of the data generation process), where "endo" means information within the analyzed process and "exo" is related to the model/phenomenon according to external existence.

On the other hand, the level of knowledge about the market and its participants is a factor that determines the efficiency of the real estate market, but is often disregarded in market analyses. Knowledge gaps may originate with active market participants who have limited information about the system and its constituent elements. Other market participants may also have limited knowledge in this area. The knowledge manifested by entities conducting transactions on the RE market is (according to theoretical assumptions) limited or negligent. The above implies that market participants conduct transactions without mutual knowledge which leads to asymmetry in the decision-making process. This could lower the efficiency and, consequently, the effectiveness of the entire market. Researchers analyzing the real estate market should also demonstrate a sufficient level of knowledge about the mutual relationships between the subjects and objects of market transactions (Renigier-Biłozor, Wiśniewski 2012).

Providing access to the knowledge of the real estate market developed in the form of a simple message is the only way to solve this problem. The authors assumed that it can be achieved by developing a measure of the rating real estate markets providing general and unambiguous/clear information classifying the object of analysis and being an effective decision-making support system. The accumulation of knowledge in the processes of preparing real estate market ratings and information regarding the level of the market's development can be considered from the perspective of transaction costs theory. According to Dahlman (1979), the first approximation to a workable concept of transaction costs are: search and information costs, bargaining and decision costs, policing and enforcement costs. According to this approach, in transaction cost theory, an increasing level of information reduces transaction costs. In this way, the rating may affect the total cost of transactions in the real estate market system. In order to make the rating able to perform mentioned function should be developed for a broad group of recipients who have varied levels of knowledge about the analyzed real estate market.

The main objective of real estate market ratings is to create a universal and standardized classification system for evaluating the real estate market. A rating system contributes to objectivity in the decision-making process and it shortens decision-making time (Renigier-Biłozor *et al.* 2014).

From this point of view the main task of this study and classification of market (rating) was the reduction of number of variables in the decision-making process, but the main aim was to reduce the possibilities of decision-making choice and thus minimizing the risk of wrong decisions.

In conclusion, rating of the real estate market is a modern tool that can be used in diagnosing the condition and potential of the real estate market development that supports market participants in the decision-making process. Since the main aim of a rating is to provide quick, objective, reliable and updated information, a dataset has to be developed as a platform for quantitative and qualitative analyses.

2. LITERATURE REVIEW

The issue related to the development of the field of market analysis including: accessing and processing information, building databases and presenting results of the applied methods and analytical procedures in the form of classification, segmentation and ratings is a strongly emerging trend due to the need to reduce the increasing noise of information, of which we are witnesses to.

Kaklauskas *et al.* (2011) argues that one of the macro-level recommendations for construction and real estate crisis management is reduction of the psychological tension and panic related to coming crisis and new methods must be developed for crisis forecasting and modeling.

The Global Real Estate Transparency Index (Global Real Estate…2014) covers 102 markets worldwide and shows the transparency of the commercial real estate around the world. One of the main components included in the development of the transparency index is the existence of real estate measures e.g. in the form of "the existence the Official Public Real Estate Index" etc. It also indicates the necessity of developing the real estate market ratings that may affect the credibility increase of the country from the investor point of view.

Real estate market ratings serve a variety of practical purposes. They are used to develop portfolio investment strategies (Anglin, Yanmin 2011; Collett *et al.* 2003) and formulate long-short portfolio strategies on housing indices for more risky and less risky assets characterized by low liquidity (Beracha, Skiba 2011). The scarcity of relevant information results from the shortcomings of market effectiveness analyses (Case, Shiller 1989; Fama 1990; Grossman, Stiglitz 1980; Dawidowicz *et al.* 2014; Cellmer *et al.* 2014). According to Case and Shiller (1989, 1990), the ineffectiveness of the analyzed market can be attributed to individual investors who do not have access to objective knowledge about the real estate market. On the other hand, from the investor point of view, it must be stressed that, without favourable conditions for investments, no shelter is provided for the people.

