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Article

Ways to Improve The Methodological Foundations of Mass Appraisal for Real Estate Taxation

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Abstract: This article focuses on improving the methodology for real estate appraisal for taxation purposes. It emphasizes that the lack of an updated, transparent, and adequate appraisal system used by local government authorities for taxation purposes results in significant financial losses. The research identifies existing problems in the mass appraisal system, proposes solutions, and highlights issues related to the absence of market data and the use of outdated methodologies. The findings support the idea of establishing, implementing, and maintaining a mass appraisal system as a fundamental element of fair real estate taxation. This approach promotes regional development and supports economic activities associated with the real estate market. Additionally, the article includes specific measures and recommendations for improving mass appraisal for real estate taxation purposes.

Keywords: Mass Appraisal, Real Estate, Taxation, Value, Regression, Logarithm, Model, Approach

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1. Introduction

Currently, the real estate market in Uzbekistan is in a state of moderate stagnation, characterized by a lack of transparency, inconsistencies in cadastral data, and weakly developed institutional infrastructure. These issues are also reflected in the activities of mass appraisal of real estate for taxation purposes.

Real estate taxation and mass appraisal are interrelated processes that play a crucial role in establishing an effective tax system. Through this system, the state can form revenues and balance the interests of taxpayers. This connection is primarily explained by the fundamental principle of real estate taxation – the use of market value in determining the tax base.

Mass appraisal is the process of efficiently, quickly, and automatically determining the value of a large number of real estate objects based on standardized methods and models. The process involves the use of general information databases, mathematical-statistical models, and automated systems. This approach enables the efficient evaluation of numerous objects within a short period.

Mass appraisal is typically used in taxation, cadastral management, or urban planning processes. This method considers general market data, location, area, and type of use as key factors. The main goal is to provide systematic and objective appraisals close to market value. This is crucial for ensuring a fair and transparent system in calculating real estate taxes.

Mass appraisal for taxation purposes is a specialized activity where it is important to attract the attention of interested parties to the results of the appraisal. On the one hand, the government monitors the dynamics of the real estate market through regional bodies and obtains indicators necessary for managing regions and ensuring local budgets. On the other hand, civil society, as taxpayers, expresses its attitude toward reforms concerning property taxes and additional wealth taxes based on appraised cadastral values.

Since the first decade of this century, despite having experience in mass appraisal for certain types of real estate for taxation purposes, tax authorities have continued to calculate property taxes based on initial mass appraisal values without updating them. Another segment of real estate (land) is taxed using normative values established in the 1970s, with occasional indexation updates. As a result, local government budgets face significant financial losses, which are reflected in stagnant regional development dynamics and socio-economic conditions.

The relationships in the real estate market and the awareness level of citizens, i.e., property taxpayers, have also increased. This aspect is manifested in the emergence of new factors that influence property value and appraisal conditions. The outdated models used in previous appraisals create several issues during their application, and the results obtained do not correspond to the current market level and its variability.

These problems have created complex conditions for developing and implementing new methodologies based on modern mathematical modeling methods. Implementing a tax system based on the market value of real estate is one of the essential aspects of tax reform in many countries. Transitioning to this new system is especially relevant for developing economies where concepts such as «private property», «market relations», and «market value» are relatively new.

Currently, comprehensive tax reform is being implemented in Uzbekistan, which includes introducing a new approach to real estate taxation based on market value appraisal. Implementing a real estate cadastre system plays a vital role in creating a solid foundation for tax appraisal [**Error! Reference source not found.**].

Mass registration and appraisal of real estate for taxation purposes are mainly based on cadastral data and are closely related to the implementation of the new property taxation system. Since mass registration of real estate objects is being carried out gradually, the new property taxation system is also being implemented gradually as part of this process.

In developing economies, real estate taxes are an essential source of revenue for local budgets. Establishing an efficient real estate taxation system is a critical foundation for public administration. Compared to other local tax revenue sources, real estate taxes, when managed correctly, stand out as a fair and highly effective financial instrument.

