STATISTICS IN THE CONTEXT OF ECONOMIC THEORY AND THE LIMITS OF AUTOMATED VALUATION MODELS IN THE VALUATION OF INDIVIDUAL PROPERTIES

PROF. EWA KUCHARSKA-STASIAK
FACULTY OF ECONOMICS
AND SOCIOLOGY,
UNIVERSITY OF ŁÓDŹ
DEPARTMENT OF INVESTMENT
AND REAL ESTATE

TEGoVA
THE EUROPEAN GROUP OF VALUERS' ASSOCIATIONS

POLSKA FEDERACJA STOWARZYSZEŃ
RZECZOZNAWCÓW MAJĄTKOWYCH

REVASE
Erasmus+ | Léargas

Erasmus+

Funded with the support of the Erasmus+ programme of the European Union

ABOUT

ABOUT THE AUTHOR

PROFESSOR DR HAB EWA KUCHARSKA-STASIAK

Professor Kucharska-Stasiak is a founding member of the modern Polish valuation profession. She graduated from The University of Łódź, where she gained a doctorate in economics followed by habilitation in 1990.

Since 2000 she has been a Professor of economic sciences at the University of Łódź. In 1991 she became the head of the university's Investment and Real Estate Department and in 1998 joined an inter-faculty doctorate commission. She is also the head of post-graduate studies in "Real Estate" at the university's Economics-Sociology Department. In 1999 she became a member of the National Advisory Board to the Chairman of the Polish Department of Housing and Urban Planning.

Professor Kucharska-Stasiak is a longstanding member of the Polish Valuers' Qualifications' Commission as well as a member of the Arbitration Commission of The Polish Federation of Valuers' Associations (PFVA). She is the author and co-author of many text books, a member of the editorial committee of the "Journal of Property Tax Assessment and Administration" and a contributor to the quarterly journal "Świat Nieruchomości".

This paper was presented at a REVASE Multiplier Event in Warsaw on 27 February 2018 and reproduced in this publication with the kind permission of its Author.

THE AUTHOR

STATISTICS IN THE CONTEXT OF ECONOMIC THEORY AND THE LIMITS OF AUTOMATED VALUATION MODELS IN THE VALUATION OF INDIVIDUAL PROPERTIES

BY PROFESSOR EWA KUCHARSKA-STASIAK

SUMMARY

Current debate about the use of statistics in property valuation constitutes part of a wider question concerning the role of mathematics in the field of economics. This paper starts with a review of the evolution of the application of mathematics, including statistics, in economics and draws conclusions about the applicability and effectiveness of such science in property valuation.

As regards the application of statistical methods in valuation, the focus should not be on the technical possibility of applying statistical methods in property valuation or concern about the job prospects of valuers, which would be significantly reduced if automated valuation models were adopted. Rather we should seek answers to the following questions:

- Does the value determined by statistical methods correctly reflect: the concept of market value set on the basis of the most advantageous use, the characteristics of the valued property, the terms of transaction, the complexity of the real estate market, the competitive position of the property on the market and the behaviour of buyers? In other words, is trust in statistical methods justified and does their application ensure the adequate credibility of the result?
- Are the results of estimations made using statistical methods understood by the recipient?

In seeking answers to these questions, one needs to look at valuation both as a process of reaching a value, and as the result of this process.

THE USEFULNESS OF STATISTICAL METHODS FOR THE VALUATION OF REAL ESTATE

Traditional valuation methods evolved in a period characterized by a significantly lower availability of statistical data than today. This was determined by the smaller number of transactions and reduced market transparency. Today, the availability of multiple sources of competent data is greater, especially in urban areas. **However, the problem remains of the small number of transactions – although they cover the entire population – especially for rare, unique properties.**

The value estimated in the valuation process should reflect not only the technical, economic and legal characteristics of the property, but also the valued property as a component of the real estate market, and therefore the importance of these features in the eyes of market

participants, the reflection of these features in property prices, the market potential of the valued property, if it exists, its competitive position, and also the strength of the market, which determines the risk of investing.

The subject of the valuation is very individualized, not only in terms of physical features, but also the economic and legal characteristics. The correct application of statistical methods would require: firstly, acquiring a large amount of information on the transaction prices of very similar properties, which would correctly reflect the impact of legal, physical and economic characteristics in property prices; and secondly, the acquired data meeting the definitional conditions of market value, relating not only to the conditions of concluded transactions, but also the time of their conclusion (in accordance with the principle of anticipation, transactions from the distant past cannot be used, because they do not reflect the expectations of investors regarding the future).

However, meeting these conditions on the real estate market is difficult, even impossible.

This is determined by several factors:

- the **diversity of properties,** which significantly impedes the isolation of data sets with the appropriate number of similar properties on local markets;

- the **low efficiency of the real estate market**, which means that prices on the market do not reflect all changes taking place in the environment, and therefore, prices on the market cannot be the only basis for determining value;

- the **low awareness of real estate market participants of the influence of individual characteristics**, such as the floor layout, the storey, the age of the building, the view and the transferable rights (ownership, or ownership rights to the premises), on the price paid.