The multiple-criteria decision making method was recommended in: Kaklauskas *et al.* (2006, 2007a, 2007b), as one of the most useful tool resolving a variety of the real estate sector problems.

Although recent year have witnessed the growing popularity of various support systems, comprehensive and effective information systems that facilitate real estate management and analyses continue to be in short supply. The above results from the specific character of real estate management operations which involve complex procedures and decisions, as well as the unique character of real estate data. Those factors prevent smooth flow of information which is required for the implementation of rational decisions and actions in business, investment, financial and promotional projects. It is essential to underline the fact that nowadays there is not a problem with information quantity and access to data (due to information noise), but rather with their selection, the quality and choice of relevant information.

One from the most important reasons behind undertaking research in this area is the problem which occurs in the advanced real estate analysis, as collection of appropriate features of real estate market and development dataset. Market features are usually divided into macroeconomic and microeconomic factors, including socio-demographic development, overall economic development and political, legal condition and property market. The main problem involves the selection and application of appropriate features, which would be relevant to the specificity of information related to the real estate market and create a kind of coherent system aiding the decision-making process.

Over the past three decades, a considerable attention in literature has paid to modeling, forecasting, and explaining long-run equilibrium of house prices (Azadeh *et al.* 2012) and segmentation of real estate market (Goodman, Thibodeau 2003). McCue and Belsky (2007) discussed on a number of factors that disturb the equilibrium between the supply and demand quantities in housing markets. Sæther (2008) classified housing market variables into three classes including endogenous, exogenous, and excluded. (Shakoorifar, Kaveh 2001) proposed housing parameters and their related effective factors as a general framework of the supply and demand system components. Moreover, Shakoorifar and Kaveh (2001) argues that: some of the defined components have to be eliminated and provide a simplified model for housing market in order to investigate the model more precisely.

When performing analysis of literature items, including Irwin (1993), Jaffe and Sirmans (1989), Ball and Wood (1999), Foryś (2011), Global Real Estate Transparency Index (2014), McCue and Belsky (2007) along with own studies of authors Dawidowicz *et al.* (2014), Renigier-Biłozor *et al.* (2014), Renigier-Biłozor and Biłozor (2015) a general outline of factors and information reflecting the condition of the real property market (Table 1) was made.

The range of factors was divided into four subcategories: technical and spatial, social, economic, political and behavioural. These are the most common factors which directly or indirectly impact the residential real property market.

Additionally, the authors proposed the division of factors into originators (involve causes of changes) and demonstrators (involve effects of changes) as the evidence of the most important information which affects the result of real estate rating (Table 1). In this case, the originators supply the impulse and initiate events, setting the market system into motion; they may be expressed by the availability of land for residential investments, attractiveness of the location at the micro level, the

Table 1. Information base of the residential real estate market

Technical and spatial factors	Social factors	Economic factors	Political and behavioral factors
Originators • Land use structure • Supply of real estate • Spatial reach of market • Attractive location, e.g. proximity of forests, parks, water bodies • Arduous neighborhood: major roads, railway lines, industrial plants, etc. • Availability of vacant land • Access to real estate – condition of roads, airports, railway lines, planned construction projects, e.g. ring roads. Demonstrators • Number of new dwellings • The technical state of the property. • Condition of real estate. • Comparison of new and old property. • Comparison of property on the primary and secondary real estate market. • Number of issued construction permits • Balance of the supply and demand • Other....	Originators • Unemployment rate • Fulfillment of basic needs, including home ownership • Population on a given market • Programs that stimulate demand for real estate, e.g. subsidized housing, subsidies for residential renewable energy • Public utilities: universities, hospitals, public administration, etc. • Internal and external market communication • Population growth Demonstrators • Net migration • Number of real estate agencies and construction firms • Job market and job creation • Social development of area • Other....	Originators • Offer price of real estate • Real estate maintenance costs • Average salary • Development prospects and new investments • Purchasing power on the real estate market • Mortgage availability • Price of fuel (affects urban sprawl) • Real estate revenues in the municipal budget • Prices of construction materials • Local authorities' revenues and spending on housing policy • Real estate tax and fees • Prices of energy carriers, including electricity, gas, coal, etc. Demonstrators • Price of real estate • dynamics of price changes • Ratio of average replacement value of $1m^2$ to average market value of $1m^2$ • Creditworthiness • Infrastructural development of area • Other....	Originators • Market trends • Settlement traditions • Prestige associated with home ownership • Individual motivations driving market demand • Satisfaction with local government • Local government's support for new investments and projects • Global economic outlook (credit ratings, demand for high-risk investments) • Planning reports, e.g. availability of local zoning plans Demonstrators • The ratings and classifications of urban space, etc. • The quality of life • City's significance in the region • Public mood • Other....

