

Theoretical and fundamental

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Unveiling value and price of residential land in urban fringe: presenting foundational principles and a generalizable floating price formula

Hadi Farhangdoust^{1*}, Sanaz Saeidi Mofrad²

1. Master of Islamic Architecture, Department of Islamic Art and Architecture, Faculty of Islamic Art and Architecture, Imam Reza International University, Mashhad, Iran
2. Associate Professor, Department of Urbanism, Ma.C., Islamic Azad University, Mashhad, Iran

Abstract

The valuation of residential land within the urban fringe consistently confronts fundamental challenges, including opacity, inflexibility of conventional models, and a deficiency of precise scientific criteria, all due to structural complexities, market volatility, and susceptibility to shifting urban policies. This research was designed to devise a scientific and operational model for dynamic land pricing in these peripheral zones. Utilizing a mixed research method, the study delineates and analyzes the land value determinants. The qualitative phase involved identifying and categorizing key factors through semi-structured interviews with experts in architecture, urban planning, and land economics, further refined by the Delphi technique. Subsequently, the analytic hierarchy process (AHP) was employed to determine the relative weight of each determinant. For the quantitative phase, secondary data from recorded transactions and the physical-spatial characteristics of land parcels in sample districts were analyzed. The Hedonic pricing model, combined with multiple regression analysis, was applied to test hypotheses and quantify the influence of each variable on the final price. The primary outcome of this research is a dynamic, floating mathematical formula that cohesively integrates variables such as access to services and infrastructure, physical characteristics, regulatory constraints, and urban development plans. Validation confirms that the proposed model offers better accuracy and congruence with market realities than the traditional appraisal methods. It is intended to serve as an efficacious tool for urban policy-makers, investors, and citizens, fostering a more profound understanding of land market dynamics, enabling informed decision-making, and promoting sustainable development in urban peripheries.

Keywords

Hedonic Model
Mixed-Methods
Property Valuation
Urban Fringe Land Policy

* Corresponding Author: h.farhangdoust@imamreza.ac.ir

1. Introduction

The physical expansion of cities and the formation of peripheral zones, or the “urban fringe,” is a global phenomenon. Metropolises and large cities in Iran (Mehriar et al., 2020; Ravetz & Sahana, 2024), as well as smaller provincial centers like Ardabil, are confronting this issue with increasing intensity (Mohammadi-Hamidi et al., 2022). Urban fringes, as transitional zones between dense urban fabrics and rural or natural spaces, possess unique economic, social, and physical dynamics (Demiroğlu İzgi, 2024; Parishan et al., 2023). Often viewed as reserves for future urban development, these areas have become focal points of demand for various land uses, particularly residential, due to their interstitial location (Yang & Ye, 2020; Dahal, 2023).

In the Iranian urban planning and management system, the “urban fringe” (Harim) is defined as a specific, approved boundary located outside the “legal city limits” (Mahdoodeh) but functionally in direct interaction with the city’s spatial and physical structure (Islamic Parliament of Iran, 2005). The urban fringe essentially demarcates the boundary between urban space and the surrounding rural or natural environment, determining the city’s future sphere of influence and the area for construction control regulations based on urban development plans (Pilehvar, 2021). Legally, this area falls under the jurisdiction of the municipality, which aims to guide physical development and prevent unplanned, informal urban sprawl (Dadashpour & Salarian, 2018). In contrast, the “urban margin” (Hashiyeh) is a socio-economic concept referring to settlements often formed outside formal regulations through informal development processes (UN-Habitat, 2020). While the urban fringe is a legal construct and a spatial planning tool, the urban margin signifies unstable social and economic conditions surrounding the city. Although spatial overlap exists between these two areas in many Iranian metropolises, equating them functionally and managerially leads to analytical ambiguity. Accordingly, this research considers the urban fringe not as marginal settlements or informal housing, but as a formal territory directly influenced by urban development policies and comprehensive plans. Such a precise and distinct definition allows for a more scientific analysis of land price dynamics and policy impacts within this specific zone.

Crucially, the land market in these areas is highly susceptible to speculation, bubble-like price growth, and unplanned, informal developments¹ (Tonucci,

2023). A primary reason for this disorder is the absence of a scientific, transparent, and dynamic mechanism for land valuation and pricing. Traditional pricing models, generally based on the comparative method (comparison with similar properties)², lose their efficacy when faced with the complexity and spatial heterogeneity of urban fringes, failing to accurately explain the reasons for value differentials among land parcels (Wei et al., 2022). This deficiency not only leads to inaccurate estimates and market uncertainty³ (Biswas & Hartmann, 2022) but also facilitates the inequitable distribution of rents arising from land-use changes and civil project implementation, thereby posing serious challenges to sustainable land management⁴ (Johnson et al., 2023).

The significance of this research lies in various dimensions. From an economic perspective, presenting an accurate pricing model can help stabilize the land market, reduce investment risk, and optimize resource allocation⁵ (Harbinger Content Team, 2025; Chen et al., 2023). When prices are determined based on real value-creating components, the formation of price bubbles that threaten macroeconomic stability is prevented (Hirano & Toda, 2025). Socially, a transparent and fair pricing system can enhance households’ ability to secure adequate housing and reduce spatial inequalities⁶ (Biggar & Friendly, 2022). Opaque pricing often benefits informed and powerful groups, further limiting access to land for low-income groups⁷ (Meyfroidt et al., 2021). From an urban planning perspective, a scientific land valuation model is a vital tool for policymakers (Bencure et al., 2019). Institutions such as municipalities and organizations responsible for land and housing can use this model to calculate levies and land value capture taxes, acquire lands for public projects, and guide development toward desirable locations. Without a scientific understanding of price-shaping factors, urban policies may yield counterproductive results, fueling disorder in urban fringes rather than organizing them⁸ (Rumiani Mahmoudi et al., 2025).

Despite the subject’s importance, existing research literature on land pricing in Iran, particularly in fringe areas, contains significant gaps. Many studies have been descriptive, sufficing with a general identification of factors, or, in quantitative studies, have focused solely on a few limited physical and accessibility variables, neglecting a comprehensive and integrated analysis of other dimensions, including qualitative, legal, and environmental factors. Furthermore, most presented models are static in nature and incapable of

adapting to market fluctuations and changes resulting from urban policies. This contrasts with the “floating” nature of land prices, which requires a dynamic model capable of reflecting temporal and spatial changes.

Table 1 compares traditional and modern land-pricing models, elucidating the position of hedonic models as an advanced analytical approach.

Table 1. Comparison of traditional and modern land pricing models (taken from Blackledge, 2016; Jafary et al., 2024; Mohammadi & Pourghanbari, 2024; Vasconcelos, 2024; VillaTerras, 2025; Financial Model, 2019; and Nunnington et al., 2025)

Model Type	Key features	Advantages	Disadvantages & limitations
Traditional comparative method	It is based on comparing the subject property with similar properties sold in the recent past.	Simplicity, understandable to the public, and reliance on actual market data	Requires an active market and similar properties; inability to isolate the effect of each attribute; high subjectivity; inefficiency in heterogeneous markets
Cost method	Land value equals its replacement or reproduction cost (generally for improvements).	Useful for special-use properties (e.g., schools); clear logic	Ineffective for vacant land; ignores location and market factors; fails to reflect utility and demand
Income method	Property value is determined based on its future income-generating potential (rent).	Suitable for commercial and investment properties; based on financial principles	Requires accurate prediction of future income; high sensitivity to capitalization rates; not applicable for residential land lacking direct income
Hedonic pricing model	Property price is a function of the sum of the values of its structural, locational, and environmental attributes.	Ability to isolate and value each attribute; transparency; based on economic theory; capability to analyze policy impacts	Requires large data volumes, statistical complexity, assumption of a perfectly competitive market, and difficulty in measuring qualitative variables
Statistical algorithms for big data ⁹	Provides value estimates in very short times; a combination of Hedonic and Comparative methods.	High speed and efficiency; fully automated; economical and scalable for large data volumes; eliminating human subjective effects; providing uniform and transparent results	Heavy dependence on data quality and currency; inability to consider physical condition, renovations, or unique features; unsuitable in volatile markets or for complex/unique properties
GIS tools in land valuation	Uses geographic data (spatial details, land use, infrastructure, environmental, etc.) for spatial analysis of land value.	Precise spatial analysis; predicting the effect of infrastructural and environmental factors visually and spatially; combinable with other models for developability analysis	Requiring accurate, up-to-date data; lack of uniformity across regions; high implementation cost; need for technical expertise; legal and ethical issues regarding privacy and data protection
Discounted cash flow (DCF)	Forecasts future cash flows (NOI or income) and discounts them to present value based on an appropriate discount rate. ¹⁰	Emphasis on real value estimating based on cash flow; applicable for assets with continuous income	Reduced accuracy due to high dependence on accurate forecasts of cash flows and discount rates; market instability and unpredictable changes; high sensitivity to inputs (small estimation errors significantly impact results)
Residual Method	The residual of subtracting development costs (construction, permits, developer profit, etc.) from the gross development value. ¹¹	Focus on development potential and real profit; useful for evaluating land ready for construction; possibility for scenario building and sensitivity analysis; helpful in determining the maximum payable price for land while maintaining project profit	High sensitivity to numerous assumptions and estimates that may not be realistic; complex and requiring expertise in financial modeling, market trends, and costs; may not consider the value of other opportunities, thereby underestimating the true economic value of the land
AI & machine learning	Uses algorithms like neural networks to discover complex patterns in data.	High prediction accuracy; ability to model non-linear relationships; flexibility	Requiring very large datasets; “black box” nature of the model; requiring high computational expertise

Accordingly, this research aims to bridge existing gaps by presenting a comprehensive and operational framework. The main objective is “Designing a scientific and operational model for the floating pricing

of residential land in urban fringes.”

In line with the above objective, the main research questions are formulated as follows:

1. What are the key structural, accessibility, environmental, and legal-institutional factors affecting residential land prices in the fringes of Iranian metropolises? (Comprehensive identification and categorization of key factors affecting land value in urban fringes using a mixed approach).
2. How can the weight and importance of each identified factor in determining the final land value be assessed through integrating expert opinions (Delphi and AHP methods)? (Presenting foundational principles and a theoretical framework for land pricing that encompasses both market considerations and legal/urban planning requirements).
3. How can a dynamic regression model be formulated using the Hedonic pricing method to predict floating land prices, reflecting the simultaneous impact of multiple variables? (Formulating a dynamic (floating) mathematical formula for calculating land price

capable of adapting to changes).

4. To what extent can the proposed model improve the accuracy and transparency of land value estimation compared to traditional methods in sample areas (fringes of Tehran and Isfahan)? (Validating the proposed model by testing it in sample areas and comparing results with actual market data).

To answer these questions, a “research strategy” based on a mixed-methods approach is employed. This strategy involves qualitative analysis of expert opinions to identify and weight variables, followed by quantitative modeling (Hedonic and Econometrics) to formulate and test the pricing formula. This dual approach allows for incorporating both subjective and qualitative market dimensions (such as expectations and preferences) and objective, quantitative property characteristics into the analysis. Table 2 succinctly presents the principal gaps identified in previous studies and outlines this research’s approach to addressing them.

Table 2. Summary of research gaps and the current study’s approach

Identified research gap	Examples of related sources	Approach and innovation of current research
Focus on static models and neglect the dynamic and “floating” nature of land prices	Classical studies based on Cross-sectional regression (Olea et al., 2025)	Designing a floating price formula incorporating time-dependent variables and future policies (e.g., approved development plans)
Neglect of qualitative, institutional, and legal factors or difficulty in measuring them	Most quantitative studies that only model physical and accessibility variables (Dmytrów & Gnat, 2019; Bagheri et al., 2021)	Use of mixed methods: Utilizing Delphi technique and AHP to convert qualitative data (expert opinion) into quantitative weights for model integration
Limitations of studies to formal inner-city fabrics and a lack of research in fringe areas	Studies related to changes in land value and rental costs due to marginalization in urban settlements (Adewoyin et al., 2024)	Special focus on the unique dynamics of the land market in urban fringes and selecting sample areas from these zones
Failure to provide an operational and practical model for policymaking institutions	Most studies are analytical and academic, not leading to operational solutions. (Bencure et al., 2019)	Aimed to develop a formula and model applicable to municipalities, registration organizations, and land authorities

Based on the above strategy, a set of main hypotheses has been formulated for testing in the quantitative phase:

- Hypothesis 1 (H1): There is a significant negative relationship between accessibility characteristics (e.g., distance from the city center and metro stations) and the price per square meter of land in urban fringes.
- Hypothesis 2 (H2): There is a significant positive relationship between desirable physical characteristics (e.g., appropriate area and large frontage) and the price per square meter of land.
- Hypothesis 3 (H3): Legal-institutional characteristics

(e.g., inclusion in approved development plans and having a formal title deed) have a significant positive impact on the price per square meter of land and explain a considerable portion of price variance.

- Hypothesis 4 (H4): The weights extracted from the analytic hierarchy process (AHP), reflecting the factors’ importance from the experts’ perspective, are positively correlated with the magnitude of corresponding standardized coefficients in the Hedonic regression model. This hypothesis tests the bridge between qualitative and quantitative findings.
- Hypothesis 5 (H5): The floating price model developed in this research, resulting from the

integrated mixed approach, possesses higher explanatory power (adjusted R-squared) and prediction accuracy (lower RMSE) compared to simple regression models that focus solely on physical and accessibility variables.

2.Theoretical literature

This section systematically reviews the theoretical foundations and conceptual frameworks related to land value and pricing. The aim is to establish a solid scientific foundation for understanding the complexities governing the urban land market and identifying the fundamental variables used in price modeling. The related literature can be examined along three main axes (Harvey & Jowsey, 2019): Classical and neoclassical land value theories, multidimensional factors affecting price, and scientific valuation models with an emphasis on the Hedonic approach.

Theoretical foundations of land value: The modern understanding of land value is rooted in traditional (classical) economic theories. David Ricardo (2015) presented the “Theory of differential rent” in 1821, arguing that land value stems from its fertility and scarcity (Settlement Geography, 2015). In his view, differences in productivity of various lands result in rent for owners of higher quality lands (McDonald, 2018). Although Ricardo’s theory focused on agricultural land, the concept of “rent derived from advantage” became the cornerstone of subsequent analyses in urban economics. Following him, in 1826, Johann von Thünen introduced “Location theory”, arguing for “location” and “transportation costs” as key factors in determining land value (Kumbhar, 2024). According to his model, land value decreases with distance from the market center (city) due to increasing transportation costs. This theory founded “accessibility-based” analyses, which remain central to urban pricing models today (Rosenberg, 2025).

Neoclassical economics developed these foundations by focusing on concepts such as “utility,” “supply and demand,” and “rational behavior of economic agents” (Munien & Telukdarie, 2024). From this perspective, land is a heterogeneous good whose value is determined not only by intrinsic characteristics but also by the utility it generates for the consumer (household or firm) (Herscovici, 2019; Missemmer & Pottier, 2025). William Alonso’s “Bid-Rent Theory”, which integrated Von Thünen’s views with neoclassical economics, demonstrated that households and firms compete for locations with higher utility, offering

different prices for land (Poot, 2025). This competition creates a price gradient from the city center to the periphery. This theoretical framework paved the way for modern models attempting to extract the value of each utility-generating characteristic of land separately.

Political economy perspectives on land valuation: In the theoretical analysis of land value, one cannot ignore the differences in ideological approaches within political economy, as each offers a specific logic explaining the land price determination mechanism. Leftist perspectives view land as a public and limited resource whose value should be regulated through state intervention, tax policies, and rent control (Harvey, 2018; Smith, 2010). In this view, land pricing is not merely a product of market forces but a result of power relations and redistributive policies. From this perspective, the concept of “land rent” is analyzed in connection to spatial justice and equal access to urban resources (Fainstein, 2010; Marcuse, 2010). Conversely, right-leaning political economy perspectives emphasize market self-regulation and the role of supply and demand forces in shaping price (Hayek, 2024; Friedman & Appelbaum, 2020). In this approach, state intervention in the land market causes inefficiency, resource waste, and price distortion. Land, like any other economic good, is valued based on allocative efficiency and consumer preferences, with rent being a natural result of scarcity and competition.

At an intermediate level, new institutional theories attempt to explain the role of formal institutions, public policies, and legal structures as mediators between state and market (North, 2019; Hodgson, 2022). According to this view, land value is not only a function of physical and spatial characteristics but also a product of institutional and policy interactions among various actors in the land market. Relying on this theoretical foundation, the present research defines the concept of “floating price” as an intermediate mechanism that attempts to understand and model real market dynamics within an institutional and policy-oriented framework. Thus, the proposed model, while accepting market mechanisms, pays attention to the impact of legal structures, land policies, and public decisions on value fluctuations, establishing a link between the two classical poles of interventionist and market-oriented approaches.

Multidimensional factors affecting land prices: Extensive literature in urban economics and planning studies has identified and classified factors affecting land prices. These factors can be categorized into

several main groups, detailed in Table 3.

- **Physical and structural characteristics:** This category includes the physical specifications of the land parcel. Lot size is a fundamental variable¹² (Ritter et al., 2019). Generally, the total price decreases with increasing area, and the price per unit area (square meter) decreases with increasing area (Agosta et al., 2025). Geometric shape, slope, and topography also influence construction costs and final utility (Huang & Hewings, 2021).
- **Access and locational characteristics:** Originating from Von Thünen’s theory, these are the most important explainers of price differences at the urban scale. Distance from the central business district (CBD), distance to employment centers, access to public transport networks (metro and bus stations), and proximity to main arterial roads are key variables (Cordera et al., 2019; Morales et al., 2017). Additionally, access to public services like schools, hospitals, shopping centers, and green spaces has a direct positive impact on land value (Wu et al., 2017).
- **Neighborhood and environmental characteristics:** Land is not just a physical commodity but functions within a social and environmental context (Aziz et al., 2021). General neighborhood quality, measured by variables such as average resident income, crime rates, and social prestige, plays a significant role (Kallberg & Shimizu, 2025; Seok et al., 2024). Environmental factors such as air quality, noise pollution, views, and proximity to parks or natural hazards (e.g., fault lines or floodways) act as environmental amenities or disamenities affecting land value (Kamtziridis et al., 2023; Chen et al., 2022; An et al., 2023).
- **Legal and institutional characteristics:** Often ignored in traditional analyses, these factors play a decisive role in real markets. Zoning regulations that determine permitted use (residential, commercial, etc.) are the most critical in this group (Abdulla & Ibrahim, 2023). Permitted building density (FAR), lot coverage, and the number of allowable floors directly affect construction potential and thus land value (Lin, 2024). Inclusion in urban development plans (Comprehensive or Detailed plans), type of ownership deed (formal vs. informal), and municipal tax rates are other significant variables (Chung & Yoon, 2023).

Table 3. Classification of factors affecting urban land price in research literature

Factor category	Specific factor	Description and expected impact on price	Selected references
Physical-structural	Plot area	Positive effect on total price; negative effect on unit price	(Fang et al., 2021)
	Geometric shape	Regular plots (square/rectangle) have a higher value	(Lee, 2024)
	Slope & topography	High slope increases construction costs and reduces value	(Huang & Hewings, 2021)
Accessibility-locational	Distance from the city center	Negative effect; price decreases with increasing distance	(D’Acci, 2019; Tuofu et al., 2021)
	Access to transport	Proximity to metro/highway has a positive effect	(Kothari, 2025; Tan et al., 2019)
	Access to services	Proximity to schools, hospitals, and parks has a positive effect	(Linlin et al., 2022)
Neighborhood-environmental	Neighborhood quality	Social prestige and neighborhood security have a positive effect	(Nadai & Lepri, 2018; Bamiteko & Adebisi, 2020)
	Air & noise quality	Less air and noise pollution implies a higher value	(Miłuch & Kopczewska, 2024)
	View & green space	Access to desirable views and green space has a positive effect	(Trojanek et al., 2018)
Legal-institutional	Land use & zoning	Commercial usage potential is usually more valuable than residential; potential for change to commercial is also valuable	(Eicher, 2024; Sayin, 2019; Guida, 2024)
	Permitted density	Positive effect; higher building potential implies higher value	(Brueckner et al., 2024)
	Urban plan status	Inclusion in development plans increases value	(Abdulla & Ibrahim, 2023)

Hedonic pricing model: To transition from qualitative analyses to a quantitative model, the Hedonic pricing model is recognized as a standard and powerful tool in urban economics. This model, developed by Kelvin Lancaster in consumer theory and Sherwin Rosen in applied markets, is based on the premise that goods do not possess utility in themselves; rather, it is their constituent characteristics that are the source of utility and value (Greenstone, 2017). In the land market, the price of a parcel (P) can be expressed as a function of its vector of characteristics (X): $P=f(x_1, x_2, \dots, x_n)$. These characteristics are the factors mentioned in the previous section (physical, accessibility, environmental, legal). By collecting data on the price and characteristics of a large number of traded land parcels, regression analysis can be used to formulate a mathematical equation that determines the contribution of each

characteristic to the final price.

The coefficient of each variable in the regression equation¹² represents the market's willingness to pay for a one-unit increase in that specific characteristic, holding other characteristics constant. Selecting the appropriate "functional form" is a key issue in hedonic modeling, as this choice influences the interpretation of coefficients and the model's accuracy. The most common forms are linear, semi-logarithmic, and double-logarithmic, which are compared in Table 4. The choice between these forms is typically made based on theoretical foundations, statistical tests (such as the Box-Cox test)¹³, and ease of interpretation. The semi-logarithmic form (logarithm of the dependent variable) is highly popular in applied studies due to the simple interpretation of coefficients as percentage changes and the mitigation of heteroscedasticity.

Table 4. Comparison of functional forms in hedonic modeling (taken from Spagnolo & et. al., 2024; Spagnolo & et. al., 2024; Liu et. al., 2024, and Rey-Blanco et. al., 2024)

Functional form	Equation	Coefficient interpretation (β_i)	Pros and cons
Linear	$P=\beta_0+\sum\beta_iX_i+\epsilon$	A one-unit increase in X_i changes P by β_i	Simple to calculate and interpret; May not correctly model non-linear market relationships
Semi-Log (Log-Level)	$\ln(P)=\beta_0+\sum\beta_iX_i+\epsilon$	A one-unit increase in X_i changes P by $(\beta_i \times 100)\%$	Coefficients interpreted as percentages; Reduces heteroscedasticity; One of the most widely used forms
Semi-Log (Level-Log)	$P=\beta_0+\sum\beta_i\ln(X_i)+\epsilon$	A 1% increase in X_i changes P by $(\beta_i/100)$ units	Suitable for explanatory variables with high skewness; Interpretation is less common
Double-Log (Log-Log)	$\ln(P)=\beta_0+\sum\beta_i\ln(X_i)+\epsilon$	A 1% increase in X_i changes P by β_i percent (Elasticity)	Coefficients are interpreted as price elasticities; requires taking the logarithm of all variables

This model is the statistical and operational translation of utility theory in the real estate market. Its theoretical foundations were established by Kelvin Lancaster (1966) and Sherwin Rosen (1974). Lancaster proposed the revolutionary idea that individual utility is derived not from goods themselves, but from the "characteristics" or "attributes" of those goods. For example, a buyer of residential land does not merely purchase "land," but buys a bundle of characteristics such as "area," "access to metro," "location in a safe neighborhood," and "having a suitable view". This perspective allows for breaking down a heterogeneous good such as land into its constituent components and valuing each component.