Market participants know little about this – **they are unaware of the prices of property characteristics.** In many cases, price distributions will be curved rather than linear. Furthermore, mutual influences occur between the features, which affect the prices – for example, central heating costs depend not only on the floor surface, but also the height of the room, the square footage and the number of storeys. There is no evidence that improvements in the statistical methods used would produce significant increases in accuracy.

Not only do doubts exist regarding whether statistical methods allow property features to be effectively reflected in the price, but even greater doubts arise at the level of reflection of the market and the behaviour of its participants, because:

- statistical models are based on the distribution of numerical data according to normal distribution. The distribution of market data regarding transaction prices from the investment market or the rental market (rental rates) does not resemble a bell curve. The distribution of data on the real estate market is skewed to the left or right. This calls into question the construction of statistical considerations based on a normal distribution;

- the use of statistical methods requires a large amount of data to be obtained. When using statistical methods, property valuers either take dissimilar properties as the basis for determining values or they adopt an unreasonably long observation period (often 10 years). Since the valuation model is an investor model, meaning that the value, in accordance with the principle of anticipation, must reflect the expectations of today's investors regarding the future, the adoption of a long observation period is erroneous, because changes occurring in the economy – in the economic, legal and political spheres as well as in the real estate market – cause a shift in investors' expectations. **Old market information does not reflect the expectations of today's investors regarding the future;**

- the use of statistical methods also does not allow the reflection of many other economic principles that are important in the process of value creation, such as the principle of change, the principle of compe-

tition, the principle of external balance (the balance between the capital invested in the property and the quality of the surroundings and neighbourhood), the principle of internal balance (the ratio of the value of the land to the value of its constituent elements), and the principle of the highest and best use, which has been deemed at the heart of the valuation. **This means that the closer we are to the acceptance of statistical methods in property valuation, the further we are from the economic principles of valuation.**

This means that the stage of attaining the value requires an individualized approach: reflecting the market potential of the property and its market competitiveness in the eyes of investors. This stage should reflect the typical expectations of investors. Applying statistics at this stage would appear to be a fantasy; statistical models poorly simulate the way of thinking of market participants (Wilson 1995).

One of the great opponents of these methods is Dell, who prefers statistical methods in property valuation to be employed in market analysis.

Dell equates the use of AVM to a black box with a funnel at the top. *"You put the data into the funnel, the box rattles and buzzes, and the output is 'respect', which is not an estimate of value"* (Dell 2004, p. 13 after: Lorenz 2006, p. 165). The basis for such severe criticism of advanced methods, including AVM, is the fact that they do not observe *"the subject of the valuation, its conditions and threats, the usability of the plot, traffic conditions, and so on [...]. They work poorly for unique properties and mixed housing estates and can be highly erroneous in any direction"* (Lorenz 2006, p. 165). These methods lead to the determination of an average transaction price. The average price cannot be the basis for determining the market value; not only does it not reflect the most probable price, but above all, it does not reflect the current competitive position of the property on the market.

A major drawback to the use of AVM is the elimination of the involvement of a qualified property valuer.

Lorenz claims that the group of alternative methods should not be called valuation methods – instead, they should be thought of as data analysis methods, or tools to support the decisions of real estate valuers (Lorenz 2006, p. 164).

The dominant belief is that traditional methods are better suited for the valuation of individual properties, while advanced methods are more useful for mass valuations (Lorenz 2006, p. 164). The collective behaviour of market participants can be reflected using traditional methods. They therefore reveal the market experiences of participants who do not think via the prism of mathematical formulas. Mathematical formulas are perceived by investors as a modern form of alchemy. In the words of Bogle: "Too much complexity, too little simplicity" (Bogle 2009).

Statistical methods can be helpful at the market analysis stage. However, this awareness is not sufficient to transform a price into value. Transforming prices into value on the real estate market is particularly difficult. This being a low-efficiency market, the prices do not reflect all the changes occurring in the environment. Prices on the real estate market do not fully reflect the current state of the real estate market; they often reflect historical price levels (on the investment market and on the rental market), and not the expectations of market participants today. An external consideration of these methods is necessary for the assessment of the competitiveness of the valued property and for its individualisation to be revealed. The specificity of the property and the specificity of the real estate market mean that the process of individual property valuation is and should remain a craft-based process. The future progress in valuation methodology should not rely on improving statistical methods but on discovering the relationships between market participants and the increasingly complex environment, and their impact on value. To answer this call, valuation methodology should open up to the accomplishments of behavioural economics.

Unfortunately, combating the abuse or misuse of mathematics and statistics in economics is difficult, because someone who has become, or thinks they have become, a master of a particular analytical method will be the last one to notice its weaknesses.

INTRODUCTION

A current topic of discussion amongst real estate valuers is the application of statistical methods in the valuation of individual properties. The popularity of advanced statistical methods is growing particularly in the development of so called Automated Valuation Models (AVM).