Source: Own study basis on Renigier-Biłozor and Biłozor (2015).

condition of the bank sector and access to mortgage credits, etc. The demonstrators, on the other hand, are the presentation of the existing effects, and may be expressed by the number of completed apartments, the value of transactions or new investments, etc.

3. METHODOLOGICAL ASSUMPTIONS OF DEVELOPING THE "RATING ATTRIBUTES TOOLKIT"

The efficiency of the real estate market thus depends on effectively working databases and decision-making systems. The disclosure, description and systematisation of the system and the available information structure are essential for the selection and verification of necessary data. Accordingly, the structure of system information concerning the real estate market was elaborated by the authors (Fig. 1).

The real estates market works as a one of the subsystems of the economic system of a given country. This subsystem is related to the economic and socio-economic sphere. The following research theses are formulated in the following way: the real estate is more developed when it is more interdependent and integrated with the economic system of the country and heteronomous with respect to the international economic system. In this context, the division of information is supposed to take into account macro-, mezo- and micro-scale of economy, along with the division into specific categories of data/information which are connected with the analysed market. Some of the information may be considered as exogenic, that is directly related to the real estate market, and endogenic, also related to the real estate market, but with indirect relationship or influence and extended in time.

The above approach was adopted due to different target recipients of the rating and a demand-supply imbalance. This division was also dictated by significant differences in the growth potential of the analyzed real estate markets.

As a result of the proposed system, most relevant information is obtained in the form of factors,

which are representations of initiating events and set into motion the market system (originators) and features that are specific proof of the presentation of the existing effect (demonstrators).

Because the main aim of the rating is to provide quick, objective, reliable and updated information, a dataset has to be developed as a specific knowledge platform for dedicated analyses. In view of the specific character of the real estate market, the availability of market information and the sudden and unpredictable changes that often occur on that market, the developed system for gathering market data should be flexible enough to enable frequent modifications.

The determination of databases for the real estate markets rating was prepared in the form of a procedure aimed at obtaining a significant element supporting decision making on the market (Fig. 2).

The presented procedure assumes conducting certain set of sequences activities to develop a knowledge platform (database) for the rating classification of the real estate markets. The main task of the developed procedure was to create a data model in the form of „rating attributes toolkit" that constituted a set of indicators enabling reliable phenomena analysis on the real estate market. The procedure was tested on the basis of polish real estate markets. An analysis of the main markets of the country represented by the major regional cities was performed (Fig. 3).

