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Article

The impact of public transportation accessibility on apartment prices in Shiraz: A comparative study in a developing urban context

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Abstract: Public transportation accessibility can significantly affect real estate prices. However, the extent of this impact can greatly vary depending on the specific urban context. This study investigates the impact of accessibility to public transportation on apartment prices in two distinct districts of Shiraz, Iran: District 1, which has the highest vehicle ownership per capita, and District 8, which has the lowest. Using 182 transactions from District 1 and 65 transactions from District 8, a hedonic pricing model was employed to analyze data on apartment prices, area, age, number of bedrooms, and distances to the nearest bus stop, subway station, park, hospital, school, and the Central Business District. The findings revealed distinct patterns across the districts. In District 8, where vehicle ownership per capita is low, accessibility to bus stops significantly influenced apartment prices. Conversely, accessibility to subway stations did not significantly impact apartment prices in either district, nor did bus stop accessibility in District 1. This study underscores the varying influence of public transportation accessibility on property prices in different urban contexts, particularly in relation to vehicle ownership levels.

Keywords: public transportation accessibility; value capture; apartment price; vehicle ownership; hedonic price model; Shiraz

1. Introduction

The relationship between public transportation accessibility and residential property values has been the subject of interest in urban economics and real estate studies [1,2]. The value of residential properties is influenced by various factors, such as the physical characteristics of the buildings, socio-economic characteristics of the neighborhoods [3,4], presence of green areas [5,6], and accessibility to public transportation [7]. Public transportation accessibility can be defined as the ease of reaching various destinations using public transportation modes, such as bus stops and subway stations [8]. Public transportation can impact residential property values by reducing travel costs, increasing mobility options, and enhancing environmental quality. However, the extent of this impact can vary significantly depending on the specific urban context.

High vehicle ownership levels often correlate with decreased reliance on public transportation, as individuals with personal vehicles may prefer the convenience and flexibility they offer [9]. This shift can lead to decreased demand for public transportation, particularly in areas with high vehicle ownership rates. Yet, many studies in this field have simply reported correlations without critically examining the contextual nuances that might explain these variations. For example, while some research suggests that high-quality public transportation reduces vehicle dependency

[10], others do not account for local socio-economic disparities or infrastructural imbalances. This critical gap in the literature limits our understanding of how and why these relationships manifest differently across urban settings.

One standard method used to measure the impact of public transportation accessibility on residential property values is the hedonic pricing model (HPM). The hedonic pricing model assumes that the price of a property is determined by the marginal willingness to pay for its attributes, including public transportation accessibility. The hedonic pricing model can estimate the implicit prices of each attribute by regressing the observed property prices on a set of explanatory variables that capture the property and location characteristics.

In many developing countries, rapid urbanization is accompanied by uneven investments in public transportation and marked disparities in socio-economic conditions, which lead to significant variations in travel behavior and property values within the same urban area. Shiraz exemplifies the complex urban dynamics characteristic of many developing cities, where disparities in vehicle ownership, infrastructural investment, and public transit reliance yield distinct spatial patterns. This study focuses on two districts—District 1 and District 8—to elucidate the impact of public transportation accessibility on apartment prices. District 1, exhibiting the highest vehicle ownership per capita (0.509 vehicles per person), typifies areas where private vehicle use predominates, potentially attenuating the effect of public transit on property values. Conversely, District 8, with the lowest vehicle ownership per capita (0.208 vehicles per person), is indicative of a setting with greater reliance on public transportation. The deliberate selection of these contrasting districts serves as a natural experiment, facilitating a rigorous comparative analysis of how differential dependence on public transit influences real estate prices. This approach not only strengthens the internal validity of our findings but also offers valuable insights for urban planning and policy formulation in similar developing contexts.

The remainder of this paper is organized as follows: Section 2 reviews relevant literature and identifies research gaps; Section 3 details the data collection and methodology; Section 4 presents the empirical findings; Section 5 discusses the results in the context of urban policy; and Section 6 concludes with recommendations and future research directions.