Rosen's market equilibrium model: Rosen transformed this idea into a market equilibrium model. He

demonstrated that in a competitive market, the observed price of a property (P) equals the sum of the values of the "shadow prices" or "implicit prices" of its individual characteristics. These shadow prices, which correspond to the coefficients of the hedonic regression model, represent the market's marginal willingness to pay for an additional unit of each characteristic. In other words, the hedonic price function, $P(X)$, is the convex envelope of buyers' willingness-to-pay curves and sellers' willingness-to-supply curves. Therefore, estimating a regression of price on characteristics is not merely a statistical correlation but an estimate of the market equilibrium price function rooted in the optimizing behavior of economic agents.

Table 5. Comparison of the theoretical foundations of pricing model

Pricing model	Main theory	Key assumption	Application in land valuation
Classical (Ricardo/Von Thünen)	Differential and location rent theory	Value stems from fertility and/or transportation costs	Initial explanation of the role of scarcity and location in determining base land value
Neoclassical (Alonso)	Urban rent and utility theory	Rational agents trade off between access and space to maximize utility	Analysis of spatial price structure in the city and price gradient from the center to the periphery
Hedonic (Rosen/Lancaster)	Characteristics and market equilibrium theory	The value of a good equals the sum of the values of its constituent characteristics	Separation and measurement of the contribution of each physical, accessibility, and environmental characteristic to the final land price
Multi-criteria decision making (Saaty)	Analytic hierarchy process (AHP)	Complex problems can be solved by breaking them down into a hierarchy and pairwise comparisons	Determining the weight and relative importance of qualitative and quantitative factors affecting land value from the experts' perspective

Urban rent theory: Developed by William Alonso (1967) based on Von Thünen’s work, this theory serves as the starting point for analysis. It states that land prices in cities are fundamentally determined by “accessibility”. Households and firms compete to locate in places with better access to employment centers, services, and markets. This competition manifests as a “bidding” process—specifically a latent auction for space—forming the “bid-rent” curve (Lemoy et al., 2017, pp. 7-10). In the integrated view based on Von Thünen and Alonso, the willingness to pay more for locations closer to the center is not an independent proposition but a natural consequence of the market equilibrium structure, where reduced travel costs, increased access, and the possibility of consuming more other goods collectively form a downward price gradient from the center to the periphery. Thus, the classical proposition of value reduction with increasing distance is redefined in Alonso’s model as behavioral and optimization-based, completing its theoretical coherence¹⁴.

The synthesis in Table 5 indicates that von Thünen’s theory of locational rent and Alonso’s theory of urban rent should not be understood as two competing models. Instead, they represent two stages in the evolution of a unified theoretical framework. Von Thünen articulates the spatial–cost foundations of land value, while Alonso extends this logic within the context of modern cities by including households’ rational behavior and the trade-off between commuting costs and residential space consumption. Accordingly, the explanatory discussion of Alonso’s theory after the table is a methodological necessity for connecting these two theoretical systems and laying the conceptual foundation for contemporary valuation

models.

Within this framework, residential location choice is an optimization decision: households weigh better accessibility (and lower commuting costs) and larger living space (which is cheaper in peripheral areas) (Palma, Li, & Yu, 2023, pp. 5–7). As a result, a land parcel’s price mainly reflects its relative utility to market actors compared with alternative locations (Bhat, 2015; Gagné, Koster, Moizeau, & Thisse, 2022). In the urban fringe, this trade-off becomes more complex; factors such as environmental quality, landscape, and distance from urban pollution are incorporated into the utility function as locational amenities, which can offset the higher cost of commuting (Morawetz & Klaiber, 2022; Kyriakopoulou & Picard, 2021).

From an extended perspective of urban rent theory, Alonso demonstrates that the same fundamental logic identified by von Thünen—that transportation costs increase with distance from the center—still holds in today’s cities. However, it appears as an optimal choice balancing accessibility, transportation costs, and land consumption. Hence, the negative price gradient from the center to the periphery is not an isolated empirical observation but the direct outcome of the interaction of two mechanisms: von Thünen’s location-based logic and households’ economic behavior in Alonso’s model. Ultimately, the literature indicates that no single model can fully explain land market complexity. Hybrid approaches that integrate qualitative analysis (to identify context-specific variables and understand market structure) with quantitative modeling (to measure effects precisely) offer richer and more practical insights. Building on this integrated approach, the present study seeks to develop a comprehensive

framework for dynamic land pricing in peri-urban areas, integrating expert knowledge through Delphi and AHP with hedonic modeling. While the hedonic model is highly effective for analyzing quantitative market data, identifying—and especially assessing—the relative importance of variables, particularly those with qualitative attributes (such as neighborhood safety or urban design quality), requires additional methodologies. Here, multicriteria decision-making (MCDA) theories and expert judgment are employed.

3. Theoretical foundations

The analysis of land value and pricing—particularly within the complex and dynamic domains of peri-urban areas—encounters fundamental conceptual challenges that traditional econometric models alone cannot adequately explain. In line with its objective of “unveiling value” and presenting “foundational principles,” this study grounds its theoretical framework in the argument that the value of land, before being a quantifiable variable (Price), is a social construct and a multidimensional concept (Value). Classical pricing models, such as rent-based approaches (Ricardian Rent) or location theory, although successful in explaining macro-level spatial-economic structures, fall short in analyzing the qualitative, institutional, and perceptual dimensions that play a decisive role in the informal and transitional land markets characteristic of peri-urban zones (Healey & Barrett, 1990, pp. 140–145).

Fundamentally, land in the modern economy—as Karl Polanyi argues—is a “fictitious commodity”; it is not a commodity inherently produced for sale, but one whose value is deeply embedded in social relations, power structures, and institutional frameworks (Polanyi, 2001, pp. 73–77). In the urban fringe, the social nature of value is maximum due to legal ambiguities, overlapping governance systems (urban and rural), and the intense dynamics generated by expectations of future development. David Harvey, in his analyses of urban rent, similarly demonstrates that the land value is not a function of its current use, but rather the product of claims on its future value—claims that arise directly from political processes, planning interventions, and speculative behavior (Harvey, 2018, pp. 345–351).

Accordingly, valuation in these areas is less a technical calculation and more a meaning-making process. Diverse actors—policymakers, speculators, residents, and experts—assign “value” to land based on their interpretation of legal, social, and spatial signals

(Fainstein, 2010, pp. 46–50). Hedonic regression models, which conceptualize price as a function of characteristics, often overlook these interpretive and qualitative dimensions or reduce them to simplified dummy variables, thereby leading to omitted variable bias.

By acknowledging this conceptual complexity, the present study adopts a different methodological orientation. Instead of testing predetermined hypotheses derived from quantitative models, this research employs qualitative content analysis, specifically the category-based analytical approach, to achieve its objectives. This method, systematized by Philipp Mayring, is grounded in the principle that through a structured and rule-guided analysis of texts and communications (in this case, in-depth expert interviews), we can extract the fundamental categories and core concepts (foundational principles) governing a phenomenon (Mayring, 2014, pp. 53–56).

The aim here is to discover the cognitive and interpretive frameworks used by experts in architecture, urban planning, and land economics when evaluating land value. In effect, before asking “How much does each factor matter?” (a quantitative question), we must ask “What are the influencing factors, and how are they defined?” (a qualitative question) Category-based analysis enables the inductive transformation of dispersed qualitative data obtained from interviews into a coherent system of “main categories” and “subcategories” (Kuckartz, 2014, pp. 100–105). These categories constitute the very “foundational principles” that the research seeks to elucidate.

This approach resolves the theoretical limitations of purely quantitative studies in two key ways:

1. Conceptual richness: Qualitative analysis allows for identifying and defining complex concepts that are difficult to quantify—such as “legal validity of land documents,” “policy transparency,” “investment risk,” or “neighborhood quality”—capturing their full semantic depth.
2. Contextual validity: Rather than imposing universal variables derived from economic models, this method extracts categories specific to the distinctive context of Iran’s urban fringes, with all their legal and institutional complexities.

In this framework, the concept of “floating price” acquires a deeper meaning. Fluidity is not merely numerical fluctuation in market prices; rather, it is a form of conceptual floating. This means that the very foundational principles and categories constituting

value shift over time and policy cycles, with their relative weights reconfigured accordingly. Qualitative content analysis provides a precise tool for identifying these categories and understanding their hierarchical relationships (through analyzing the prominence and frequency of themes in expert discourse) (Schreier, 2024, pp. 86–90).

Thus, the theoretical foundations of this study conceptualize peri-urban land value not as a fixed number but as a “discursive construction” defined by key actors (elites). Through category-based analysis, the present research deconstructs this discourse to uncover the fundamental principles (core categories) that shape this value. Subsequently, the classical and neoclassical literature on land value (discussed in later sections) is examined not as the governing framework of the study but as one among several sources that have previously identified some of these potential categories (such as accessibility and location).

Moreover, the theoretical framework of this study conceptualizes the “urban fringe” not merely as a geographic tract (as commonly defined in conventional physical–legal terminology) but as a liminal space and a complex assemblage. Classical urban-economic theories based on the bid–rent curve and distance from the center face inherent limitations in explaining the dynamics of such threshold spaces, where value is defined not by current land use but by future—often uncertain—potential (Fainstein, 2015, p. 98).

In these areas, value emerges from an unstable assemblage of heterogeneous elements: promised (yet absent) infrastructure, evolving (and interpretive) legal regulations, informal networks of power, and speculative actors. According to Assemblage Theory, employed in urban studies by theorists such as McFarlane, value in such contexts does not result linearly from the sum of attributes; rather, it is produced through an interaction and co-functioning process among these multiple components (McFarlane, 2011, pp. 204–222). This theoretical orientation exposes a fundamental limitation of traditional quantitative models (such as hedonic regression), since these models inherently seek to measure static attributes, whereas value in urban fringes is the outcome of dynamic processes. Within this context, the methodological significance of qualitative content analysis (QCA) becomes even more pronounced¹⁵.

From another perspective, the limitations of conventional theories in explaining land value in urban

fringes stem from their neglect of the institutional dimensions of the market. New institutional economics—particularly the works of Douglass North—emphasizes that institutions, or the “rules of the game,” determine transaction costs in the market and directly shape economic performance and the value of assets (North, 2019, pp. 5–6). In urban fringes, the central challenge is the presence of an institutional void or institutional conflict. In these areas, the rules of the game are ambiguous, unstable, and often contradictory. Within such a context, the value of a parcel of land reflects not so much its physical utility or accessibility, but rather the degree of legal certainty and the transaction costs required to secure ownership and obtain development permissions.

For instance, a land ownership deed is not just a “variable” in this theoretical framework, but a powerful “institution” for reducing future transaction costs and risks (Williamson, 2007). Therefore, the qualitative categorical analysis in this study seeks to identify categories that represent these “institutional mechanisms.” The categories extracted from the expert interviews reflect how market actors encounter and manage “institutional uncertainty.” This theoretical framework guides the research narrative from a scattered cataloguing of factors to a coherent analysis of “institutional processes” that shape value in the absence of stable market rules.

4. Literature review

This section reviews and analyzes empirical studies conducted internationally and domestically on the subject of the present research. The aim is to identify methods, variables, and key findings of previous research, understand existing trends, and accurately determine the position and innovation of the current study.

International studies: The history of using the Hedonic pricing model to analyze housing and land markets dates back to the 1970s. Since then, thousands of studies have been conducted worldwide. One fundamental study was Rosen (1974), which established a theoretical framework for the hedonic model in competitive markets. Subsequently, Linneman (1980), in a classic study on Los Angeles data, found that neighborhood characteristics (such as school quality and crime rates) were even more important than property characteristics in determining prices. With urban expansion, studies also focused on suburban and fringe areas.

Geoghegan et al. (1997), using GIS data in Maryland, USA, showed that proximity to open spaces and forests had a significant positive effect on property values in suburban areas, while proximity to agricultural land had a negative effect. In another study, Cervero and Kang (2011) examined the impact of transit-oriented development (TOD) on housing prices in Seoul, South Korea. Their findings showed that properties within a 500-meter radius of new transit stations experienced a price increase of 10 to 20 percent. In recent years, the use of mixed methods and

advanced techniques has become prevalent. Kolomak and Nezavitina (2021) used a spatial hedonic model in the Russian housing market to incorporate external effects or spatial spillovers. Results showed that a property's price depends not only on its own characteristics but also on the prices of adjacent properties. Asmawi et al. (2018) used a combination of factor analysis and hedonic regression to identify hidden dimensions of neighborhood quality and their impact on housing prices. Table 6 summarizes selected international studies.

Table 6. Selected international studies on Hedonic property pricing

Researcher(s) & year	Study area	Methodology	Key variables	Main finding
(Lovell & Lynch, 2002; Geoghegan et al., 2003)	Maryland (3 counties), USA	Hedonic Regression with GIS data	Adjacent land use; distance from open spaces & forests	Proximity to open space and its formal preservation increases value; proximity to agricultural or developable land decreases value.
(Im & Hong, 2017; Shin et al., 2007)	Daegu & Seoul, South Korea	Difference-in-Differences & Hedonic model	Distance from new public transport stations	Properties near new stations experienced significant price increases ¹⁶ .
(López & Kholodilin, 2023; Ozhegov & Ozhegova, 2022)	St. Petersburg, Russia	Spatial Hedonic Model	Access to the city center; distance to the metro; building features	Prices have spatial dependence; property price is influenced by adjacent property prices.
(Li et al., 2022; Tang & Niemeier, 2021)	Various US cities	Meta-analysis of Hedonic studies	Air pollution; proximity to hazardous sites	Negative impact of pollution on housing prices confirmed in most studies, but the magnitude varies.
(Spagnolo et al., 2024)	European Metropolises	Quantile Hedonic Regression	Property features; access; neighborhood prestige	The impact of variables varies across different price levels (cheap vs. expensive properties) (non-linear effects) ¹⁷ .

Domestic Studies: In Iran, numerous studies have also been conducted on the analysis of housing and urban land prices by scholars in geography and urban planning, economics, and management. Shahidi and Fadaei Nasab, in their book "Urban Land Policies in Iran after the Islamic Revolution", provided a comprehensive examination of land market dynamics and related policies, and, alongside a theoretical analysis, highlighted the challenges of pricing in metropolitan areas (Shahidi & Fadaei Nasab, 2011). Similar works likewise emphasized the decisive role of governmental policies and urban development plans in shaping land rent and land prices (Lalehpour, 2020; Meshkini & Nourmohammadi, 2019). In quantitative studies, Nikpoor et al. (2019) spatially analyzed the land prices in the city of Babolsar, employing the Geographically Weighted Regression (GWR) model. Their findings indicated that the influence of variables such as access to service centers and land use is not uniform across different parts of

the city, and that local models—such as GWR—possess significantly greater explanatory power compared to global models such as OLS. More precisely, the results demonstrated that GWR provides substantially higher accuracy in estimating land prices when compared to global statistical models, with the local coefficient of determination (Local R²) ranging from 0.57 to 0.79¹⁸. Fayazi and Hemmatjou (2022) examined the impact of constructing environmental amenities—implemented through investment in urban development projects—on the prices of surrounding residential properties across the 22 municipal districts of Tehran. Using a hedonic model that accounts for spatial autocorrelation, they found that such projects function as urban amenities and exert a positive influence on the value of adjacent properties. According to them, environmental variables, such as infrastructure and urban facilities, particularly the share of street network in the total area of neighborhoods, have a stronger effect on housing prices.

Soltani and colleagues conducted a study using a multilevel hedonic model incorporating extensive data (32,108 residential units). Their results indicated that proximity to educational, cultural, recreational, and social service centers has a positive effect, whereas proximity to certain facilities—such as medical centers, commercial corridors, and parks—can sometimes harm property values, for instance due to traffic congestion or reduced safety (Soltani et al., 2023). Najafi et al. (2024), in a study on residential properties in Shiraz, employed a hedonic model with OLS regression and accessibility variables (including distance to the metro station). They used data from 128 apartment transactions collected through questionnaires administered to real estate agencies within a 1000-meter radius of metro stations. The variables included distance to the metro, distance to the central business district (CBD), distance to parks and schools, as well as structural attributes such as size, building age, and number of rooms, in addition to variables related to the urban district. Their analyses showed that proximity to newly constructed metro stations exerts a positive and significant effect on apartment prices (a spatial effect dependent on neighborhood context). However, proximity to existing metro stations had no significant impact, indicating that the housing market in Shiraz is more sensitive to structural characteristics than to accessibility features. Moradi et al. (2022) examined the effect of the Ghadir Park green space (a GIS-based structural variable) on residential properties' prices in the city of Yazd, using a

hedonic regression model (OLS). The data were collected via questionnaires and real estate agencies located around Ghadir Park. Fifteen independent variables—including renovation status, number of floors, number of bedrooms, distance to the main street, distance to the city center, and distance to the park—were analyzed using EViews 9. The study concluded that although green spaces and parks are not tradable goods, they do have an impact on the housing market; that is, the presence of a park nearby significantly increases the price. Despite the value of these studies, the domestic literature also reveals several major shortcomings. First, most research focused on inner-city and formal urban areas, with limited attention to the complex dynamics of urban fringes. Second, many studies—due to constraints in data availability—omitted legal and institutional variables, such as approved building density or types of property deeds, thereby reducing the credibility of their models. Third, the use of mixed-method approaches capable of integrating experts' tacit and qualitative knowledge with quantitative analyses was very limited. Fourth, the diversity of variables affecting price determination in different cities of Iran reflects different behavior and interests in housing markets, which restricts the generalizability of findings to other metropolitan contexts¹⁹. The present study seeks to address these gaps by focusing on urban fringe areas and employing a mixed-method methodology. Table 7 summarizes a selection of domestic studies.

Table 7. Selected domestic studies on urban land valuation in Iran

Researcher & year	Area	Methodology	Key variables	Main finding
(Moradi et al., 2022)	Yazd	Hedonic Pricing Model (OLS) in EViews	Price/sqm; floor area; parking; distance to main street & park	Distance to the main street and park has significant negative effects on housing prices; heterogeneous effects are observed.
(Hajiheidari et al., 2023)	Tehran	Spatial Analysis in ArcGIS	Distance from centers (highway, land uses); economic concentration; topography	There is a strong spatial autocorrelation in price differences; thriving economic centers drive housing prices.
(Moradzehi, 2019)	Khash	Hedonic Pricing & PCA	Building condition; age; area; parking; green space; etc.	All variables significantly affect price; area, green space, building condition, and age have the most impact.
(Rahdari & Leylian, 2012)	Kerman	Hedonic Pricing (Panel Data)	Physical, situational, and environmental factors; infrastructure income; central heating system; distance from the city center	Physical factors have the highest positive impact; income elasticity for infrastructure > 1 indicates high sensitivity.

Researcher & year	Area	Methodology	Key variables	Main finding
(Aboonori & Ramezani, 2002)	Sari	Hedonic Model	Floor area; land area; the number of rooms; distance to main street; distance to city center	The most important factors are floor area, land area, number of rooms, and distance to the main street and city center.
(Gholizadeh et al., 2010)	Hamedan	Traditional & Reid Hedonic Models ²⁰	Physical characteristics (area, age of building, amenities); environmental/neighborhood characteristics; buyer characteristics	The Reid Hedonic model is more effective; buyer characteristics also play a significant role in price determination.
(Akbari et al., 2004; Saremi et al., 2024)	Mashhad	Spatial Econometrics (SAR, OLS)	Economic characteristics (such as rent, type of deed), accessibility (proximity to the Holy Shrine and parking availability), and physical or structural, environmental, and spatial characteristics	Proximity to the Holy Shrine is a critical variable for commercial and residential prices in the Samen district.

A systematic review of domestic studies (Table 7) shows that a significant portion of studies focus on cities like Yazd, Shiraz, Kerman, Sari, and Babolsar, with a noticeable lack of focus on metropolises like Tehran and Isfahan—especially in the urban fringe zone. Furthermore, the majority of them study housing or land within formal limits, not the fringe. The geographical classification of Table 7 highlights a significant research gap regarding land valuation models within the fringes of Tehran and Isfahan, a gap that justifies the necessity of conducting a study from a spatial, institutional, and policy perspective.

The literature review indicates that 1) The theoretical framework and quantitative tools—particularly the hedonic model—are well developed for analyzing land prices; 2) A set of physical, accessibility-related, environmental, and legal factors are globally and nationally recognized as key determinants of land value; and 3) Numerous studies in Iran have successfully employed hedonic models to analyze land and housing markets. Nevertheless, several clear gaps remain that the present research seeks to address:

- **Content gap:** There is limited focus on urban fringes as a distinct spatial domain with dynamics different from inner-city fabrics. Land markets in these areas are strongly influenced by expectations about the future, forthcoming development projects, and more complex ownership and legal structures.
- **Methodological gap:** A few studies employed an integrated mixed-methods approach. Most existing research is either exclusively qualitative or exclusively quantitative. By combining Delphi and AHP (for identifying and qualitatively weighting factors) with hedonic modeling (for quantitative analysis), this study aims to create methodological synergy.

- **Practical gap:** There is a lack of a dynamic pricing model that can be operationally applied by urban institutions. The aim of this research goes beyond academic analysis to provide a practical formula and tool for land valuation that reflects temporal and policy-related changes.

The case-specific gaps can also be articulated based on the above points. First, at the national level, none of the reviewed studies analyzed land valuation in the fringes of metropolitan areas; instead, their focus was on formal urban fabric and real estate transactions within statutory boundaries. Second, in the two cities selected as pilot cases for this study—Tehran and Isfahan—there exists no research that integrates physical, accessibility, institutional, and planning factors into a single, unified valuation model. Accordingly, the discrepancy between the existing literature and the scientific need for a structured analytical framework for land valuation in urban fringes constitutes the core research gap that this study addresses. Therefore, by focusing on the fringes of Iran’s metropolitan areas and employing an innovative mixed-methodology, this research seeks to contribute new and practical knowledge in land price valuation.

5. Theoretical framework

The theoretical framework of the study is grounded in the assumption that land value in urban fringe areas results from the interaction of four fundamental mechanisms: the institutional–legal mechanism, the physical–spatial mechanism, the accessibility–locational mechanism, and the environmental–neighborhood mechanism. These four mechanisms, as theoretical categories, constitute the conceptual

structure of the study and form the basis for selecting its indexes and variables. Within this conceptual system, land value is not the product of a single factor but the outcome of the structural interplay among these four mechanisms, which together shape pricing dynamics.

To operationalize the theoretical categories defined within the conceptual framework, the Delphi method was employed for identifying and building expert consensus on relevant factors, while the analytic hierarchy process (AHP) was used for institutional-analytical weighting of the variables. These two methods perform a methodological and procedural role in the research, serving to translate theoretical constructs into measurable indexes and determine their relative weights.

Conceptual structure of the integrated model: This study conceptualizes land value (V) as a multidimensional construct shaped by the complex interaction among four principal groups of characteristics. This relationship can be expressed conceptually as follows:

Equation 1. Conceptual structure of land valuation

$$V = f(C_{Ph}, C_{Ac}, C_{En}, C_{Lg})$$

Where:

- C_{Ph} (Physical components) includes physical characteristics of the land parcel, such as area, dimensions, shape, and slope.
- C_{Ac} (Accessibility components) includes locational variables indicating the cost and time of interaction with other parts of the city, such as distance from the city center, public transport stations, and main services.
- C_{En} (Environmental components) includes qualitative characteristics of the neighborhood and surrounding environment, such as view, green space, pollution, and social prestige.
- C_{Lg} (Legal components) includes constraints and opportunities arising from urban planning regulations and the legal system, such as permitted land use, building density, deed status, and inclusion in

development plans.