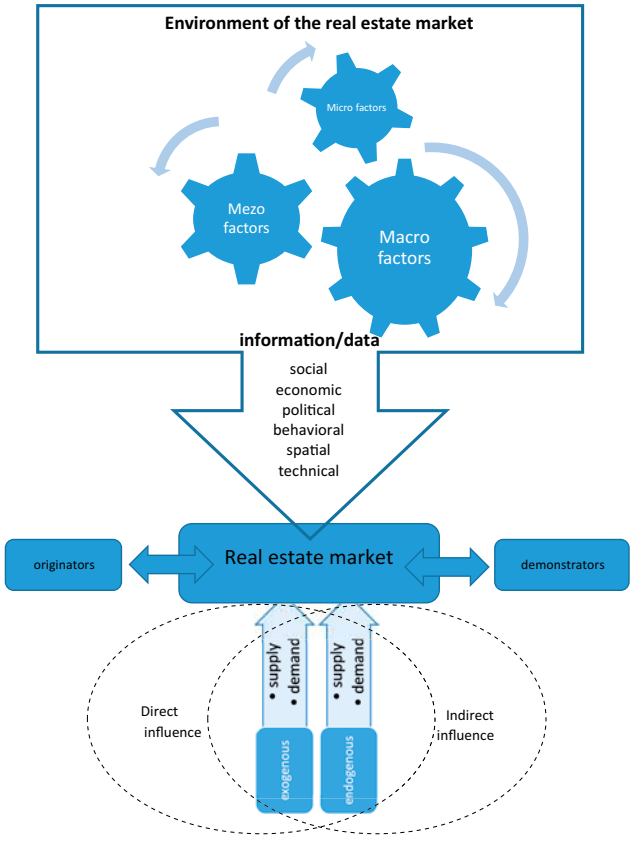

Fig. 1. Structure of the information system on the real estate market

Source: Own study.

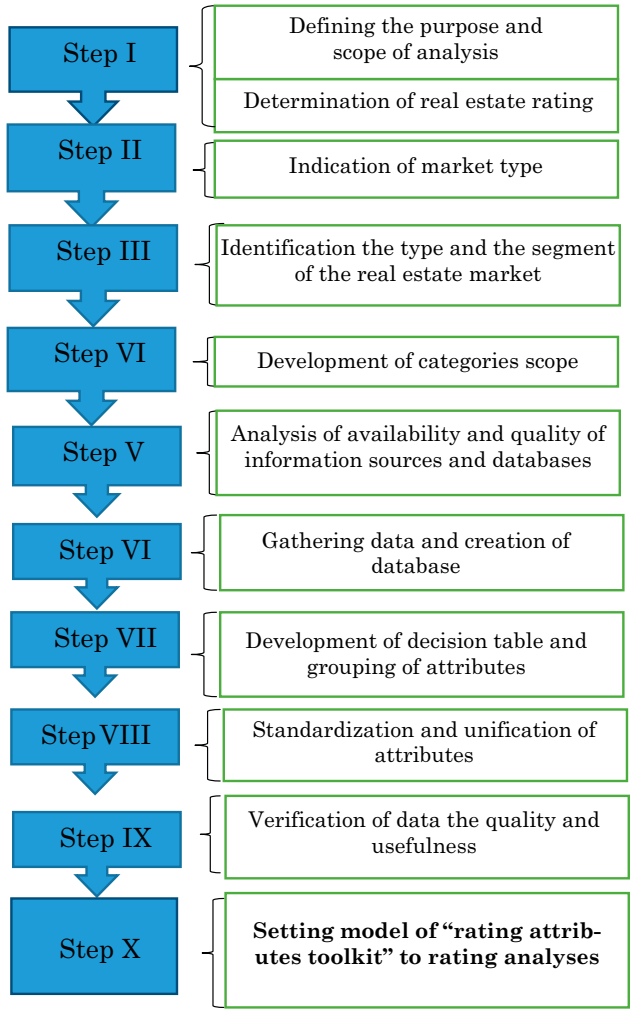

Fig. 2. Procedure of database "rating attributes toolkit" elaboration

Source: Own study.

Fig. 3. Main real estate markets in Poland

Source: Own study.