I believe that in determining the applicability of such methods including the use of AVMs in the valuation of individual properties we should not concentrate on either the technical possibility of applying statistical methods in property valuation or the concern for the job prospects of valuers, which would be significantly reduced if statistics based automated valuation methods were adopted.

Rather the discussion should seek answers to the following questions:

- **does the value determined by statistical methods correctly reflect the concept of market value set on the basis of the most advantageous use, the characteristics of the valued property, the terms of the transaction, the complexity of the real estate market, the competitive position of the property on the market and the behaviour of buyers?** In other words, **is trust in statistical methods justified and does their application ensure a credible result?**

- **are estimates of value arrived at on the basis of statistical methods understood by the recipients?**

In seeking answers to these questions, we should look at valuation both as a process of reaching a value, and as the result of this process.

The discussion about the use of statistics / mathematics in property valuation constitutes part of a wider question concerning the role of mathematics in the field of economics. This is why it is worth reviewing the evolution of the application of mathematics, including statistics, in economics and drawing conclusions about the applicability and effectiveness of such science in property valuation.

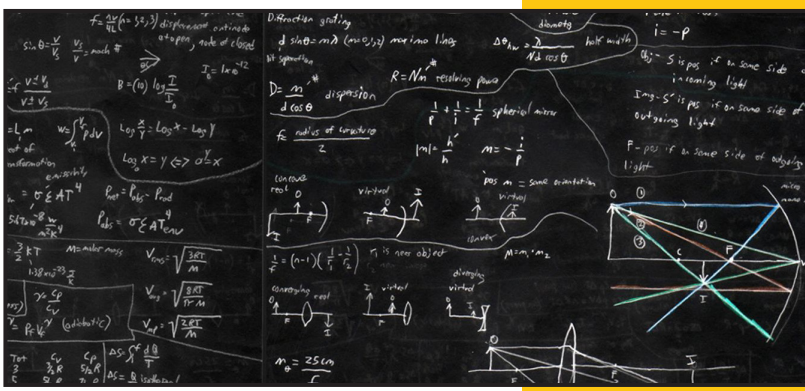
1. THE USE OF MATHEMATICS IN ECONOMICS. THE EVOLUTION OF THE APPROACH

There are many branches of mathematics, statistics being one of them. Its focus is the use of statistical tests to identify numerical observations. Another branch of mathematics is mathematical economics, which deals with the application of mathematical techniques in the formulation of hypotheses. This is a form of abstract analysis. The combination of the two branches results in econometrics.

Attempts to make economics a field of mathematics were seen as early as the 19th century, when a significant number of economists sought to make economics the most exact of the soft sciences. Even earlier, Leonardo da Vinci stated that no human research can be called real science unless it can be demonstrated mathematically.

The mathematical approach to economics has attracted both supporters and opponents. It is worth noting that **the boundary of this division is not determined by mathematical background.** Those opposing the use of mathematics have included competent mathematicians, while many of the new talents in the field of quantitative science have supported its use. Meanwhile, among those economists who have opposed the formalization of economic thinking, there are supporters of data collection and statistical analysis. Among the many branches of mathematics, statistics, which allows real dependencies to be distinguished from random ones, has seen a surge in popularity (Landreth and Colander 2005, p. 520). This does not mean that the use of statistical analysis has not raised doubts. For example, both Marshall and Edgeworth faced uncertainties when considering the possibility of the statistical measurement of a demand curve, since the assumption of ceteris paribus accompanying this research poses difficulties at the stage of numerical recognition (Ibid., p. 520). This is an example of the difficulty of using statistical methods in the field of economic phenomena analysis.

David Ricardo (1772-1823) is considered to be responsible for introducing mathematics to economics; he had "the gift of abstract reasoning based on the use of a simple analytical model with a small number of variables that gave rise to very radical conclusions following a series of transformations" (Skousen 2012, p. 136). His focus on **the construction of abstract models and the use of false and misleading assumptions to prove the desired results** became known as **Ricardo's sin**, which is identified as an occupational hazard for economists and has survived to this



day. In essence, it is "the basing of an argument on purely deductive reasoning connected to mathematical equations, without any ref-

erence to history, sociology, philosophy or institutional conditions. Its expression is abstract theorizing and the building of models based on unrealistic and even false assumptions" (Skousen 2012, pp. 137-138). In economic literature, Ricardo's writings were recognised as the source of misunderstandings on which all economic theory was based (Ibid., p. 138).

Mathematics joined the realm of economics for good in the 1870s, when Stanley Jevons and Leon Walras began to use mathematical equations in economic textbooks (Ibid., p. 488). Among those who developed a fascination with mathematical methods was Paul Samuelson, considered to be the father of modern mathematical economics.

At the beginning of the 1960s, Samuelson announced that economics had become more mathematical and technical than ever before (Skousen 2012, p. 489). The triumph of mathematics seemed complete: 96% of articles published in the 1980s in the American Economic Review were mathematical in nature (Ibid., p. 489) and doctoral programmes in economics were dominated by abstract modelling, confirming the growing detachment of economic analysis from the real world (Ibid., p. 138). The formalization of economics influenced its form of expressing major thoughts.

