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PART II

ARTICLES

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THE EFFECTIVENESS OF REAL ESTATE MARKET VERSUS EFFICIENCY OF ITS PARTICIPANTS

Abstract: Real estate markets (REMs) may be classified as strong-form efficient, semi-strong-form efficient or weak-form efficient. Efficiency measures the level of development or goal attainment in a complex social and economic system, such as the real estate market. The efficiency of the real estate market is the individual participant's ability to achieve the set goals. The number of goals is equivalent to the number of participants. Every market participant has a set of specific efficiency benchmarks which can be identified and described. In line with the theory of rational expectations, every participant should make decisions in a rational manner by relying on all available information to make the optimal forecast. The effectiveness of the real estate market is a function of the efficiency of individual market participants.

This paper attempts to prove the following hypothesis: the effectiveness of a real estate market may be identified by analysing the effectiveness of its participants. The authors also discuss methods based on the rough set theory which can influence the efficiency and efficacy of market participants, and consequently, the effectiveness of the real estate market and its participants.
Key words: subject efficiency, rough sets.

1. INTRODUCTION

The real estate market is one of the most rapidly developing goods markets that attract massive investments. The contemporary real estate market attracts investments from large corporations, specialist companies, small contractors and individuals. The objective of every market participant is to obtain a profit on the investment. In such a scenario, an in-depth analysis of the real estate market

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is highly complex because the behaviours of all market participants are (most probably) impossible to trace. Nonetheless, such analyses have to be carried out to diagnose the structures and the functioning of contemporary real estate markets. The resulting knowledge supports the decision-making process based on the structure and the functions assigned to the real estate market system.

What is the key challenge in analyses investigating the efficiency of real estate markets? In answering this question, the following factors have to be taken into account:

– the object of research, i.e. the real estate market – its efficiency, structure, functions, market environment;

– real estate market participants – their preferences, motivation, information resources, skills, capabilities;

– level of knowledge about the market and its participants – of both active market participants and the researcher performing the analysis;

– applied research methods – lack of appropriate measures, the need to find adequate, existing methods, search for new methods;

– unavailability of systems for gathering and analysing real estate market data – evaluating the information efficiency of a real estate market.

As an object of research, the real estate market poses numerous problems. The market can be analysed in various categories and from various perspectives. The following determinants can be a source of uncertainty in market evaluations:

– market effectiveness – the achievement of the desired level of development by market structures and functions, the ability to maintain system processes (dynamic and informational balance), crisis survival ability (stability), the ease and possibility of controlling processes in the short-term, mid-term and long-term perspective, and many others;

– market structure, namely the configuration of market institutions and organisations – market structure may be well developed (highly developed markets, e.g. in Great Britain), developing (emerging markets, e.g. in Poland) or weakly developed (e.g. in Belarus);

– market functions – the ability to satisfy market participants' basic needs and cater to changing demands;

– market environment – the social and economic framework in which the RE market operates and which can be a source of crisis.

Real estate market participants are the most important entities in the real estate market system who are charged with the highest responsibility for conducting market transactions. Market participants are the most complex and problem-ridden factor in market analyses and surveys. They are responsible for the functioning of the entire real estate market. This problem will be discussed at greater length in the following section.

The level of knowledge about the market and its participants is a factor that determines the efficiency of the RE 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 analysing the RE market should also demonstrate a sufficient level of knowledge about the mutual relationships between the subjects and objects of market transactions.

From the analytical point of view, the solution to the problem requires the selection of appropriate methods for analysing the available information rather than, as it is often observed in practice, the adaptation of the existing information to popular analytical methods, such as econometric models. In the era of globalisation, quick and unified solutions (procedures, algorithms) are needed to enhance the objectivity and the reliability of research results. The preferred solutions should address the problem on a global scale while accounting for the local characteristics of the analysed markets and the relevant information.