Figure 2 is assumed to precisely define the type and the segment of the real estate market, and the utility function of real estate. A real estate market would be very difficult to rate without prior classification. Market type is indicative of the utility function of real estate: investment market, commercial market, industrial market, agricultural market etc. Market segment accounts for a specific group of real estate which is identified in a given type of a market in view of its utility function. Type: investment market: residential, services, retail, etc.; type: commercial market: retail, services, offices; type: industrial market: industrial, warehouse, etc. The aim of the proposed division is to introduce a certain degree of uniformity to the rating procedure.

4. ANALYTICAL ASSUMPTIONS OF DEVELOPING THE "RATING ATTRIBUTES TOOLKIT"

In this study, the authors assumed that the rating will be performed for residential real estate markets represented by residential apartments taking into account the commonality of their use. All proposed province cities constitute the most important space of impact onto other regions and the best point of reference – representation of their region, also on account of more complete access to data.

The next step of the procedure assumed development of data categories scope. The existing knowledge was compiled to develop a set of indicators for overall evaluating real estate markets. An attempt was made to develop features that can have the most important influence on market decision-making on the basis of literature analysis and thoughtful observations of participants on the real estate market. These include categories of information relating to the strictly residential, economic and political, social, spatial and location realm. Each of the mentioned realms represents a different range of information that more or less affects quality of life. Thus, in the long term, it has an influence on decisions concerning the buying, renting or selling of residential real estate.

In the light of the aforesaid, the authors modified a proposed solutions and adapted to the real estate market actual situation. The rating attributes toolkit for the residential property market was developed for different categories (Fig. 4) based on the available information. Categories of information presented in Figure 4 have been developed on the basis of Table 1 and Figure 1, considering the verification of the assumptions due to the substantive and practical possibilities of obtaining specific information and access to sources of information. The developed diagram allows for the multicriterial description of information affecting and illustrating the condition of the residential real estate markets. Variables were classified and labeled during the construction of the database.

The next step assumed collection of a database and its preparation in the form of a decision-making table. For this purpose the available sources of information from common databases were reviewed i.e.: National Bank of Poland (reports on the residential property market), Central Statistical Office (local data bank), Polish Bank Associations e.g.: AMRON – SARFIN reports, real estate agents pages e.g.: www.otodom.pl; www.gratka-dom.pl etc., Colliers International "Review of polish property market", OberHausproperty agency "Report from real estate market", published social rankings e.g.: "Polityka" newspaper, "Rzeczpospolita" newspaper.

During the data processing the initial data was unified and adjusted to the object of analyses. With this purpose in mind, unification of "raw" data was performed, referring to a given area of local market, by transforming it into indices expressed in the form of units per inhabitants, units of space, average pay of local inhabitant or average price of real property. The example of transformed data is presented in Table 2. The study contains 122 attributes, which are going to be used for rating classification of real property markets. In the study, data for 16 province cities was taken into account of 2011–2013 and prepared in the form of a decision-making table. The description of collected data for rating attributes toolkit is presented in Supplementary Appendix 1.

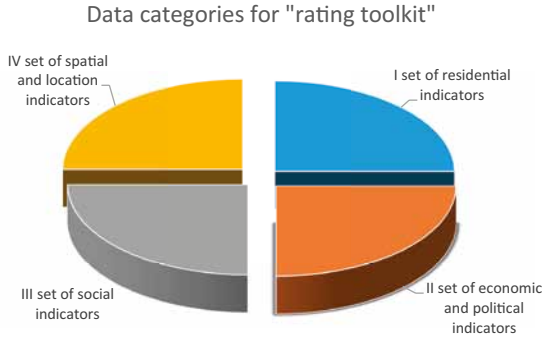

Fig. 4. Classification of data categories for "rating attributes toolkit"

Source: Own study.