The innovation of this framework lies in how these components are defined, measured, and interact. Unlike traditional models that simply enter these factors independently into a regression, this framework proposes a two-stage process integrating qualitative and quantitative dimensions:

- Stage 1 (expert-based qualitative assessment): The importance and relative weight (w) of each of these four main components and their subsets are not fixed and universal but a function of spatial and temporal context. These weights are extracted via Delphi and AHP processes relying on experts' tacit knowledge.

- Stage 2 (market-based quantitative assessment): The actual and final impact of each attribute on the observed market price (P) is measured via Hedonic modeling and analysis of real transaction data.

Conceptualizing floating price: One of the main pillars of this theoretical framework is the concept of floating price, contrasting with static models. The floating price in this research has two dimensions:

1. Temporal floating: Land price is not constant over time and changes due to factors like inflation, policy changes, and macroeconomic developments. The proposed model accounts for this by including temporal variables (e.g., year or season of transaction) or time-series analysis.

2. Policy floating: Floating is defined here as an institutional mechanism, not just a technical feature of the regression model. In the land market of Iranian urban fringes, the value of each parcel is heavily dependent on frequent changes in legal regulations, urban plan rules, and land allocation policies. Therefore, institutional variables like land use, density, or status in development plans are defined as "conditional variables," meaning their value changes depending on the policy scenario. Thus, the model is capable of reproducing land prices under different scenarios (e.g., land use change from agricultural to residential or increased approved density).

Table 8. Integrated research theoretical framework

Framework variable	Theoretical basis	Methodological tool	Role in the model	Expected output
Factors identification	Utility theory; research literature	Semi-structured interview, Delphi technique	Preparing a comprehensive and context-based list of potential variables affecting price	Final consensus list of factors in 4 main categories
Factors weighting	Multi-criteria decision theory	Analytic hierarchy process (AHP)	Determining the relative importance of each factor from the experts' view to understand the priority structure	Vector of quantitative weights for each criterion and sub-criterion

Framework variable	Theoretical basis	Methodological tool	Role in the model	Expected output
Model formulation	Hedonic pricing theory	Multiple regression (OLS)	Formulating the mathematical relationship between land characteristics and observed market price	Regression equation with estimated coefficients (shadow prices)
Validation & floating	Statistical & prediction theories	Diagnostic tests; cross-validation	Evaluating model accuracy/reliability; Adding temporal and policy dimensions	Final validated model and floating price formula
Policy simulation	Policy impact assessment theory	Scenario analysis	Using the final model to predict the impacts of land use or development plan changes	Analytical reports to support urban decision-making

This coherent framework elevates the research beyond a merely descriptive or correlational analysis, transforming it into an analytical and predictive tool capable of addressing complex and practical questions in land-use policy.

6. Research methodology

Methodology, as the research roadmap, constitutes a set of logical and systematic principles, procedures, and tools that guide the researcher in addressing the research questions and achieving its objectives (Bouchrika, 2025). Selecting an appropriate methodology ensures the validity and reliability of the study's findings (Sreekumar, 2023). Given the multifaceted and complex nature of the present research topic—which requires both a deep understanding of phenomena and an accurate assessment of relationships—the mixed-methods approach was chosen as the most suitable framework (Watkins, 2022). Specifically, this study employs the explanatory sequential design (Draucker et al., 2020). Tehran and Isfahan were selected as two sample metropolises in this study based on a comparative logic designed to evaluate the performance of the proposed model across two distinct spatial and economic contexts. Tehran, as the capital and the country's largest land market, is characterized by intense demand pressures, heterogeneous land-use patterns, institutional complexity, and pronounced price volatility (Saharkhiz et al., 2018). In contrast, Isfahan, a historically significant metropolis with more balanced development and a polycentric spatial structure, exhibits different dynamics in its growth patterns and land-price behaviors (Bagheri & Soltani, 2023). This selection allows the study to test the model's validity under diverse land-market conditions and urban policy environments, and to assess its adaptability to spatial variations.

In both metropolitan areas, the sampling zones were chosen within the boundaries of the "officially approved urban fringe." The primary criteria for parcel selection included: 1) location within areas directly influenced by the master plan and detailed development plan; 2) availability of officially recorded transaction data during the study period; 3) physical diversity in terms of size, shape, and spatial location; and 4) clear legal status with formal documentation. The parcels were selected through a combination of secondary data extracted from the national real estate transaction system, GIS datasets, and field verification. To enhance the generalizability of the model, Tehran and Isfahan were considered as two "representative samples" of the main typologies of urban fringe structures in Iran:

- Type I: Urban fringes of dense and highly populated metropolises with strong demand pressures (e.g., Tehran, Mashhad, and Tabriz).
- Type II: Urban fringes of medium-sized metropolises with balanced growth and polycentric morphology (e.g., Isfahan, Shiraz, and Karaj).

Accordingly, the floating formula derived from the integrated dataset of these two cities can be adapted to other similar urban fringes across the country and may be employed in a generalized form for land valuation and policy-analysis purposes at the national scale.

In this design, the research proceeds through two main and consecutive phases: an initial qualitative phase followed by a quantitative phase. This approach ensures that the final quantitative model is grounded in rich qualitative insights and contextual knowledge. The operational process of the study consists of three major steps: 1) qualitative inquiry to identify and weight the influencing factors, 2) quantitative analysis to construct and test the model, and 3) integration of results to formulate the final floating land-price equation.

In total, 1,000 residential land parcels in Tehran and Isfahan were selected as the main dataset for the quantitative section, with 500 parcels from the Tehran fringe and 500 parcels from the Isfahan fringe. Each parcel's data were recorded, including its precise location (with GIS coordinates), document type, legal status, area, permitted use, approved density, and status within the boundaries of urban development plans (comprehensive or detailed). In Tehran, approximately 62 percent of sampled parcels were located within the boundaries of the approved detailed plan, while 38 percent were outside the plan area but still within the legally defined urban fringe. A similar distribution was observed in Isfahan, where 58 percent of parcels fell within development plan boundaries, and 42 percent were outside the plans yet still under the city's functional influence.

Analytical findings revealed that the location of parcels within urban development plan boundaries was one of the most influential variables affecting land value. This factor not only indicated the legal feasibility of land development but also served as a proxy for "investment security" in the land market (Hosseini & Hajilou, 2019). Parcels situated within master and detailed plan areas benefited from planned access to building permits, infrastructure provision, and urban services, resulting in significantly higher willingness-to-pay.

Accordingly, the hedonic pricing model used in this research incorporated the variable "location within development plans" as a key binary predictor in the regression equation, enabling quantitative assessment of how urban policies shape land prices. This clarification strengthened the logical connection between spatial data and analytical outcomes, thereby enhancing the methodological coherence of the

research.

The primary objective of the qualitative phase was to identify the most comprehensive set of factors influencing land value within urban fringes and to determine the relative importance of each factor from the perspective of experts and key market actors. To achieve this goal, a combination of three methods was employed: semi-structured interviews, the Delphi technique, and the Analytic Hierarchy Process (AHP).

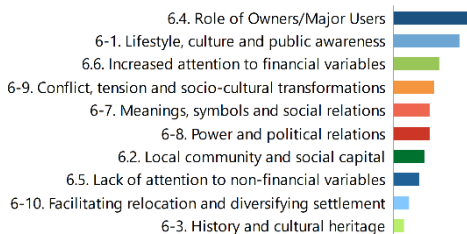
1. Semi-structured interviews, to conduct an initial exploration and an in-depth identification of qualitative and quantitative variables influencing land prices from the perspective of experts. This approach allows the researcher to go beyond predefined frameworks in the literature and uncover context-specific and locally grounded variables. The target population in this phase consisted of specialists and informed actors in the land and housing sectors of the metropolitan areas of Tehran and Isfahan. Sampling was conducted through purposive sampling combined with the snowball technique. The sample size continued to expand until theoretical saturation was achieved²¹.

The primary research instrument was the interview protocol containing open-ended and guiding questions (Table 9). The questions focused on themes such as "What are the most significant determinants of land value in the urban fringe?", "How do the influential factors in the fringe differ from those in the inner urban fabric?", and "What is the role of urban development plans in price fluctuations?". With participants' consent, all interviews were recorded and fully transcribed. The qualitative data obtained from the interviews were analyzed using thematic content analysis in MAXQDA software. The output of this stage was a comprehensive and structured list of key factors and concepts.

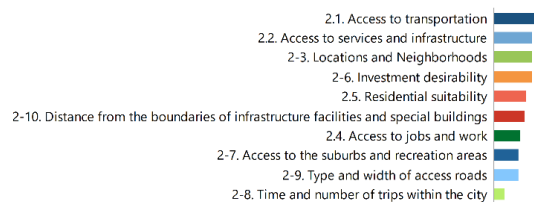
Table 9. Semi-structured interview protocol

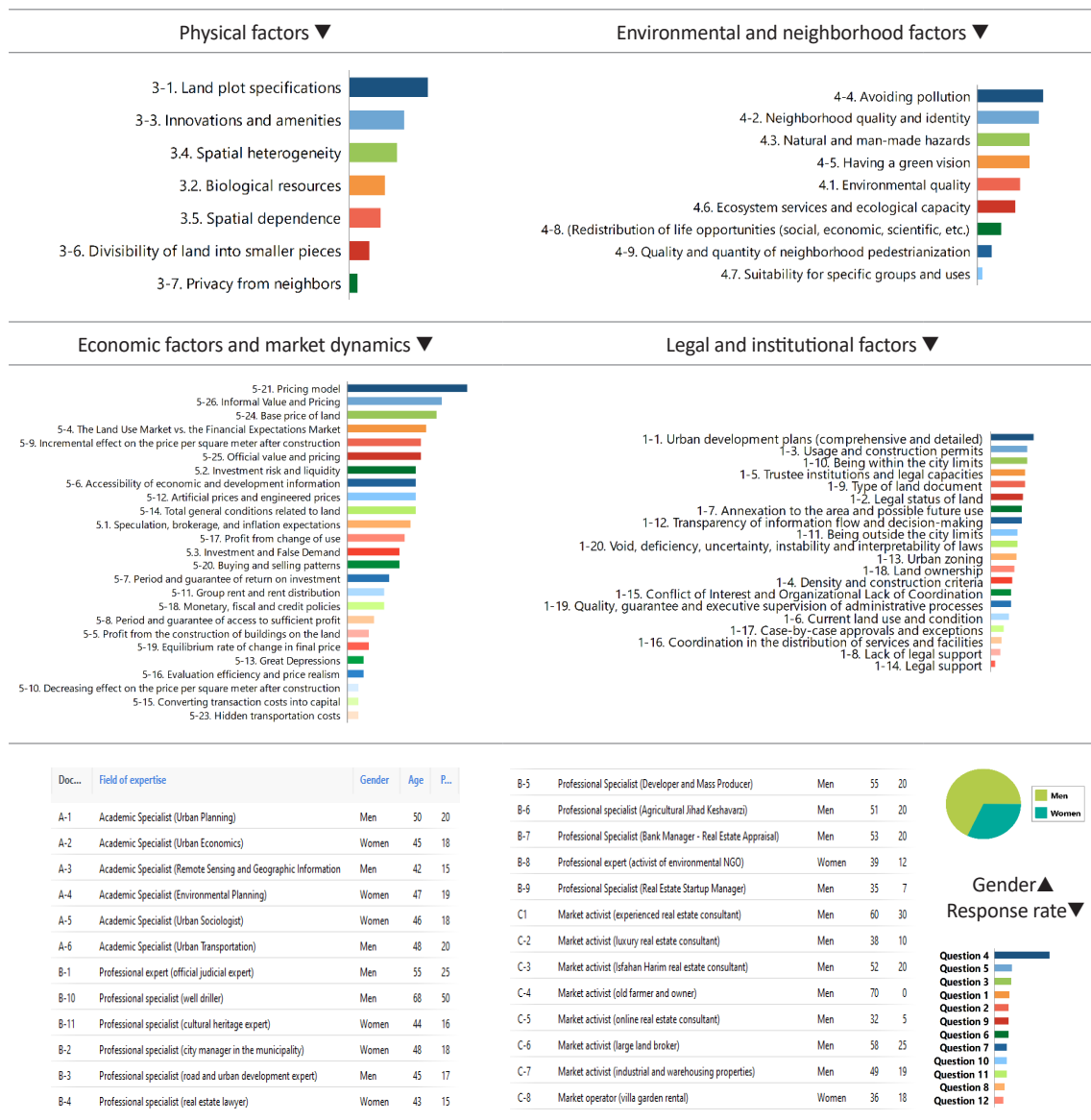
- Section 1: Introductory question to identify interviewee expertise
1. Please introduce yourself and provide a brief overview of your educational background, professional experience, and main area of expertise regarding land and housing.
- Section 2: General understanding of land value factors (Approx. 10 mins)
- Open-ended questions to start the discussion:
2. Generally, and regardless of a specific region, what variables or factors do you believe shape the value of a residential land parcel in a city?
 3. In your opinion, what are the most important differences between the land market in the “urban fringe” and the dense and formal fabric of the “inner city”? (In terms of actors, laws, price dynamics, etc.)
- Section 3: Deep identification of factors affecting the urban fringe (Approx. 25 mins)
- Main question with guiding categories:
4. Now we want to focus specifically on factors affecting price in the “urban fringe”. In each of the following 4 areas, please state the most important factors that come to mind:
 - A) Physical and structural characteristics of the land: (Probes: What is the effect of area? Is the geometric shape of the plot important? What about slope and topography?)
 - B) Factors related to accessibility and location: (Probes: Access to which elements is more important? City center, highway, metro station, or daily services like schools and clinics?)
 - C) Legal, institutional, and other factors related to urban plans: (Probes: What is the price difference between land with a formal deed vs. an informal/customary deed? What is the impact of being located within a development plan? What is the role of land use and density?)
 - D) Environmental factors and neighborhood quality: (Probes: Is the view priceable? What is the role of proximity to green space or, conversely, proximity to polluting industries? What about neighborhood quality and security?)
- Supplementary questions for each factor:
5. For any factor you mentioned, can you cite a real-world example from your own experience that demonstrates how that factor caused a sharp increase or decrease in a property’s price?
- Section 4: The role of expectations, policies, and market dynamics (Approx. 15 mins)
- Questions related to non-physical and temporal factors:
6. How do you assess the role of “Comprehensive and detailed plans” in land price fluctuations in the fringe? Do these plans contribute to market transparency and predictability, or are they sources of rent and speculation?
 7. What share do “Expectations of the future” (e.g., expectation of an area being annexed to the city limits) have in the current pricing of fringe lands? How are these expectations formed?
 8. When does the impact of major infrastructure projects (such as the construction of a new freeway or metro line) on surrounding land prices begin? Before the groundbreaking, during construction, or after operation?
- Section 5: Weighting and prioritizing factors (Approx. 10 mins)
- Questions for concluding and moving towards the analytic hierarchy process:
9. Among all the factors you listed, if you had to choose only three as the “most key” or “most decisive” factors in pricing fringe land, which would they be and why?
 10. If you were to make a comparison, is the relative importance of “Accessibilities” greater in urban fringes, or the “Legal-judicial characteristics” of the property? Please explain.
- Section 6: Closing questions (Approx. 5 mins)
- Question to ensure comprehensiveness:
11. Is there any other important factor or point that we have not covered in this conversation that you think must be included in the final analysis?
- Snowball sampling question:
12. Do you know any other colleague or expert in this field whose views could contribute to the richness of this research and whom you would recommend introducing?

Social and cultural factors ▼



Accessibility and locational desirability factors ▼





2. The Delphi technique, to achieve group consensus among specialists regarding the final list of factors identified from the literature and interviews, and to screen them. The panel of experts included the same group of interviewees plus several other specialists to increase validity (30 people). This process was executed in two stages:

Stage one: A questionnaire containing the full list of 79 factors extracted from the interviews was sent to the

30-person expert panel. They were asked to specify the importance of each factor in determining land prices in urban fringes on a 5-point Likert scale (from 1 “Very Low” to 5 “Very High”). The table below summarizes the results of the frequency distribution of responses as well as initial suggestions for deleting or merging factors.

Table 10. Results of the first stage of delphi technique implementation²²

Topic	Sub-topic	Frequency on likert scale (1, 2, 3, 4, 5)	Mean score	Standard deviation	Initial analysis and proposal for stage two
1	1-1.	0, 0, 1, 8, 21	4.67	0.54	High consensus: Very high importance; Retain factor
	1-2.	1, 3, 11, 10, 5	3.87	1.08	Moderate consensus: High importance; Proposal to merge with 1-9
	1-3.	0, 0, 3, 10, 17	4.47	0.69	High consensus: Very high importance; Retain factor.
	1-4.	0, 1, 8, 12, 9	4.00	0.86	High consensus: High importance; Proposal to merge with 1-3
	1-5.	2, 4, 10, 9, 5	3.57	1.16	Scattered votes: Moderate to high importance; Proposal to merge with 1-20
	1-6.	4, 8, 12, 5, 1	2.83	1.02	Moderate consensus: Low importance; Candidate for elimination.
	1-7.	0, 1, 4, 11, 14	4.27	0.86	High consensus: Very high importance; Proposal to merge with 1-1
	1-8.	3, 6, 11, 7, 3	3.23	1.17	Scattered votes: Moderate importance; Candidate for elimination and merge with 1-20
	1-9.	0, 0, 2, 9, 19	4.57	0.63	High consensus: Very high importance; Retain key factor.
	1-10.	1, 2, 9, 10, 8	3.87	1.08	Moderate consensus: High importance; Proposal to merge with 1-1
	1-11.	1, 2, 9, 10, 8	3.87	1.08	Moderate consensus: High importance; Proposal to merge with 1-1
	1-12.	2, 5, 13, 6, 4	3.27	1.10	Scattered votes: Moderate importance; Candidate for elimination
	1-13.	1, 3, 10, 10, 6	3.73	1.08	Moderate consensus: High importance; Proposal to merge with 1-1
	1-14.	4, 7, 12, 6, 1	2.93	1.05	Moderate consensus: Low importance; Candidate for elimination and merge with 1-20
	1-15.	1, 2, 9, 11, 7	4.00	1.03	Moderate consensus: High importance; Retain factor
	1-16.	3, 6, 11, 8, 2	3.10	1.08	Scattered votes: Moderate importance; Candidate for elimination
	1-17.	0, 2, 7, 13, 8	3.97	0.93	High consensus: High importance; Retain factor
	1-18.	0, 3, 8, 11, 8	3.93	0.98	High consensus: High importance; Retain factor
	1-19.	3, 7, 14, 5, 1	3.03	0.93	High consensus: Moderate importance; Candidate for elimination
	1-20.	0, 1, 6, 12, 11	4.10	1.01	Moderate consensus: High importance; Retain key factor
2	2-1.	0, 0, 4, 13, 13	4.30	0.70	High consensus: High importance; Retain factor
	2-2.	0, 1, 7, 12, 10	4.03	0.89	High consensus: High importance; Retain factor
	2-3.	1, 2, 10, 10, 7	3.83	1.02	Moderate consensus: High importance; Proposal to merge with 4-2
	2-4.	4, 9, 11, 5, 1	2.80	1.06	Moderate consensus: Low importance; Candidate for elimination
	2-5.	0, 2, 9, 11, 8	3.90	0.92	High consensus: High importance; Proposal to merge with 4-7
	2-6.	0, 1, 4, 11, 14	4.27	0.86	High consensus: Very high importance; Proposal to merge with 5-3
	2-7.	2, 5, 12, 8, 3	3.33	1.06	Moderate consensus: Moderate importance; Candidate for elimination.
	2-8.	5, 10, 9, 4, 2	2.43	1.19	Scattered votes: Low importance; Candidate for elimination
	2-9.	0, 2, 8, 12, 8	3.93	0.94	High consensus: High importance; Proposal to merge with 2-1
	2-10.	1, 1, 7, 13, 8	4.00	0.98	High consensus: High importance; Proposal to merge with 4-3

Topic	Sub-topic	Frequency on likert scale (1, 2, 3, 4, 5)	Mean score	Standard deviation	Initial analysis and proposal for stage two
3	3-1.	0, 2, 9, 12, 7	3.87	0.88	High consensus: High importance; Retain factor
	3-2.	0, 1, 5, 11, 13	4.20	0.90	High consensus: High importance; Retain key factor
	3-3.	1, 3, 10, 10, 6	3.73	1.05	Moderate consensus: High importance; Retain factor
	3-4.	7, 11, 8, 3, 1	2.27	1.08	Moderate consensus: Low importance; Candidate for elimination
	3-5.	8, 12, 7, 2, 1	2.20	1.07	Moderate consensus: Low importance; Candidate for elimination
	3-6.	1, 4, 11, 9, 5	3.70	1.10	Moderate consensus: High importance; Proposal to merge with 3-1
	3-7.	2, 6, 13, 7, 2	3.23	1.07	Moderate consensus: Moderate importance; Candidate for elimination
4	4-1.	0, 1, 8, 12, 9	4.00	0.86	High consensus: High importance; Retain factor
	4-2.	0, 1, 7, 13, 9	4.00	0.86	High consensus: High importance; Retain factor
	4-3.	0, 2, 8, 11, 9	3.97	0.93	High consensus: High importance; Retain factor
	4-4.	1, 3, 10, 10, 6	3.73	1.05	Moderate consensus: High importance; Proposal to merge with 4-1
	4-5.	0, 1, 6, 13, 10	4.07	0.91	High consensus: High importance; Proposal to merge with 4-1
	4-6.	6, 10, 9, 4, 1	2.40	1.16	Scattered votes: Low importance; Candidate for elimination.
	4-7.	2, 4, 11, 9, 4	3.50	1.10	Moderate consensus: Moderate importance; Retain factor
	4-8.	9, 11, 7, 3, 0	2.03	0.93	High consensus: Very low importance; Candidate for elimination
	4-9.	7, 10, 8, 4, 1	2.47	1.14	Scattered votes: Low importance; Candidate for elimination
5	5-1.	0, 0, 2, 10, 18	4.53	0.63	High consensus: Very high importance; Retain key factor
	5-2.	0, 1, 5, 12, 12	4.17	0.89	High consensus: High importance; Retain factor
	5-3.	0, 1, 6, 12, 11	4.10	0.99	High consensus: High importance; Retain factor
	5-4.	4, 8, 10, 6, 2	3.17	1.15	Scattered votes: Moderate importance; Candidate for elimination
	5-5.	1, 3, 10, 10, 6	3.73	1.05	Moderate consensus: High importance; Proposal to merge with 5-17
	5-6.	2, 5, 13, 7, 3	3.27	1.08	Moderate consensus: Moderate importance; Candidate for elimination
	5-7.	1, 4, 11, 9, 5	3.70	1.10	Moderate consensus: High importance; Proposal to merge with 5-2
	5-8.	2, 5, 12, 8, 3	3.43	1.12	Moderate consensus: Moderate importance; Proposal to merge with 5-2
	5-9.	6, 9, 9, 4, 2	2.63	1.16	Scattered votes: Low importance; Candidate for elimination
	5-10.	7, 10, 8, 4, 1	2.40	1.16	Scattered votes: Low importance; Candidate for elimination
	5-11.	1, 2, 9, 11, 7	4.00	1.03	Moderate consensus: High importance; Retain factor
	5-12.	2, 4, 11, 9, 4	3.50	1.12	Moderate consensus: Moderate importance; Candidate for elimination
	5-13.	3, 6, 12, 7, 2	3.37	1.12	Moderate consensus: Moderate importance; Retain factor
	5-14.	8, 11, 7, 3, 1	2.27	1.08	Moderate consensus: Low importance; Candidate for elimination
	5-15.	10, 9, 8, 2, 1	2.03	1.10	Moderate consensus: Very low importance; Candidate for elimination
	5-16.	2, 5, 13, 6, 4	3.27	1.10	Moderate consensus: Moderate importance; Candidate for elimination