2. Literature review

Numerous studies have provided insights into how access to public transportation impacts property or housing prices based on the land rent theory proposed by Alonso [11], Mills [12], and Muth [13], yielding mixed results. The impact of subway stations and bus stops on residential property values varies depending on factors such as location, type of transportation service, type of property, and temporal and spatial scales [14–16].

Generally, proximity to public transportation has been found to positively affect housing prices, indicating that it is a desirable amenity for residents. For instance, studies conducted in Beijing and Lisbon found that properties with access to metro lines and bus stops have higher housing prices [17,18] However, different studies found it insignificant [19,20] and even had adverse effects in some cases [21].

Research on the impact of subway stations on property values has revealed a complex relationship influenced by various factors. Bowes and Ihlanfeldt [22] found that the effects of rail stations on property values are multifaceted, with commuting costs, retail activities, and crime playing significant roles. Debrezion et al. [14] further emphasized the importance of spatial considerations, noting that the impact of railway stations on commercial property values is more pronounced at short distances. In contrast, the effect on residential property values dominates at longer distances. Dewees [23] and Hess and Almeida [24] both highlighted the role of proximity, with Dewees [23] noting an increase in the slope of rent surface with distance from subway stations, and Hess and Almeida [24] finding a positive impact on property values for homes located closer to light rail stations. Forouhar and Hasankhani [25] highlighted the importance of contextual factors, with the Tehran Metro having a positive impact on property values in lower-income neighborhoods but a negative effect in high-income areas. Li [26] further complicated the picture by identifying a positive but nonlinear effect of subway accessibility on property values, with the lowest uplift in areas immediately adjacent to the stations. These varied findings demonstrate how subway impacts depend on multiple contextual factors that must be considered when evaluating transit-value relationships.

Similarly, the influence of bus stop accessibility on the value of residential properties can differ significantly, depending on the urban context. Yang et al. [27] found a positive correlation between bus accessibility and property prices, with a 0.5% increase in property prices for every bus stop within 500 m of Xiamen, China. Wang et al. [28] found a positive relationship between the number of bus stops within a 300–1500-m radius of a property and its sale price in Cardiff, Wales. Muñoz-Raskin [29] found that in Bogotá, Colombia, properties closest to bus stops were valued nearly 10% higher than those more than a 5-min walk away. In Seoul, South Korea, Cervero and Kang [30] studied the impact of a new bus rapid transit (BRT) system and found that properties less than 300 m from bus stops increased in value. Specifically, residential properties saw a nearly 10% increase, whereas nonresidential properties experienced a 25% increase when considering a smaller impact distance of 150 m. In Beijing, Deng et al. [31] found that for every 100-m decrease in the distance to a BRT station, the listed prices of residential properties increased by approximately 1.32% to 1.39%. Pang and Jiao [32] argued that the impact of proximity to BRT stops on pre-owned home prices varied along different routes. For instance, homes within a 5–10-min walk to BRT1 stations saw a price premium of 5.35%, whereas the impact of proximity to BRT3 stops was minimal. Soltani et al. [33] investigated the factors influencing apartment prices in Tehran’s metropolitan area. They found that distance to facilities, such as bus rapid transit stations, negatively impacts prices, signaling their role in enhancing accessibility. The collective evidence underscores how bus transit impacts vary based on system quality, urban density, and local travel behaviors.

Various techniques have been employed to gauge the impact of public transportation accessibility on residential property value. The Hedonic Price Model (HPM) is the most frequently used method for exploring the relationship between proximity to public transportation facilities and property values [34]. HPM views a property’s price as a function of its features, which include location-based attributes such as proximity to a bus stop. Some studies used the difference in differences (DID) model [35]. The DID method combines before-after and treatment-control group comparisons, providing an intuitive and robust way to measure the causal effect of treatment (introduction or change in public transport) on an outcome (residential property values). In addition, a series of studies employed Geographically Weighted Regression (GWR) to assess the impact of public transportation on residential property values [36]. The Geographically Weighted Regression (GWR) model is a localized version of spatial regression that allows the relationships between variables and change across space.