The detachment of economics from economic reality has long provoked strong opposition. The triumph of mathematics in economics has been recognised as an example of the course of the research being made subordinate to the research tools and methods. Methodologists define mathematics as merely an instrument, a tool of cognition which, in the absence of empirical application and interpretation, has no subject matter. It enables the discovery not of what is real, but of what is possible. The truth means something different for a mathematician than for a theoretician of economic sciences (Stachak 2003, p. 49). Representatives of economic sciences should know when and how to use mathematical formulae.

Defects in mathematical reasoning were already being revealed of the 18th and 19th centuries by Jean-Baptiste Say (1767-1832), who became known as the French Alfred Marshall. He regarded economics as a qualitative and not a quantitative science – and, therefore, as a science that is difficult to submit to mathematical calculus (Skousen 2012, p. 83) – and he labelled economists who abstractly theorized using mathematical models "vain dreamers" (Ibid, p. 138). Marshall, although he always applied mathematics and the principles of exact science in economics, claimed that mathematics was at best a useful scaffolding, which should be removed in the final presentation of the conclusions of the reasoning (Blaug 1994, p. 404). Consequently, he treated his equations and graphs as annexes (Skousen 2012, p. 280) and warned that a good mathematical theory is not necessarily a good economic theory. He expressed his philosophy in 6 points:

1. Use mathematics as the language of notes, not as an engine of enquiry,
2. Keep the notes until you finish your work,
3. Translate everything into English,
4. Illustrate with examples relating to the real world,
5. Burn the mathematics,
6. If you're not able to do 4, burn 3.

He was unwilling to allow the analysis to be detached from reality. Although Marshall was a great supporter of the use of mathematics in economics, he saw **the danger of succumbing to the temptation of using increasingly sophisticated tools and, at the same time, moving away from economic realities.** Even William Stanley Jevons noticed that economists sometimes abuse the authority of mathematics to prove trivial arguments (Stachak 2003, p. 50).

Another significant statement came from Roger Babson, who tried to apply Newton's principles in economics and finance; he was the creator of technical analysis, an economist, who in 1926 warned of the Wall Street crash: "The most important thing – I think – that I have learned is that the world is ruled by emotions, **not statistics**, information or anything else" (Skousen 2012, p. 376). This wording reveals the awareness of the influence of behavioural factors on market decision making.

Among the opponents of the application of mathematics in economics were representatives of the Austrian school, the creators of the contemporary concept of values.

Carl Menger claimed that it is formal and not mathematical language that reflects economic phenomena. The representatives of this school declared that the use of mathematics in economics is erroneous, because this method synchronizes values which, in the perspective of time and creative entrepreneurship, are heterogeneous, and does not allow the qualitative 'essence' of phenomena such as value, rent and profit to be reached. It follows that it is a pernicious conviction to say that mathematical methods allow the measurement of values (Blaug 1994, p. 307).

Robert Kuttner, co-founder of the Institute of Economic Policy in the USA, stated that faculties of economics are producing doctoral idiots who know mathematics well but have no idea about the actual economy (Ibid., p. 490). The abuse of mathematics and statistics in economics is labelled as trickery (Ibid., p. 490). Milton Friedman also stated that economics is becoming an increasingly secretive branch of mathematics instead of dealing with real economic problems (after Ratajczak 2014, p. 59). Even Paul Samuelson himself, the father of modern mathematical economics, admitted that the best students know everything except common sense (Ibid., p. 487).

The protest against the dominance of mathematics in economics led to the creation of a new journal, which is today the most widely read journal on economic theory – the Journal of Economic Perspectives – from which mathematics is practically absent (Skousen 2012, p. 491).

The 2007-2008 crisis strengthened the wave of criticism of the mathematical formalization of economics. There has been increasing articulation of the opinion that economic problems cannot be reduced to a set of axioms, mathematical models or statistical dependencies. The evidence cited includes the analysis of the economists who publicly warned of the impending crisis. Out of twelve, only two of them formulated a warning based on their own mathematical models (Wojtyna 2014, p. 43). Many economists, bolstered by the experience of the recent crisis, have called for a closer connection between economics as a scientific discipline and economic reality, which is subject to dynamic changes. This makes it difficult to use quantitative analysis and mathematical modelling based on constant assumptions and regularities and encourages the development of qualitative analysis (as indicated by Mączyńska 2010, p. 65, among others). Belka cites statements suggesting that the most important and most urgent element for healing the economy is the rejection of the use of mathematics in economic research, and that