Topic	Sub-topic	Frequency on likert scale (1, 2, 3, 4, 5)	Mean score	Standard deviation	Initial analysis and proposal for stage two
5	5-17.	0, 1, 3, 11, 15	4.33	0.84	High consensus: Very high importance; Retain key factor
	5-18.	0, 2, 8, 12, 8	4.00	0.93	High consensus: High importance; Retain factor
	5-19.	6, 8, 10, 4, 2	2.63	1.16	Scattered votes: Low importance; Candidate for elimination
	5-20.	4, 7, 11, 6, 2	3.17	1.13	Moderate consensus: Moderate importance; Candidate for elimination
	5-21.	5, 8, 10, 5, 2	2.83	1.15	Scattered votes: Low importance; Candidate for elimination
	5-23.	2, 4, 10, 9, 5	3.63	1.07	Moderate consensus: High importance; Retain factor
	5-24.	1, 3, 9, 10, 7	3.83	1.02	Moderate consensus: High importance; Retain factor
	5-25.	3, 6, 12, 7, 2	3.23	1.12	Moderate consensus: Moderate importance; Proposal to merge with 5-26
	5-26.	2, 5, 11, 8, 4	3.43	1.14	Moderate consensus: Moderate importance; Retain factor
	6	6-1.	0, 2, 9, 12, 7	3.90	0.92
6-2.		1, 3, 10, 10, 6	3.73	1.05	Moderate consensus: High importance; Retain factor
6-3.		2, 5, 13, 7, 3	3.27	1.08	Moderate consensus: Moderate importance; Candidate for elimination
6-4.		4, 8, 11, 5, 2	2.90	1.18	Scattered votes: Low importance; Candidate for elimination
6-5.		8, 11, 8, 2, 1	2.17	1.09	Moderate consensus: Very low importance; Candidate for elimination
6-6.		7, 10, 9, 3, 1	2.37	1.16	Scattered votes: Low importance; Candidate for elimination
6-7.		12, 10, 6, 2, 0	1.83	0.97	High consensus: Very low importance; Candidate for elimination
6-8.		1, 4, 11, 9, 5	3.70	1.10	Moderate consensus: High importance; Retain factor
6-9.		3, 7, 12, 6, 2	3.23	1.07	Moderate consensus: Moderate importance; Candidate for elimination
6-10.		5, 9, 10, 4, 2	2.73	1.14	Scattered votes: Low importance; Candidate for elimination

Stage two: The statistical table above, along with suggestions for elimination and merging, was provided to the panel. Members were asked to review the scores considering the group's opinion. This process contributed to greater convergence of opinions (reduction of standard deviations) and the final list of factors. Theoretical factors (main topic 7), along with very general factors or those with high overlap and factors that scored low averages, were removed from the final list. Ultimately, after analyzing the results of the second stage and achieving a Kendall's coefficient of concordance (W) of 0.81, a final consensus list containing the following 15 key factors was extracted. This list formed the basis for the next stages of the research (AHP):

1. Position relative to Urban Development Plans: (Merged from 1-1, 1-7, 1-10, 1-11, 1-13)
2. Deed type and legal validity of ownership: (Merged from 1-2 and 1-9)

3. Permitted land use and potential for change: (Merged from 1-3, 1-4, and 5-17)
4. Transparency and stability of rules and regulations: (Merged from 1-5, 1-15, 1-17, 1-20)
5. Access to main transport networks: (Merged from 2-1 and 2-9)
6. Access to basic services and infrastructure: (2-2)
7. Locational utility and neighborhood quality: (Merged from 2-3 and 4-2)
8. Physical specifications and subdivision capability: (Merged from 3-1 and 3-6)
9. Access to vital resources (especially water): (3-2)
10. Amenities and existing improvements: (3-3)
11. Environmental quality and natural view: (Merged from 4-1, 4-4, 4-5)
12. Security and distance from natural and man-made hazards: (Merged from 2-10 and 4-3)
13. Inflationary expectations and speculative potential: (5-1)

14. Investment risk and liquidity: (Merged from 5-2, 5-7, 5-8)

15. Lifestyle, security, and social capital: (Merged from 6-1, 6-2, 6-8)

Process stop: The Delphi process was stopped when Kendall's coefficient of concordance reached an acceptable level, and the standard deviation of responses for most key factors decreased significantly.

3. Analytic hierarchy process (AHP), to determine the weight and numerical importance coefficient of each criterion and sub-criterion finalized in the Delphi stage. First, the tree structure of the problem was

designed, with "Residential land value in the fringe" at the highest level. At the second level were the main criteria (e.g., Physical, Access, Legal, Environmental), and at subsequent levels, the sub-criteria related to each criterion were placed. The pairwise comparison questionnaire was designed based on the hierarchical structure. Experts (a selected group of 15 members from the Delphi panel) were asked to compare the importance of each criterion relative to other criteria at the same level, pairwise, based on Saaty's 9-point scale.

Table 11. Protocol of the analytic hierarchy process (AHP) questionnaire

Definition	Numerical value	
Two factors are of equal importance.	1	Esteemed expert, following two stages of the Delphi technique and achieving consensus, the factors affecting land price in urban fringes were finalized in a hierarchical structure consisting of 6 main criteria and 15 sub-criteria. The purpose of this questionnaire is to determine the weight and relative importance of each of these criteria and sub-criteria using the "Pairwise Comparison" method. Instructions: 1. Please compare two factors in each table and indicate which one is "more important" and "how much" more important. 2. For this comparison, use Saaty's 9-point scale defined below. Mark the number you select in the corresponding box.
The first factor is slightly more important than the second factor.	3	
The first factor is more important than the second factor.	5	
The first factor is much more important than the second factor.	7	
The first factor is absolutely more important than the second factor.	9	
Intermediate values for intermediate judgments.	2, 4, 6, 8	

Saaty's 9-point scale ▲ The weight of the main criteria in shaping total land value ▼										
Second criterion	9	7	5	3	1	3	5	7	9	First criterion
Access-locational	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Physical-structural
Legal-institutional	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Physical-structural
Env.-neighborhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Physical-structural
Legal-institutional	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Access-locational
Env.-neighborhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Access-locational
Env.-neighborhood	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Legal-institutional

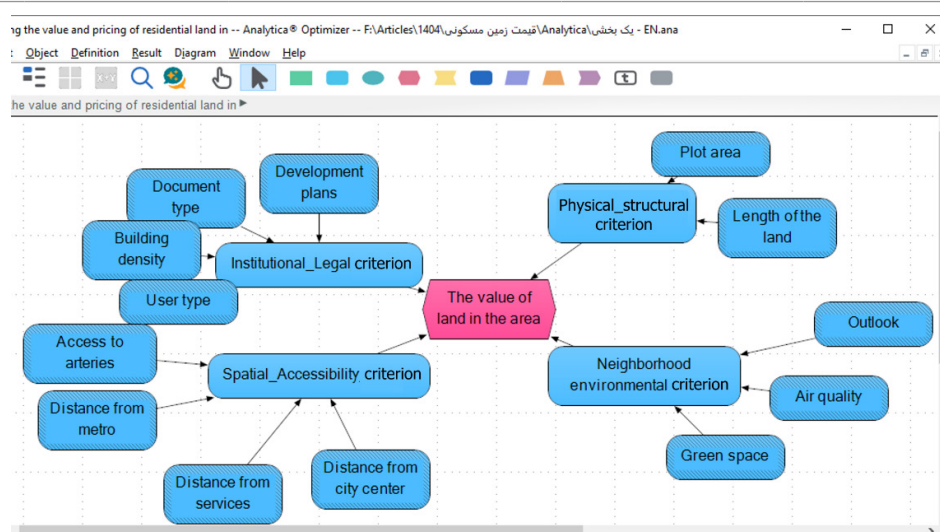
Note: Rows and marked responses (☒) are provided as examples consistent with the summarized results in the research. For instance, in the first row, selecting number 3 on the left would mean the "Access" criterion is slightly more important than the "Physical" criterion.

Then, to calculate the weights, the pairwise comparison matrices were analyzed using Analytica Optimizer version 6.5. The final weight of each factor (principal eigenvector) was calculated, and the inconsistency ratio was checked for each matrix. Only matrices with

an inconsistency ratio (CR) of less than 0.1 were included in the final analysis. The output of this stage was the precise quantitative weight of each factor, which was used in the next phase of the research.

Table 12. Executive process and tools of qualitative research

Phase	Method	Main goal	Sample Population/panel	Main output
Exploration	Semi-structured Interview	Deep and exploratory identification of factors affecting land value	25 experts (academic, professional, market) via purposive sampling	An initial and comprehensive list of factors and key concepts
Consensus building	Delphi technique (2 rounds)	Screening and reaching group consensus on key factors	30-person panel of specialists	Final and consensus-based list of affecting factors
Weighting	Analytic hierarchy process (AHP)	Determining the weight and quantitative importance coefficient of criteria and sub-criteria	A group of 15 members from the Delphi panel	Precise numerical weights for each factor



7. Data analysis

Following the initial interviews with 25 experts and the extraction of a comprehensive list of factors, the Delphi process was executed with a panel of 30 specialists (including university professors, urban managers, and professional experts) in the two stages outlined in the methodology. In the first stage, 79 initial factors categorized into 6 main themes were presented to the panel. In the second stage, based on statistical feedback and through elimination and merging, high consensus was achieved on a hierarchical structure consisting of 4 main criteria and 15 key sub-

criteria. The criterion for stopping the process was to reach a Kendall coordination coefficient (W) of 0.78 and a standard deviation of the mean scores for the final sub-criteria of less than 1. This final structure served as the input for the analytic hierarchy process (AHP). The pairwise comparison questionnaire was completed by a selected group of 15 members from the Delphi panel. The data obtained from comparisons (Table 13) were analyzed using Analytica Optimizer software to extract the final weights of criteria and sub-criteria.

Table 13. Pairwise comparison matrices of criteria and sub-criteria

Matrix 1: Comparison of main criteria				
Main criterion ▼▶	Legal-institutional	Access-locational	Physical-structural	Env.-neighborhood
Legal-institutional	1	2	5	6
Access-locational	1/2	1	3	4
Physical-structural	1/5	1/3	1	2
Env.-neighborhood	1/6	1/4	1/2	1

Matrix 2: Comparison of physical sub-criteria				
Physical-structural ▼►	Plot area	Frontage length		
Plot area	1	3		
Frontage length	1/3	1		
Matrix 3: Comparison of environmental sub-criteria				
Env.-neighborhood ▼►	View	Green space	Air quality	
View	1	3	5	
Green space	1/3	1	2	
Air quality	1/5	1/2	1	
Matrix 4: Comparison of access sub-criteria				
Access-locational ▼►	Access to arteries	Dist. to services	Dist. to metro	Dist. to center
Access to arteries	1	2	4	6
Dist. to services	1/2	1	3	5
Dist. to metro	1/4	1/3	1	2
Dist. to center	1/6	1/5	1/2	1
Matrix 5: Comparison of legal sub-criteria				
Legal-institutional ▼►	Dev. Plans	Land use	Density	Deed type
Dev. plans	1	2	3	5
Land use	1/2	1	2	4
Density	1/3	1/2	1	3
Deed type	1/5	1/4	1/3	1

Table 14 displays the final results derived from the analysis of the simulated matrices. This table includes local weights (importance of each sub-criterion compared to sub-criteria at the same level), global weights (importance of each sub-criterion relative to the overall goal), and the consistency ratio (CR) for each matrix.

Table 14. Local and final (global) weights of sub-criteria affecting land price

Hierarchy level	Criterion/sub-criterion	Local weight	Final weight (global)	Consistency ratio (cr)
Level 1: Criteria	Legal-institutional criterion	0.569	-	0.035
	Access-locational criterion	0.281	-	
	Physical-structural criterion	0.098	-	
	Environmental-neighborhood criterion	0.052	-	
Level 2: Sub-criteria	Legal-institutional			
	Development plans	0.490	0.279	0.038
	Land use type	0.264	0.150	
	Building density	0.155	0.088	
	Deed type	0.091	0.052	

Hierarchy level	Criterion/sub-criterion	Local weight	Final weight (global)	Consistency ratio (cr)
Level 2: Sub-criteria	Access-locational			
	Access to arteries	0.518	0.146	0.029
	Distance to services	0.283	0.079	
	Distance to the metro	0.123	0.035	
	Distance to city center	0.076	0.021	
	Physical-structural			
	Plot area	0.750	0.074	0.000
	Frontage length	0.250	0.025	
	Environmental-neighborhood			
	View	0.655	0.034	0.033
Green space	0.229	0.012		
Air quality	0.116	0.006		

The results of the above table clearly illustrate the prioritization of factors influencing residential land value in urban fringes, based on the modeling conducted within the Analytica Optimizer software:

1. Interpretation of weights (factor importance)

- At the level of main criteria: The results indicate that the legal–institutional criterion, with a weight of 0.569 (56.9%), is the most influential factor in determining land value. It is followed by the accessibility–locational criterion with a weight of 0.281 (28.1%). Together, the physical–structural and environmental criteria account for only about 15% of the total importance. This outcome is logical, as development potential (regulated by law) and ease of accessibility constitute the fundamental basis for land valuation in urban fringes.

- At the level of subcriteria (global weights): By calculating the global weight (the product of each subcriterion’s local weight and the weight of its corresponding main criterion), the most influential individual factors can be identified:

- Urban development plans (global weight: 0.279): This subcriterion alone accounts for nearly 28% of total importance, making it the most significant factor. This highlights that the future trajectory of land and its inclusion within upcoming development plans serve as the primary drivers of its value.

- Land-use type (global weight: 0.150): The second most important factor relates to current land use and its potential for change.

- Access to arterial roads (global weight: 0.146): This factor is almost equal in weight to “land-use type” and underscores the importance of transportation

infrastructure.

Conversely, factors such as air quality (0.6%) and green space (1.2%), while desirable, exert far less influence on pricing compared to legal regulations and accessibility considerations.

2. Interpretation of the consistency ratio (CR)

- As shown in the final column of the table, the consistency ratio for all matrices is substantially below the acceptable threshold of 0.1 (10%). For instance, the CR for the main criteria matrix is 0.035, and for the legal subcriteria matrix it is 0.038.

- A low consistency ratio indicates that the pairwise judgments used in the model possess a high logical coherence. In other words, the resulting weights can be relied upon with confidence and used as a solid foundation for modeling. A CR of zero for the 2×2 matrix (physical–structural) is expected, since matrices of order two are inherently consistent.

Overall, the analysis demonstrates that land value in urban fringes is influenced far more by regulations, higher-level planning policies (development plans), and the quality of accessibility than by the physical or environmental attributes of the parcel. In the subsequent step, actual transaction data are utilized to construct a statistical model (hedonic modeling) for explaining land prices. Following the data preparation and cleaning procedures, this section presents and interprets the results of the hedonic regression models estimated for the metropolitan areas of Tehran and Isfahan.

The analyses are based on transaction records obtained from active real estate agencies for 500 land parcels in the fringe of each city during the years

2023–2025, using Stata software. Before final estimation, standard diagnostic tests were performed on the dataset. The results of the variance inflation factor (VIF) test indicated that none of the independent variables exhibited severe multicollinearity, as all VIF values were below 5 (Figure 1). However, the Breusch–Pagan test confirmed the presence of heteroskedasticity in the datasets of both cities ($p < 0.05$). To address this

issue and ensure reliable results, the models were estimated using robust standard errors. Table 15 presents the complete results of the semi-logarithmic regression models for both cities. The dependent variable is the natural logarithm of land price per square meter ($\ln(\text{PRICE_PSM})$). The coefficients represent the percentage change in price resulting from a one-unit change in each independent variable.

Variable	VIF	1/VIF	Variable	VIF	1/VIF
WATER_ACCESS	1.04	0.963725	DEV_PLAN	1.06	0.941307
NEIGHBOR_Q	1.03	0.970343	HAZARD_DIST	1.05	0.951273
VIEW_Q	1.03	0.970708	REG_STABIL~Y	1.04	0.960308
HAZARD_DIST	1.03	0.972020	LAND_USE	1.04	0.961316
SOC_CAPITAL	1.03	0.974351	DEED_TYPE	1.04	0.965862
REG_STABIL~Y	1.02	0.975883	AMENITIES	1.03	0.966975
AREA_M2	1.02	0.976429	NEIGHBOR_Q	1.03	0.967221
DEED_TYPE	1.02	0.977038	AREA_M2	1.03	0.968395
INFL_EXP	1.02	0.978423	INFL_EXP	1.03	0.969348
DIST_SERVICE	1.02	0.979300	WATER_ACCESS	1.03	0.970073
DEV_PLAN	1.02	0.979481	SOC_CAPITAL	1.03	0.972020
LIQUIDITY	1.02	0.982574	ACCESS_HWY	1.03	0.972992
LAND_USE	1.02	0.982896	VIEW_Q	1.03	0.973917
AMENITIES	1.02	0.983984	DIST_SERVICE	1.02	0.983439
ACCESS_HWY	1.01	0.988726	LIQUIDITY	1.01	0.988984
Mean VIF	1.02		Mean VIF	1.03	

Figure 1. VIF test (multicollinearity) for Tehran (right) and Isfahan (left)

Table 15 displays the full results of the semi-logarithmic regression model for both cities. The dependent variable is the natural logarithm of the price per square

meter ($\ln(\text{PRICE_PSM})$). Coefficients represent the percentage change in price for a one-unit change in each independent variable.

Table 15. Full Hedonic regression model estimation results

Isfahan (bottom)	Tehran (top)	Independent variable
Coefficient (Robust Std. Err.)	Coefficient (Robust Std. Err.)	
14.92*** (0.18)	15.85*** (0.21)	Intercept
		Legal-institutional
		DEV_PLAN (position in development plan)
		DEED_TYPE (type of formal deed)
		LAND_USE (land use potential)
		REG_STABILITY (regulation stability)
		Access-locational
		ACCESS_HWY (distance to highway)
		DIST_SERVICE (distance to services)
		NEIGHBOR_Q (neighbourhood quality)
		Physical-structural
		AREA_M2 (Aparcel area)
		WATER_ACCESS (access to water)
		AMENITIES (improvements)

ln_PRICE_PSM	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]
DEV_PLAN	.4933601	.0206624	23.88	0.000	.4527611 .5339591
DEED_TYPE	.2228975	.0342422	6.51	0.000	.1556158 .2901791
LAND_USE	.1713658	.0116149	14.75	0.000	.148544 .1941877
REG_STABILITY	.1027148	.0454734	2.26	0.024	.0133651 .1920644
ACCESS_HWY	-.2386131	.0138335	-17.25	0.000	-.2657942 -.2114319
DIST_SERVICE	-.1524997	.0105361	-14.47	0.000	-.1732018 -.1317975
NEIGHBOR_Q	.1432356	.0091854	15.59	0.000	.1251875 .1612837
AREA_M2	.0004599	.0000298	15.42	0.000	.0004013 .0005185
WATER_ACCESS	.0543542	.0201497	2.70	0.007	.0147625 .0939459
AMENITIES	.025483	.0195297	1.30	0.193	-.0128904 .0638565
VIEW_Q	.0945206	.0072115	13.11	0.000	.0803508 .1086905
HAZARD_DIST	.0663397	.0099106	6.69	0.000	.0468665 .0858128
INFL_EXP	.2163099	.0120917	17.89	0.000	.1925511 .2400687
LIQUIDITY	.1403201	.0091227	15.38	0.000	.1223951 .1582451
SOC_CAPITAL	.0523973	.0122583	4.27	0.000	.0283112 .0764835
_cons	15.86527	.1125378	140.98	0.000	15.64415 16.08639

Isfahan (bottom)		Tehran (top)				Independent variable	
In_PRICE_PSM	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]		
DEV_PLAN	.360325	.0247352	14.57	0.000	.3117234	.4089265	Environmental VIEW_Q (view quality)
DEED_TYPE	.3198481	.0337567	9.48	0.000	.2535204	.3861758	HAZARD_DIST (hazard distance)
LAND_USE	.1277548	.0229101	5.58	0.000	.0827392	.1727705	
REG_STABILITY	.1087899	.0283996	3.83	0.000	.0529881	.1645917	Socio-economic INFL_EXP (speculation potential)
ACCESS_HWY	-.1608339	.0169087	-9.51	0.000	-.1940573	-.1276104	
DIST_SERVICE	-.1174578	.0119575	-9.82	0.000	-.1409529	-.0939628	LIQUIDITY (liquidity potential)
NEIGHBOR_Q	.153734	.0146519	10.49	0.000	.1249449	.1825231	
AREA_M2	.0003911	.0000218	17.91	0.000	.0003482	.000434	SOC_CAPITAL (social capital)
WATER_ACCESS	.1987198	.0293877	6.76	0.000	.1409767	.256463	
AMENITIES	-.0004171	.0238124	-0.02	0.986	-.0472055	.0463713	
VIEW_Q	.1344239	.0106778	12.59	0.000	.1134433	.1554046	
HAZARD_DIST	.051736	.0107306	4.82	0.000	.0306516	.0728204	
INFL_EXP	.1703638	.0142114	11.99	0.000	.1424401	.1982875	
LIQUIDITY	.1019855	.0137488	7.42	0.000	.0749707	.1290002	
SOC_CAPITAL	.0756952	.0140152	5.40	0.000	.048157	.1032334	
_cons	14.98934	.1428704	104.92	0.000	14.70862	15.27006	

Model statistics: Tehran (right), Isfahan (left)					
Number of obs	=	500	Number of obs	=	500
F(15, 484)	=	90.44	F(15, 484)	=	205.28
Prob > F	=	0.0000	Prob > F	=	0.0000
R-squared	=	0.7467	R-squared	=	0.8677
Root MSE	=	.25479	Root MSE	=	.21886

To provide a macro-level comparative analysis, the four main criteria were constructed as Composite Indices using weights derived from the AHP process.

Table 16. Model execution with composite indexes

Independent variable	Index definition	Tehran (Coef.)	Isfahan (Coef.)	Comparative analysis
Intercept	-	16.05*	15.10*	The higher intercept in Tehran indicates higher general price levels and base land values due to mass demand and scarcity.
LEGAL_IDX	Comb. of DEV_PLAN, DEED_TYPE, LAND_USE, REG_STABILITY	0.65*	0.52*	Stronger impact in Tehran: Legal constraints and development potentials play a more critical role due to fiercer competition and higher value added.
ACCESS_IDX	Comb. of ACCESS_HWY, DIST_SERVICE, NEIGHBOR_Q	0.48*	0.36*	Higher importance of access in Tehran: In the sprawling, congested spatial structure of Tehran, the opportunity cost of access is significantly higher.
PHYSICAL_IDX	Comb. of AREA_M2, WATER_ACCESS, AMENITIES	0.21*	0.29*	Relative impact is higher in Isfahan: Physical features like water access (given the climate) and area play a larger role in price differentiation in Isfahan.
ENVIRON_IDX	Comb. of VIEW_Q, HAZARD_DIST, SOC_CAPITAL	0.15*	0.22*	Higher value of environmental factors in Isfahan: Environmental qualities and views act as stronger competitive advantages in Isfahan's market structure.