After gaining independence, the republics of the former USSR began implementing comprehensive tax system reforms, including real estate taxation, as they embarked on building or restoring market economies [**Error! Reference source not found.**].

Globally, there are various approaches to real estate taxation. In some countries, tax calculations are based on the size of land and buildings, while in others, taxation is based on the market value of land and structures.

Area-based systems are administratively simple. Determining taxes based on land size requires only measuring the area, avoiding costly data collection, market analysis, and reappraisal processes. Additionally, land area measurement is more objective than market value appraisal, as appraisers often rely on similar properties to form their valuations. Area-based appraisal methods result in fewer disputes compared to market value-based methods [**Error! Reference source not found.**].

Literature Review

A number of studies and perspectives by foreign scholars on the evaluation of real estate for taxation purposes cover various approaches and challenges related to implementing an effective appraisal system. These studies analyze property tax as a local financing tool. Researchers have examined the specific aspects of property tax implementation based on legislation, appraisal systems, and economic and social conditions in various countries. For example:

McCluskey studied the theoretical and practical aspects of real estate valuation. He proposed diversifying local revenue sources through the implementation of land value taxation. As noted by McCluskey, real estate, being a «visible, immovable, and tangible form of wealth», is an essential asset for taxation [4].

Bird and Bahl analyzed the theoretical foundations of local taxation, focusing on the role of property tax in developing countries. Their research aimed at optimizing the taxation system [5].

Malme and Youngman explored the development of property taxation in Central and Eastern European countries. They highlighted the significance of property tax in the transition of societies from an economic transformation phase to financial stability [6], [7], [8].

Uzbek economists, including I.Niyazmetov, M.To‘ychiev, A.Mirkhoshimov, U.Pardayev, G.Safarov, S.Boymurodov, Sh.Musalimov, A.Nazarov, F.Fayziyev and U.Tulakov, have aligned their views on property valuation with the country's development, socio-economic conditions, and state policy priorities [9], [10], [11], [12]. Uzbek scholars emphasize the importance of increasing local budget revenues through property appraisal. They also note that strengthening local budgets is achievable by making the taxation process accurate and transparent. From this perspective, developing and implementing appropriate appraisal methods is considered a critical condition for ensuring the country's economic stability

2. Materials and Methods

The methodological foundation of this research is based on the study and systematization of various aspects, including property valuation for taxation purposes, the current state of the local real estate market, investment analysis aimed at real estate efficiency, fiscal policy, mathematical modeling, and real estate management [13], [14], [15].

During the research, reference was made to legislation and regulatory documents in the fiscal field, cadastral data, practices of real estate management and valuation, methodological guidelines, online information sources, and educational materials [16], [17], [18].

General scientific methods and methodologies were applied in the research, which include the following: analysis and synthesis, induction and deduction, grouping, comparison, analogy, scientific abstraction, and statistical methods [19].

3. Results

According to experts in the field, developing countries that implement value-based property tax systems face two main challenges:

1. The absence of a comprehensive inventory of taxable properties.
2. Insufficient information on transaction prices.

Although these issues can be addressed with adequate resources, governments are often reluctant to take such measures despite the potential benefits of these changes [7].

In Uzbekistan, a comprehensive inventory of real estate is ensured through the State Register of Real Estate and the introduction of relevant legislation. The implementation of mass registration programs and the continuous monitoring of real estate transactions enable the state to create a reliable database on real estate properties and related rights [20], [21].

Regarding transaction data, government bodies currently lack complete information on prices reflected by transaction participants, partly due to the impact of price dumping.

Other challenges relevant to the mass appraisal system for real estate are interconnected with the country's broader economic systems. For example: Unregistered buildings and illegal constructions.

If taxpayers perceive that others evade property tax because their properties are not registered in the government's reporting system, attitudes toward property tax may worsen significantly. Informal land and property ownership complicates tax registry maintenance and undermines the universality of property tax [8].

Currently, Uzbekistan is developing valuation models for taxation purposes, which are shaped by the applicable appraisal approaches and methods [2].