the forms of mathematical deductive reasoning are not an adequate tool for thorough social analysis (Belka 2014, p. 96). According to Sedláček, economics "is more than using mathematical formulae and if we want to talk about human behaviour, we need to know different economic approaches. Therefore, mathematics is useful, but not sufficient" (Sedláček 2012, pp. 299-300). He notes that economists sometimes pay more attention to mathematical methods than to the problems to which they apply (Ibid., p. 300). These methods appear attractive, elegant and precise, but when we use them, we never know what we are talking about or whether we are telling the truth (Ibid., p. 305). Sedláček quotes the statement of Nobel Laureate Wassily Leontief: "No other field of empirical research (than economics) applies such a powerful and complicated **statistical mechanism** with such mediocre results" (Ibid., p. 307). It was also noted that, although publications on economic are rich in mathematical formulas, models and econometric test results, there is no link between these different approaches. As a result, "Although the number of economic studies increased, human activity was less and less understood. Economics could no longer be explained or predicted. Therefore, the best direction for it to take was to open up to sociology and psychology" (Wojciechowska et al. 2017, p. 38). This unlocks a new perspective on the needs of market analysis: the transition from a subjective to an objective approach, to the study of the behaviour of its participants.

These statements prove that there has been a reappraisal of views on the role of mathematics as a specific panacea for traditional problems. These changes should not be equated with the idea of limiting the use of mathematics, but with a change of its role. It cannot fulfil the role of approximating economic research to an exact science. It is hard to disagree with the statement that economics, as a social science, is not and never will be an exact science; it will always have a socio-qualitative dimension (Ratajczak 2014, p. 56). A group has emerged among economists calling for the closer connection of economics as a scientific discipline with economic reality. One of its participants, Hodgson, wrote that the most important and most urgent element for healing the economy is the rejection of the use of mathematics in economic research and in teaching economics as an independent goal (Belka 2014, p. 96), and Lawson states that the forms of mathematical deductive reasoning are practically inadequate as tools for thorough social analysis (Belka 2014, p. 96). According to Krugman, the economy has been a bit lost, and economists have perceived the beauty in the form of impressive patterns to be the truth, using them to show off their proficiency in mathematics (Krugman 2009).

To sum up, the main objections to the use of mathematics in economics – that is, abstract analysis – arise in relation to the formulation of hypotheses and the explanation of their implications, and resistance has also been encountered where statistical analysis methods have been inadequately applied to a problem. Not only their defects, but also their misapplication and misinterpretation, have been noted. For example, a high R-squared coefficient cannot constitute evidence of a causal influence of one variable on another (Skousen 2012, p. 490).

It appears that the explanation of complex realities requires a different perspective. It is no surprise that the turn of the 20th and 21st centuries saw a major return to the roots of economics, to philosophy. Economics developed metaphysical aspects relating to cognition theory as well as the problems of ethics, and began to draw on the principles of psychology.

2. STATISTICAL METHODS IN PROPERTY VALUATION

2.1 DIFFERENTIATION OF VIEWS

The popularity of the use of mathematics and statistics in property valuation is growing. This growth in popularity is due to the increased availability of empirical data associated with the big data era. There is a belief among the supporters of statistical models that access to an electronic, complete set of data calls into question the desirability of estimation based on research samples. They believe that the statement that "valuers rarely have access to all information available for use in their analysis is a past truth and a mistaken belief on which a large part of the theory of value estimation is based" (Dell 2013, p. 333). The use of mathematics and statistics has gained an increasing number of supporters, not only among property valuers – it has also seen increasing recognition among the recipients of valuations: the banking sector, courts and tax offices.

The increase in the popularity of statistical methods has contributed to the development of alternative (advanced) valuation methods. The group of advanced methods is not uniform but includes hedonic models, econometric forecasting, intelligent systems, house price index models, and tax assessment value models. Many of the advanced valuation methods are used to construct automated valuation models (AVM).

Three groups of views can be distinguished in discussions regarding the applicability of statistical methods in property valuation:

- the first group rejects statistical methods in the process of attaining value. One of the representatives of this group is Lind, who rejects the possibility of statistical valuation. He claims that "In most valuations, there is not enough information to estimate the formation of possible prices, other than approximately. In this case, there is not enough information to estimate the difference between the average, median or mode" (Lind 2003). In Poland, one of the opponents of statistical methods is Prystupa, who notes that these methods are used, among other things, to determine the weightings of market characteristics of properties, as well as the value of properties (Prystupa 2017, p. 3). To determine the market weightings, valuers use the correlation between the price (dependent variable) and features of the property such as location, technical condition, neighbourhood, and so on, which are assigned appropriate weights. Due to the multiplicity of characteristics affecting the price, assuming the principle of *ceteris paribus*, the market results defining the weighting of market characteristics are completely unreliable. This leads Prystupa to the conclusion that it is **much better to determine the weightings of market characteristics based on our**

own experience and observations than to trust patterns that give completely unreliable results (Ibid., p. 3). He also considers the use of a multiple regression equation model in defining the value of real estate to be incorrect. The results of the calculations are not consistent with the results obtained in the comparative approach; therefore, they do not lead to a reliable valuation. The greater the number of variables used in the regression model, the greater will be the contradiction with the state of the market, because the number of mutually correlating traits will be higher (Ibid., pp. 4-5);