In the 21st century, a real estate market cannot be evaluated without the involvement of effective systems for gathering and processing information. The popularity of computerised systems for collecting and processing of real estate market data has soared in recent years. Despite the above, comprehensive and effective systems that facilitate analyses of real estate market data, support real estate management and other market analyses continue to be in short supply. The above results from the specificity of the real estate market which embodies various procedures and decisions, as well as the specific nature of real estate information. These shortcomings obstruct the smooth flow of comprehensive data which is required for initiating actions and making decisions regarding economic processes, business, investment, financial and promotional projects in the area of real estate.

2. EFFECTIVENESS AND EFFICIENCY OF REAL ESTATE MARKETS

Any discussion concerning the efficiency of real estate market participants would be incomplete without a reference to the classical approach to market effectiveness (in particular capital markets). In line with the assumptions made by this study, efficiency determines effectiveness, and effectiveness is – in a way – determined by efficiency. This section discusses the rudimentary concepts of market effectiveness vs market ineffectiveness, market equilibrium vs market imbalance, perfect vs imperfect markets. Those concepts will be further defined in section 3.

2.1. Theory of Market Effectiveness and Its Consequences

According to research in the area of real estate market efficiency, a market is (theoretically) efficient if it fulfils the following assumptions (Wiśniewski, 2008):

– it has an infinite number of participants who appraise the value of real estate independently in an effort to maximise the profit generated by real estate;
– a single participant is unable to change real estate prices;
– information that could affect real estate prices is generated in an uncorrelated manner;
– information instantly reaches all market participants;
– information is freely available;
– there are no transaction costs;
– all investors make instant use of the received information;
– every investor has identical expectations as regards the information's effect on real estate prices and the expected return rate;
– all market participants have identical investment horizons.

In line with the above assumptions, prices are determined as follows (cf. http://www.naukowy.pl/...; Grossman Stanford and Stiglitz, 1980):

– prices ideally reflect the value of real estate at any moment;
– prices change instantly in response to new information, and they remain stable until new information enters the market;
– higher than average profits cannot be generated in the long run;
– prices change independently.

The causes of anomalies on real estate markets differ from those encountered on other markets, including capital markets, due to the specific nature of real estate. According to the definition proposed by Kucharska-Stasiak (1999) and Bryx (2006), based on the general concept of a perfect market, a perfect real estate market has the following attributes:

– there is a large number of buyers and sellers – no participants have sufficient 'market power' to set the price of a product, buyers and sellers have to be dispersed;
– product homogeneity (uniformity and full substitution) – when products are homogenous, the decision to buy a given product will be determined by the price rather than variations in the product's nature and transaction conditions;
– perfect information (market transparency) prices and quality of products are assumed to be known to all consumers and producers;
– utility and profit maximisation – in addition to maximising their profits, decision-makers also attempt to maximise their security or significance;
– zero entry or exit barriers – a competitive market is freely available to all participants, owners can move their capital to market segments generating higher revenues, the capital market is marked by a high degree of liquidity.

Research studies analysing perfect markets (including the real estate market) also investigate market imperfections. The following factors contribute to real estate market imperfections:

1. Speculation.
2. Monopolistic practices, such as the policies adopted by municipalities.
3. Large spread between prices quoted for similar real estates – the prices on local markets, in particular weakly developed markets, may differ even several-fold due to:
   – unavailability of information,
   – specific features of a transaction,
   – specific features of real estate,
   – financing method,
   – subjective evaluation of real estate's utilitarian value,
   – underestimation of prices in property deeds.
4. Low asset liquidity – real estate is difficult to sell at a price equal to its market value.
5. Sporadic market equilibrium – on the real estate market, supply and demand are usually out of balance due to:
   – market outlook,
   – fluctuations in return rates,
   – specificity of the local market,
   – the return on alternative investments,
   – situation on the construction market,
   – state policy,
   – frequent legislative changes.
6. Small number of transactions – real estate turnover is low.
7. Irrational behaviour – buyers' and sellers' decisions are influenced by factors other than the price, including trends, neighbourhood, tradition and advertising. Irrational behaviour may result from:
   – subjective evaluation of real estate's utilitarian value,
   – unequal access to market information,
   – mutual dependencies between parties,
   – acting under coercion.
8. Insufficient information, differences in interpreting data.