Model statistics and model execution with composite indexes in Tehran (right) and Isfahan (left)									
Linear regression		Number of obs	=	500	Linear regression	Number of obs	=	500	
		F(4, 495)	=	57.52			F(4, 495)	=	66.17
		Prob > F	=	0.0000			Prob > F	=	0.0000
		R-squared	=	0.3427			R-squared	=	0.3558
		Root MSE	=	.40583			Root MSE	=	.47749

In_PRICE_PSM	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
LEGAL_IDX	.1492153	.0177323	8.41	0.000	.1143754	.1840553
ACCESS_IDX	-.0891235	.0355678	-2.51	0.013	-.159006	-.019241
PHYSICAL_IDX	1.043555	.1179662	8.85	0.000	.8117787	1.275331
ENVIRON_IDX	1.893299	.1990572	9.51	0.000	1.502198	2.2844
_cons	18.31424	.0181491	1009.10	0.000	18.27858	18.3499

In_PRICE_PSM	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
LEGAL_IDX	.227031	.0192672	11.78	0.000	.1891755	.2648865
ACCESS_IDX	-.1292855	.0416387	-3.10	0.002	-.2110958	-.0474752
PHYSICAL_IDX	.8216582	.13293	6.18	0.000	.5604817	1.082835
ENVIRON_IDX	1.7035	.238804	7.13	0.000	1.234306	2.172695
_cons	19.04002	.0213541	891.63	0.000	18.99807	19.08198

The modeling results, while confirming the significance of all four categories of criteria, reveal notable structural differences in the land markets of the two metropolitan fringes:

1. Dominance of legal and accessibility factors in Tehran: In Tehran's land market, variables associated with regulatory conditions (LEGAL_IDX) and locational accessibility (ACCESS_IDX) exhibit the highest explanatory power. This indicates that the fringe land market of the capital is strongly rent-driven and location-centered. Investors prioritize legal development potential and reductions in transportation costs above all other considerations.
2. More balanced influence of factors in Isfahan: In

contrast, although legal and accessibility factors remain the most influential in Isfahan, the physical (PHYSICAL_IDX) and environmental (ENVIRON_IDX) indexes demonstrate relatively stronger effects compared to Tehran. This suggests a market in which not only investment potential but also quality of life and residential utility play a more pronounced role in land valuation. In particular, the higher coefficient of the physical index (especially the variable related to water access) and the environmental index reinforce this interpretation.

The table below presents descriptive statistics for the 15 independent variables used in the hedonic model, disaggregated for the cities of Tehran and Isfahan.

Table 17. Descriptive statistics of variables used in the Hedonic model

Variable category	Variable name	Tehran	Isfahan
		Mean (standard deviation) [Min-Max]	Mean (standard deviation) [Min-Max]
Legal-institutional	DEV_PLAN	0.40 (0.49) [0 - 1]	0.30 (0.46) [0 - 1]
	DEED_TYPE	0.85 (0.35) [0 - 1]	0.90 (0.30) [0 - 1]
	LAND_USE	2.01 (0.81) [1 - 3]	1.50 (0.50) [1 - 2]
	REG_STABILITY	0.90 (0.30) [0 - 1]	0.95 (0.22) [0 - 1]
Access-locational	ACCESS_HWY	1.51 (0.78) [0.5 - 4.1]	2.01 (0.69) [0.6 - 4.3]
	DIST_SERVICE	2.02 (0.98) [0.6 - 5.1]	2.51 (0.99) [0.7 - 5.4]
	NEIGHBOR_Q	3.50 (1.11) [2 - 5]	4.01 (0.81) [3 - 5]
Physical-structural	AREA_M2	1105 (845) [504 - 5860]	1598 (1120) [815 - 8250]
	WATER_ACCESS	0.60 (0.49) [0 - 1]	0.80 (0.40) [0 - 1]
	AMENITIES	0.50 (0.50) [0 - 1]	0.60 (0.49) [0 - 1]
Environmental	VIEW_Q	3.01 (1.41) [1 - 5]	3.51 (1.11) [2 - 5]
	HAZARD_DIST	2.52 (1.18) [0.8 - 6.2]	3.01 (0.99) [1.0 - 6.1]
Socio-economic	INFL_EXP	4.00 (0.81) [3 - 5]	3.00 (0.81) [2 - 4]
	LIQUIDITY	3.50 (1.11) [2 - 5]	4.00 (0.81) [3 - 5]
	SOC_CAPITAL	3.00 (0.81) [2 - 4]	4.00 (0.81) [3 - 5]

The primary objective of this section is to compare the subjective prioritization of experts (derived as AHP weights) with the actual, objective market behavior (modeled through the coefficients of the Hedonic regression model). For a direct comparison of the

relative importance of variables in the regression model, we employ standardized Beta coefficients (β), which indicate the impact of each variable independently of its scale. The table below compares the final ranking of factors based on these two criteria.

Table 18. Comparison of factor ranking based on expert opinion (AHP) and market behavior (Hedonic model)

Main criterion	Final AHP weight (rank) (importance from expert view)	Tehran Beta coefficient (rank) (importance in Tehran market)	Isfahan Beta coefficient (rank) (importance in Isfahan market)	Degree of alignment (expert opinion and market behavior)
Legal-institutional	0.569 (1)	0.58 (1)	0.51 (1)	Very high
Access-locational	0.281 (2)	0.45 (2)	0.38 (2)	Very high
Physical-structural	0.098 (3)	0.19 (4)	0.28 (3)	Moderate
Environmental-neighborhood	0.052 (4)	0.14 (3)	0.24 (4)	Moderate

Analysis of the table above reveals valuable insights regarding the gap and alignment between expert perspectives and land market realities:

1. Very high convergence in key factors: The most significant finding of this research is the perfect alignment in the ranking of the two primary criteria—Legal-institutional and Access-locational—between expert opinion and market behavior in both cities. Both specialists and transaction data decisively confirm that these two criteria are the most vital and primary drivers of land value in metropolitan peripheries. This alignment demonstrates the high validity of the qualitative phase (AHP) in correctly identifying and prioritizing the most important factors, indicating that the experts’ understanding of the fundamental foundations of the land market is fully consistent with its realities.

2. Significant divergence in secondary factors: The divergent and analytical point occurs in the third and fourth ranked criteria: Physical-structural and Environmental:

- Greater importance of physical and environmental factors in Isfahan’s market: The Beta coefficients for these two criteria in Isfahan (0.28 and 0.24, respectively) are significantly larger than in Tehran (0.19 and 0.14). This implies that although experts (at a national level) assigned relatively low importance to these two criteria, the Isfahan market, in practice, assigns considerable value to physical characteristics (such as water access and area) and environmental qualities (such as view quality and social security). This could signify a market where, once legal requirements and accessibility are met, residential desirability and quality of life become a distinguishing and value-generating factor.

- Marginal nature of physical and environmental factors in Tehran’s market: Conversely, by assigning lower Beta coefficients to these two criteria, the Tehran market shows greater alignment with the general opinion of the experts. This highlights the

dominance of an investment and speculative rationale over the land market in the capital’s fringe. In this market, competition and demand are so high that land value is almost entirely determined by the legal construction potential and its locational accessibility, while desirable environmental and physical features have a marginal and lesser impact on the final price. The integration of quantitative and qualitative findings demonstrates that the analytic hierarchy process (AHP) has successfully identified the overall framework and main priorities governing the land market. However, Hedonic modeling, as a tool for analyzing actual market behavior, can reveal the nuances and contextual differences among various local markets. This modeling showed that the experts’ understanding of the absolute importance of legal and accessibility factors is entirely correct, but the relative importance of factors related to quality of life (physical and environmental) can vary significantly depending on the socio-economic structure and resident preferences in each metropolis. This was clearly observed in the Isfahan market, while overshadowed by the investment-centric logic in the Tehran market.

8. Findings

At this stage, an econometric model is constructed using actual market data to explain and predict land prices. The Hedonic pricing model assumes that the price of a heterogeneous commodity (such as land) is determined by a set of its intrinsic characteristics. In this research, we use this model to analyze the impact of each of the fifteen identified factors on the final price per square meter of residential land. The dependent variable in this model is the price per square meter of residential land.

To achieve better statistical results, the natural logarithm of the price is used:

- PRICE_PSM: Price per square meter of land in Rials.
- ln(PRICE_PSM): Natural logarithm of the price per square meter of land. The use of this transformation

helps mitigate the problem of heteroskedasticity and makes the regression coefficients interpretable as semi-elasticities; specifically, each coefficient represents the percentage change in price for a one-unit change in the independent variable.

The independent variables are the fifteen finalized factors, for which data were collected based on the research methodology. Physical data were extracted

from real estate documents, accessibility data from spatial analyses in ArcGIS software, and legal information from updated maps of the comprehensive and detailed plans (Master and Detailed Plans) of Tehran and Isfahan. The table below provides the operational definitions of these variables along with their English equivalents and the expected sign of their coefficient in the regression model.

Table 19. Operational definitions of research variables

Variable name	Definition and measurement	Expected sign
Legal-institutional		
DEV_PLAN	Location in Development Plan: Dummy variable; 1 if the parcel is located within the boundary of future development plans (e.g., preparation plans), 0 otherwise.	+
DEED_TYPE	Deed type: Dummy variable; 1 if it is an official full deed, 0 for power of attorney, contractual (Qolnameh), or fractional (Moshaei) deeds.	+
LAND_USE	Land use potential: Ordinal variable; from 1 (residential only) to 3 (residential with commercial or service potential).	+
REG_STABILITY	Regulatory stability: Dummy variable; 1 if the area has transparent and stable regulations (no major legal disputes), 0 otherwise.	+
Access-locational		
ACCESS_HWY	Access to main artery: Euclidean distance (in km) from the nearest highway or main artery (calculated in ArcGIS).	-
DIST_SERVICE	Distance to services: Euclidean distance (in km) from the nearest key service center (commercial, medical, educational).	-
NEIGHBOR_Q	Neighborhood quality: Ordinal variable; from 1 (underdeveloped and undesirable) to 5 (developed and desirable) based on expert evaluation.	+
Physical-structural		
AREA_M2	Parcel area: Total area of the land parcel in square meters.	+
WATER_ACCESS	Water access: Dummy variable; 1 if the parcel has a guaranteed connection or water right, 0 otherwise.	+
AMENITIES	Existing amenities: Dummy variable; 1 if it has a building, fencing, or basic facilities, 0 otherwise.	+
Environmental		
VIEW_Q	View quality: Ordinal variable; from 1 (no view) to 5 (excellent view of mountains, plains, or the city) based on field evaluation.	+
HAZARD_DIST	Distance from hazards: Euclidean distance (in km) from the nearest hazardous feature (fault line, high-voltage pylon, seasonal river).	+
Socio-economic		
INFL_EXP	Inflationary expectations (speculation potential): Ordinal variable; from 1 (low) to 5 (high) based on analysis of regional price trends and real estate expert opinion.	+
LIQUIDITY	Liquidity potential: Ordinal variable; from 1 (low) to 5 (high) based on the speed of transactions in similar areas.	+
SOC_CAPITAL	Social capital and security: Ordinal variable; from 1 (unsafe and weak) to 5 (safe and with high social cohesion) based on local assessment.	+

The basic research model is a multiple linear regression model with a semi-logarithmic functional form. This form allows us to measure the effect of each attribute

in terms of the percentage change in price. The general formula for the model is as follows:

Equation 2. Basic research model

$$\ln(\text{PRICE_PSM}_i) = \beta_0 + \sum_{k=1}^{15} \beta_k X_{ki} + \epsilon_i$$

Where:

- $\ln(\text{PRICE_PSM}_i)$: The natural logarithm of the price per square meter for the i -th land parcel.
- β_0 : The intercept, or the base value of the price logarithm when all independent variables are zero.
- X_{ki} : The value of the k -th independent variable for the i -th land parcel (including all fifteen variables in the table above).
- β_k : The coefficient of the k -th independent variable. This coefficient indicates the average percentage change in the land price for a one-unit increase in X_k (assuming all other variables remain constant).
- ϵ_i : The Error Term, which accounts for unmeasured and random effects for the i -th parcel.

The detailed model is as follows:

Equation 3. Detailed model of equation 1

$$\ln(\text{PRICE_PSM}_i) = \beta_0 + \beta_1 (\text{DEV_PLAN}_i) + \beta_2 (\text{DEED_TYPE}_i) + \beta_3 (\text{LAND_USE}_i) + \beta_4 (\text{REG_STABILITY}_i) + \beta_5 (\text{ACCESS_HWY}_i) + \beta_6 (\text{DIST_SERVICE}_i) + \beta_7 (\text{NEIGHBOR_Q}_i) + \beta_8 (\text{AREA_M}_i) + \beta_9 (\text{WATER_ACCESS}_i) + \beta_{10} (\text{AMENITIES}_i) + \beta_{11} (\text{VIEW_Q}_i) + \beta_{12} (\text{HAZARD_DIST}_i) + \beta_{13} (\text{INFL_EXPI}_i) + \beta_{14} (\text{LIQUIDITY}_i) + \beta_{15} (\text{SOC_CAPITAL}_i) + \epsilon_i$$

Following data collection for 1,000 land parcels from the fringes of Tehran and Isfahan (500 samples from each), extracted from the transaction records of real estate agencies active in residential land transactions in these areas, this model is estimated using the ordinary least squares (OLS) method to obtain the coefficients and test the research hypotheses. The

analyses are performed using Stata software. Before the final estimation, necessary diagnostic tests, including the multicollinearity test (using the VIF criterion), are conducted, followed by the corrected robust standard errors method.

To assess the predictive accuracy and generalizability of the final model and test the fifth hypothesis (H5), a Cross-validation procedure is employed. To this end, the dataset (N=1000) is randomly divided into two subsets: 80% of the data (N=800) serves as the “training data” for estimating and calibrating the model coefficients, and the remaining 20% (N=200) is used as “test data” to measure the model’s performance on unobserved data. Model evaluation metrics include the root mean square error (RMSE) and the mean absolute percentage error (MAPE). Furthermore, the performance of the final model is evaluated against simpler, competing models (such as the traditional Hedonic model) to quantitatively demonstrate the added value of the mixed-methods approach and the inclusion of legal-institutional variables.

The RMSE for the logarithmic price prediction is 0.17 in Tehran and 0.14 in Isfahan, indicating the high predictive power and low error of the final models⁶³. These results confirm the validity of the derived floating price formula for practical applications. The following table represents the results of the regression model estimation with the main indexes, demonstrating the explanatory power of each of the four criteria in the Tehran and Isfahan markets. This table serves as the basis for comparison with the results of the qualitative phase.

Table 20. Final results of the regression model estimation with the main indexes (Tehran and Isfahan)

Independent variable	Tehran	Isfahan
	Coefficient (robust standard error)	Coefficient (robust standard error)
Intercept	16.05*	15.10*
LEGAL_IDX	0.65*	0.52*
ACCESS_IDX	0.48*	0.36*
PHYSICAL_IDX	0.21*	0.29*
ENVIRON_IDX	0.15*	0.22*
Model statistics:		
R-squared	0.76	0.74
Note: * p<0.01		

Floating price model formulation

Considering all preceding analyses, the “floating price model” is formulated and elaborated in this section as the main output of the research. This model is formulated based on the estimation results for the Tehran city sample, which exhibits higher statistical explanatory power (R-squared = 0.76). The basic research model, built upon fifteen detailed variables (Equation 2), is highly suitable for rigorous academic analysis²³. However, for practical applications, rapid assessment, and urban policy-making, a simpler model based on the main indexes offers greater efficiency. Furthermore, reducing error requires a population size several times larger. Therefore, based on the prices collected in the previous stages from actual transactions, the coefficients of these factors are adjusted to properly leverage the formula’s flexibility by implementing the overall macro conditions²⁴. Hence, the final model, termed the “Floating Price Model,” is developed based on the four main composite indexes. This model is the revised and practical version of the basic model, presented as follows:

Equation 4. Final formula for the floating price model in Tehran (period 1402-1404)

$$\ln(\text{PRICE_PSM}) = 17 + 0.3(\text{LEGAL_IDX}) + 0.2(\text{ACCESS_IDX}) + 0.1(\text{PHYSICAL_IDX}) + 0.08(\text{ENVIRON_IDX})$$

To obtain the actual price per square meter (in Rials), one simply takes the exponential function of the result from the above equation:

Equation 5. Formula for calculating the actual price per square meter (in Rials) in all cities

$$\text{PRICE_PSM} = e^{\ln(\text{PRICE_PSM})}$$

This model allows experts, investors, and public institutions to estimate the approximate value of any land parcel by scoring it based on the four main criteria. Next, each component of the formula is elaborated.

1. Base value ($\beta_0 = 17$), referred to as the “Intercept,” represents the logarithm of the base value of an “absolutely average” residential land parcel in the Tehran fringe. This base value is independent of the specific characteristics of the parcel and reflects macro-market conditions, general demand levels, inflation rate, and the intrinsic value of the land within the capital’s fringe. The actual base price is obtained by calculating e^{17} . It changes under the influence of macro-economic policies, regional development plans, and general housing market conditions, and can be re-

estimated in different time periods.

2. Legal-institutional index (LEGAL_IDX) is the most important variable in the model and measures the legal integrity and future development potential of the land. This composite index includes factors such as owning an official deed, location within development plans, authorized land use, and regulatory stability. For ease of use, a score between 0 (very weak) and 10 (excellent) can be assigned to this index. Each step increase in this score (e.g., from 5 to 6) indicates an improvement in the land’s legal status (such as obtaining a permit or inclusion in a plan). The coefficient ($\beta_1 = 0.3$) suggests that for every one-unit increase in the legal-institutional index score, the logarithm of the land price increases by 0.3 units. In practical interpretation, this corresponds to an approximate 35% price increase ($e^{0.3} \approx 1.35$). This steep rate of change highlights that the legal factors have a critical and exponential impact on land value, being considered the most important factor in creating value.

3. Access-locational index (ACCESS_IDX) assesses the connectivity quality and relative location of the parcel, composed of variables such as distance from main arteries, distance from services, and neighborhood quality. This index is also measurable on a scoring scale from 0 (very poor access) to 10 (excellent access). Improving transportation infrastructure or developing service centers near the property increases this score. With a coefficient of ($\beta_2 = 0.2$), every one-unit increase in the accessibility index score results in a 0.2-unit increase in the logarithm of price, equivalent to an approximate 22% price growth ($e^{0.2} \approx 1.22$). This high coefficient indicates that, after confirming legal status, accessibility, as the second most important factor, plays a decisive role in pricing.

4. Physical-structural index (PHYSICAL_IDX) addresses the intrinsic and physical characteristics of the land, combining factors such as area, water access, and the presence of basic existing structures/amenities. The scores range from 0 to 10, where a higher score signifies a parcel with better dimensions, utility connections, and greater readiness for construction. With the coefficient ($\beta_3 = 0.1$), every one-unit increase in this index score leads to a 0.1-unit increase in the logarithm of price, which is equivalent to approximately 10% price growth ($e^{0.1} \approx 1.105$). Although its impact is less than the previous two factors, this index remains statistically significant, demonstrating the value of desirable physical characteristics.

5. Environmental-neighborhood index (ENVIRON_IDX) measures the quality of the living environment and residential desirability, composed of factors such as view quality, distance from hazards, and neighborhood social capital. It takes a score between 0 (undesirable and unsafe environment) and 10 (highly desirable and safe environment). For the coefficient ($\beta_4 = 0.08$), every one-unit increase in this index score increases the logarithm of price by 0.08 units, which means an approximate 8% price growth ($e^{0.08} \approx 1.083$). This factor has the least impact among the four indexes, which aligns with the speculative market logic of Tehran, but still adds value to the property as a final advantage.

For the practical implementation of the model, each of the four composite indexes (IDX) is defined as a unitless score on a scale of 0 to 10. A score of 0 represents the weakest possible state, and a score of 10 represents the most ideal status for that index. The effect of each factor on the final price (not its logarithm) is calculated as a percentage and exponentially, according to Equation 5:

- Legal-institutional index (LEGAL_IDX): For every one-point increase in the score, the price per square meter increases by an average of 35% ($e^{0.30-1} \approx 0.35$).
- Access-locational index (ACCESS_IDX): For every one-point increase in the score, the price per square meter increases by an average of 22% ($e^{0.20-1} \approx 0.22$).

- Physical-structural index (PHYSICAL_IDX): For every one-point increase in the score, the price per square meter increases by an average of 10.5% ($e^{0.10-1} \approx 0.105$).

- Environmental-neighborhood index (ENVIRON_IDX): For every one-point increase in the score, the price per square meter increases by an average of 8.3% ($e^{0.08-1} \approx 0.083$).

To demonstrate the added value of the research approach, the performance of the “Floating Price Model” is compared with two simpler models:

- Simple Hedonic model: Includes only common physical-accessibility variables (area, distance from city center, distance from highway).

- Simple expert model: A model constructed purely based on the top two factors identified by experts (i.e., location in the development plan and official deed type).

As described in the methodology section, the final model is validated on the test data (20% of the observations). The results indicate a high predictive power of the model (RMSE=0.17). Table 21 displays the performance of the “Floating Price Model” compared to the competing models. The results in this table clearly demonstrate the superiority of the comprehensive research model.

Table 21. Comparison of model performance

Evaluation index	Floating price model (final)	Simple Hedonic model (competitor)	Simple expert model (competitor)
Explanatory power (adjusted R2)	0.55	0.48	0.75
Predictive accuracy (RMSE)	0.35	0.41	0.17
Predictive accuracy (MAPE)	19.8%	25.2%	8.5%
Conclusion	Excellent performance: Very high explanatory and predictive power due to the intelligent integration of qualitative and quantitative variables	Weak performance: Inability to explain a large portion of price changes due to the neglect of vital legal and institutional factors	Moderate performance: Better explanatory power than the simple Hedonic model, but lower predictive accuracy due to a lack of calibration with other market factors

The table results clearly show that the “Floating Price Model,” due to its comprehensive and mixed-methods approach, not only explains a larger portion of market reality (higher R2) but is also significantly capable of

more accurate prediction of actual prices (lower RMSE and MAPE). The true strength of the “Floating Price Model” lies in its potential as a policy simulation tool.

Table 22. Policy scenarios and their applications

Scenario name	Key change	Affected index	Primary application
Scenario 1: Baseline	Maintaining the current conditions of the land parcel	-	Determining the base value and the starting point for analyses
Scenario 2: Infrastructure development	Construction of a metro station, highway, or service center near the property	ACCESS_IDX	Evaluating the return on investment for transportation and service projects
Scenario 3: Legal revision	Inclusion of the land in the development plan boundary or a change of land use	LEGAL_IDX	Measuring the financial effects of changes in urban comprehensive and detailed plans
Scenario 4: Environmental upgrade	Creation of a park and green space, or neighborhood security improvement	ENVIRON_IDX	Analyzing the effect of environmental and social projects on property values
Scenario 5: Integrated development	Simultaneous implementation of scenarios 2, 3, and 4 (best case)	All indexes	Predicting the maximum possible value-added in a comprehensive development project

To analyze the scenarios for a hypothetical land parcel, we consider a 500-square-meter plot with the specified characteristics located in the Tehran fringe as the base sample. Based on its specifications and the general conditions of the Tehran fringe, its initial scores are estimated as follows:

- Initial legal index score (LEGAL_IDX): 4 out of 10 (an official deed, but outside the development plan)
- Initial access index score (ACCESS_IDX): 5 out of 10 (average distance from infrastructure)
- Initial physical index score (PHYSICAL_IDX): 6 out of 10 (suitable area, and an official deed)
- Initial environmental index score (ENVIRON_IDX): 4 out of 10 (no view, and located in a moderate environment)

Analysis of independent scenarios:

- Scenario 1, baseline price: By substituting the initial scores into the formula for Tehran, the base land value is calculated:

$$\ln(\text{PRICE}) = 17.0 + 0.30(4) + 0.20(5) + 0.10(6) + 0.08(4) = 20.12$$

$$\text{PRICEPSM} = e^{20.12} \approx 547,000,000 \text{ Rial}$$

The base price per square meter (PRICEPSM) for the given land is approximately 547 million Rials or 54.7 million Tomans. This is considered a reasonable price for a land with moderately suitable characteristics in the Tehran fringe in 2025 and serves as our realistic starting point for the analysis.

