REAL ESTATE VALUATION METHODS IN CADASTRE: APPROACHES, CHALLENGES, AND RECOMMENDATIONS

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Abstract: *Accurate and transparent valuation of real estate is the cornerstone of an effective cadastral system, influencing taxation, mortgage lending, public asset management, and real estate market regulation. Traditional property appraisal methods face challenges in scalability, transparency, and adaptability to dynamic market conditions. This article examines the primary valuation approaches used within real estate cadastres — including the cost approach, sales comparison approach, income capitalization, hedonic regression, and emerging automated valuation models (AVMs) — evaluating their strengths, limitations, and applicability to a Central Asian context, with special reference to ongoing reforms in Uzbekistan. Drawing on both international literature and recent Uzbek research, the study analyses methodological, data-centric, legal, and institutional obstacles that impede accurate cadastral valuation. The article proposes a hybrid, multi-method framework integrating geospatial data, econometric modeling, and machine learning to improve assessment precision, transparency, and repeatability. Key recommendations include establishing standardized data collection protocols, creating centralized transaction databases, applying hedonic or AVM-based mass appraisal for urban areas, and periodic revaluation to reflect market dynamics. Successful implementation could significantly enhance fiscal fairness, market confidence, and efficient land use planning.*

Keywords: *Real estate valuation; property cadastre; cost approach; sales comparison approach; hedonic regression; automated valuation model (AVM); mass appraisal; cadastral value; Uzbekistan; property taxation; spatial data.*

Real estate represents a fundamental economic asset for both individuals and states. In a cadastral framework, property valuation serves multiple critical purposes: establishing fair taxation, enabling mortgage financing, guiding expropriation decisions, and forming the basis for municipal planning, infrastructure investment, and land-use regulation. The reliability of a cadastre — and public trust in property taxation and transactions — depends on the objectivity, transparency, and consistency of value assessments.

However, conventional appraisal practices often rely on individual expert judgments, limited sample comparables, and manual calculations, which can lead to inconsistent values and suspicion of bias. In jurisdictions undergoing rapid urbanization and economic transformation — as in many post-Soviet countries — real estate markets evolve quickly, while legal, institutional, and data infrastructure may lag behind.

In Uzbekistan, recent reforms aim to modernize real estate valuation and cadastral systems. For example, the government announced the implementation of a mass evaluation system covering millions of properties and land plots, to produce reliable values for taxation, mortgage, and public asset management.

This renewed emphasis on cadastral valuation underscores the urgency of adopting robust, scalable, and transparent valuation methodologies. The present study analyses the main valuation methodologies applicable to cadastre, discusses their limitations, and proposes an integrated approach adapted for transitional economies.

The cost approach calculates the value of a property as the sum of the land value and the reproduction (or replacement) cost of improvements, minus depreciation. This method is most appropriate for new or special-purpose properties where market comparables or income data are unavailable. Its strength lies in its simplicity and objectivity: construction costs and land value can be estimated based on publicly available data and building norms. However, drawbacks include the difficulty of accurately estimating depreciation — especially for older buildings — and the assumption that replacement cost reflects market value, which may not hold in volatile or speculative markets. Because buyers seldom pay exactly the reconstruction cost, cost approach often undervalues or overvalues properties depending on market conditions.

The sales comparison approach (also known as the market or comparative approach) determines value by comparing the subject property with recently sold, similar properties (comparables), adjusting for differences in characteristics (e.g., size, location, age, amenities). This method is widely regarded as the most direct reflection of market behavior because it relies on actual transaction data. Its strengths include market relevance and adaptability to prevailing supply-demand dynamics. The approach is most effective in active markets with sufficient comparable sales. Nevertheless, its reliability declines in markets with insufficient transactions, heterogeneous property characteristics, or opaque sales data — circumstances often encountered in emerging property markets or rural areas.

The income capitalization approach assesses value based on the expected present value of future income generated by the property — typically for commercial, rental, or income-producing real estate. It requires data on rental income, vacancy rates, operating costs, and appropriate capitalization or discount rates. In stable markets with good data, this method reflects property's economic productivity. However, in many regions (including parts of Uzbekistan), rental markets lack transparency, long-term income data are scarce, and estimates of operating costs may be unreliable, reducing the method's applicability.

Hedonic regression models — a statistical variant of the sales comparison approach — decompose a property into constituent characteristics (e.g., floor area, age, number of rooms, neighborhood amenities, distance to city center), estimate the marginal value contributed by each attribute, and compute a composite value. Hedonic modeling enables valuation even when direct comparables are scarce, and supports creation of price indices adjusting for quality differences over time. It offers greater transparency and analytical power than traditional comparable analysis. Challenges include the need for large, high-quality datasets, statistical expertise, and risk of omitted variable bias (e.g., unique local features not captured in the model).