The efficiency of real estate markets may be impossible or difficult to maintain due to the specific nature of the studied object, i.e. the specificity of real estate. The distribution of real estate prices shows an absence of linearity and the presence of outlying observations (asymmetric, right-skewed distribution) that distort the classical equilibrium and affect the stability of the real estate market. If those two assumptions are not met at the stage of preliminary analysis, the above leads to the formulation of incorrect conclusions, such as the overestimated value of coefficient R^2.

According to Peters (1997, following Pareto), a distribution has fatter tails (suggesting the inefficiency of a market where prices do not follow random walks) when information reaches the market irregularly or when the investors' response to information is delayed. When the information flow exceeds critical

values, investors respond to all information that had been previously ignored. This implies that, contrary to Newton's theory where every action produces an instant response, market participants demonstrate a non-linear response to information.

The attributes describing real estate are often intuitively selected, and in some cases, this produces measurable results – the 'human' factor prevails, but it significantly affects the decision-making process on the real estate market (often leading to inappropriate decisions). The actions initiated by real market participants (behavioural) are difficult to forecast, and they are even more difficult to objectify. The above results from a high number of decision goals (objective functions) that the investors set for real estate. In this context:

– real estate can satisfy the participants' housing needs and/or a need for prestige;
– real estate can be a source of present, future and regular income;
– market participants expect that the capital invested in real estate will grow with time;
– the capital invested in real estate may secure additional sources of financing (loans, credits) for future investments.

2.2. Equilibrium and Stability of the Real Estate Market

In an equilibrium, most of the characteristic features describing a given market are in a steady state. Those steady states are known and predictable. The above implies that a real estate market system features predictable relations or relations whose probability can be deduced from the registered states of every characteristic trait describing the market.

A state of equilibrium is marked by an absence of factors that can be referred to as 'distortions' (such as behavioural factors related to the participants' emotions). In a defined state of equilibrium, a state of near equilibrium is a simplified expression of market behaviour. In a practical approach, illustrated by, for example, the investors' linear response to information, an equilibrium state is easy to interpret and analyse, but it also implies the absence of growth.

Every economy is a dynamic system. A free market economy, of which the real estate market is a part, undergoes (re)evolution processes. The use of models (which simplify reality) to illustrate this system is difficult, and it should not result in excessive simplification. Models have to account for the discussed distortions, thus bringing the 'model state' closer to the 'real state'. In the worst case scenario, the failure to account for market dynamics could distort the investigated phenomenon, leading to false conclusions or, at best, it could prevent researchers from deepening their knowledge about the market.

The concept of equilibrium, which embodies the perfect state, should not be negated. Above all, it needs an appropriate definition. Equilibrium in a real estate

market, a complex, changing and often unpredictable system, can and should be analysed in non-linear (non-proportional) categories. According to Domański (2002), equilibrium does not have to be a point (as it is the case in linear systems), but it may be a closed curve which repels or attracts the system trajectory.

Stability is yet another element that is closely related to the equilibrium of a real estate market. According to Bertalanffy (1984), a state of stability (self-regulation) is characterised by steady proportions of components derived from the environment, regardless of the magnitude and the composition of such supplies and the distortions produced by the environment. According to Kucharska-Stasiak (1999) and Bryx (2006), the absence of equilibrium on the real estate market results from the following factors:

– the features of real estate as a commodity (including permanent location, low substitutability, capital intensity, long construction cycle);
– monopolistic practices;
– external effects of activities initiated on the real estate market (e.g. construction of freeways, hypermarkets, functional changes in the land development plan);
– unequal distribution of incomes, preferential loans, housing bonuses;
– neglectful practices in the past;
– poor growth of supply.