Table 2. Sample database for the rating attributes toolkit

Markets	No. of indicators for 2013							
	1*	2	3	4	5	6	7	...
	social	social	social	econ.	econ.	econ.	econ.	...
Gdansk	44	9.58	21.30	5.23	26	234.61	1607.42	...
Olsztyn	36.8	7.75	18.50	5.59	18	496.34	852.20	...
Szczecin	33.9	9.61	21.10	5.44	32	250.11	733.60	...
Bydgoszcz	23.3	9.76	21.60	5.31	19	197.11	586.89	...
Białystok	40.3	7.45	18.10	5.50	18	174.11	1048.67	...
Poznan	33.1	10.03	21.30	5.37	21	124.77	891.87	...
Warszawa	40.3	10.21	22.40	5.46	20	215.86	1055.70	...
Łodz	30.7	13.24	24.30	5.39	19	334.11	1034.03	...
Wrocław	53.5	9.40	21.50	5.31	22	363.91	822.74	...
Lublin	40.3	8.27	20.40	5.30	16	305.87	1577.41	...
Krakow	34.9	8.94	21.00	5.24	19	286.78	528.65	...
Rzeszów	44.5	7.11	17.80	5.33	17	410.25	1331.75	...
Zielona Gora	21.5	8.42	20.40	5.27	24	150.92	545.78	...
Kielce	31.3	8.92	21.60	5.38	16	220.73	983.01	...
Katowice	53.1	10.70	22.50	5.29	15	322.81	1404.23	...
Opole	40.7	9.49	21.20	5.37	20	327.14	982.64	...
	No. of indicators for 2012							
	1	2	3	4	5	6	7	...
Gdansk	n.d.**	9.11	20.70	5.65	26	191.50	2465.97	...
Olsztyn	n.d.	7.43	17.60	5.82	17	236.61	781.83	...
Szczecin	n.d.	9.16	20.30	5.77	33	267.94	1065.32	...
Bydgoszcz	n.d.	9.65	20.80	5.7	18	123.77	713.96	...
Białystok	n.d.	6.90	17.60	5.72	20	185.29	1348.31	...
Poznan	n.d.	9.55	20.60	5.61	24	159.49	1079.63	...
Warszawa	n.d.	9.93	22.00	5.71	19	162.67	1237.05	...
Łodz	n.d.	12.68	23.40	5.69	20	235.06	707.92	...
Wrocław	n.d.	9.29	20.80	5.67	22	265.62	1259.86	...
Lublin	n.d.	8.19	19.50	5.59	18	254.34	991.17	...
Krakow	n.d.	8.97	20.50	5.65	19	170.11	580.70	...
Rzeszów	n.d.	6.36	17.20	5.76	14	291.67	1212.36	...
Zielona Gora	n.d.	8.61	19.50	5.59	24	282.93	514.11	...
Kielce	n.d.	8.67	20.70	5.54	17	153.07	1194.04	...
Katowice	n.d.	10.60	21.80	5.72	16	240.26	1218.64	...
Opole	n.d.	8.69	20.20	5.8	15	290.46	597.59	...
	No. of indicators for 2011							
	1	2	3	4	5	6	7	...
Gdansk	n.d.	8.56	20.00	5.15	27	183.67	1870.73	...
Olsztyn	n.d.	6.67	16.80	5.23	18	284.37	1218.86	...
Szczecin	n.d.	8.82	19.50	5.2	35	252.84	983.63	...
Bydgoszcz	n.d.	8.74	20.10	5.14	17	121.17	689.04	...
Białystok	n.d.	6.87	17.00	5.08	21	136.81	1474.16	...
Poznan	n.d.	8.98	19.80	5.25	28	131.38	1665.54	...
Warszawa	n.d.	9.30	21.50	5.11	19	158.19	1224.92	...
Łodz	n.d.	12.39	22.60	5.14	19	256.62	523.67	...
Wrocław	n.d.	8.82	20.10	5.14	27	295.76	1165.98	...
Lublin	n.d.	8.33	18.80	5.11	17	181.09	781.26	...
Krakow	n.d.	8.46	19.90	5.23	20	160.20	635.88	...
Rzeszów	n.d.	6.62	16.70	5.22	17	285.91	951.92	...
Zielona Gora	n.d.	7.96	18.70	5.11	25	210.26	386.02	...
Kielce	n.d.	7.77	19.80	5.08	19	215.23	1504.60	...
Katowice	n.d.	10.41	21.20	5.08	17	299.68	825.38	...
Opole	n.d.	7.87	19.30	5.11	19	243.59	881.14	...