The automated valuation model (AVM) — a modern evolution leveraging big data, statistical and machine learning algorithms — combines aspects of sales comparison, hedonic regression, and income approaches, often enhanced by spatial data, remote sensing,

and real-time transaction databases. AVMs generate property value estimates rapidly, support mass appraisal across large portfolios, and can incorporate a wide range of variables (e.g., building attributes, geolocation, neighborhood data, market trends). Despite the technological advantages, AVMs raise concerns about transparency, reproducibility, data privacy, and fairness, especially when algorithmic decisions affect taxation, mortgage eligibility, or compensation.

Challenges and Limitations in Cadastre-Based Valuation Systems

Implementing reliable valuation methods in a cadastral context encounters several challenges. First, data scarcity and quality: many regions lack comprehensive transaction registries, detailed building inventories, accurate land parcel maps, or updated market data. In Uzbekistan, while the official cadastre database has expanded since 2017, many properties remain insufficiently documented, and sales data often remain private or unregistered. Second, market volatility and informal transactions erode the reliability of sales-based approaches: unreported sales, barter deals, or grey-market transactions distort average prices, leading to undervaluation or overvaluation. Third, heterogeneity of properties complicates comparison: differences in building materials, maintenance status, micro-location, and informal improvements are difficult to quantify or standardize. Fourth, institutional and legal constraints: lack of standard appraisal regulations, insufficient licensing of appraisers, inconsistent depreciation norms, and limited enforcement of periodic revaluation undermine objectivity. In Uzbekistan, although recent legislative acts aim to regulate cadastral registration and valuation (e.g., introducing mass evaluation for 8 million properties and land plots) , effective enforcement and data transparency remain ongoing challenges. Fifth, technical capacity and resource constraints: deploying econometric models or AVMs requires skilled personnel, robust IT infrastructure, and secure data management systems — assets often limited in transitional economies.

Proposed Integrated Framework and Methodological Recommendations

To address the limitations of single-method valuation and to harness the strengths of multiple approaches, this paper proposes a hybrid multi-method framework for cadastral valuation, combining cost, hedonic regression, and AVM techniques, supported by updated spatial and transactional databases. The framework operates as follows:

Base valuation with cost approach for new constructions, unique or non-market properties, and public buildings — ensuring that replacement cost sets a minimum value baseline.

Hedonic regression-based mass appraisal for urban residential properties, leveraging historical transaction data, building characteristics, and neighborhood attributes stored in a centralized database.

AVM overlay layer that dynamically adjusts base and hedonic values in response to macro-level market trends (inflation, demand-supply shifts, zoning changes), using machine learning models trained on national and local data.

Periodic revaluation cycle (e.g., every 3–5 years) to reflect market fluctuations, infrastructural developments, and changes in neighborhood amenities.

Transparency and auditability mechanisms: standardized data collection protocols, publicly accessible transaction registries, documented algorithmic parameters, and regulatory oversight to ensure fairness and reproducibility.

Integration with GIS and spatial data: using cadastral parcel maps, satellite imagery, elevation data, neighborhood amenity layers (schools, transport hubs, green zones), and environmental risk zones — all contributing as variables in hedonic and AVM models.

By combining deterministic (cost-based) and statistical (hedonic/AVM) methods, the framework benefits from the reliability of cost inputs and the market responsiveness of statistical modeling — ensuring both baseline valuation and dynamic adjustments. This dual-layered system can enhance the credibility and acceptance of cadastral values among stakeholders — property owners, tax authorities, banks, and municipalities.

Policy Implications and Institutional Recommendations

For practical implementation in Uzbekistan and similar transitional economies, the following measures are recommended: establishment of a national real estate transaction registry, mandatory registration of all property sales, standardization of building attribute reporting at constructiontation of aggregated cadastral value maps — could foster market trust and discourage informal property trading. Regulatory adoption of the proposed hybrid valuation model should be supported by pilot projects (for example, cities like Tashkent or regional centers), capacity-building programs for valuers and data managers, and development of secure IT infrastructure, including data privacy protections. Such institutional reforms will improve tax fairness, reduce litigation over valuations, and provide reliable data for urban planning, infrastructure investment, and social housing programs.

Conclusion

Real estate valuation in cadastral systems must balance objectivity, transparency, scalability, and responsiveness to market dynamics. Relying solely on one method — whether cost, sales comparison, or income — often results in undervaluation, overvaluation, or inconsistent results, especially in emerging and volatile markets. This

article argues for a hybrid, multi-method valuation framework combining cost-based baseline, hedonic regression mass appraisal, and machine-learning-driven AVMs, anchored in standardized, high-quality spatial and transaction data and periodic revaluation cycles.

Implementing this framework in Uzbekistan's cadastre — particularly amid ongoing reforms towards mass valuation — could significantly improve valuation accuracy, institutional reliability, and public trust. Long-term benefits would include more equitable property taxation, enhanced mortgage and credit markets, effective urban and regional planning, and optimized use of land assets. For this transformation to succeed, coordinated institutional action, regulatory modernization, technical capacity building, and data transparency are essential.

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