3. EFFICIENCY OF REAL ESTATE MARKET PARTICIPANTS

The concepts discussed in section 2 are related to market effectiveness, a concept that has been developed since the early 20th century, as well as the consequences of market ineffectiveness or 'limited effectiveness' of a real estate market. This section discusses the problem of efficiency of real market participants.

3.1. Concept of 'Efficiency of Real Estate Market Participants'

The titular concept of 'efficiency of real estate market participants' immediately breeds a methodological problem. The discussed approach relies on the term 'efficiency of real estate market participants', but could the notion of 'real estate market efficiency' be used interchangeably? As noted in this paper, the concept of 'efficiency' should be reserved for evaluating the outcomes of actions initiated by market participants, rather than for assessing the market as a whole (figure 1). The term 'effectiveness' should be used to evaluate the achievement of goals planned for the entire real estate market. Effectiveness measures the level of goal attainment in the entire system, rather than the achievement of individual goals by market participants.

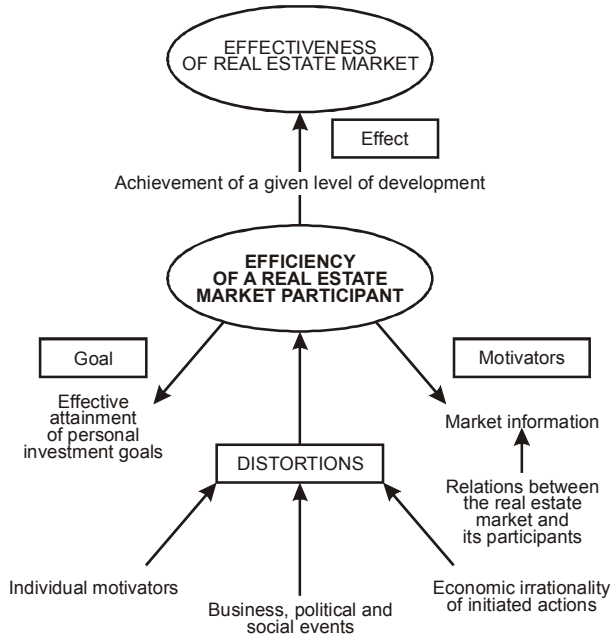

Fig. 1. Efficiency of market participants and the effectiveness of real estate market
Source: authors' study

The introduced nomenclature should not separate the two concepts. The proposed terminology has a symbolic character, and its purpose is to better organise our cognitive apparatus. By following this approach, 'efficiency' at the market level should be termed 'effectiveness', whereas the 'effectiveness of market participants' should be referred to as the 'efficacy and efficiency of market participants' (figure 2). In article assume that for the distinction from the individual efficiency of the subject, the efficiency of the property market will be called his effectivity. In the real estate market system, each concept occupies an immanent place – one at the individual level, and the other at the global level. They are closely interconnected and necessary to foster an understanding of the processes that take place in that system.

The efficiency of the real estate market can be defined as *the individual participant's ability to achieve the set goals within the structures of the real estate market system.* Efficiency evaluates the manner in which market participants pursue their goals, and it relates to the executive plane. Efficiency is the result of initiated actions, and it is described by the correlation between the achieved effects and the borne outlays. It is an indication of the optimal results achieved in production, distribution, sales, promotion etc. By investing on the real estate market, every participant is forced to identify, plan, execute and evaluate development processes. These stages should involve every market participant, both a small-scale proprietor

who buys a piece of land with the aim of building a small service outlet and a giant developer pursuing a network development scheme.