Comparative approach methods are used when there is sufficient sales data for standard real estate objects (apartments, residential buildings, land plots).

To use a comparative approach in determining the value of the evaluation object, the appraiser must select at least three analogs. The main criterion for selecting analogs is the most effective use of the evaluation object.

The evaluator uses the following quantitative and qualitative methods for calculating adjustments, depending on the information on the ratio of the comparison elements in which the adjustment is made with the number of analogs.

a) if the number of analogs exceeds or is equal to the number of comparison elements used when comparing analogs with the object of evaluation multiplied by unit, quantitative methods for calculating adjustments for evaluation are used. These methods include:

a method for analyzing data pairs that allows for the identification of corrections to be made depending on the comparison element by comparing two objects that differ by this element;

a method for analyzing data groups, which involves grouping data by variables such as time of sale or location, with the aim of determining statistical patterns of value change depending on time or location;

the method of linear algebra, based on solving systems of linear equations as matrices;

a method for evaluating real estate objects using correlation-regression or cluster analysis. It is advisable to use this method when the number of analogs is five times greater than the number of comparison elements.

graphical analysis method. In this case, the appraiser draws conclusions about the nature of the change in value based on the analysis of price changes graphs;

cost analysis method. In this respect, to bring the technical or legal characteristics of the analogue to the object of evaluation, it is based on the use of data on costs incurred in relation to this analogue, and the adjustments must correspond to average market indicators;

a method for analyzing secondary data based on recommendations presented in specialized publications on real estate;

a method for capitalizing lease differences, based on calculating adjustments by capitalizing the difference in lease rates established by the shortcomings or advantages of the analogue in comparison with the evaluation object.

b) if the number of analogs is less than the number of comparison elements used when comparing analogs with the object of evaluation multiplied by unit, qualitative methods for calculating adjustments for evaluation are used. These methods include:

a method of comparative analysis based on a comparative analysis of the object of evaluation and analogues in order to determine the position of the object of evaluation in the ascending or decreasing row of prices of analogues;

a method of expert evaluation based on the subjective opinion of the appraiser or involved experts about the object of evaluation and analogues [**Error! Reference source not found.**].

Based on the income approach, real estate valuation can be carried out either through direct capitalization or through cash flow discounting.

The direct capitalization method is based on the direct conversion of the most typical annual income of real estate into the value of real estate. In this case, real estate income is determined by dividing it by the capitalization rate (calculated based on the analysis of market data on the ratio to the value of real estate objects similar to the valuation object):

$$\mathbf{V = \frac{I}{R}} \quad \mathbf{(1)}$$

in this case,

V - cost of the object of evaluation;

I - net operating income;

R - is the total capitalization rate.

The direct capitalization method is used when income flows are stable over a long period of time or when income flows change at a stable and moderate rate.

The method of direct capitalization is not used, as a rule, if the object of assessment requires serious repair (reconstruction) or is in a state of unfinished construction.

The capitalization rate calculation by the market compression method is based on market data on the sale prices of analog objects and the values of net operating income and is calculated according to the following formula [2]:

$$\mathbf{R = \sum_{i=1}^{n} \left(\frac{I_i}{V_i} \times W_i \right)} \quad \mathbf{(2)}$$

in this case,

R - capitalization rate;

n - is the number of comparable real estate objects.

Ii - net operating income of the i-th object of evaluation;

Vi - is the sale price of the i-th analogue object.

Wi - is the measure (weight) of the i-th result.

The value of the object of assessment, determined by the cost approach, consists of the value of property rights to the land plot and the restoration value of improvements minus accumulated wear and tear, as well as the replacement value, which includes the income of the entrepreneur.

Cost-based approaches yield objective results when it is possible to accurately assess the costs of new construction, wear and tear, the market value of the right to use land, and the entrepreneur's profit under conditions of relative equilibrium of supply and demand in the real estate market.