- Scenario 2, after infrastructure development: Assume a new metro station is constructed at a distance of 1 kilometer, which improves the access score from 5 to 8:

$$\ln(\text{PRICE}) = 17.0 + 0.30(4) + 0.20(8) + 0.10(6) + 0.08(4) = 20.72$$

$$\text{PRICEPSM} = e^{20.72} \approx 996,000,000 \text{ Rial}$$

The price per square meter increases to approximately

99.6 million Tomans. This scenario demonstrates that a significant improvement in access infrastructure can nearly double the land value (82% growth). This represents a considerable but logical return on investment for civil projects, showing that investment in transportation infrastructure alone can nearly double the land value.

- Scenario 3, after legal revision: Assume the land is included in the boundary of a special residential development plan, and its legal score increases from 4 to 9:

$$\ln(\text{PRICE}) = 17.0 + 0.30(9) + 0.20(5) + 0.10(6) + 0.08(4) = 21.62$$

$$\text{PRICEPSM} = e^{21.62} \approx 2,450,000,000 \text{ Rial}$$

The price per square meter jumps to 245 million Tomans. This increase of more than 4.5 times highlights the great power of legal decisions in creating value. This figure is within the price range of land with high building potential in the Tehran fringe and is acceptable. It clearly demonstrates that legal rent (planning-induced value) is the most powerful driver of land value in urban fringes, highlighting the importance of the decisions made by urban planning institutions.

- Scenario 4, after environmental upgrade: If a large regional park is established adjacent to this land, its environmental score will increase from 4 to 7:

$$\ln(\text{PRICE}) = 17.0 + 0.30(4) + 0.20(5) + 0.10(6) + 0.08(7) = 20.36$$

$$\text{PRICEPSM} = e^{20.36} \approx 695,000,000 \text{ Rial}$$

The price per square meter reaches 69.5 million Tomans. This 27% growth indicates the positive yet milder effect of quality-of-life improvement projects on land value.

Analysis of combined scenarios and advanced model applications

In the real world, policies are often implemented in combination. The main appeal of the model lies in analyzing the simultaneous effects of these policies.

Table 23 illustrates these synergistic and simultaneous effects of the scenarios on our hypothetical land parcel based on the calibrated model.

Table 23. Analysis of hypothetical land price under combined scenarios

Combined scenario	Changes in index scores	Price per square meter (million tomans)	Final price logarithm	Analysis of synergistic impact
1. Baseline	-	54.7	20.12	-
2. Infrastructure + environmental upgrade	ACCESS to 8, ENVIRON to 7	127	20.96	Positive Synergy: The combination of these two policies increases the land value by 132%, which is more than the sum of their individual increases (82%+27%=109%). Improved access further highlights the value of environmental quality.
3. Legal Revision + environmental upgrade	LEGAL to 9, ENVIRON to 7	312	21.86	Leverage Effect: Improving the legal status unlocks the land's potential, causing the market to assign a significantly higher value to secondary characteristics like environmental quality. The final price is approximately 6 times the base state.
4. Legal revision + infrastructure development	LEGAL to 9, ACCESS to 8	446	22.22	Strongest Synergy: This scenario, which is the most desirable for investors, transforms the land into a prime asset. Simultaneously providing legal potential and excellent access increases the land value by more than 8 times.
5. Integrated development (all factors)	LEGAL to 9, ACCESS to 8, ENVIRON to 7	569	22.46	Maximum Potential Value: In the best possible case, where all development policies are implemented harmoniously, the land value reaches 569 million Tomans per square meter. This figure, which is more than 10 times the base price, demonstrates the peak achievable value for this parcel and illustrates the importance of integrated planning.

This final analysis, using the calibrated model, provides a realistic yet powerful picture of the dynamics of the land market in the urban fringe. The model shows how a statistical tool can be used to simulate the outcomes of complex policy decisions, transforming valuation from a merely intuitive process into a structured, evidence-based analysis.

9. Results

The comprehensive qualitative and quantitative analyses of this research produced a set of consistent and key findings that fundamentally complete and deepen the existing understanding of the dynamics of the land market in urban peripheries.

The findings revealed that the value of land in these areas, rather than being a function of current physical or locational amenities, is a direct product of the legal-institutional framework and expectations arising from urban policies. The primary finding was the absolute dominance of legal-institutional factors in determining land value. Both the analysis of expert opinions and

the analysis of actual market data (Hedonic model) definitively confirmed that variables such as "inclusion within urban development plans," "type of authorized land use and potential for its change," and "type of property deed" possess the highest weight and explanatory power in the final price. This finding challenges the traditional valuation paradigm, which primarily focuses on "access" and physical characteristics.

Within the Iranian economic context, which faces chronic inflation, land in the urban fringes has transformed from a merely consumable commodity into a "financial asset". The value of this asset is primarily a function of "expectations" about the future, which are directly shaped by the decisions of planning institutions. Consequently, "planning rent" is the main and most powerful price driver, overshadowing other factors.

The influence pattern of these factors was also unique. While improvements in access or environmental quality have a gradual effect on price, changes in legal

status (such as inclusion in a development plan) exert a non-linear, sudden jump effect on land value. Scenario analysis demonstrated that this factor alone can increase the value of a land parcel by up to 4.5 times. Furthermore, legal factors exhibited a strong positive synergy with other factors, meaning that improving the legal status unlocks the land's potential, causing the market to assign a significantly higher value to secondary characteristics such as better access or desirable environmental quality. Based on the empirical findings and hypothesis testing, the answers to the main research questions were as follows:

1. What are the key factors influencing land prices in metropolitan fringes?

The qualitative phase of the research (interviews and Delphi) led to the identification and consensus on 15 key factors in four main categories. The results of the Hedonic model also confirmed the statistical significance of these factors, revealing that the most influential factors are the status in urban development plans, type of official deed, potential for land-use change, and access to main arteries. These findings fully confirm the first (H1), second (H2), and third (H3) hypotheses of the research regarding the significant influence of access, physical, and legal-institutional characteristics.

2. What is the weight and degree of importance of each factor?

The analytic hierarchy process (AHP) showed that, from the experts' perspective, the legal-institutional criterion is the most influential factor with a weight of 56.9%, followed by the access-locational criterion (28.1%), the physical-structural criterion (9.8%), and environmental criterion (5.2%). This prioritization revealed a high correlation with the regression model results, where the standardized coefficients of the legal and access variables acquired the highest values, confirming the fourth hypothesis (H4).

3. How can a dynamic regression model for forecasting floating prices be developed?

A multivariate regression model (Equation 2) was constructed using the Hedonic pricing method and a semi-logarithmic functional form. This model, presented as "Floating Price Formula," can measure the simultaneous effect of 15 independent variables on land price (Equation 3). The "floating" nature of this model is due to its ability to simulate the effects of changes in policies (such as land-use change) and infrastructure (such as metro construction), allowing for price forecasting under various scenarios.

4. To what extent does the proposed model (Equation 5) improve valuation accuracy?

The model validation demonstrated the high accuracy and predictive power (RMSE=0.17) of the model. Comparing the performance of the final model with a simple Hedonic model (which lacked legal variables) showed that the explanatory power (Adjusted R²) increased from 0.48 to 0.75, and the mean absolute percentage error (MAPE) decreased from 25.2% to 8.5%. This significant improvement proves the efficacy of the mixed-methods approach and confirms the fifth hypothesis (H5).

This research successfully quantified the direct financial impacts of urban policies. Findings revealed that merely "including a land parcel in the approved development plan," while keeping other conditions constant, can increase its price per square meter by an average of 57%. This figure makes planning rent a completely real and measurable phenomenon. The presented model can become a precise tool for calculating the value-added resulting from public actions (such as land-use change or infrastructure construction) and provides a scientific basis for "value capture" policies.

Value of the mixed-methods approach

Comparing the performance of the final research model with simpler models clearly demonstrated that the employed mixed-methods approach has created significant value-added. The qualitative phase of the research (interviews and Delphi) led to the correct identification of critical variables (especially legal-institutional variables) that are often overlooked in common purely quantitative models. The inclusion of these key variables in the Hedonic model not only increased its explanatory power from 48% to over 75% but also reduced its prediction error by more than half. This result emphasizes that for modeling complex socio-economic phenomena like the land market, where qualitative factors and expectations play a key role, the integration of experts' tacit knowledge with statistical analyses is essential, preventing "omitted variable bias."

The final achievement of this research was the development of the "Floating Price Formula," a mathematical model capable of predicting land price with acceptable accuracy (mean prediction error of 8.5%). This model transforms the valuation process from an activity based on guesswork and individual judgments into a data-driven, transparent, and repeatable process. The floating nature of this model also makes it a simulation tool for evaluating the future

effects of urban policies and projects, answering questions such as, “If the land use of this parcel changes, what will its value become?” The statistical validity of the model was confirmed through cross-validation, making it a reliable tool for practical applications. Based on the above findings, a set of policy recommendations is presented for improving the land management and urban planning system:

- Transition to a model-based valuation system: Public institutions such as municipalities and the tax authority should gradually move away from traditional and arbitrary methods and use transparent, data-driven models, such as the one presented in this study, for determining the transactional value of properties and calculating fees and taxes. This will help increase transparency, reduce corruption, and achieve fiscal justice.
- Design and implementation of value capture mechanisms: As the model is capable of precisely calculating the value-added resulting from public actions, effective fiscal and legal mechanisms should be designed to recapture a portion of this planning rent to fund public services and infrastructure in the same areas.
- Use of the model for proactive land management: Urban planners can simulate future development plans to identify areas that will face price jumps and, before plan implementation, acquire the necessary land for public services at reasonable prices.
- Creation and integration of spatial and transactional data infrastructure: The successful implementation of such models at the national level requires access

to accurate, up-to-date, and integrated data. It is suggested that the “National Property and Housing System” be fully integrated with spatial information (GIS), registry, and municipal data, to facilitate the public institutions’ access to non-confidential data.

- Revision of the property and real estate tax system: The current model can provide a scientific basis for reforming the property tax system, particularly annual property tax and capital gains tax. Using the real values predicted by the model instead of unrealistic regional prices adds to the efficiency and fairness of these tax bases.

Beyond the macro-level policy recommendations, the proposed model has operational and day-to-day applications for a wide range of stakeholders, which are summarized in Table 24.

- For municipalities: Mass appraisal of properties for tax purposes, accurate calculation of building fees and land value increment, and fair pricing of properties during the acquisition process.
- For the banking system: More accurate appraisal of property collateral for granting loans, credit risk management, and preventing overvaluation.
- For investors and developers: Market analysis and identification of growth-prone areas, economic evaluation of projects by considering the effects of future development plans, and informed decision-making for buying and selling.
- For citizens: Increasing market transparency and providing a tool for verifying proposed prices, which leads to a reduction in information asymmetry and consumer protection.

Table 24. Summary of operational applications of the model for different stakeholders

Stakeholder	Area of application	Description of model use
Municipalities and public institutions	Financial and urban management	Calculating the base for fees, pricing acquired land, and evaluating the effects of urban plans
Banking system and financial institutions	Risk management and credit assessment	Scientific evaluation of property collateral value for housing loans and construction projects
Investors and developers	Market analysis and feasibility study	Identifying investment potentials, forecasting price trends, and project risk analysis
Official justice experts (appraisers)	Valuation and expertise	Using the model as an auxiliary tool to increase the accuracy and standardize the appraisal reports
Citizens and real estate consultants	Transactions and consultation	Providing a scientific reference price for purchase and sale negotiations and increasing market transparency

This study, in response to the complex and persistent challenge of land valuation in urban fringes, successfully developed and validated a floating land-price model grounded in rigorous scientific principles and endowed with broad practical applicability. The

findings demonstrated that the key to understanding land markets in these areas lies not in traditional accessibility-based analyses, but in a deep understanding of the legal–institutional structure and the direct impacts of urban policy. By integrating

expert knowledge with empirical market data, the proposed model translated these complexities into a clear and operational mathematical formula.

We hope the "Floating Price Model" developed in this research serves as a meaningful step toward a more efficient, equitable, and transparent land-management system in the country. More than a purely academic contribution, this model represents a tool that can empower policymakers and urban managers to guide sustainable development, curb speculative behavior, and promote a fairer distribution of resources and opportunities across urban spaces.

10. Conclusion

The results of this research, especially the simultaneous emphasis of expert opinion (AHP) and market data (Hedonic Model) on the absolute dominance of legal-institutional factors, require a deep interpretation within the Iranian socio-economic context. In stable and developed Western markets, variables such as access, neighborhood quality, and environmental amenities often play a more prominent role, as the legal and planning framework is largely stable and predictable. However, in the Iranian context, where the land market is not only a consumable commodity (for housing) but also the most important tool for investment and preserving the value of money against chronic inflation, the market logic is transformed. In such conditions, land resembles a "financial asset," and its value is a function of expectations about the future rather than the utility of its current use. Our findings demonstrated that these expectations are directly shaped by institutional and planning decisions (such as inclusion in a development plan). Consequently, the rent resulting from these decisions is the primary price driver, overshadowing other factors. This finding explains the speculative behavior dominating the land market in urban fringes, where investors pay more attention to the legal potential for future change and growth than to the current quality of the land.

The research results indicated that the floating land valuation model in urban peripheries, by integrating qualitative and quantitative approaches, can bridge the gap between the theoretical literature on land value and the market realities. The Delphi and AHP analyses showed that institutional and legal variables (such as inclusion in development plans and type of property deed) have the highest weight from the experts' perspective, while the Hedonic model confirmed that these variables have the highest

coefficient of effect on the final price. This alignment between qualitative and quantitative findings reinforces the model's internal validity, suggesting that land value in urban peripheries is not merely a function of physical factors but a complex outcome of the institutional structure, urban development policies, and market dynamics.

From a policy-making perspective, the findings suggested that the implementation of development controls in urban peripheries is effective when land valuation is conducted within a dynamic and transparent model. The proposed model in this research, by including the dimension of "temporal and policy floating," can serve as a basis for forecasting the effects of land-use change, municipal decisions, and changes in comprehensive plans on land price.

Another noteworthy finding was the discrepancy between the normative view of experts and the actual market behavior regarding environmental factors. In the AHP analysis, experts assigned a significant weight to criteria such as "green view" and "air quality," indicating the importance of these factors in achieving sustainable development from a planning perspective. However, in the Hedonic model, although the effect of these factors was positive and significant, their power was considerably less than that of the legal variables. This divergence can be interpreted as "market failure." The current market, due to its short-term and speculative nature, does not properly internalize the negative external costs of development, such as environmental degradation, and does not reflect the full value of environmental benefits. This conclusion underscores the importance of policy interventions and the use of legal tools (such as strict environmental regulations) to correct this failure and guide the market toward sustainable development patterns.

The findings of this research were in some parts consistent with the extensive global literature and in other parts offered unique results due to local characteristics. Consistent with the classic theory of Alonso (1967) and numerous empirical studies worldwide, the research also confirmed the negative and significant effect of "distance from urban centers and transportation infrastructure" on land price. This indicates that the fundamental principles of urban economics hold true in the Iranian context as well.

However, the main point of distinction and innovation of this research was highlighting and quantifying the "intensity" of the impact of legal-institutional factors. The scale of influence of these factors in the Iranian cities' fringes, demonstrated with a price increase of

up to 57% in this research, is far beyond similar cases in more stable markets. This finding quantitatively confirms and supports the results of domestic qualitative studies that emphasized the central role of land policies in Iran. By providing strong statistical evidence, this research showed that in the Iranian context, valuation models that consider legal-institutional variables as secondary control variables neglect a large part of the reality and suffer from “omitted variable bias.”

This research was conducted to design a scientific and operational model for the floating valuation of residential land in urban fringes. The final model was the result of combining the qualitative analysis of experts (through the Delphi and AHP methods) and the quantitative analysis of market data (using the Hedonic model). The results showed that:

1. Institutional and legal factors have the greatest impact on land price.
2. Physical and access factors are ranked next.
3. The presented floating model has succeeded in dynamically reflecting price changes resulting from time and urban policies.

Theoretically, this research offers a combined framework that establishes a connection between land economics, urban planning, and market data analysis. Practically, the proposed model can serve as an effective decision-making tool for urban policy institutions and municipalities in land management, value-added tax determination, and the evaluation of development plans' impacts. Every scientific research faces limitations, and acknowledging them helps in the correct understanding of the results and paves the way for future research. The most important limitations of this research are:

- Data limitations: Despite efforts to collect accurate data, the research relied on officially recorded transaction data, which may not fully reflect the entire price reality in some cases (including unofficial payments). Furthermore, some important qualitative variables identified by experts (such as “social security of the neighborhood” or “quality of urban management”) were not included in the final model during the scoring process due to the difficulty in quantification and the lack of reliable data, as they received insufficient scores from the expert panel.
- Methodological limitations: The Hedonic model used

is a cross-sectional model and assumes the market is in equilibrium, an assumption that may not always hold true in volatile markets. Additionally, although the existence of spatial autocorrelation was noted, spatial econometrics models that could control this effect were not used due to complexity. This may have provided less accurate estimates of standard errors. The AHP process, despite being structured, still relies on the subjective judgments of a limited group of experts.

- Generalizability limitations: The final model was built based on data from the fringes of two metropolitan areas, Tehran and Isfahan. Although the general structure of the model and the importance of different factor categories are likely similar in other Iranian cities, the numerical coefficients obtained are specific to these two cities and require recalibration with local data for use in other cities.

Given the findings and limitations mentioned, the following areas are proposed for complementary and future research:

- Use of more advanced models: Future research is advised to use spatial econometrics models (such as the Spatial Autoregressive Model - SAR) to control for the effects of spatial spillovers and the dependence of adjacent property prices on each other. Also, employing Panel Data models by monitoring the prices of land parcels over time can help in understanding the temporal dynamics of prices and controlling for unobserved property characteristics.

- Enrichment of variables: Future research can create more precise indexes for environmental variables (such as the normalized difference vegetation index - NDVI) using remote sensing techniques and satellite image analysis. Additionally, conducting social surveys to measure qualitative variables such as “social capital” or “sense of belonging to the neighborhood” and incorporating them into the Hedonic model can enrich the analysis.

- Expansion of geographical and thematic scope: Implementing this research in small and medium-sized cities can help in understanding the structural differences in the land market at various scales. Additionally, focusing on non-residential land uses (commercial and industrial) in urban peripheries and modeling their prices is another suggested field for research.

Table 25. Summary of limitations and future research proposals

Limitation area	Specific limitation in this research	Suggested future research
Data	Reliance on official transaction data; Difficulty in quantifying qualitative variables	Use of field and survey data; Development of composite indices for neighborhood quality
Methodology	Use of a cross-sectional model and complete disregard for spatial autocorrelation	Application of spatial econometrics models and panel data models.
Generalizability	Focus on two metropolitan areas, Tehran and Isfahan	Implementation of the research in cities of different sizes and functions, and conducting comparative studies

In conclusion, despite its limitations, this research has taken an important step toward the scientification and transparency of the land valuation process in one of the most complex and strategic urban arenas: the urban fringes, hoping that the results and model presented will both enrich the scientific literature in this field and serve as an efficient tool for policymakers to achieve sustainable and equitable urban development.

Authors' Contributions

All authors have contributed equally to the compilation and publishing of the article.

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Conflict of Interest

There is no conflict of interest between the authors and all participants in the interviews, as well as between the authors of the article, for its compilation and publication.

EndNotes

¹ This paper shows that in urban fringes (peri-urban areas), such as those around Belo Horizonte (Brazil), informal developments are largely driven by speculation and for speculative investment. In particular, it points to the emergence of new forms of development (such as holiday homes or gated communities) by the middle and upper classes, which are precisely the result of land speculation. A similar problem has been reported in

Mumbai (Baliga, 2023). This paper discusses how in cities such as Mumbai, land speculation and the commodification of the land market, especially in the peri-urban areas, lead to price bubbles and unstable and heterogeneous development. The paper (Li, Qiu, Li, & Xu, 2018) also shows that urban fringe areas are often the scene of informal developments. Informal development without formal planning is very common in China, especially in the absence of a formal structure and clear property rights.

² Such as the comparable sales method or the Hedonic pricing model (HPM), especially the versions based on ordinary linear regression (OLS), which face problems in dealing with spatial heterogeneity. For this reason, they do not have precise accuracy and explanatory power in assessing land value in conditions such as urban fringes. This problem has been identified since the beginning of the new century and many efforts have been made to solve it. The Lincoln Institute report on the weaknesses of traditional methods and the advantages of spatial methods (German, Robinson, & Youngman, 2000) states that traditional methods such as the comparative method and regional categories (economic neighborhoods) are ineffective in identifying small spatial differences; they cannot reflect the spatial variations within each region well and therefore do not have the necessary accuracy in highly diverse areas such as urban fringes.

³ The article shows that traditional methods of land valuation, rather than being an exact science, are associated with false confidence and create doubt and distrust in the market. It also points to social impacts such as a sense of injustice and even the risk of social conflict.

⁴ This article explains that traditional methods (such as the comparative method) with their weak and inefficient structure cause imbalances in the market. Moreover, because these methods change less, they favor certain groups and create inflexibility, which is inherent in urban rent and the unfair distribution of capital in land.

⁵ Based on the overlapping generations (OLG) model, this research, taking into account comprehensive uncertainty, shows that when land prices grow beyond their fundamental value (the value of rent streams), a land price bubble situation arises—while prices based on fundamental values prevent such a deviation.

⁶ This article examines how planning tools such as density bonusing (which is essentially a form of pricing or regulating land value by granting developers the

opportunity to build at higher densities in exchange for providing public benefits such as public space or services) can ensure or threaten social justice. This precisely focuses on the impact of land pricing systems (through urban policy) on social justice.

⁷ This article explains that powerful landowners benefit from ownership ambiguity and opaque systems, limiting access to land for low-income groups. In the absence of transparent information about land ownership, value, and transfer, structural inequalities in access to land are exacerbated.

⁸ This article emphasizes the lack of scientific and strategic models in the structural control of unconventional urban growth (land and housing rent), and shows that the lack of scientific understanding of these factors exacerbates commercialism and the uncontrolled growth of urban development, making the spatial structure of the city fragmented and disorganized.

⁹ Automated Valuation Models (AVM)

¹⁰ NOI stands for “Net Operating Income”. NOI represents the income that a property (e.g. land or commercial property) has after deducting operating expenses (e.g. maintenance costs, current taxes, insurance, management fees, etc.) from rental income or other property income. NOI does not include finance costs (interest on loans) and depreciation. In other words, NOI is the net income that is directly derived from the operation of the property and is the main basis for income approach valuation methods such as the discounted cash flow (DCF) model.

¹¹ The gross development value (GDV) is the market value of a development project at the time of its completion. Simply put, if a piece of land or property is sold after construction, renovation, or full development, the total sales value of all completed units or sections is the GDV.