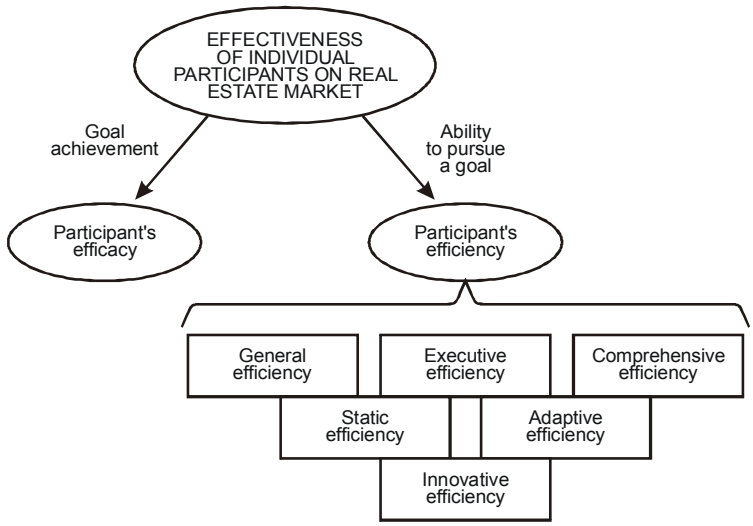

Fig. 2. Effectiveness of individual participants on real estate market
Source: authors' study

The efficiency of real estate market participants implies not only 'doing things the right way' – general efficiency, but also 'doing the right things' – executive efficiency. As shown in figure 2, general efficiency is the ability to initiate adequate actions which require outlays and generate outcomes, i.e. it is the achievement of results which commensurate with the outlays borne (e.g. effort, time, capital, knowledge). Executive efficiency is the ability to choose the appropriate goals and actions that minimise costs and outlays (e.g. effort, time, capital, knowledge). Efficient actions are actions that are performed in the most productive manner, but they do not always guarantee the achievement of the planned result. Reasonable and desirable outcomes can be attained only through the development of comprehensive efficiency which combines general and executive efficiency. In this case, a market participant adapts to market requirements, he can use those requirements for own needs, he can respond to market changes, he demonstrates an adequate level of knowledge and skill, he is aware of the existing threats (risks) and opportunities, he can evaluate his performance, he has an innovative approach to planning, decision-making, action and assessment.

As regards real estate market participants, efficiency should be analysed as a dynamic concept. In the process of pursuing their goals, market participants are influenced by the immediate and the more distant environment. The set goals should be analysed in view of the participant's 'place' in the system (local real estate market). This 'place' in the market space, described as: x, y, value, time,

has a decisive impact on various factors that affect market participants' efficiency. The immediate and the more distant environment exerts a dynamic influence on the participants. From this perspective, the efficiency of real estate market participants may be analysed in terms of static, adaptive and innovative efficiency.

Static efficiency is the ability to preserve organisational, functional and technological structures in periods of normal operation when the market is not growing dynamically, when market activity is stable between the phases of recession and intensive growth.

Adaptive efficiency is the ability to gradually adapt to changes in the immediate and the more distant environment. It enables market participants to recognise and solve the problems that emerge.

Innovative efficiency is the ability to introduce innovations, namely methods that enhance decision-making, organisational, executive and evaluation processes on the real estate market.

The differences in operational efficiency are an important source of variations in the income generating capacity of market participants (competitors) for two significant reasons. Firstly, higher efficiency affects the distinctiveness of market participants and the level of borne costs. Secondly, effective operations in the market place, which are related to organizational structures, improve the employees' individual productivity and working comfort (cf. Rogers, 1998).

Operational efficiency may be a source of competitive advantage. In the long-term perspective, operational efficiency does not suffice. According to Rogers (1998), a 'rapid diffusion of optimal actions', including organisational efforts, may affect total efficiency and may generate higher profits. Strategic tools, such as the optimisation of an organisation's overall operating costs, also affect competitiveness and market effectiveness.