This approach is implemented in the following sequence:

a. Assessment of the full cost of reproduction/replacement of buildings and structures;
b. Assessment of aggregate wear and tear;
c. Assessment of the entrepreneur's profits;
d. Assessment of the market value of the right to use a land plot;

calculation of the final cost of the object by adjusting the cost of reproduction/replacement of buildings and structures to wear and tear and adding the cost of the right to use the land plot.

The market value of real estate is calculated using the following formula [2]:

$$S_k = S_e + (S_{tq} + TF - I_n) \quad (3)$$

in this case,

Sk - cost of the real estate object;

Se - the value of the property right to the land plot;

St.q. - restorative value of the real estate object;

TF - profit of the entrepreneur;

In - is cumulative wear and tear.

The problems inherent in the public valuation system in the Republic of Uzbekistan and the imbalances that occur to some extent in all countries that have introduced a property tax system based on market value, can create the following difficulties at the stages of development of the system:

a. Identification of objects and subjects subject to taxation;
b. Quality and transparency of market data;
c. Problems in the methodology for determining the tax base;
d. Organizational problems in the public assessment system infrastructure.

Due to the increasing dynamics of the development of modern methodologies, the mass assessment models currently used in Uzbekistan for calculating the tax base have been simplified. This is due to the small number of factors used in determining the value of real estate and the simple methods used to reflect the complex relationships that form market value. These established models do not adequately reflect the full range of factors influencing the value of the real estate market, as a result of which they are often subject to modification. Therefore, real estate valuation methodologies should be modified in accordance with the principles of the contribution of various factors and taking into account that the market value of the valuation object is not an arithmetic sum of the values of land and improvements in it.

The expert-analytical method aims to formalize the dependence of the market value of land on a complex of influencing factors through expert examination. This method is widely recognized at the national and local levels when determining adjustment coefficients for value factors for individual assessments. However, its application in large cities and small and medium-sized cities with non-standard urban characteristics can lead to a significant distortion of results relative to the actual value of certain parts of urban areas. As a solution, it is necessary to divide these cities, as objects of assessment, into more adapted territorial zones according to their value characteristics, with the allocation of corresponding subzones in accordance with their functional purpose.

Value factors are presented in linear models and do not have the ability to ensure the elasticity of operational factors in nonlinear functions. For example, the depreciation of the field factor, which is interpreted linearly by the value, leads to distortions, and it is clear that in the interaction of two or more factors, their combined effect is much less than the simple sum of individual influences.

Another drawback was observed in the use of factors to correct the value, which was resolved by grouping the quantitative variables into segments and clustering. This led to the formation of a value scale, but caused the loss of the true value between the two adjacent values.

The impairment effect reflects the distortion of mass evaluation results by arithmetically summarizing the values of the components of the evaluation object without adjusting their complex properties. The market value of real estate is not equal to the sum of the values of its independently assessed components. This effect exists both at the level of value factors and at the level of elements of the evaluation object when forming the value of real estate. For example, when the cost of construction and the average cost of vacant land are added, it is not equal to the value of this property in the free market.

Existing valuation models for complex real estate categories, encompassing land plots and buildings as elements of total value, are based on the principle of equal load distribution for all regions of the country. This approach leads to incorrect results due to differences in the level of development of real estate markets for different regions of the country.

A combination of statistical and expert-analytical methods is an effective approach to developing a mass real estate valuation model, as both methods have advantages and can complement each other.

Joint methods eliminate mutual shortcomings caused by external and internal factors. For example:

errors in the development of initial models using the expert-analytical method can be corrected using complex regressions formed through statistical processing of market data.

errors caused by a lack of information, low transparency, and the inaccuracy of existing statistics can be effectively resolved through an expert-analytical approach through the application of a methodology based on empirical practice.

Logarithmization is a widely used method for solving cases involving nonlinear dependencies, which increases the accuracy of the model, taking into account nonlinearity. Real estate values often have a logarithmic (nonlinear) relationship with various factors, such as square meters of area, distance to the center, number of garages or auxiliary buildings. Logarithmization allows for the consideration of these relationships in the model, which makes the model more accurate.