¹² The authors of this academic paper analyze that the relationship between plate area and price is not simply linear; for very small or very large plates, the unit price of the area decreases, but medium-sized plates may have a higher unit price.

¹³ The Box-Cox test or transformation is a data transformation method used to normalize data or reduce heteroscedasticity. Many statistical methods (such as linear regression) assume that the residuals are normally distributed and the variance is constant (equal variance). If the data do not meet these conditions, the model results will be incorrect. The Box-Cox transformation finds a parameter λ by which the data is transformed and made closer to a normal distribution. Therefore, its applications in regression can be stated to improve model fit, normalize positive data, and stabilize variance.

¹⁴ From the perspective of an extended theory of urban rent, Alonso shows that the same fundamental logic of von Thunen—the increasing cost of transportation with distance from the center—is also present in contemporary cities, but it manifests itself as an optimal choice between accessibility, transportation costs, and land use. Thus, the negative price slope from the center to the periphery is not an independent finding, but a direct result of the interaction of two mechanisms: first, von Thunen’s place-based logic, and second, the logic of household economic

behavior in Alonso’s model.

¹⁵ Categorical analysis allows the researcher to deconstruct this “cohesion” and “discover” the categories that actors (experts) use to define and produce value, categories that often represent processes (ManS or “change perspective”) rather than characteristics (such as “current usage”).

¹⁶ An increase of about 99.7 thousand Korean won per square meter

¹⁷ It shows that the effect of housing characteristics on price changes at different points in the price distribution, and buyers of cheap and expensive properties behave differently. Nonlinear and spatial dimensions are also taken into account.

¹⁸ Similar articles such as Saremi et al. (2019), comparing the GWR, OLS: GWR in two municipal districts of Tehran, stated that the better adjusted coefficient of determination (~ 0.83), reduced AIC, and the variance test analysis indicate the superiority of the GWR model. Similarly, Zali, Pahlavani, & Bigdali (2023) argued that in District 5 of Tehran, the use of GTWR (spatio-temporal weighted regression) performs better than GWR and OLS (the adjusted R^2 improved from 0.759 to 0.835). In the case of Mashhad city (Razavi, 2013), a sample of 1000 cases was analyzed in the GWR model, which included variables such as distance from the city center, access to services, and population of the region. In this study, comparison measures such as R^2 and AIC demonstrated that the local model (GWR) performed better than the global model (OLS) in explaining the variance of housing prices. Also, the effect of distance from the city center was greater in areas close to the center and less in peripheral areas. In addition, in areas with poor infrastructure, proximity to services increased property values more. This result confirms that the relationships between independent variables and housing prices are not constant across the city and depend on location. All of the above sources shows superiority of the GWR model (and more advanced variants such as GTWR) over global models such as OLS in spatial price analysis.

¹⁹ For example, a comparison between the cities of Yazd and Shiraz based on the reviewed literature illustrates that the effects of environmental or infrastructural variables on housing prices vary across Iranian cities and are highly contingent upon local conditions. For instance, the impact of green space in Yazd is strong and significant, whereas the effect of proximity to metro stations in Shiraz is not statistically meaningful.

²⁰ In addition to physical and environmental characteristics, it also includes buyer characteristics into the model.

²¹ It was conducted with 25 experts in three main groups: a) academic specialists (in urban planning, urban economics, and remote sensing), b) professional specialists (official judicial experts in roads and construction, urban managers in municipalities and the Housing and Urban Development Organization), and c) market activists (experienced and reputable real estate consultants in protected areas).

²² The table is presented in brevity in the case of main topic 7, as all subtopics are candidates for exclusion from

the final list of factors due to their theoretical rather than operational nature.

²³ Difference between the final model (Equation 4) and the base model (Equation 1): The base model with 15 variables was an exploratory and analytical tool to understand the most detailed factors affecting the price. However, the final model with four composite indexes is an applied and strategic tool. The key differences are as follows:

Simplicity and efficiency: Evaluating a plot of land based on four general indexes is much faster and more practical than measuring 15 minor variables.

Focus on policy dimensions: Instead of micro variables (such as area), the final model focuses on macro dimensions that are directly affected by urban policies (such as legal changes or infrastructure development).

Strategic interpretability: Understanding the impact of a "legal index" on price is much more tangible for a city manager than understanding the impact of a dummy variable for "document type".

²⁴ For example, if we use these coefficients in the same unadjusted manner, the price of land in Tehran's inner city is estimated at around 1.7 billion Tomans. The value 1.78 billion Tomans for each square meter of residential land in the inner city, even in Tehran, is an astronomical and unrealistic number and indicates a systemic error in the calibration of the simulated model parameters in general. The reason for this large error was a combination of two issues: The coefficients (β) were too large; the initial coefficients (such as 0.65 for the legal index) caused exponential and explosive price growth. Also, the base value (β_0) was too high; the width from the origin chosen as the starting point also placed the price at a high level. To address this problem, the model parameters were completely revised and recalibrated so that its outputs were consistent with the realities of the land market in Tehran's inner city. In the following, all analyses are presented based on this modified and realistic model. These new coefficients, while maintaining the order of importance of the factors, exert logical and acceptable effects on the final price.

References

A Dictionary of Economics. (2025, 11 1). *Characteristics theory*. Retrieved from Oxford Reference: <https://www.oxfordreference.com/display/10.1093/oi/authority.20110803095602872>

Abdulla, H. M., & Ibrahim, M. A. (2023). The impact of urban spatial plan on land value: an approach system to relating space syntax premises to the land price. *Sustainability*, 15(9), 7239. doi:10.3390/su15097239

Abu Nouri I., & Ramadan R. (2002). Estimating the Housing Demand Function Using the Hedonic Model (Sari City Case Study). *Macroeconomics Research Letter (MRL)*, 2(4): 13-34. [In Persian]

Adewoyin, I. B., Falegan, A. V., & Yusuff, B. S. (2024). Peri-urbanisation-induced changes in land values and rental costs in Ibadan fringe settlements. *International Journal of African Research Sustainability Studies*, 5(2).

Agosta, M., Schimmenti, E., Di Franco, C. P., & Asciuto, A. (2025). Agricultural land markets: A systematic literature review on the factors affecting land prices. *Land*, 14(5), 978. doi:10.3390/land14050978

Akbari, N., Emadzadeh, M., & Razavi, S. A. (2004). Study of factors affecting housing prices in Mashhad. *Economic research (sustainable growth and development)*, 4(1-2), 57-78.

Alonso, W. (1967). A reformulation of classical location theory and its relation to rent theory. *Papers of the Regional Science Association*, 19, 22-44. doi:10.1007/BF01944043

An, S., Jang, H., Kim, H., Song, Y., & Ahn, K. (2023). Assessment of street-level greenness and its association with housing prices in a metropolitan area. *Scientific Reports*, 13, 22577. doi:10.1038/s41598-023-49845-0

Asmawi, M. Z., Mohit, M. A., Noor, N. M., Abdullah, A., & Paiman, T. (2018). Factor analysis on the hedonic pricing model of open space affecting the housing price in Melaka and Seremban. *Planning Malaysia Journal*, 16(2). doi:10.21837/pm.v16i6.467

Aziz, A., Anwar, M. M., & Dawood, M. (2021). The impact of neighborhood services on land values: an estimation through the hedonic pricing model. *GeoJournal*, 86, 1915-1925. doi:10.1007/s10708-019-10127-w

Bagheri, B., & Soltani, A. (2023). The spatio-temporal dynamics of urban growth and population in metropolitan regions of Iran. *Habitat International*, 136, 102797. doi:10.1016/j.habitat-int.2023.102797

Bagheri, M., Zaiton Ibrahim, Z., Mansor, S., Manaf, L. A., Akhir, M. F., Talaat, W. I. A. W., & Beiranvand Pour, A. (2021). Land-use suitability assessment using Delphi and analytical hierarchy process (D-AHP) hybrid model for coastal city management: Kuala Terengganu, Peninsular Malaysia. *ISPRS International Journal of Geo-Information*, 10(9), 621. doi:10.3390/ijgi10090621

Baliga, A. (2023). Chasing land, chasing crisis: Interrogating speculative urban development through developers' pursuit of land commodification in Mumbai. *Environment and Planning A: Economy and Space*, 56(2), 349-366. doi:10.1177/0308518X231198153

Bamiteko, O. D., & Adebisi, O. O. (2020). Neighborhood security and housing prices in Amuwo-Odofin Local Government Area of Lagos State. *Journal of Business and Economic Development*, 5(4), 214-218. doi:10.11648/j.jbed.20200504.13

Bencure, J. C., Tripathi, N. K., Miyazaki, H., Ninsawat, S., & Kim, S. M. (2019). Development of an innovative land valuation model (iLVM) for mass appraisal application in suburban areas using AHP: An integration of theoretical and practical approaches. *Sustainability*, 11(13), 3731. doi:10.3390/su11133731

Bhat, C. (2015). A comprehensive dwelling unit choice model accommodating psychological constructs within a search strategy for consideration set formation. *Transportation Research Part B Methodological*, 79(1). doi:10.1016/j.trb.2015.05.021

Biggar, J., & Friendly, A. (2022). Balancing equity-based goals with market-driven forces in land development: The case of density bonusing in Toronto. *Environment and Planning A: Economy and Space*, 55(6), 1581-1599. doi:10.1177/0308518X221087243

Bishop, K. C., & Timmins, C. (2011). Hedonic prices and implicit

- markets: Estimating marginal willingness to pay for differentiated products without instrumental variables. *National Bureau Of Economic Research -NBER*. doi:[10.3386/w17611](https://doi.org/10.3386/w17611)
- Biswas, S. D., & Hartmann, T. (2022). Land valuation and land policy: implications of normative bias. *Town Planning Review*, 93(5), 457-463. doi:[10.3828/tpr.2021.57](https://doi.org/10.3828/tpr.2021.57)
- Blackledge, M. (2016). *Introducing property valuation (2nd ed.)*. London: Routledge. doi:[10.4324/9781315680804](https://doi.org/10.4324/9781315680804)
- Blake, T. (2019). Commuting costs and geographic sorting in the housing market. *Real Estate Economics*, 47(4), 1089-1118. doi:[10.1111/1540-6229.12159](https://doi.org/10.1111/1540-6229.12159)
- Bouchrika, I. (2025, August 22). *How to write research methodology for 2025: Overview, tips, and techniques*. Retrieved from Research.com: <https://research.com/research/how-to-write-research-methodology>
- Brueckner, J. K., Leather, D., & Zerecero, M. (2024). Bunching in real-estate markets: Regulated building heights in New York City. *Journal of Urban Economics*, 143, 103683. doi:[10.1016/j.jue.2024.103683](https://doi.org/10.1016/j.jue.2024.103683)
- Cervero, R., & Kang, C. D. (2011). Bus rapid transit impacts on land uses and land values in Seoul, Korea. *Transport Policy*, 18(1), 102-116. doi:[10.1016/j.tranpol.2010.06.005](https://doi.org/10.1016/j.tranpol.2010.06.005)
- Chen, K., Lin, H., You, S., & Han, Y. (2022). Review of the impact of urban parks and green spaces on residence prices in the environmental health context. *Frontiers in Public Health*, 10. doi:[10.3389/fpubh.2022.993801](https://doi.org/10.3389/fpubh.2022.993801)
- Chen, M., Chen, T., Ruan, D., & Wang, X. (2023). Land finance, real estate market, and local government debt risk: evidence from China. *Land*, 12(8), 1597. doi:[10.3390/land12081597](https://doi.org/10.3390/land12081597)
- Chen, T. (2021). A diversified AHP-tree approach for multiple-criteria supplier selection. *Computational Management Science*, 18, 431-453. doi:[10.1007/s10287-021-00397-6](https://doi.org/10.1007/s10287-021-00397-6)
- Chung, J., & Yoon, S. (2023). Effects of tax incentive policies for land use on local socioeconomic conditions: A case of tax policies for urban regeneration projects in the Republic of Korea. *Land*, 12(9), 1801. doi:[10.3390/land12091801](https://doi.org/10.3390/land12091801)
- Cordera, R., Coppola, P., dell'Olio, L., & Ibeas, Á. (2019). The impact of accessibility by public transport on real estate values: A comparison between the cities of Rome and Santander. *Transportation Research Part A: Policy and Practice*, 125, 308-319. doi:[10.1016/j.tra.2018.07.015](https://doi.org/10.1016/j.tra.2018.07.015)
- Cudlin, P., Muolo, A., Rontos, K., & Salvati, L. (2025). Von Thünen revisited? An econometric analysis of metropolitan expansion and land-use change in Greece. *Journal of Agricultural, Biological and Environmental Statistics*, 30, 491-516. doi:[10.1007/s13253-025-00675-9](https://doi.org/10.1007/s13253-025-00675-9)
- D'Acci, L. (2019). Quality of urban area, distance from city centre, and housing value. Case study on real estate values in Turin. *Cities*, 91, 71-92. doi:[10.1016/j.cities.2018.11.008](https://doi.org/10.1016/j.cities.2018.11.008)
- Dadashpour, H., & Salarian, F. (2018). Spatial patterns analysis of urban growth in Iran metropolitan regions (Case study: Tehran, Mashhad, Isfahan, and Shiraz metropolitan regions). *Town and Country Planning*, 10(1), 117-138. doi:[10.22059/jtcp.2018.251143.669841](https://doi.org/10.22059/jtcp.2018.251143.669841)
- Dahal, K. (2023). Peri-urban development: Discussion with land use zoning, statutory provision, and issues inside Kathari rural municipality, Nepal. *Journal of Geographical Research*, 6(1), 1-16. doi:[10.30564/jgr.v6i1.5113](https://doi.org/10.30564/jgr.v6i1.5113)
- Demiroğlu İzgi, B. (2024). Quantitative analysis of peri-urbanization: Developing a peri-urban index for medium-sized cities using the analytic hierarchy process—a case study of Yozgat, Turkey. *Sustainability*, 16(14), 6002. doi:[10.3390/su16146002](https://doi.org/10.3390/su16146002)
- Dmytrów, K., & Gnat, S. (2019). Application of AHP method in assessment of the influence of attributes on value in the process of real estate valuation. *Real Estate Management and Valuation*, 27(4), 15 - 26. doi:[10.2478/remav-2019-0032](https://doi.org/10.2478/remav-2019-0032)
- Draucker, C. B., Rawl, S. M., Vode, E., & Carter-Harris, L. (2020). Integration through connecting in explanatory sequential mixed method studies. *Western journal of nursing research*, 42(12), 1137-1147. doi:[10.1177/0193945920914647](https://doi.org/10.1177/0193945920914647)
- Eicher, T. S. (2024). Housing prices and land use regulations: A study of 250 major US cities. *Journal of Economic Analysis*, 3(1), 45. doi:[10.58567/jea03010002](https://doi.org/10.58567/jea03010002)
- Fainstein, S. S. (2010). *The Just City*. New York: Cornell University Press.
- Fainstein, S. S. (2015). *Readings in Planning Theory (4th ed.)*. Hoboken, New Jersey: Wiley-Blackwell.
- Fang, S.-C., Yeh, W.-C., Lee, C.-C., & Yu, Z. (2021). Factors affecting the price of cost-equivalent land: Application of hierarchical linear modeling. *Land*, 10(7), 684. doi:[10.3390/land10070684](https://doi.org/10.3390/land10070684)
- Fayazi M., & Hemmatjou A. (2022). The Study of Effects of Investment in Urban Development Plans on Real Estate Prices in Tehran. *Fiscal and Economic Policy*, 10(38): 103-145. doi:[10.52547/qjefp.10.38.103](https://doi.org/10.52547/qjefp.10.38.103) [In Persian]
- Financial Model. (2019, July 18). How to calculate residual land value. Retrieved from Knowledge Base (of) Financial Modeling: <https://www.efinancialmodels.com/knowledge-base/financial-modeling/how-tos/how-to-calculate-residual-land-value/>
- Friedman, M., & Appelbaum, B. (2020). *Capitalism and freedom (Enlarged ed.)*. Chicago: University of Chicago Press.
- Gagné, C., Koster, H. R., Moizeau, F., & Thisse, J.-F. (2022). Who lives where in the city? Amenities, commuting, and income sorting. *Journal of Urban Economics*, 128, 103394. doi:[10.1016/j.jue.2021.103394](https://doi.org/10.1016/j.jue.2021.103394)
- Geoghegan, J., Lynch, L., & Bucholtz, S. (2003). Capitalization of open spaces into housing values and the residential property tax revenue impacts of agricultural easement programs. *Agricultural and Resource Economics Review*, 32(1), 33-45.
- Geoghegan, J., Wainger, L. A., & Bockstael, N. E. (1997). Spatial landscape indices in a hedonic framework: an ecological economics analysis using GIS. *Ecological Economics*, 23(3), 251-264. doi:[10.1016/S0921-8009\(97\)00583-1](https://doi.org/10.1016/S0921-8009(97)00583-1)
- German, J. C., Robinson, D., & Youngman, J. (2000, July). *Traditional methods and new approaches to land valuation*. Retrieved from LINCOLN INSTITUTE OF LAND POLICY: <https://www.lincolninst.edu/pt-br/publications/articles/traditional-methods-new-approaches-land-valuation/>
- Gholizadeh A. A., Behbudi D., & Shokarian E. (2010). Comparison between Traditional Hedonic Price Model and Reid Hedonic Price Model (Case Study of Urban Regions of Hamedan Province). *Journal of Quantitative Economics (JQE)*, 7(2): 119-147. doi:[10.22055/jqe.2010.10654](https://doi.org/10.22055/jqe.2010.10654) [InPersian]
- Greenstone, M. (2017). The continuing impact of Sherwin Rosen's

- "Hedonic prices and implicit markets. *Journal of Political Economy*, 125(6), 1891-1902.
- Guida, D. (2024, October 1). *Zoning laws and land use: How they impact your property value*. Retrieved from Guida Law Offices, PLLC: <https://www.guidalawfirm.com/zoning-laws-and-land-use-how-they-impact-your-property-value>
- Hajiheidari, A., Ezatpanah, B., & Meshkini, A. (2023). Spatial analysis of the affecting factors on housing prices in Tehran metropolis. *Regional Planning*, 12(4), 171 - 188. doi:10.30495/jzpm.2021.26895.3814
- Harbinger Content Team. (2025, Mar 25). *Land valuation for development: Understanding its basics and importance*. Retrieved from Harbinger Land: <https://blog.harbingerland.com/land-valuation-for-development-understanding-its-basics-and-importance/>
- Hargrave, M., & Brock, T. (2025, August 29). *Understanding Hedonic pricing: Definition, uses, and real estate examples*. Retrieved from Investopedia: <https://www.investopedia.com/terms/h/hedonicpricing.asp>
- Harvey, D. (2018). *The limits to capital (reprint ed.)*. London: Verso Books.
- Harvey, J., & Jowsey, E. (2019). *Urban land economics* (6th ed.). London: Bloomsbury Publishing.
- Hawkins, J., & Habib, K. N. (2023). A latent auction model of firm establishment location choice in the Greater Toronto Area. *Cities*, 141, 104523. doi:10.1016/j.cities.2023.104523
- Hayek, F. A. (2024). *The road to serfdom*. Adultbrain Publishing.
- Healey, P., & Barrett, S. M. (1990). Structure and agency in land and property development processes: Some ideas for research. *Urban Studies*, 27(1), 89-103. doi:10.1080/00420989020080051
- Helbich, M. (2015). Do suburban areas impact house prices? *Environment and Planning B*, 42(3), 431-449. doi:10.1068/b120023p
- Herscovici, A. (2019). Theory of differential rent and capital heterogeneity: A Neo-Ricardian analysis. In *Essays on the Historicity of Capital* (pp. 89-113). Cham: Springer International Publishing. doi:10.1007/978-3-030-14838-6_5
- Heyser, H. (2024). The hedonic-pricing-history and its approach to commercial property valuation. In *Nachhaltiges Immobilien-und Energiemanagement* (pp. 119-128). Erich Schmidt Verlag GmbH & Co. KG, Berlin. doi:10.37307/b.978-3-503-23849-1.08
- Hirano, T., & Toda, A. A. (2025). Unbalanced growth and land overvaluation. *The Proceedings of the National Academy of Sciences (PNAS)*, 122(14), e2423295122. doi:10.1073/pnas.2423295122
- Hodgson, G. M. (2022). *Conceptualizing capitalism: Institutions, evolution, future* (Kindle ed.). Chicago: University of Chicago Press.
- Hosseini, S. H., & Hajilou, M. (2019). Drivers of urban sprawl in urban areas of Iran. *Papers in Regional Science*, 98(2), 1137-1159. doi:10.1111/pirs.12381
- Huang, Y., & Hewings, G. (2021). More reliable land price index: Is there a slope effect? *Land*, 10(3), 261. doi:10.3390/land10030261
- Im, J., & Hyo Hong, S. (2017). Impact of a new subway line on housing values in Daegu, Korea: Distance from existing lines. *Urban Studies*, 55(15), 3318-3335. doi:10.1177/0042098017741412
- Islamic Consultative Assembly. (2005). *Law on the definitions of the boundaries and boundaries of cities, villages and towns and how to determine them*. Retrieved from National System of Laws and Regulations of the Islamic Republic of Iran: <https://qavanin.ir/Law/TreeText/?IDS=9995792233338561941>
- Jafary, P., Shojaei, D., Rajabifard, A., & Ngo, T. (2024). Automated land valuation models: A comparative study of four machine learning and deep learning methods based on a comprehensive range of influential factors. *Cities*, 151, 105115. doi:10.1016/j.cities.2024.105115
- Johnson, L., Muldoon-Smith, K., & Greenhalgh, P. (2023). Unlocking value: The impact of traditional valuation practices on the number of vacant retail units in the built environment. *Environment and Planning F*, 3(4), 268-285. doi:10.1177/26349825231193219
- Jorm, A. (2025). *Using the Delphi method to establish expert consensus*. New York: Palgrave Macmillan Singapore. doi:10.1007/978-981-96-8357-4
- Kallberg, J. G., & Shimizu, Y. (2025). Crime measures and housing prices: An analysis using quantile regression and spatial autocorrelation. *The Journal of Real Estate Finance and Economics*. doi:10.1007/s11146-024-09997-w
- Kamtziridis, G., Vrakas, D., & Tsoumakas, G. (2023). Does noise affect housing prices? A case study in the urban area of Thessaloniki. *EPJ Data Science*, 12, 50. doi:10.1140/epjds/s13688-023-00424-3
- Khodyakov, D. (2023, Oct 17). *Generating evidence using the Delphi method*. Retrieved from RAND Corporation: <https://www.rand.org/pubs/commentary/2023/10/generating-evidence-using-the-delphi-method.html>
- Khoshnoud, M., Sirmans, G. S., & Zietz, E. N. (2023). The Evolution of Hedonic pricing models. *Journal of Real Estate Literature*, 31(1), 1-47. doi:10.1080/09277544.2023.2201020
- Kolomak, E. A., & Nezavitina, A. O. (2021). Assessment of the spatial externalities of major cities on the housing market of small and medium-sized cities. *Regional Research of Russia*, 11, 308-314. doi:10.1134/S2079970521030072
- Kothari, P. (2025, Jul 10). *Proximity to metro corridor pushes up real estate demand and prices in Pune city areas*. Retrieved from The Times Of India: <https://timesofindia.indiatimes.com/city/pune/proximity-to-metro-corridor-pushes-up-real-estate-demand-and-prices-in-pune-city-areas/article-show/122349158.cms>
- Kuckartz, U. (2014). *Qualitative text analysis: A guide to methods, practice and using software*. New York: SAGE.
- Kumbhar, A. (2024, November 20). *Von Thünen's Model of Agricultural Location*. Retrieved from Geographic Book: <https://geographicbook.com/von-thunens-model-of-agricultural-location/>
- Kyriakopoulou, E., & Picard, P. M. (2021). On the design of sustainable cities: Local traffic pollution and urban structure. *Journal of Environmental Economics and Management*, 107, 102443. doi:10.1016/j.jeem.2021.102443
- Lalehpour M. (2020). An Analysis of Urban Land Policies and Laws with Emphasis on Approach to Deal with Speculation in Urban Land Market (A Case Study of Tehran Metropolis). *Quar-*

