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Automated Valuation Model for Residential Real Estates

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AUTOMATED VALUATION MODEL FOR RESIDENTIAL REAL ESTATES

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Abstract*: The general aim of this research project is to point out a series of essential and relevant elements to have a better understanding on several issues of valuation. His particular purpose is to highlight the content of a significant and actual valuation technique, i.e. Automated Valuation Model, and the possibility of its application in Cluj-Napoca, which is one of the most dynamic cities in Romania, especially when it comes to residential buildings. In our paper we will try to create an algorithm and for that we will use a software program, and in the end, we expect to simplify the valuation process.*

Key words: Automated Valuation Model (AVM); property valuation; software; market value.

JEL Codes: C88 Other Computer Software; R31 Housing Supply and Markets; R32 Other Spatial Production and Pricing Analysis.

Introduction

In the real estate field, at least three current and relevant global trends can be easily identified: an increase in automation, an increase in regulation and an increase in the demand for transparency and verifiability. The use of automation was based on the increased availability of appropriate software solutions, a better understanding of the statistical methods applied and the accumulation of digitally archived data, which allows a variety of applications, such as in property appraisals. The desire for transparency and data verification is met in certain areas such as banks, insurance and evaluation service providers, systems and organizations (Power, 1994).

The purpose of valuation is to estimate the value for a specific need, such as selling or buying price, mortgage loans, tax purposes, settling estates, the determination of a rental rate or for financial reporting purpose. The essence of an evaluation process is to estimate the value of the property rights, therefore the rights involved, and the specific type of value must be clearly identified (American Society of Real Estate Counsellors, 2011).

The valuation process starts at the same time as the appraiser identifies the subject matter to be evaluated and ends when reporting the conclusion to the client (American Society of Real Estate Counsellors, 2011).

It's important for appraisers to estimate an accurate value for real estate using Automated Valuation Models that has evolved over the past 50 years (Moore, 2006, p 43).
Automated Valuation Models are now widely used by real estate appraisers, by the general public, Government, and it is complimentary to traditional valuations. Removing the human factor, it's claimed by some advocates, that Automated Valuation Models reduce incorrect values which could arise on human judgement (I.A.A.O., 2003).

In this paper we deal with the problem of the automatic valuation of real estate, which in international language represents AVM - Automated Valuation Model, and our research has two objectives: (i) to clarify the content of this solution of valuation of assets and the diffusion of its use in international practice, and (ii) to investigate the possibility of applying AVM in Romania, including the possibility to integrate it in the national valuation standards. We propose in this regard a computer model with an appropriate software solution, as well as a platform where could be managed a database of residential real estate, which can be accessed by both a real estate professional and the ordinary population.

In this study we will measure housing value using an Automated Valuation Model.

The type of property on which this research is focused is the real estate, namely the one-room and two-room apartments in the city of Cluj-Napoca from Romania.
The contributions of our research could be the following: supporting the valuation by creating a modern and accurate valuation model, a new software for real estate valuation and a database of residential properties, especially one- and two-bedroom apartments, for Cluj-Napoca City, which can be accessed by appraisers, local authorities and other interested people.
Predicting sales prices in a specific geographical area. This type of evaluation will shorten the time of writing a classic evaluation report, especially for those assessments for the purpose of bank guarantee and mortgaging.

Literature review

The term Automated Valuation Model (AVM) has entered as a current of valuations only in the last years of the 20th century. Prior to this, similar, if not identical, methods were described as computer-assisted mass evaluation or just mass evaluation. Currently, academics and practitioners use the term automated evaluation model to underline the high degree of process automation, even if the models are not usually without human interaction.
Automated Valuation Models have his origins in United States of America, the first application being in 1981. After that it began to be developed in the United Kingdom, in the 1990s (Worzala et al., 1995).

From our point of view, Automated Valuation Model would be an advantage for evaluators, since the valuation process would be done easier. AVMs is the most convenient for residential properties, like apartments with one and two rooms. These properties are suitable to such an automated system because multiple properties from a certain area of a city with similar characteristics can be identified.
Automated Valuation Models have been developed and advanced for several reasons, in particular for fast and low-cost alternative to a full valuation (Worzala et al, 1995).

Currently, AVMs are commonly used in the US, Canada, Australia and in several EU member countries, such as the UK and Denmark. AVMs are also seen as an effective response to asset quality analyzes of the European Central Bank (Brucato, 2015), which may gradually lead to greater interest in other EU member countries.

Royal Institution of Chartered Surveyors (2013) identifies the following areas where AVMs are used: in-arrears assessment in banks, revaluation for credit decision in banks, full valuation audits in banks, capital tax planning for the individual, identification of fraudulent activity in banks, determining capital adequacy ratios in banks, estimating relocation compensation by government, cost / benefit analysis for potential public expenditure, mark-to-market bank's portfolio of properties in banks, mass appraisal for local taxes by government.