3.2. Innovative Efficiency of Real Estate Market Participants and the Application of Methods Based on the Rough Set Theory

The innovative efficiency of real estate market participants creates numerous applications for various innovative solutions on the real estate market. The specific nature of the real estate market, including real estate itself, spurs the search for convenient solutions addressing this area of research. One of such solutions are methods based on the rough set theory. Their origin suggests that they can be used to investigate phenomena characterised by imprecision, excessive generalisation and uncertainty in the process of data analysis.

The rough set theory and the methods derived from it have various applications in the area of economy, banking, urban planning, medicine, pharmacology, chemistry, sociology, acoustics, linguistics, general engineering, neural engineering and machine diagnostics. Those methods are suitable for analysing real estate market data because they are derived from a theory of knowledge (theory of IT systems),

and they can be used as tools for describing knowledge that is uncertain and inaccurate. Methods based on the rough set theory are used in approximation, modelling decision-making systems, feature recognition systems and classification.

According to the authors, the methods and algorithms based on the rough set theory (Renigier-Biłozor, 2006, 2008a, b, 2010, 2011; Renigier-Biłozor and Biłozor, 2007, 2008, 2009a, b, c; Renigier-Biłozor and Wiśniewski 2011) which are used by real estate market participants can improve the participants' efficiency, in particular innovative efficiency. Figure 3 presents various options of improving the quality of data analyses and information flows in the context of distortions that obstruct the process of achieving the set goals on the real estate market. There are four types of innovative efficiency (figure 3):

– *decision-making efficiency* – related to the introduction of innovations in the process of selecting goals and methods of goal achievement;

– *organisational efficiency* – related to the development of innovative solutions in organisational structures as part of which participants function on the real estate market;

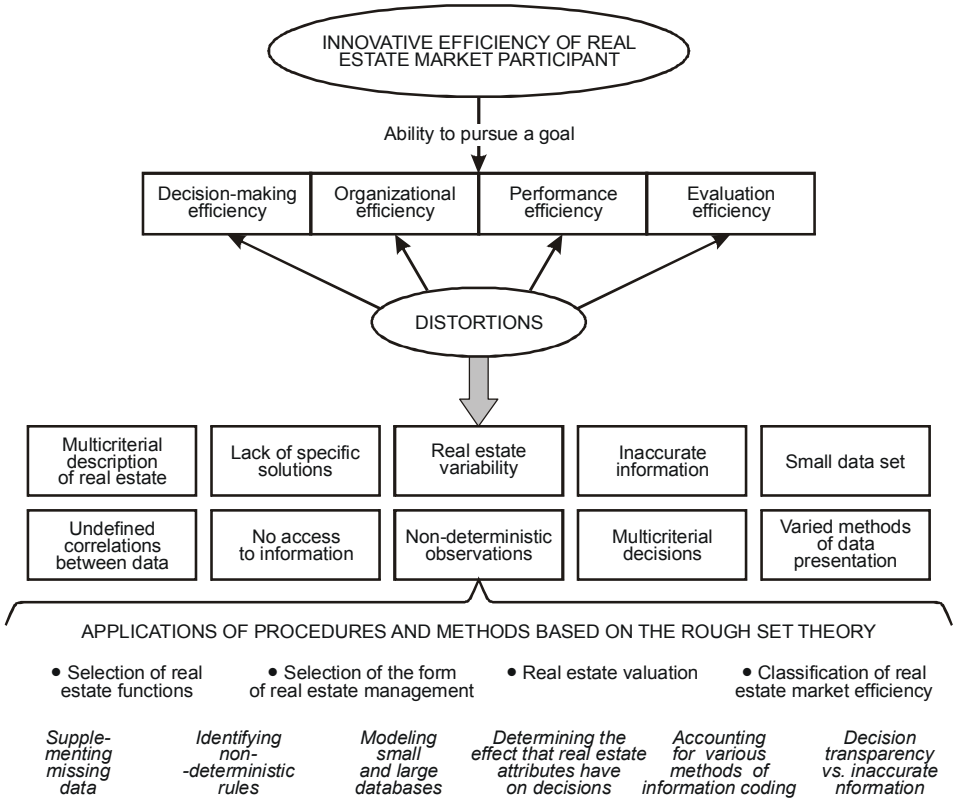

Fig. 3. Innovative efficiency of real estate market participants determined with the use of methods based on the rough set theory
Source: authors' study