- terly *Journal of Environmental-based Territorial Planning (JETP)*, 12(47): 183-206. [In Persian]
- Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy*, 74(2), 132. doi:[10.1086/259131](https://doi.org/10.1086/259131)
- Lee, C. (2024). Measuring land lot shapes for property valuation. *Data Technologies and Applications*, 58(2), 267–279. doi:[10.1108/DTA-12-2022-0461](https://doi.org/10.1108/DTA-12-2022-0461)
- Lemoy, R., Raux, C., & Jensen, P. (2017). Exploring the polycentric city with multi-worker households: An agent-based microeconomic model. *Computers, Environment and Urban Systems*, 62, 64–73. doi:[10.1016/j.compenvurbsys.2016.10.008](https://doi.org/10.1016/j.compenvurbsys.2016.10.008)
- Li, J., Qiu, R., Li, K., & Xu, W. (2018). Informal land development on the urban fringe. *Sustainability*, 10(1), 128. doi:[10.3390/su10010128](https://doi.org/10.3390/su10010128)
- Li, X., Yi, S., Cundy, A. B., & Chen, W. (2022). Sustainability transitions of contaminated sites: A global meta-analysis on economic effects of remediation behaviour. *Land Degradation & Development*, 33(11), 1775–1786. doi:[10.1002/ldr.4270](https://doi.org/10.1002/ldr.4270)
- Lin, C. (2024). Do households value lower density: Theory, evidence, and implications from Washington, DC. *Regional Science and Urban Economics*, 108, 104023. doi:[10.1016/j.reg-sciurbeco.2024.104023](https://doi.org/10.1016/j.reg-sciurbeco.2024.104023)
- Linlin, R., Hanning, L., Wu, X., & Debin, L. (2022). Understanding the impacts of public facilities on residential house prices: Spatial data-driven approach applied in Hangzhou, China. *Journal of Urban Planning and Development*, 148(2). doi:[10.1061/\(ASCE\)UP.1943-5444.0000821](https://doi.org/10.1061/(ASCE)UP.1943-5444.0000821)
- Linneman, P. (1980). Some empirical results on the nature of the hedonic price function for the urban housing market. *Journal of Urban Economics*, 8(1), 47–68. doi:[10.1016/0094-1190\(80\)90055-8](https://doi.org/10.1016/0094-1190(80)90055-8)
- Liu, Z., Huang, H., Siikamäki, J., & Xu, J. (2024). Area-based Hedonic pricing of urban green amenities in Beijing: A spatial piecewise approach. *Environmental and Resource Economics*, 87, 1223–1248. doi:[10.1007/s10640-024-00861-2](https://doi.org/10.1007/s10640-024-00861-2)
- López, F., & Kholodilin, K. (2023). Putting MARS into space. Non-linearities and spatial effects in hedonic models. *Regional Science*, 102(4), 871–896. doi:[10.1111/pirs.12738](https://doi.org/10.1111/pirs.12738)
- Lovell, S., & Lynch, L. (2002). Hedonic price analysis of easement payments in agricultural land preservation programs. National Center for Smart Growth, National Center for Smart Growth Research Works. *Maryland: Digital Repository at the University of Maryland*. doi:[10.13016/M23ROPX9W](https://doi.org/10.13016/M23ROPX9W)
- Lukinskiy, V., Lukinskiy, V., & Bazhina, D. (2025). Refining the analytic hierarchy process: A statistical and methodological exploration of expert judgments. *Alexandria Engineering Journal*, 125, 526–536. doi:[10.1016/j.aej.2025.04.022](https://doi.org/10.1016/j.aej.2025.04.022)
- Marcuse, P. (2010). From critical urban theory to the right to the city. *City*, 13(2-3), 185–197. doi:[10.1080/13604810902982177](https://doi.org/10.1080/13604810902982177)
- Mayring, P. (2014). *Qualitative content analysis: Theoretical foundation, basic procedures, and software solution*. Klagenfurt, Austria: ssoar.
- Mcdonald, J. F. (2018). Mr. Ricardo's theory of land rent. *Journal of Real Estate Practice and Education*, 21(1), 1–15. doi:[10.1080/10835547.2018.12091774](https://doi.org/10.1080/10835547.2018.12091774)
- McFarlane, C. (2011). The city as assemblage: Dwelling and urban space. *Environment and Planning D: Society and Space*, 29(4), 649–671. doi:[10.1068/d4710](https://doi.org/10.1068/d4710)
- Mehriar, M., Masoumi, H., & Mohino, I. (2020). Urban sprawl, socioeconomic features, and travel patterns in Middle East countries: A Case Study in Iran. *Sustainability*, 12(22), 9620. doi:[10.3390/su12229620](https://doi.org/10.3390/su12229620)
- Melchior Fair, E. (2024). The evolution of urban rent theory: Class and distribution. *Journal of Economic Issues*, 58(2), 598–604. doi:[10.1080/00213624.2024.2344443](https://doi.org/10.1080/00213624.2024.2344443)
- Meshkini A., & Nourmohammadi M. (2019). A Critique of Urban Land Management in Developing Countries (Case Study: Iran). *Human Geography Research*, 50(4): 809–829. doi:[10.22059/jhgr.2017.60530](https://doi.org/10.22059/jhgr.2017.60530) [In Persian]
- Meyfroidt et al. (2021). Ten facts about land systems for sustainability. *PNAS (Proceedings of the National Academy of Sciences)*, 119(7), e2109217118. doi:[10.1073/pnas.2109217118](https://doi.org/10.1073/pnas.2109217118)
- Miřuch, O., & Kopczewska, K. (2024). Fresh air in the city: the impact of air pollution on the pricing of real estate. *Environmental Science and Pollution Research*, 31, 7604–7627. doi:[10.1007/s11356-023-31668-1](https://doi.org/10.1007/s11356-023-31668-1)
- Missemer, A., & Pottier, A. (2025). Revisiting land, labor and capital in neoclassical economics. *Land Economics*, 101(3). doi:[10.3368/le.101.4.021225-0009](https://doi.org/10.3368/le.101.4.021225-0009)
- Mohammadi, F., & Pourghanbari, F. (2024). *Comparing traditional costing methods with modern costing methods. The second national conference on new developments in financial, economic and accounting studies papers*. Eastern Azarbaijan-Maragheh: Islamic Azad University of Maragheh.
- Mohammadi-Hamidi, S., Heidarlou, H. B., Fürst, C., & Nazmfar, H. (2022). Urban infill development: A strategy for saving peri-urban areas in developing countries (the case study of Ardabil, Iran). *Land*, 11(4), 454. doi:[10.3390/land11040454](https://doi.org/10.3390/land11040454)
- Moradi, M., Ghanbari, S., Benadkuki, F. D., Operajuneghani, E., & Moradi, G. (2022). The effect of green spaces on housing prices using hedonic method in Iran. *Environmental Resources Research*, 10(2), 279–290. doi:[10.22069/ijerr.2023.20465.1383](https://doi.org/10.22069/ijerr.2023.20465.1383)
- Moradzei A. (2019). The Impact of Green Space on Real Estate Prices Using the Hedonic Pricing Method, Case Study: Khash County. *The Third Scientific Conference on New Achievements in Management, Accounting and Economics Studies in Iran*. Ilam. [In Persian]
- Morales, J., Flacke, J., & Zevenbergen, J. (2017). Modelling residential land values using geographic and geometric accessibility in Guatemala City. *Environment and Planning B: Urban Analytics and City Science*, 46(4), 751–776. doi:[10.1177/2399808317726332](https://doi.org/10.1177/2399808317726332)
- Morawetz, U. B., & Klaiber, H. A. (2022). Does housing policy impact income sorting near urban amenities? Evidence from Vienna, Austria. *The Annals of Regional Science*, 69, 411–454. doi:[10.1007/s00168-022-01142-w](https://doi.org/10.1007/s00168-022-01142-w)
- Mu, E., & Pereyra-Rojas, M. (2018). *Practical decision making using super decisions v3: An introduction to the analytic hierarchy process*. New York: Springer.
- Munien, I., & Telukdarie, A. (2024). Updating neoclassical economics with contemporary conceptions of homo economicus: a bibliometric analysis. *Quality & Quantity*, 59, 1123–1151. doi:[10.1007/s11135-024-02007-4](https://doi.org/10.1007/s11135-024-02007-4)
- Nadai, M. D., & Lepri, B. (2018). The economic value of neighborhoods: Predicting real estate prices from the urban environment. *5th International Conference on Data Science and Ad-*

- vanced Analytics (DSAA). Turin, Italy: IEEE. doi:[10.1109/DSAA.2018.00043](https://doi.org/10.1109/DSAA.2018.00043)
- Najafi Kashkooli, H., Hajipour, K., Arasteh, M., & Soltani, A. (2024). The impact of subway station proximity on apartment prices in Shiraz. *Transportation in Developing Economies*, 10, 16. doi:[10.1007/s40890-024-00198-x](https://doi.org/10.1007/s40890-024-00198-x)
- Nikpoor D., Reza Zadeh M., & Elhaghli Tabarnashli F. (2019). Analysis of the Role of Factors Affecting Land Price Using Geographical Weight Regression Model (Case Study: Babolsar City). *Geography and Territorial Spatial Arrangement*, 9(31): 93-112. doi:[10.22111/gaj.2019.4707](https://doi.org/10.22111/gaj.2019.4707) [In Persian]
- North, D. C. (2019). *Institutions, institutional change and economic performance* (Audible Audiobook by: Tantor Audio ed.). Cambridge: Cambridge University Press.
- Nunnington, N., Dimopoulos, T., & da Silva, F. A. (2025). Automated valuation models. In *The Income Approach to Property Valuation* (8th ed.). London: Routledge. doi:[10.1201/9781003490357](https://doi.org/10.1201/9781003490357)
- Olea, J., Hoyos, D., & García-Enríquez, J. (2025). Paving the way towards predistribution: A study on the introduction of a land value tax. *The Annals of Regional Science*, 74, 29. doi:[10.1007/s00168-024-01353-3](https://doi.org/10.1007/s00168-024-01353-3)
- Ozhegov, E. M., & Ozhegova, A. (2022). Distance in geographic and characteristics space for real estate pricing. *International Journal of Housing Markets and Analysis*, 15(5), 938-952. doi:[10.1108/IJHMA-04-2021-0041](https://doi.org/10.1108/IJHMA-04-2021-0041)
- Ozhegov, E. M., Ozhegova, A., & Mitrokhina, E. (2019). Distance in geographic and characteristics space for real estate price prediction. In *Analysis of Images, Social Networks and Texts* (pp. 63-72). Cham: Springer. doi:[10.1007/978-3-030-37334-4_6](https://doi.org/10.1007/978-3-030-37334-4_6)
- Palma, A. d., Li, Z.-C., & Yu, D.-P. (2023). *An analytical model for residential location choices of heterogeneous households in a monocentric city with stochastic bottleneck congestion*. Université de Cergy-Pontoise.
- Parishan, M., Nadayi Tosi, S., Farajirad, K., & Mirmiran, H. (2023). Presenting the ideal model for the management of tehran metropolitan area. *Physical Social Planning*, 10(2), 87-104. doi:[10.30473/psp.2023.65965.2638](https://doi.org/10.30473/psp.2023.65965.2638)
- Pilehvar, A. (2021). Spatial-geographical analysis of urbanization in Iran. *Humanities And Social Sciences Communications*, 8(63). doi:[10.1057/s41599-021-00741-w](https://doi.org/10.1057/s41599-021-00741-w)
- Polanyi, K. (2001). *The Great Transformation: The Political and Economic Origins of Our Time* (2nd ed.). Boston: Beacon Press.
- Poot, J. (2025). William Alonso (1933-1999): Urban economist and economic demographer par excellence. In P. Batey, & D. Plane (Eds.), *Great Minds in Regional Science*, Vol. 3 (pp. 235-260). Cham: Springer. doi:[10.1007/978-3-031-90625-1_13](https://doi.org/10.1007/978-3-031-90625-1_13)
- Rahdari, M., & Leylian, N. (2012). Estimate of demand function of housing, using the Hedonic price model (1378-88) case study: Kerman. *Journal of Economics and Modelling*, 3(10), 237-258.
- Ravetz, J., & Sahana, M. (2024, Sep 5). Where is the peri-urban? a working definition and global typology. In M. Sahana (Ed.), *Remote Sensing and GIS in Peri-Urban Research* (pp. 3-25). Amsterdam: Elsevier BV. doi:[10.1016/B978-0-443-15832-2.00001-0](https://doi.org/10.1016/B978-0-443-15832-2.00001-0)
- Razavi, M. M. (2013). Spatial analysis of Mashhad's house prices by geographically weighted regression. *Journal of Urban Ecology Research*, 4(7), 73-84. doi:[20.1001.1.25383930.1392.4.7.5.2](https://doi.org/20.1001.1.25383930.1392.4.7.5.2)
- Rey-Blanco, D., Zofio, J. L., & González-Arias, J. (2024). Improving hedonic housing price models by integrating optimal accessibility indices into regression and random forest analyses. *Expert Systems with Applications*, 235, 121059. doi:[10.1016/j.eswa.2023.121059](https://doi.org/10.1016/j.eswa.2023.121059)
- Ricardo, D. (2015). *On the principles of political economy and taxation*. Seattle, Washington: Arkose Press.
- Ritter, M., Hüttel, S., Odening, M., & Seifert, S. (2019). *Revisiting the relationship between land price and parcel size*. Berlin: Humboldt-Universität zu Berlin, DFG Research Unit 2569 FORLand "Agricultural Land Markets - Efficiency and Regulation". doi:[10.18452/19877](https://doi.org/10.18452/19877)
- Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy*, 82(1). doi:[10.1086/260169](https://doi.org/10.1086/260169)
- Rosenberg, M. (2025, April 29). *Learn about the Von Thünen model*. Retrieved from Thought Co: <https://www.thoughtco.com/von-Thünen-model-1435806>
- Rumiani Mahmoudi, K., Saeideh Zarabadi, Z. S., & Dadfar, S. (2025). Effectiveness of the theories of smart growth in controlling urban land and housing rent revisited: A meta-analysis and systematic review study. *Journal of Urban Economics and Planning*, 5(3), 144 -163. doi:[10.22034/uep.2024.446915.1471](https://doi.org/10.22034/uep.2024.446915.1471)
- Saaty, T. L. (1980). *The analytic hierarchy process: Planning, priority setting, resource allocation (decision making series)*. Columbus, Ohio: McGraw-Hill.
- Saharkhiz, M., Fatemi, S., & Barakchian, S. (2018). Hedonic analysis of land price (A case study in Tehran, Zone 8). *The Journal of Economics Studies and Policies*, 1(1), 227-242.
- Saremi H., Heydari M., & Aghaei F. (2018). Spatial Analysis of housing Price Using Geographically Weighted Regression (A Case Study in District 2 of Tehran Metropolitan City, Iran). *Urban Economics*, 3(2): 19-38. doi:[10.22108/ue.2018.109447.1056](https://doi.org/10.22108/ue.2018.109447.1056) [In Persian]
- Saremi, H., khandan, S., & Khandan, A. (2024). Investigating the effect of physical, environmental and economical factors on the price of commercial real estate: A case study of Samen area of Mashhad. *Urban Economics*, 9(1), 35-54. doi:[10.22108/ue.2024.140209.1280](https://doi.org/10.22108/ue.2024.140209.1280)
- Sayin, Y. (2019, November 22). *The economic costs of land use regulations*. Retrieved from D.C. POLICY CENTER: <https://www.dcpolicycenter.org/publications/economic-cost-land-use/>
- Schreier, M. (2024). *Qualitative content analysis in practice* (Online pub ed.). New York: SAGE. doi:[10.4135/9781529682571](https://doi.org/10.4135/9781529682571)
- Seok, K. W., Kim, E., & Wookjae, H. (2024). The association between SOC and land prices considering spatial heterogeneity based on finite mixture modeling. *The Korea Spatial Planning Review*, 114, 53-78. doi:[10.15793/kspr.2022.114.004](https://doi.org/10.15793/kspr.2022.114.004)
- Settlement Geography. (2015, 07 31). *Ricardian theory of rent / urban economics*. Retrieved from Planning Tank: <https://planningtank.com/settlement-geography/ricardo-theory-of-rent>

- Shahidi S. M., & Fadaei Nasab M. (2011). *Urban Land Policies in Iran after the Islamic Revolution*. Tehran: Omide Enghelab. [In Persian]
- Shin, K., Washington, S., & Choi, K. (2007). Effects of transportation accessibility on residential property values: Application of the spatial hedonic price model in Seoul, South Korea, metropolitan area. *Transportation Research Record: Journal of the Transportation Research Board*, 1994(1), 66-73. doi:[10.3141/1994-09](https://doi.org/10.3141/1994-09)
- Situ, M., & Karner, A. (2024). Choice or constraint? A locally tailored assessment of housing and transportation costs in central Texas. *Transportation Research Record: Journal of the Transportation Research Board*, 2678(11), 1562-1575. doi:[10.1177/03611981241245690](https://doi.org/10.1177/03611981241245690)
- Smith, N. (2010). *Uneven Development: Nature, Capital, And The Production Of Space*. New York: Verso.
- Soltani, A., Zali, N., Mirzaei, R., Heydari, M., Rahimi, A., & Hamidi, A. (2023). Multilevel impacts of urban amenities on housing prices in Tehran, Iran. *Journal of Urban Planning and Development*, 149(4), 05023028. doi:[10.1061/JUPDDM.UP-ENG-4434](https://doi.org/10.1061/JUPDDM.UP-ENG-4434)
- Spagnolo, F. S., Borgoni, R., Carcagnì, A., Michelangeli, A., & Salvati, N. (2024). A spatial semiparametric M-quantile regression for hedonic price modelling. *AStA Advances in Statistical Analysis*, 108, 159–183. doi:[10.1007/s10182-023-00476-w](https://doi.org/10.1007/s10182-023-00476-w)
- Sreekumar, D. (2023, August 28). *What is research methodology? Definition, types, and examples*. Retrieved from Paperpal: <https://paperpal.com/blog/academic-writing-guides/what-is-research-methodology>
- Tan, R., He, Q., Zhou, K., & Xie, P. (2019). The effect of new metro stations on local land use and housing prices: The case of Wuhan, China. *Journal of Transport Geography*, 79. doi:[10.1016/j.jtrangeo.2019.102488](https://doi.org/10.1016/j.jtrangeo.2019.102488)
- Tang, M., & Niemeier, D. (2021). How does air pollution influence housing prices in the bay area? *International Journal of Environmental Research and Public Health*, 18(22), 12195. doi:[10.3390/ijerph182212195](https://doi.org/10.3390/ijerph182212195)
- Taramino, R. (2018). *Anne Haila, urban land rent. Singapore as a property state*. Chichester, West Sussex: Wiley Blackwell, 291 pp.–2016. Ardeth. *A Magazine on the Power of the Project*, (3), 243-244.
- Tonucci, J. (2023). Property-led informality: Shifting Informal land development from popular housing to middle-class and elite speculation in Belo Horizonte. *International Journal of Urban and Regional Research*, 47(4), 527–545. doi:[10.1111/1468-2427.13196](https://doi.org/10.1111/1468-2427.13196)
- Trojaneck, R., Gluszek, M., & Tanas, J. (2018). The effect of urban green spaces on house prices in Warsaw. *International Journal of Strategic Property Management*, 22(5), 358-371. doi:[10.3846/ijspm.2018.5220](https://doi.org/10.3846/ijspm.2018.5220)
- Tuofu, H., Qingyun, H., Dongxiao, Y., & Xiao, O. (2021). Evaluating the impact of urban blue space accessibility on housing price: A spatial quantile regression approach applied in Changsha, China. *Frontiers in Environmental Science*, 9. doi:[10.3389/fenvs.2021.696626](https://doi.org/10.3389/fenvs.2021.696626)
- UN-Habitat. (2020). *World cities report 2020: The value of sustainable urbanization*. New York: UN-Habitat.
- Vasconcelos, M. (2024, Jul 22). *Automated valuation models (AVMs) in real estate: A powerful tool for homeowners and buyers*. Retrieved from Home Shift Team: <https://homeshift-team.com/learn/buying/automated-valuation-models/>
- VillaTerras. (2025, 07 01). *Land value evaluation methods and techniques*. Retrieved from VillaTerras: <https://villaterras.com/villa-terras-real-estate-platform/land-evaluation/land-value-evaluation-types/>
- Watkins, D. C. (2022). *Secondary data in mixed methods research*. Thousand Oaks, CA, United States: SAGE.
- Wei, C., Fu, M., Wang, L., Yang, H., Tang, F., & Xiong, Y. (2022). The research development of hedonic price model-based real estate appraisal in the era of big data. *Land*, 11(3), 334. doi:[10.3390/land11030334](https://doi.org/10.3390/land11030334)
- Williamson, O. E. (2007). The economic institutions of capitalism. Firms, markets, relational contracting. In C. Boersch, & R. Elschen (Eds.), *Das Summa Summarum des Management* (pp. 61–75). Gabler. doi:[10.1007/978-3-8349-9320-5_6](https://doi.org/10.1007/978-3-8349-9320-5_6)
- Wong, M. (2018). A tractable approach to compare the hedonic and discrete choice frameworks. *Journal of Housing Economics*, 41, 135-141. doi:[10.1016/j.jhe.2018.06.001](https://doi.org/10.1016/j.jhe.2018.06.001)
- Wu, C., Ye, X., Du, Q., & Luo, P. (2017). Spatial effects of accessibility to parks on housing prices in Shenzhen, China. *Habitat International*, 63, 45-54. doi:[10.1016/j.habitatint.2017.03.010](https://doi.org/10.1016/j.habitatint.2017.03.010)
- Yang, Y., & Ye, L. (2020, October 15). *Peri-urban development*. doi:[10.1093/obo/9780190922481-0008](https://doi.org/10.1093/obo/9780190922481-0008)
- Zabel, J. (2015). The hedonic model and the housing cycle. *Regional Science and Urban Economics*, 54(C), 74-86. doi:[10.1016/j.regsciurbeco.2015.07.005](https://doi.org/10.1016/j.regsciurbeco.2015.07.005)
- Zali S., Pahlavani P., & Bigdali B. (2023). A spatial-temporal analysis of the factors effective on housing prices (case study: District 5 of Tehran municipality). *Town and Country Planning*, 15(1): 115-130. doi:[10.22059/jtcp.2022.341584.670318](https://doi.org/10.22059/jtcp.2022.341584.670318) [In Persian]
- Ziemann, V., & et al. (2023). *Urban house price gradients in the post-COVID-19 era*. OECD Economics Department Working. Organisation for Economic Co-operation and Development-OECD. doi:[10.1787/3c94ca85-en](https://doi.org/10.1787/3c94ca85-en)