The relationship between vehicle ownership and property values is complex and context-dependent [37]. Huang et al. [38] examined how changes in the cost of car ownership influence the house price gradient concerning the distance from the Central Business District (CBD) in Singapore. The theory suggests that housing prices near the city center will also increase as transportation costs increase. Residents in denser, urban, or more transit-accessible neighborhoods tend to own fewer cars, affecting their residential location choices [39]. In addition, the characteristics of vehicle traffic, such as the average daily traffic and nighttime volumes, can have a modest but statistically significant impact on property values [40]. However, accurately appraising the pricing implications of these variations is difficult because of a lack of secondary market trading and vehicle heterogeneity.

Overall, the impact of accessibility by public transportation on residential property values, which has been comprehensively analyzed using diverse methods and data, appears context-dependent and varies across different cities and urban environments. While proximity to public transportation facilities can sometimes enhance property values, it can also have adverse effects owing to external factors associated with public transit systems. This variability underscores the complexity of urban dynamics and the role of public transportation infrastructure in shaping the property markets. **Table 1** summarizes studies on the influence of public transportation accessibility on residential property values.

This synthesis underscores two critical gaps addressed by our study. First, while prior work focuses predominantly on mature transit systems in developed cities (e.g., Lisbon, Seoul), fewer studies examine evolving networks in developing contexts like Shiraz, where infrastructural immaturity and socio-economic disparities may alter outcomes. Second, the moderating role of vehicle ownership—a proxy for transit dependence—remains underexplored. By analyzing districts with diametric vehicle ownership rates, this study isolates how car dependency mediates the transit-price relationship, offering novel insights into urban mobility's interplay with housing markets in rapidly developing economies.

Table 1. Summary of studies on the effect of public transportation accessibility on residential property values.

Authors	**City**	**Data**	**Method**	**Major findings**
Martínez and Viegas [18]	Lisbon, Portugal	A total of 12,488 residential properties on sale	Spatial hedonic pricing models	Proximity to one or two metro lines leads to significant property value changes.
Munoz-Raskin [29]	Bogotá, Colombia	2000 to 2004 Department of Housing Control data	Econometric analysis	Properties closest to bus stops were valued nearly 10% higher than those more than a 5-min walk away.
Forouhar and Hasankhani [25]	Tehran, Iran	A total of 2160 sales transactions during 2004–2017	Trend analysis, the difference-in-difference model, and qualitative impact assessment methods	There are significant increases in premiums for residential properties near the subway stations in lower-income neighborhoods. In contrast, there is an adverse effect for residential properties lying close to the subway stations in high-income neighborhoods.
Yang et al. [27]	Xiamen, China	Database of 22,586 secondhand residential properties in 358 residential estates	Spatial hedonic pricing models (one standard and three Box-Cox transformed) and two spatial econometric models	For every bus stop within 500 m, the price of a property is 0.5% higher, all else being equal.
Chwiałkowski and Zydroń [41]	Poznań, Poland	2561 residential transactions completed in 2020	Hedonic pricing method (HPM)-OLS (ordinary least squares) and WLS (weighted least squares)	Convenient accessibility to trams is positively related to housing prices. No statistically significant relationship between housing prices and distance from bus stops.
Kashkooli et al. [42]	Shiraz, Iran	Various property attributes along subway line 1.	Hedonic Pricing Model	Distance to subway stations has an insignificant effect on apartment prices in Shiraz.