* – the columns are the numbers of indicators from Supplementary Appendix 1; ** n.d. – no data.

Source: Own study.

Moreover, in each of the set categories, the subcategories of indicators determining (det.) or destimulating (des.) supply or demand were distinguished (Fig. 5). Determinants positively influence the features that shape the housing real estate market condition, while the destimulants have a negative influence on them. Such a division was proposed due to the diversity of the target group for these two market phenomena. Certain indicators are "bipolar", which means they can have significant importance both on supply and demand, e.g. affordability of rental housing or contribution of individuals in the post-productive age, etc.

Another step was a priori verification of the quality of data in the rating attributes toolkit. The aim of the aforementioned verification was removal of redundant information. For this purpose, the following analytical procedure was applied. The first step was meritorical verification, simultaneously prepared with cross-correlation analysis. For this purpose, the Pearson correlation analysis (parametric method) and Kendall's τ (to verify the existence of the orderliness a data set probability – non-parametric method) was applied and data with cross-correlation higher than 0.80 (on the basis of Guilford (1964), who considered such a result of correlation to be very high) and result of test of statistical significance for $p < 0.05$ (bold), respectively (separately for the supply and demand set of indicators), were selected. The results were determined based on the below formulas:

a) Pearson's correlation coefficient:

$$\rho_{x,y} = \frac{\operatorname{cov}(X,Y)}{\sigma_x \sigma_y}, \tag{1}$$

where: cov – covariance; σ – standard deviation of x and y.

b) Kendall's tau (τ) correlation coefficient:

$$\tau = \frac{p-q}{\frac{1}{2}n(n-1)}. \tag{2}$$

where: p – number of concordant pairs; q – number of discordant pairs; n – number of observations.

The information that shows specificity of strong redundancy was identified (Table 3). The selected combination of indicators were considered a matter of explanation merits, e.g. combination 2: features with high correlation considered to be apparent without substantive justification. In combination no. 7 regards to correlation above 0.99 (Pearson) and 0.96 (Kendall) reduction of current unemployment rate for average unemployment rate within last 5 years was conducted.

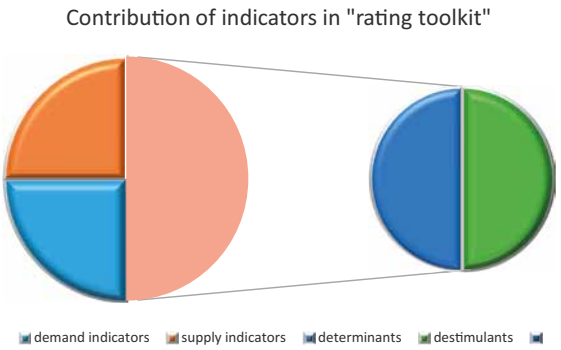

Fig. 5. Contribution of rating attributes toolkit in the real estate market rating model

Source: Own study.

Combinations no. 10 and 15 did not cross the Kendall test of statistical significance (no. 10 – 0.15; no. 15 – 0.25). These indicators as non-redundant features were considered. In the next step, the cross-correlation of time-series (3 years) were determined (Supplementary Appendix 2). The analysis was conducted in order to prove the existence of strong autocorrelation.

The analysis indicated that every established combination exhibited strong autocorrelation as well.