- the second group supports the use of mathematics and statistics in the field of valuation. This group includes Kummerow, who argues that statistical methods may prove useful in producing more objective valuations, which renders the valuation service more valuable (Kummerow 2000, pp. 318-326). Dell, with a background in mathematics, econometrics and statistics, is also an advocate of the use of statistical methods, but in the area of market analysis. Writing about a new paradigm for estimating the value of real estate, he draws attention to the usefulness of the statistical methods at the stage of selecting comparables in the valuation process. He states that the traditional estimation of values, based on the subjective assessment of the selection of comparables is doubtful in the world of large data sets, while statistical methods allow for objective data selection (Dell 2017, p. 229). Comparables should come from the competitive real estate segment, while real estate which is non-competitive for property under valuation should be rejected. In identifying the market relevant segment, he sees the usefulness of using regression analysis. He emphasizes the necessity of correct application of this tool, which does not ensure the reliability of the result when incorrectly applied (for example, Dell 2013, pp. 332-346; Dell 2017, pp. 217-229);

- the third group represents the most radical views, approving the use of automated (computer) valuation models (Mooya 2016 p. 65).

2.2 THE USEFULNESS OF STATISTICAL METHODS FOR THE VALUATION OF REAL ESTATE

Traditional valuation methods evolved during a period of a significantly lower availability of statistical data than today. There was a smaller number of transactions and less market transparency. Today, the availability of multiple sources of competent data is greater, especially in urban areas. **However, the problem remains of the small number of transactions especially for rare, unique properties.**

The value estimated in the valuation process should reflect not only the technical, economic and legal characteristics of the property, but also the valued property as a component of the real estate market, and therefore the importance of these features in the eyes of market participants, the reflection of these features in property prices, the market potential of the valued property, if it exists, its competitive position, and also the strength of the market, which determines the risk of investing.

The subject of the valuation is very individualized, not only in terms of physical features, but also the economic and legal characteristics. The correct application of statistical methods would require: firstly, acquiring a large amount of information on the transaction prices of very similar properties, which would correctly reflect the impact of legal, physical and economic characteristics in property prices; and secondly, the acquired data meeting the definitional conditions of market value, relating not only to the conditions of concluded

transactions, but also the time of their conclusion (in accordance with the principle of anticipation, transactions from the distant past cannot be used, because they do not reflect the expectations of investors regarding the future). **However, meeting these conditions on the real estate market is difficult, even impossible.** This is determined by several factors: **the diversity of properties**, which significantly impedes the isolation of data sets with the appropriate number of similar properties on local markets; the low efficiency of the real estate market, which means that prices on the market do not reflect all changes taking place in the environment, and therefore, prices on the market cannot be the only basis for determining value; and the **low awareness of real estate market participants of the influence of individual characteristics, such as the floor layout, the storey, the age of the building, the view and the transferable rights (ownership, or ownership rights to the premises), on the price paid.** Market participants know little about this – **they are unaware of the prices of property characteristics.** Evans doubts whether statistical surveys provide such knowledge. In many cases, price distributions will be curved rather than linear. Furthermore, mutual influences occur between the features, which affect the prices – for example, central heating costs depend not only on the floor surface, but also the height of the room, the square footage and the number of storeys. Evans argues that there is no evidence that improvements in the statistical methods used would produce significant increases in accuracy of valuations (Evans 2004, chapter IV).

Not only do doubts exist regarding whether statistical methods allow property features to be effectively reflected in the price, but even greater doubts arise at the level of reflection of the market and the behaviour of its participants, because:

- statistical models are based on the distribution of numerical data according to the normal distribution. The distribution of market data regarding transaction prices from the investment market or the rental market (rental rates) does not resemble a bell curve. The distribution of data on the real estate market is skewed to the left or right. This calls into question the construction of statistical considerations based on a normal distribution;

- the use of statistical methods requires a large amount of data to be obtained. When using statistical methods, property valuers either take dissimilar properties as the basis for determining values or they adopt an unreasonably long observation period (often 10 years). Since the valuation model is an investor model, meaning that the value, in accordance with the principle of anticipation, must reflect the expectations of today's investors regarding the future, the adoption of a long observation period is erroneous, because changes occurring in the economy – in the economic, legal and political spheres as well as in the real estate market – cause a shift in investors' expectations. Old market information does not reflect the expectations of today's investors regarding the future;
- the use of statistical methods also does not allow the reflection of many other

economic principles that are important in the process of value creation, such as the principle of change, the principle of competition, the principle of external balance (the balance between the capital invested in the property and the quality of the surroundings and neighbourhood), the principle of internal balance (the ratio of the value of the land to the value of its constituent elements), and the principle of the highest and best use, which has been deemed the heart of the valuation (The Appraisal of Real Estate, 14th, s.26-34). **This means that the closer we are to the acceptance of statistical methods in property valuation, the further we are from the economic principles of valuation.**

To summarise, the stage of attaining the value requires **an individualized approach:** reflecting the market potential of the property and its market competitiveness in the eyes of investors. This stage should reflect the typical expectations of investors. Applying statistics at this stage would appear to be a fantasy; statistical models poorly simulate the way of thinking of market participants (Wilson 1995).