3. Materials and methods

The selection of the hedonic pricing model (HPM) is based on its robust capacity to decompose the value of a property into the implicit prices of its individual attributes [14]. Unlike alternative methods, such as spatial econometric models or the difference-in-differences approach, the HPM offers a direct estimation of the marginal willingness to pay for characteristics like accessibility to public transportation, building area, and age. This makes it particularly advantageous for our study, as it aligns with our objective of isolating and quantifying the impact of transit accessibility on apartment prices in Shiraz. Moreover, the extensive use of HPM in similar urban contexts further supports its suitability for addressing the nuanced variations in property values observed in districts with contrasting vehicle ownership patterns. This methodological choice is thus firmly grounded in both theoretical and empirical precedents.

This study focuses on apartment dwellings, the predominant residential type in Shiraz, ensuring a homogeneous and data-rich sample. Detached houses and other residential types were excluded due to their heterogeneity, which could confound the analysis of transit accessibility effects.

3.1. Case study

Shiraz is a city in southwest Iran with a population of approximately 1.8 million. The city is divided into 11 urban districts covering an area of 240 km^2. Shiraz's public transportation system is vital to urban mobility and development. It comprises buses, taxis, and subways, each with advantages and disadvantages. Buses are the most widely used mode of transportation in Shiraz. They serve all city districts and connect them to neighboring cities and villages. However, buses can sometimes be crowded, slow, and unreliable, particularly during peak hours. Shiraz's subway system consists of six lines. Currently, subway line 1 is the only operational line, whereas the other lines are still under construction. Line 1 covers six districts in Shiraz: 1, 2, 6, 7, 8, and 11. It spans 24.5 km between Shiraz Airport and Ehsan Square, with 20 stations. The construction of the subway system began in 2001, and the first section opened in 2014, followed by the completion of the second section in 2017 (**Figure 1**).

According to Shiraz's Transportation and Traffic Master Plan [43], vehicle ownership per capita varies significantly across districts. District 1 has the highest vehicle ownership rate of 0.509 per capita. This district covers an area of 25.66 km^2 and has a population of 150,200 people (49,693 households), according to Shiraz's Statistical Yearbook [44]. In contrast, District 8 has the lowest vehicle ownership per capita of 0.208. District 8 covers an area of 3.6866 km^2 and has a population of 24,417 people (8248 households). There are five subway stations and 359 bus stops in District 1, whereas District 8 has two subway stations and 166 bus stops.