Logarithmization (log-transformation) is a special transformation of data that allows for a better representation of nonlinear (for example, logarithmic) relationships observed in the original (raw) data in a model. Specifically, when evaluating real estate values, a logarithmic/exponential relationship is often observed between the square meter area, distance to the center, the number of garages, the availability of auxiliary buildings, and other factors.

In many cases, such as real estate values, the question of «how much will the price change when the price increases by 1 unit» may not directly answer the same question. For example, when the area of an apartment is changed from 50 m2 to 51 m2, the price increases by the same amount, and when it is changed from 100 m2 to 101 m2, a completely different amount can be observed. Logarithmization, on the other hand, «corrects» such a nonlinearity and provides greater accuracy in the model.

If there exists a relationship between two variables x (e.g. square meters) and y (values) in the form ($y = a * x^b$), it can be linearly modeled by logarithm:

$$log(y) = log(a \cdot x^b) = log(a) + b\, log(x).$$

This allows for the use of simple linear regression, resulting in easier and more accurate estimates of parameters.

Price or natural indicators (e.g. population size, sales volume) are often more spread out and easily affected. The logarithmed data (for example, log (y)) approaches a more normal distribution, which positively affects the regression calculation.

In a logarithmic model, the parameters (coefficients) often explain the percentage effects. For example, $log(price) = \alpha + \beta\, log(field) + \gamma(garage) + \ldots$ the formula gives an idea of how much γ increases/decreases on average when the coefficient β increases by x 1%.

Logarithm can be used to describe how much the price changes when a property (such as area or distance) changes as elasticity. This helps to understand market relations.

When using logarithms, they are less characteristic of outside values and asymmetric distributions. This reduces the impact of unusual observations and improves the stability of estimates. The log-number equation helps make the explanation of the model coefficients easier and intuitive. For example, in a linear model, an increase in a factor by one unit can be interpreted as a percentage or proportional change in the derivative value.

Many statistical methods, including regression, assume that the error distributions are normal. Using logarithms brings the distribution closer to its normal state, improving the model's consistency with these assumptions. A model based on log-number regression reduces multicollinearity between factors and makes estimates more stable.

It is recommended to introduce elastic log-number regressions into the model equation to reduce the reflective effect for the cost factors and components of the evaluation object. The author proposes separating the value function associated with land improvements from the construction value function.

Factors related to real estate or valuation are often not linear, but can be logarithmic, exponential, polynomial, or otherwise nonlinearly related. Technologically, elastic log-number (log-log) regressions «linearize» this nonlinear relationship and allow it to be better reflected in the model. As a result, each factor is evaluated in terms of percentage or elasticity, which is important in reducing the reversible effect.

In elastic log-number regressions, the coefficient β indicates how much the resulting variable (price, value) changes when a factor increases by 1%. For example, when the area increases by 1% (the cost of construction or the cost of land), it is clear how much % increases or decreases. This allows for both scientifically and practically understandable and convenient calculations.

With approximate logarithms, the coefficients are easier to «manage» because the logarithmed data can approach a more normal distribution. This will help make the regression equation more accurate.

The value of real estate is particularly important in the model of accurate perception of the distribution between the cost of construction (building) and the cost of land plot. Because land value is linked to geographical location, infrastructure development, environment, communications, and many other factors. The cost of construction is influenced by materials, labor, architectural solutions, depreciation, and the condition of the building. Taking these two in a mixed state in one «value function» often leads to incorrect results.

In mass valuation, it is necessary to simultaneously calculate the value of thousands or millions of objects. If building and land values are studied separately and elastic log-numeric regression models are developed for each, then the impact of the components can be assessed separately. In this way, the mutual «return» effect is reduced, each component is accurately assessed, and consequently, the total error rate is reduced.

At one facility, for example, the value of land may be high, but the quality of construction may be low. Or, on the contrary, the quality of construction is very good, but the location of the land plot is unfavorable. Not understanding such contradictions and

describing them in one general equation (combining construction and land) increases the risk of misjudgment. Because only one factor (for example, the cost of a land plot) is high, the total price can be raised, but in reality the construction part can be cheaper. This author's proposal provides for the avoidance of such errors.