2.3 EVALUATION OF THE USE OF AUTOMATIC VALUATION MODELS IN LIGHT OF THE AVAILABLE LITERATURE

Statistical methods form the basis for creating alternative valuation methods. The use of computer based automated valuation models (AVM) arouses the strongest feelings. One of the major opponents of these methods is Dell, who prefers statistical methods in property valuation for the purposes of market analysis.

Dell equates the use of an AVM to a black box with a funnel at the top. “You put the data into the funnel, the box rattles and buzzes, and the output is ‘respect’, which is not an estimate of value” (Dell 2004, p. 13 after: Lorenz 2006, p. 165). The basis for such severe criticism of advanced methods, including AVM’s, is the fact that they do not observe “the subject of the valuation, its conditions and threats, the usability of the plot, traffic conditions, and so on [...]. They work poorly for unique properties and mixed housing estates and can be highly erroneous in any direction” (Lorenz 2006, p. 165). These methods lead to the determination of an average transaction price. The average price cannot be the basis for determining the market value; not only does it not reflect the most probable price, but above all, it does not reflect the current competitive position of this property on the market.

A major drawback to the use of AVMs is the elimination of the involvement of a qualified property valuer: “The estimation of the average price is done from behind a desk, without inspecting the property being valued...” (Grzesik 2017, p. 39). **Lorenz claims that the group of alternative methods should not be called valuation methods – instead, they should be thought of as data analysis methods, or tools to support the decisions of real estate valuers** (Lorenz 2006, p. 164).

A critical approach to using these models for property valuation also comes to light in a report prepared by George Matysiak, who noted that "the European industry of automated valuation models is shrouded in secrecy. It is very difficult to verify the validity of these models, which are advertised and sold as very complicated and advanced tools" (European Valuer 2017). They are not made available for independent testing and verification in terms of the accuracy of the results obtained. They require supplementation in the form of the professional judgement of a valuer. The European Banking Authority has confirmed that it is not acceptable to use these methods as the only actual valuation of a property. Neither can they constitute the only method for verifying a valuation. This verification should be carried out by a qualified valuer who possesses the skills and experience necessary to carry out the valuation and who remains independent of the decision-making process regarding the granting of loans (European Valuer 2017). In the light of these opinions, it is clear that AVMs do not describe reality or reflect the behaviour of investors who do not think through the prism of mathematical formulae. They are thus abstract, indeed a fiction. Mathematical formulae are perceived by investors as a modern form of alchemy. In the words of Bogle: "Too much complexity, too little simplicity" (Bogle 2009). They do more harm than good.

CONCLUSIONS

There is ongoing discussion within the social and economic sciences community on the legitimacy of using 'hard' and 'soft' research approaches (Gorzelak 2017, p. 1). It would seem that this discussion will not be drawing to a close any time soon. "Advocates of the quantitative approach, often using sophisticated statistical and mathematical methods undergoing constant modifications and 'improvements', indicate that only the application of these methods allows the acquisition of 'objective' results that are fully scientific, thus meeting the conditions of inter-subjective communication and repeatability, including verifiability. Advocates of the qualitative and heuristic approaches maintain that, firstly, quantitative methods are not completely 'objective' because they always contain a number of contractual assumptions (...), and secondly, the informational content of the available data, especially in the social sphere, cannot cover all research issues" (Ibid., p. 1).

These conclusions are particularly confirmed at the stage of value estimation, including the estimation of property values. The authors of the latest edition of the textbook 'The Appraisal of Real Estate' note the possibility of using statistical methods for summarizing and describing data, drawing conclusions and constructing prognostic models. They warn, however, that statistical methods may be used incorrectly, abused as a result of ignorance or a deliberate attempt to mislead (The Appraisal of Real Estate, 14th ed., p. 749). They may also be used as instruments of self-deception or wishful thinking (Dell 2017, p. 218).

There is no proof that the application of statistical methods guarantees objectivity and does away with valuation uncertainty. Statistical methods can be helpful at the market analysis

stage. However, this awareness is not sufficient to transform a price into value. Transforming prices into value on the real estate market is particularly difficult. This being a low-efficiency market, the prices do not reflect all the changes occurring in the environment. Prices on the real estate market do not fully reflect the current state of the real estate market; they often reflect historical price levels (on the investment market and on the rental market), and not the expectations of market participants today. Therefore, they cannot constitute the only basis for removing judgement on the level of a property's value. An external consideration of these methods is necessary for the assessment of the competitiveness of the valued property, for its individualisation to be revealed, and for an opinion of value to be presented as an art, not just science.

The specificity of the property and the specificity of the real estate market mean that the process of individual property valuation is and should remain a craft-based process. I am convinced that future progress in valuation methodology should not rely on improving statistical methods but on discovering the relationships between market participants and the increasingly complex environment, and their impact on value. To answer this call, valuation methodology should open up to the accomplishments of behavioural economics.