The AVM credibility is dependent on the data used and the skills of the modeler producing it. AVMs should be developed by appropriately qualified market analysts, for example, appraisers/valuers, who use statistically based applications to analyze data and select the best simulation of market activity for the analysis of location, market conditions, and property

characteristics from previously collected data. AVMs are designed to generate value estimates for properties at specified points in time (retrospective or prospective dates as required by client).

Downie and Robson (2008) describes their findings on AVMs and the integration within the valuation process, from a multinational perspective. In the context on a survey, there were 473 valuer responses, representing both lending and valuation organizations, described as senior professional members. The results of the study included the following findings: pune in continuare, nu e asa importnat sa scoti in evidenta

- 90% agreed that the ability to evaluate comparable was a major advantage over Automated Valuation Models
- 87% agreed that physical valuations were more accurate than Automated Valuation Models, as a result of local knowledge

The definition of an AVM has changed over time. The definition in Standard on Automated Valuation Models (revised 2018), it's describe in Chapter 3.1 as an AVM is: a mathematically based computer software program that market analysts use to produce an estimate of market value based on market analysis of location, market conditions, and real estate characteristics from information that was previously and separately collected. The distinguishing feature of an AVM is that it is a market appraisal produced through mathematical modeling. Credibility of an AVM is dependent on the data used and the skills of the modeler producing the AVM. AVMs should be developed by appropriately qualified market analysts, for example, appraisers/valuers, who use statistically based applications to analyze data and select the best simulation of market activity for the analysis of location, market conditions, and property characteristics from previously collected data. AVMs are designed to generate value estimates for properties at specified points in time (retrospective or prospective dates as required by client).

International Association of Assessing Officers, IAAO (2003), describes an Automated Valuation Model as: a mathematically based computer software program that produces an estimate of market value based on analysis of location, market conditions, and real estate characteristics from information collected. The distinguishing feature of an AVM is that it produces a market valuation through mathematical modelling. The credibility of an AVM is dependent on the data used and the skills of the modeler producing the AVM (IAOO, 2003, p 148).

The Royal Institution of Chartered Surveyors Automated Valuation Model Standards Working Group describes as: AVMs use one or more mathematical techniques to provide an estimate of value of a specified property at a specified date, accompanied by a measure of confidence in the accuracy of the result, without human intervention post-initiation (RICS, 2013).

It should be noted that three definitions of an AVM exclude any direct valuer involvement in arriving at an estimate of value.

These computer-assisted quantitative methods have their advantages in that they are systematic and rapid, reducing the dependence on the contribution of the workforce in ensuring the evaluation (Tretton, 2007). By eliminating the human element, it is claimed that AVM reduces inaccuracies that may arise due to trust in human judgment.

Bogin and Shui (2018) underline the utility of AVM from the perspective of financial lenders - banks. In the American case, we see how the evaluators tend to over-evaluate bank guarantees, in favor of bank debtors. As such, they benefit from the existence of developed AVM models that can run them and quickly verify the estimator's estimate.

These computer-assisted quantitative methods have their advantages in that they are systematic and rapid, thus reducing the dependence on the contribution of the workforce in ensuring the evaluation (Tretton, 2007). By eliminating the human element, it is claimed that AVM reduces inaccuracies that may arise due to trust in human judgment.

The automated appraisal model combines a set of algorithms, features, prices, neighborhood features and homes for sale and, finally, provide an option for evaluating individual homes (Galin et al, 2008, p. 4).

Valuation market approach encompass a variety of methods including as multiple regression analysis, Computer Assisted Mass Appraisal (McCluskey et al, 1997), a rapidly evolving variety of machine learning, artificial neural networks (Worzala et al, 1995).

Based on the arguments regarding the inefficiency of real estate markets and literature dealing with the estimation of stochastic boundaries, as well as the spatial correlation between properties, Samaha and Kamakura (2008) developed a GWR (Geographically Weighted Stochastic) based on the prospects of the seller and the buyer (highest price). Possible that the buyer expects, respectively

the lowest price that the seller bids). The detail of the stochastic frontier is fixed, taking into account the measurable characteristics of the immovable property, as a maximum price at which a property could be sold (the reservation value of the buyer).

The classical multiple regression analysis (MRA) (hedonic price or multiple regression analysis of the smallest ordinary markets - OLS) is the most common valuation method, a traditional one according to Kilpatrick (2011), which was apparently initiated in the 1980s, years relating to the beginning of the growth of information systems.
The standard MRA approach has been extended to fit into space dependency. Alternative methods were used to try to address the problem of space (geographical proximity) reflected in the dependence of the error terms, namely spatial autocorrelation (Bourassa et al. 2010).