– *performance efficiency* – related to the participants' ability to propose innovative solutions: maximising gains, lowering operating costs and furthering their performance on the real estate market;

– *evaluation efficiency* – participants who have successfully attained this level of efficiency are able to evaluate their performance in an innovative manner.

With the above definition of innovative efficiency, the decision-making process may be obstructed by a number of distortions. Such distortions directly and indirectly affect the undertaken actions and their outcomes. As shown by figure 3, the methods based on the rough set theory can be adapted to the needs of the real estate market to alleviate or eliminate the negative consequences of market distortions. In addition to the detailed solutions presented in figure 3, the application of the proposed methods on the real estate market supports:

– determination of minimum data sets (data minimisation), e.g. the increase of analytic capacity on small real estate markets by implementing systems facilitating the decision-making process;

– determination of the significance of real estate attributes, e.g. indispensable in decision-making procedure/process for direct variables identification;

– grouping of similar real estates, e.g. necessary in real estate valuation;

– development of decision-making rules which may be used to create expert systems, e.g. it significantly enhances the effectiveness of defining alternative decisions and planning future solutions for real estate resources utilisation;

– development of systems for making strategic decisions in the area of real estate management, e.g. improving and standardisation of decision-making criteria;

– identification of non-deterministic rules in data sets for the pre-selection of data (*a priori* analyses) which may be applied to build various models. e.g. useful in decision rules reduction.

According to the authors (Renigier-Biłozor, 2008a, b, 2010, 2011; Renigier-Biłozor and Biłozor, 2008, 2009a, b, c; Renigier-Biłozor and Wiśniewski 2011; Rogers 1998; Szyszka 2003), the algorithms shown in figure 3 are an important tool which supports strategic decision-making in the area of real estate management, including the selection of real estate functions, real estate management and operation methods, real estate valuation and evaluations of real estate market efficiency. In view of the specific nature of the real estate market, the rough set theory and the valued tolerance relation (Renigier-Biłozor, 2011; Renigier-Biłozor and Biłozor, 2009a, b, c; Renigier-Biłozor and Wiśniewski 2011; Rogers 1998; Szyszka 2003) offer an innovative approach to improving the effectiveness of a real estate market and the efficiency of its participants.

3.3. Efficiency of Real Estate Market Participants and a Perfect Market

The discussed attributes of a perfect market affect the efficiency of the real estate market. Each characteristic applies both on the macro (market) and micro

(participants) scale. This is not to imply, however, that those attributes deliver similar effects. Their outcomes are evaluated from different perspectives.

On the macro scale, the attributes determine the effectiveness or ineffectiveness of the entire market. A market participant's individual efficiency is analysed indirectly. The performance of a market participant has a primary character, and the effects of that performance are registered by the system. A participant's behaviour (influence) is registered only after it has been processed by the market system. On a micro scale, market attributes determine whether individual participants are able to achieve a given level of efficiency. A market participant's actions are analysed indirectly, and the outcomes of those actions can be observed.

Let us analyse the effect that the attributes of a perfect market have on the efficiency of real estate market participants. *A large number of buyers and sellers* – a participant observing the market is aware that he is unable to directly change the market's general function because similar actions would be undertaken by other market participants. He realises that his actions and the pressure exerted by the competitors enable him to 'play the game to his advantage' at any moment. He is supported in his efforts by the dispersion of other market participants – the absence of participant consolidation implies the absence of consolidated information about the participants' behaviour. A large number of market participants contributes to efficiency.