The developed analyses allowed for a decision to be made on the reduction of redundant combinations of variables. For this purpose, synthetic variables were determined with the use of the maximum likelihood method within the method of factor analysis. The results were determined based on the below formula:

$$\begin{aligned} X_i &= a_{11}F_1 + a_{12}F_2 + \ldots + a_{1k}F_k + b_1U_1 \\ X_i &= a_{11}F_1 + a_{12}F_2 + \ldots + a_{1k}F_k + b_1U_1 \Rightarrow X_i = A \cdot F + BU_1, \\ X_i &= a_{11}F_1 + a_{12}F_2 + \ldots + a_{1k}F_k + b_1U_1 \end{aligned} \tag{3}$$

where: X_i – vector of variables; $A = (a_{ij})$ – matrix of linear combination coefficient called factors loadings; F – vector of mutual factor; U – vector of specific factors; B – matrix of diagonal factors loadings for specific factors.

The test of fit goodness was conducted for all new variables (Supplementary Appendix 3). The research indicated a high degree of reliability of the new features.

The analyses conducted allowed for the reduction of variables for which there was a high probability of redundancy of information. The results of analyses led to removing 31 variables (from set of 122) and adding 11 synthetic variables instead. These added variables didn't exhibit a strong correlation with the rest of initial variables.

Table 3. Cross-correlation results for combination of indicators

	No. of combination														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of indicators	46 47	49 41	2 3	71 73 72	77 78 76	79 80	52 53	83 84 85 86	88 89	16 22	15 17	18 19	23/94 24/95	102 112 113	107 111
Cross-correlation results															
Pearson	0.95	i.c.*	0.93	*72 with 73* – 0.95 *71 with 72* – 0.95 *73 with 71* – 0.99	*76 with 77* – 0.81 *76 with 78* – 0.81 *77 with 78* – 0.92	0.96	0.99	*83 with 84* – 0.95 *83 with 85* – 0.84 *83 with 86* – 0.91 *84 with 85* – 0.89 *84 with 86* – 0.96 *85 with 86* – 0.96	0.95	0.85	0.86	0.98	0.91	*102 with 112* – 0.88 *102 with 113* – 0.82 *112 with 113* –0.96	0.87
Kendall	0.83		0.78	*72 with 73* – 0.83 *71 with 72* – 0.82 *73 with 71* – 0.95	*76 with 77* – 0.41 *76 with 78* – 0.36 *77 with 78* – 0.50	0.80	0.95	*83 with 84* – 0.69 *83 with 85* – 0.56 *83 with 86* – 0.55 *84 with 85* – 0.73 *84 with 86* – 0.76 *85 with 86* – 0.82	0.50	0.15	0.62	0.92	0.85	*102 with 112* – 0.72 *102 with 113* – 0.65 *112 with 113* – 0.87	0.25

* Apparent correlation with no substantive justification.

Source: Own study.

5. CONCLUSIONS

An overall rating classification provides market actors with additional information about the credit worthiness and performance of a given market, the quality of market processes and the consequences of decisions made by market entities. In this study, the "quality of market processes" depends on the efficiency of market participants influenced by the efficiency of information tied with the flow of information and the quality of databases. Dedicated and efficient information systems enable the efficiency of market processes to be increased and decrease the costs of transactions. In this respect, the rating of real estate market identifies the types of information and factors which affect decision-making on real estate markets.

In this study, the authors developed a database ("rating attributes toolkit") that serves as a knowledge platform for analysing the local real estate market. Information was prepared in the form of indices and constitutes a sample proposal for a set of data indispensable for use within the scope of description of residential investment market. Market attributes were verified a priori to produce quantifiable indicators. Indicators developed in the proposed analytical procedure should support a comparison of different markets. Such data is of informative nature and is "open", which means that its selection depends on the type and the segment of the market, as well as the economic situation.

The presented information constitutes the knowledge database represented essential information which describes the situation on the local real estate market. In the further analysis, the authors will prepare the procedure of a rating score for the real estate markets, based on the developed database.

ACKNOWLEDGEMENT

The study was prepared as a result of implementation of research project no. UMO-2014/13/B/HS4/00171 financed from the funds of the Polish National Science Centre.

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