Multiple regression analysis has been widely used and is the traditional method of choice. Usually, a modeling of the characteristics of the property is considered in the modeling. However, the standard MRA approach has its limitations, which are well known, including: the inability to adequately handle the interactions between variables, nonlinearity, heterogeneity, error independence and multicollinearity. Kilpatrick (2011) lists some of the problems associated with multiple regression analysis.

The multiple linear regression model is used to estimate the value of the building. It is based on several explanatory variables that are able to predict the value or the real estate price.
Several critics were invoked in relation to OLS regression for the accuracy of real estate appraisal, due to the multicollinearity of the independent variables and the inclusion of outlier properties in the sample, according to Worzala et al. (1995).

In this respect, they start from the criticisms addressed in recent years to the hedonic model of price regression, developed on the idea that the real estate market has imperfections and, therefore, the central assumption of OLS regarding a perfect market balance can be called into question. In fact, prices observed for properties cannot be market clearing prices or an unbiased estimate for fair market value. The imperfections of the real estate market, highlighted by Samaha and Kamakura (2008), which reported several studies, are related to the participation in the market of certain factors (influenced by wealth, sex, other demographic problems, uniqueness of property). Glower et al. (1998) - introduced in their model list prices, stochastic errors, as the sum of the optimal price and the seller's error in establishing the list price.

Most of the automated valuation models used are those for residential properties. A typical AVM regression model would use multiple linear regression using ordinary market (OLS) methods. These regression models are also used by the academic community as a benchmark against which new, emerging methods can be compared in automated assessment. Due to their well-tested and well-understood mechanics, these traditional methods are also favored by academics devoted to AVM (Kauko and d'Amato, 2008, p. 4-6).

Expertise systems in real estate usually aim to mimic a professional appraiser, using mixed methods, including probabilities, logic, neural networks, and traditional methods to give meaning to sporadic and incomplete information, including all its inefficiencies (Scott and Gronow, 1990). . These methods have traditionally been very experimental, but the tools for testing and validating some of these models are analyzed and improved by authors such as Kilpatrick (2011). Although today the most complex OLS systems and mixed methods based on AVM could be classified as expert systems in the most limited sense. As far as expertise is concerned, there is therefore no imminent rival for the evaluating professional.

Multiple regression analysis has been extensively used and is the traditional method of choice. Typically, a multitude of property characteristics are considered in the modelling.
McCluskey et al (2013) note that the relationship between property value and its explanatory attributes is highly complex and generally non-linear, which calls for more insightful approaches than the traditional Multiple regression analysis. For example, artificial neural networks don't rely on any of the assumptions made by Multiple regression and have been explored.

The new emerging methods have been at the center of the current research in AVM, without clear conclusions regarding their practicality. One such method is Artificial Neural Networks (ANN), which - despite constructive skepticism (McGreal, et al., 1998) - shows promise in much of the academic literature (Peterson and Flanagan, 2009). However, authors who see potential in ANN also support the nature of the black box of the system and its likely inhibitory effect on the wider adoption of ANN (McCluskey et al., 2013). In addition, a number of other methods of particular interest are studied, such as Modeling Pattern and a theory of coarse link sets (Kauko & d'Amato, 2008), especially if the demand is beyond the traditional estimate value.

Worzala et al. (1995) verify the accuracy of the ANN system as a solution for estimating the value of the building; the method is integrated in the market approach and envisages a parallel with the previous usual methods, such as sales comparison grid and OLS regression.

ANN is documented for use in related financial statements (Worzala et al., 1995). To test ANN's superiority in real estate appraisal, Worzala et al. (1995) discussed several studies that analyzed ANN comparing OLS regression for real estate. However, Worzala et al. (1995) observed other studies that did not report successful results on the application of ANN in the field of finance in general.

The content of ANN is based on the fact that the learning process taken up by the human brain takes place and reappears by repeating the input stimuli and the output response. The method uses a regression with the dependent variable a selling price generated by software that contains mathematical algorithms that allow the repetition of the tests so that the regression error is minimized. Specifically, ANN uses a first layer of inputs (independent variables, namely real estate features), a "hidden" layer that contains software coefficients allocated to the various independent variables and the output layer (dependent variable). We must find the set of coefficients assigned by a nonlinear transfer function to all independent variables that can minimize the prediction error, the error between the neural network result and the current selling price observed on a sample of real estate transactions, to reach the conclusion regarding to the accuracy of the prediction ANN.

Automated Valuation Model will combine a set of algorithms, characteristics, nearby sales, neighborhood features and homes listed for sale, and in the end offers an option for valuing individual homes (Galin et all, 2008, p 4).

Residential AVM accuracy has been studied in numerous research publications, often applied in a small area and achieving the comfort of typical evaluation accuracy. The same conclusion was reached in a broader examination by Rossini & Kershaw (2008), who states that AVMs can achieve very precise results, but these are usually "unique situations" and that AVM manufacturers may resort to models. more widespread.