The inclusion of elastic log-number regressions in the model equation reflects its nonlinear properties well and serves to reduce errors in mass estimation. Evaluating the cost of construction and the value of land (territory) using individual models more accurately evaluates the coefficient that determines the impact of each component element, reduces the return effect («backward influence») and thus improves the overall quality of the assessment.

4. Discussion

The use of an integrated model for mass real estate valuation in different regions creates certain difficulties in accepting results for local market segments. The proposal to include the construction market development coefficient in the model will be a catalyst for improving the identification of differences in estimated values for regions with different developed real estate markets. The quality of the results obtained through the model's elasticity increases with the variability of land and construction prices in different locations.

An analysis of the development of methodological and institutional foundations for the mass real estate appraisal process and the provision of a transparent and reliable market data assessment system will contribute to the phased development of the real estate market in Uzbekistan and the creation of effective and fair fiscal systems (Table 1).

Table 1. Analysis of the process and solutions for mass real estate valuation.

Sections	Key Steps/Content
Mass appraisal process	1. Registering properties. 2. Collecting and analyzing market data. 3. Developing and automating models. 4. Transparent and efficient appraisal processes.
Challenges in the real estate market	1. Lack of sufficient market data. 2. Use of outdated methodologies. 3. Weak institutional infrastructure.
Types of methodologies	1. Comparative approach: valuation based on sales data. 2. Income approach: direct capitalization or discounted cash flow. 3. Cost approach: analysis of construction costs and accumulated depreciation.
Proposed solutions	1. Developing an updated legislative base. 2. Improving the quality of market data. 3. Utilizing logarithmic and elastic models.

5. Conclusion

The Currently, the system of mass real estate valuation for tax purposes in our country is not stable and rigorous. This conclusion was confirmed based on various developed indicators. Many problems in the public assessment system in our country can be solved in a short time and with available resources.

Despite the importance of mass valuation as a modern, effective and rapid method for determining the value of real estate, this method has not been given sufficient attention in the legislation of our country. The legislation does not define its essence, scope of application and legal basis in detail and does not normally enshrine it. Therefore, it is necessary to improve the relevant legislative framework for the widespread

implementation and effective use of public assessment in practice. The introduction of the article provides an authorial definition of mass evaluation.

However, a mass assessment may be less accurate than an individual assessment, as the specific characteristics of each object are not always taken into account. Moreover, this method requires a high-quality database and perfect models to achieve the right results.

In order to be taxable, it is necessary to quickly eliminate the identified shortcomings in the system of mass valuation of real estate. This should be achieved by improving the methodological foundations used in calculating the cadastral value of real estate. In addition to legislation in this area, optimizing mass valuation processes requires the creation of real estate market indicators. These indicators should serve as a guide for revising cadastral values in the event of significant changes in the real estate market.

The improvement of quality indicators for models developed based on the proposed methodology demonstrates a possible objective goal for the development of mass real estate valuation.

Improving the real estate valuation system is of great importance in modern economic relations. This study analyzed existing problems in the mass assessment system and proposed solutions to them. In particular, the main problems were noted as a lack of market information and the use of outdated methodologies, as well as the lack of fairness and transparency in the taxation process.

The results obtained show that by implementing a modern, fair, and efficient real estate valuation system, local government bodies can expand the tax base, support regional development, and stimulate economic activity in the real estate market. The creation of a mass assessment system as a key element of the taxation system ensures the following priorities:

1. Transparency and fairness in the taxation process.
2. Increasing local budget revenues through an objective assessment of the tax base.
3. Regional development and support for economic activity in the real estate market.

It is expected that the proposed measures will serve to make the real estate taxation system more efficient and stable. The use of modern technologies and international experience in the mass assessment system is recognized as one of the main criteria for fair taxation. Implementing the proposals put forward based on the results of this study will improve the quality of market data, the methodology used in mass evaluation activities, and the accuracy of the results.

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