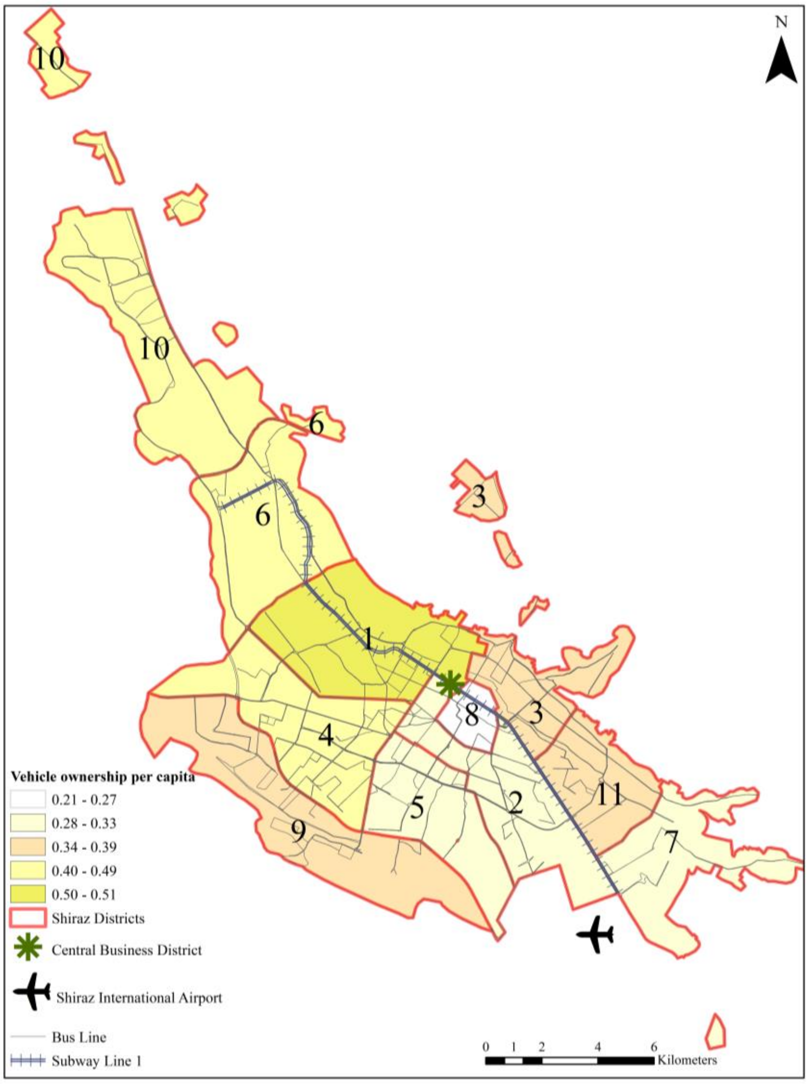

Figure 1. Case study of Shiraz, transportation infrastructure, and vehicle ownership per capita by district.

3.2. Selection of variables for the model

The selection and categorization of the variables in this study were guided by the objective of comprehensively capturing the factors influencing apartment prices in Shiraz. The variables were divided into structural, accessibility, and neighborhood. Structural variables include area, age, and number of bedrooms in the apartment, representing the property's physical characteristics. Accessibility variables encompass distances to the nearest subway station, bus stop, and Central Business District (CBD), reflecting the ease of reaching key destinations. Finally, neighborhood variables consist of distances to the nearest park, hospital, and school, indicating the quality and amenities of the surrounding area. The selection of these variables was also influenced by the availability of data and the context-specific nature of real estate markets in Shiraz, Iran. **Table 2** presents the variables used in the model.

Table 2. Selected variables used in the model.

Variable categories	Variables	Description	Data source
Dependent Variable	Apartment Price	The price at which the apartment was sold	Real estate marketplaces
Structural variables	Area	Size of the apartment in square meters	Real estate marketplaces
	Age	Age of the apartment in years	Real estate marketplaces
	Number of bedrooms	Number of bedrooms in the apartment	Real estate marketplaces
Accessibility Variables	Subway_Near_Dummy	Dummy: 1 = within 1 km, 0 = otherwise	GIS
	Distance to the nearest bus stop	Euclidean (straight-line) distance in meters from the apartment to the nearest bus stop	GIS
	Distance to the Central Business District (CBD)	Euclidean (straight-line) distance in meters from the apartment to the CBD	GIS
Neighborhood Variables	Distance to the nearest park	Euclidean (straight-line) distance in meters from the apartment to the nearest park	GIS
	Distance to the nearest hospital	Euclidean (straight-line) distance in meters from the apartment to the nearest hospital	GIS
	Distance to the nearest school	Euclidean (straight-line) distance in meters from the apartment to the nearest school	GIS

3.3. Data description

Due to the absence of an official repository of real estate transaction data in Iran, this study relied on primary data collected through structured surveys administered to local real estate agents. These agents were selected based on their extensive market knowledge and proximity to public transportation hubs, ensuring that they could provide reliable information on recent apartment transactions. To mitigate potential biases inherent in survey-based data, we employed several strategies: first, we pre-tested the questionnaire with a subset of agents to refine the instrument and improve clarity; second, we cross-validated the reported transaction prices with multiple agents operating within the same geographic area. Despite these measures, we acknowledge that the use of survey data introduces certain limitations regarding sample size and accuracy. Nevertheless, this approach provided a timely and contextually relevant snapshot of the housing market dynamics in Shiraz, thereby supporting the study's broader objectives.