Product homogeneity (uniformity and full substitution) – homogeneity does not contribute to the efficiency of real estate market participants. Participants who own similar (homogeneous) real estate are unable to demonstrate their distinctiveness. They would have to adopt similar patterns of behaviour, which is unacceptable for participants keen on preserving their individual efficiency. The differences between real estates or the terms of transaction support efficiency – a participant who has certain knowledge and skills can use them to maximise own efficiency. The substitution of products and services also has a detrimental impact on efficiency because it enables a potential buyer to choose a different solution which, in turn, detracts from the seller's efficiency.

Perfect information (market transparency) – all market options are assumed to be known to all buyers and sellers – *rarely*, market prices are assumed to be known to all buyers and sellers – *often*. Therefore, market participants' actions are not driven by opportunity (knowledge of the existing solutions), but by prices. In this situation, participants who have accumulated more knowledge, skills and information have a chance of improving their efficiency.

Utility and profit maximisation – in addition to maximising their profits, decision-makers also attempt to maximise their security or significance. In order to become more efficient, market participants have to maximise utility and profit. This attribute contributes to the efficiency of participants on the real estate market.

Zero entry or exit barriers – a competitive market is freely available to all participants, owners can move their capital to market segments generating higher

revenues, the capital market is characterised by a high degree of liquidity. This attribute describes the effectiveness of the market and the efficiency of its participants. Every participant should be entitled to freely shape his market position.

The efficiency of market participants is a derivative of their organisational, planning, performance and evaluation efficiency. The key factors limiting the efficiency of market participants are:

– unavailability of information and insufficient information on market processes;
– specific features of a transaction;
– market outlook;
– fluctuations in return rates;
– the return on alternative investments;
– situation on the construction market;
– state policy;
– frequent legislative changes.

The remaining attributes, which are often quoted as factors that lead to market imperfection, support (in a way) the efficiency of participants on the real estate market. They describe individual scenarios which may be used by a market participant to improve his efficiency. One of such attributes is termed as *irrational behaviour – buyers' and sellers' decisions are influenced by factors other than the price, including trends, neighbourhood, tradition and advertising*. This approach may not contribute to the effectiveness of a market as a whole, but it benefits the individual efficiency of its participants. Factors such as subjective evaluation of real estate's utilitarian value, unequal access to information on local markets, mutual dependencies between parties and acting under coercion influence the participants' efficiency. Those attributes provide market participants with a competitive advantage that is not available to other participants.

4. CONCLUSIONS

This paper discusses the theoretical and practical aspects of describing the efficiency of real estate market participants. Different types of efficiency demonstrated by market participants have been defined. A correlation between the effectiveness of a real estate market and the efficiency of its participants has been determined. The efficiency of market participants has been classified into the following sub-categories: general efficiency, executive efficiency and comprehensive efficiency. In a dynamic approach, the efficiency of market participants can be further sub-divided into static, adaptive and innovative efficiency. The effect of various efficiency types on a market participant's efficiency has been demonstrated. The concept of innovative efficiency has been introduced as a factor that

significantly contributes to the participants' performance on a modern real estate market.

Innovative efficiency has been discussed in the context of methods that are based on the rough set theory. The authors have presented decision-making procedures which create various applications for the rough set theory.

The proposed solutions offer a sound theoretical basis for solving problems in the area of intelligent decision-making systems. They constitute a good venture point for application studies investigating the efficiency of real estate market participants.

The authors assume that real estate markets are ineffective (or of low effectiveness) in the context of information effectiveness. Thus, considering the likelihood of obtaining overaverage profits in this respect is purely theoretical. However, it is the market of buyers and sellers, which is regulated by market forces. Therefore, the effectiveness and efficiency analysis of economic subjects operating on the real estate market is not to be avoided.

In this context, it is necessary to define economic subjects' ability to achieve their aims (i.e. their efficiency). This article tackles and presents the analysis of the above mentioned efficiency.

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