Unfortunately, combating the abuse or misuse of mathematics and statistics in economics is difficult, because someone who has become, or thinks they have become, a master of a particular analytical method will be the last one to notice its weaknesses.

REFERENCES

Belka M. (2014), "Dlaczego tylko odkrywać? Lekcje z obecnego kryzysu dla ekonomii i polityki gospodarczej", w: *E. Mączyńska (red.), Ekonomia dla przyszłości. Fundamentalne problemy teorii ekonomii i praktyki gospodarczej,* IX Kongres Ekonomistów Polskich, PTE, Warszawa.

Blaug M. (1994), "Teoria ekonomii", PWN, Warszawa.

Boogle J. C. (2009), "Dość. Prawdziwe miary bogactwa, biznesu i życia", PTE, Warszawa.

Dell G. (2013), "Common Statistical Errors and Mistakes: Valuation and Reliability", The Appraisal Journal, Fall 2013, s.332-346.

Dell G. (2017), "Regression, Critical Thinking and the Valuation Problem Today", The Appraisal Journal, Summer, s. 217-229.

Gorzelak G. (2017), "Twarde i miękkie metody badania struktur terytorialnych", maszynopis.

European Banking Authority limits use of statistical methods in valuation (2017), European Valuer, No. 8, s. 1-2, http://www.tegova.org/data/bin/a5964842d-cf67d_European_Valuer_(8)_July_2017.pdf

Evans A.W. (2004), "Economics, Real Estate and Supply of Land", Blackwell Publishing,

Grzesik K. (2017), "Zautomatyzowane modele wyceny (AVM) dla celów zabezpieczenia wierzytelności kredytowej", Rzeczoznawca Majątkowy, nr 1 (93)

Krugman P. (20.11.2009),
“Jak ekonomiści mogli aż tak się pomylić?”,
https://www.obserwatorfinansowy.pl/war-to-wiedziec/opinie/for-the-magazine-marking
pobrano (23.01.2018)

Kummerow M. (2000),
„Thinking Statistically About Valuations”,
The Appraisal Journal, July,
https://www.thefreelibrary.com/

Landreth H., Colander D. (2005),
“Historia myśli ekonomicznej”,
Wydawnictwo Naukowe PWN,

Lind H. (2003),
“A statistical definition of value:
a critical comment„
The Appraisal Journal, July,
https://www.thefreelibrary.com/

Lorenz D. (2006),
“The Application of Sustainable Development
Principles to the Theory and Practice
of Property Valuation”,
Universitätsverlag Karlsruhe, Karlsruhe.

Mączyńska E. (2010),
“Ekonomia w warunkach gospodarki
nietrwałości”
w: E. Mączyńska, J. Wilkin (red.),
Ekonomia i ekonomiści w czasach przełomu,
PTE, Warszawa.

Międzynarodowe Standardy Wyceny (2007),
IVSC, PFSRM, Warszawa 2009.

Mooya M.M. (2016),
“Real Estate Valuation Theory.
A Critical Appraisal”,
Springer.

Prystupa M. (2017),
“Po co wymyślono statystykę?” ,
Wycena nieruchomości i przedsiębiorstw,
nr 4(4).

Ratajczak M. (2014),
“Ekonomia i edukacja ekonomiczna w dobie
finansyzacji gospodarki”,
w: E. Mączyńska (red.), *Ekonomia
dla przyszłości. Fundamentalne problemy teorii
ekonomii i praktyki gospodarczej*,
IX Kongres Ekonomistów Polskich,
PTE, Warszawa.

Sedláček T. (2012),
“Ekonomia dobra i zła. W poszukiwaniu istoty
ekonomii od Gilgamesza do Wall Street”,
Wydawnictwo Studio Emka, Warszawa.

Skousen M. (2012),
“Narodziny współczesnej ekonomii.
Żywoty i idee wielkich myślicieli”,
Fijor Publishing, Warszawa.

Stachak S. (2003),
“Podstawy metodologii nauk ekonomicznych”,
Książka i wiedza, The Appraisal of Real Estate,
14th,2013, Appraisal Institute, Chicago

Wilson D.C. (1995),
“Highest and best use: preservation use
of environmentally significant real estate”,
Appraisal Journal.

**Wojciechowska R., Kucharska- Stasiak E.,
Wrońska- Bukalska** (2017),
“Psychologia na usługach ekonomii. Analiza
krytyczna związku ekonomii i psychologii”,
Texter.

Wojtyna A. (2014),
“Czy kryzys w teorii ekonomii jest głębszy, niż
w gospodarce?”,
w: *Ekonomia dla przyszłości. Fundamentalne
problemy teorii ekonomii i praktyki
gospodarczej*, Mączyńska E., red. PTE 2014.

PUBLISHED BY THE EUROPEAN GROUP OF VALUERS' ASSOCIATIONS
BOULEVARD SAINT-MICHEL 45, 1040 BRUSSELS, BELGIUM.

TEGoVA
THE EUROPEAN GROUP OF VALUERS' ASSOCIATIONS

WWW.TEGOVA.ORG
ISBN 9789081906029