We defined catchment areas around public transportation stations based on national urban planning standards (e.g., Iranian Ministry of Roads and Urban Development) and Shiraz's spatial context, including population density and walkability conditions. A 400-m radius was utilized for bus stops, and a 1000-m radius was used for subway stations, reflecting typical walkable distances established in prior studies and planning guidelines [34,42,45]. The location of each sold apartment was recorded as a point feature using ArcGIS. Using this software, we calculated the distances from each apartment to the nearest bus stop, subway station, park, hospital, school, and the Central Business District (CBD). Catchment distances were measured using network-based analysis to better reflect pedestrian accessibility rather than Euclidean distance. Not all properties fell within the catchment areas of both bus stops and subway stations. To address this issue, we introduced a dummy variable for the presence of a subway station within a 1 km radius. The dataset includes transactions completed in 2024, offering a recent snapshot of the real estate market in the studied districts. The data collection process lasted two months, from August to September 2024. During this period, we collected 182 transactions in District 1 and 65 transactions in District 8 (**Figure 2**). **Table 3** presents a descriptive analysis of the variables, including each district's minimum, maximum, mean, and standard deviation.

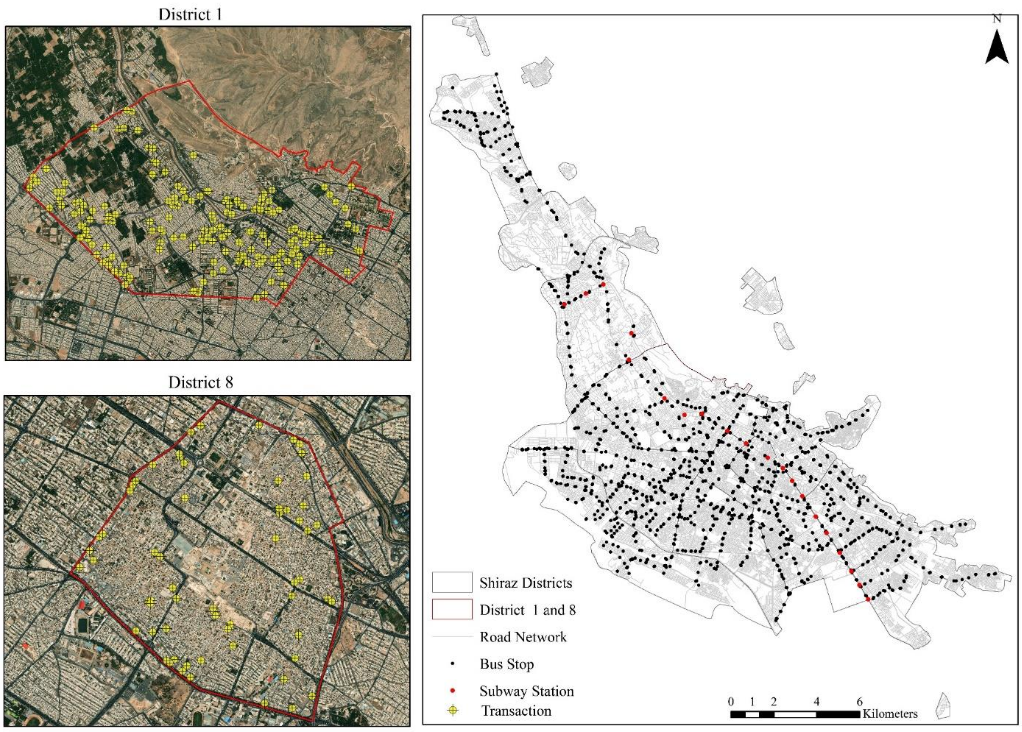

Figure 2. Location of apartment transactions in District 1 and District 8.

Table 3. Descriptive statistics of variables for each district.