CML Research also includes the statement "... the competitive advantage of speed and low cost" while avoiding (perhaps intentionally) linking to the idea that AVM would inherently provide a lower quality assessment compared to other valuation methods. It does not mean that fast and cheap would always equate to lower quality results according to Rossini and Kershaw (2008, p. 2), noting the harsh treatment of AVM by some national regulatory bodies that seem to base their opinions on current AVM selection. Other cases, such as the influence of the IAAO organization (2003), conceptualize the AVM similar to the professional evaluation, without fundamental or intrinsic

defects - basing the final functionality of the AVM on the quality of the processes and abilities of the people involved, like any other profession that requires expertise.

This is also the conclusion of Mooya (Mooya, 2011), who concluded after extensive research that there are no theoretical or practical reasons why, ultimately, the AVM should not completely replace the traditional assessment. However, despite the ability to create high-quality AVMs, which generally reach more than the accuracy of typical assessment, many supervisors are reluctant to distinguish between different AVMs, withdrawing the use of AVMs at low risk or tools that complement the work of a professional appraiser (Appraisal Institute of Canada, 2002). And while other organizations may value the value of AVM in several stand-alone applications, they ultimately assign the full responsibility of professional appraisers (Federal Deposit Insurance Corporatio et al., 2010).

From our point of view, Automated Valuation Model would be an advantage for evaluators, since the valuation process would be done easier. AVMs is the most convenient for residential properties, like apartments with one and two rooms. These properties are suitable to such an automated system because multiple properties from a certain area of a city with similar characteristics can be identified.

Methodology

As we presented above, AVM analyzes and aggregates information about transactions and real estate deals, assigning value to a property. It is currently used for residential real estate in active markets, which can generate enough information to obtain a statistically relevant population. The tendency is to use this instrument to estimate the value of the properties, the main purpose being financing their purchase for guaranteeing loans.

At this moment we are working on an empirical study based on the regression analysis for the real estate market in Cluj-Napoca, especially for one- and two-bedroom apartments.

Our research investigates the physical, technical and social characteristics of residential buildings, so that the specific elements will make the difference in the sale prices.
We will try to analyze about 1000 one- and two-room apartments, located in all the districts of Cluj-Napoca, properties defined by over 30 specific characteristics.

Through this study, we will try to demonstrate a closer value obtained by a software program and the market value of the one and two-rooms apartments. This study will be useful and will provide support to valuers evaluating real estates in the city of Cluj-Napoca.

In the city of Cluj-Napoca, we want to use this valuation tool to estimate the value of the properties for financing their purchase (guaranteeing loans), as well as for taxation.

The model we propose for creating an AVM toll is the following:

$$MV_i = a_0 + a_1(M_{1i}) + a_2(M_{2i}) + e_i$$

Where,

MV_i – market value for the comparable *i* of the sample,

M_{1i}, M_{2i}, – the multipliers we choose as relevant, computed for the comparable *i.*

A dependent variable, MV will be computed in two ways, as Cash-Flow which will be actualized and then as capitalized dividend. The author combines earnings cu book value to determine the value of the company, using accounting numbers and proposes the computation of a *pro rata* in relation to the evolution of these to indicators.

Results, conclusions and anticipated difficulties

Observing the use of AVM in the world, collecting the researchers' perception and observing the interest of the regulators for this model, we want to conclude on the possibility of applying this model in Romania.

This study will be useful and will provide support to valuers evaluating real estates, especially single and double rooms, at the end of the three years of research.

Over the last 20 years, property valuation has evolved from traditional methods based on comparable evidence, into mechanically oriented AVMs.

With this study we want to observe that the values obtained through the automated valuation are close to those obtained through the classical market approach.

The limitations of Automated Valuation Models are well known and understood. There are linked to the limited ability to account for external influences, the limited ability to address a property's condition, limited data coverage in some areas, the inability to confirm or deny whether a property exists. The crucial test is if AVMs can forecast accurately?

We expect to encounter some of these possible limitations and difficulties. First of all, we may have difficulty in obtaining the information and values for the confidentiality of the data, and some of them contain personal information.

There is little available published material on the accuracy of Romanian Automated Valuation Models. Indeed, there appears to be a reluctance to provide information or open-up methodologies more widely to independent scrutiny.

We will try to create a software program that simplifies the application of AVM in the Romanian context. At the implementation part of the software program that will facilitate this type of valuation we will try to collaborate with certain companies in the IT market, of Cluj-Napoca.
Finally, this program can be quantified and used by any wish (evaluators, real estate agents, banking, public and academic institutions, professional associations, individuals, etc.).

This type of evaluation will ease and shorten the time of writing a classic evaluation report, especially for those assessments for the purpose of bank guarantee and taxation.

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