District	Variable	*N*	Minimum	Maximum	Mean	Std. Deviation
	Apartment Price (toman)	182	1,950,000,000	19,800,000,000	8,120,065,934	3,195,590,812
	Area (m²)	182	57	200	141	30
	Age (years)	182	0	45	8	9
	Number of bedrooms	182	1	4	3	1
District 1	Subway_Dist (actual distances in meters)	182	6	2621	1101	797
	Distance to the nearest bus stop (m)	182	16	391	169	83
	Distance to the nearest school (m)	182	12	665	207	127
	Distance to the nearest hospital (m)	182	87	2282	867	464
	Distance to the nearest park (m)	182	81	2132	884	461
	Distance to the Central Business District (CBD) (m)	182	268	7352	3491	1857
	Apartment Price (Toman)	65	1,100,000,000	8,420,000,000	3,358,692,308	1,958,795,923
	Area (m²)	65	55	180	114	29
	Age (years)	65	1	52	22	16
	Number of bedrooms	65	1	4	2	1
	Subway_Dist (actual distances in meters)	65	55	1569	801	479
District 8	Distance to the nearest bus stop (m)	65	17	370	137	96
	Distance to the nearest school (m)	65	12	476	209	123
	Distance to the nearest hospital (m)	65	154	1256	764	294
	Distance to the nearest park (m)	65	240	1288	754	305
	Distance to the Central Business District (CBD) (m)	65	388	2691	1532	591

4. Model description

The hedonic model is a widely used method in real estate economics for estimating the impact of various property characteristics on its value [34]. This model assumes that the price of a property is determined by combining the values of its characteristics, such as location, size, amenities, and other features. The hedonic model is based on the idea that the price of a property can be considered a function of its attributes.

The hedonic pricing model consists of three essential mathematical functions, where represents housing prices, α_0 represents the constant term, β_K represents the coefficient of the variables (K = 1, 2, 3, ..., n, where n is the number of variables), and $X_{\mathrm{a}iK}$, X_{n}, and $X_{\mathrm{st}K}$ represent the i_{th} characteristic variable of accessibility variables, the j_{th} characteristic variable of neighborhood variables, and the t_{th} factor of structure variables, respectively [34]. The three basic mathematical functions are as follows:

Linear function. Equation (1) shows the linear model of how housing prices are affected by various characteristics. The regression coefficients indicate how much housing prices change on average when the characteristics change by one unit.

$$Price = \alpha_0 + \beta_K X_{\mathrm{a}iK} + \beta_K X_{\mathrm{n}jK} + \beta_K X_{\mathrm{st}K} + \varepsilon \tag{1}$$

Log-linear function. Equation (2) uses the logarithmic form of housing prices and their characteristics to estimate the price elasticity of each characteristic. Therefore, coefficients measure how responsive housing prices are to percentage changes in characteristics.

$$\text{Ln } Price = \alpha_0 + \beta_K \ln X_{\text{a}iK} + \beta_K \ln X_{\text{n}jK} + \beta_K \ln X_{\text{st}K} + \varepsilon \tag{2}$$

Semi-log function. Equation (3) uses the linear form of characteristics and logarithmic form of housing prices to estimate the ratio of each characteristic price to the total price. Thus, the regression coefficients measure how much the housing price changes in percentage when the characteristic price changes by one unit.

$$\text{Ln } Price = \alpha_0 + \beta_K X_{\text{a}iK} + \beta_K X_{\text{n}jK} + \beta_K X_{\text{st}K} + \varepsilon \tag{3}$$

The data collected for the model were used to test the three functional forms of the hedonic pricing model through regression analysis. The results showed that the semi-logarithmic form produced the highest R^2 value, indicating the best statistical fit. As a result, the semi-logarithmic form of the hedonic pricing model was chosen for statistical analysis of residential values near public transportation stations. This model estimates the ratio of each characteristic price to the total property price. In other words, the model measures how much housing price changes in percentage when the characteristic price changes by one unit. Thus, Equation (4) for the effect of proximity to a bus stop on apartment prices in this case study is as follows:

$$\begin{gathered}\ln(\text{price}) = \beta_0 + \beta_1(\text{Area}) + \beta_2(\text{Age}) + \beta_3(\text{Bedrooms}) + \beta_4(Subway\_Near\_Dummy) + \beta_5(\text{D\_Bus}) + \\ \beta_6(\text{D\_School}) + \beta_7(\text{D\_Hospital}) + \beta_8(\text{D\_Park}) + \beta_9(\text{D\_CBD}) + \epsilon\end{gathered} \tag{4}$$

where ln (price) is the natural logarithm of the apartment prices, β_0 is the constant term. β_1, ..., β_9 are the parameters of the model, representing how much ln (price) changes with a one-unit change in the corresponding factor, assuming that all other factors remain the same. ϵ is the error term.

5. Results

We employed the ordinary least squares (OLS) regression method to estimate the model's coefficients. These coefficients offer insights into the magnitude and direction of each independent variable's influence on apartment prices. This includes the impact of proximity to public transportation stations on apartment prices while controlling for other factors.

The normality of the data was assessed using the Kolmogorov-Smirnov test. The test results were not significant (p = 0.200 for both districts), indicating that the data did not deviate substantially from a normal distribution. The adjusted R^2 values for the regression models were 0.764 for District 1 and 0.739 for District 8, suggesting that approximately 76% and 74% of the variation in apartment prices is explained by the models in Districts 1 and 8, respectively. These values indicate a good overall fit.

To address potential concerns regarding multicollinearity among the independent variables—particularly among the distance measures—we computed the Variance Inflation Factor (VIF) for all variables. All VIF values were below 5, which confirms that multicollinearity is not a significant issue.

Table 4. Regression results of ordinary least squares regression.

Location	**Adjusted R^2**	**Variables**	**Coefficient**	***t***	**VIF**	**Sig.**
Regression of the characteristic variables of property prices within District 1	0.764	Constant	21.397	182.914	2.629	0.000
		Area	0.009^{***}	11.500	1.213	0.000
		Age	-0.012^{***}	−6.400	2.362	0.000
		Number of bedrooms	−0.023	−0.586	2.651	0.559
		Subway_Near_Dummy	−0.006	−0.131	1.049	0.896
		Distance to the nearest bus stop	0.000	−0.799	1.302	0.426
		Distance to the nearest school	0.000	1.949	2.014	0.053
		Distance to the nearest hospital	-7.947×10^{-5}	−1.766	1.508	0.079
		Distance to the nearest park	1.228×10^{-5}	0.313	1.913	0.754
		Distance to the Central Business District (CBD)	$6.310 \times 10^{-5***}$	5.758	2.629	0.000
Regression of the characteristic variables of property prices within District 8	0.739	Constant	21.666	73.128	1.222	0.000
		Area	0.008^{**}	5.623	1.352	0.000
		Age	-0.025^{**}	−9.407	1.257	0.000
		Number of bedrooms	0.036	0.651	2.176	0.518
		Subway_Near_Dummy	−0.042	−0.374	1.371	0.710
		Distance to the nearest bus stop	-0.001^{*}	−2.048	1.350	0.045
		Distance to the nearest school	-4.929×10^{-5}	−0.140	1.320	0.889
		Distance to the nearest hospital	2.875×10^{-5}	0.197	2.136	0.845
		Distance to the nearest park	6.710×10^{-6}	0.038	1.683	0.970
		Distance to the Central Business District (CBD)	0.000	−1.596	1.222	0.116

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

The results of the OLS regression analysis reveal several important insights into the factors influencing apartment prices in Shiraz’s Districts 1 and 8, both in terms of proximity to public transportation and various property characteristics. The detailed results of the OLS regression analysis are presented in **Table 4**.

As expected, apartment size (area) plays a significant role in determining property prices in both districts. The positive coefficients for the area variable indicate that larger apartments are associated with higher prices. In District 1, each additional square meter increases the price by approximately 0.009%, while in District 8, the increase is slightly lower at 0.008%. This suggests that in both districts, buyers are willing to pay more for larger living spaces, which is consistent with typical housing market trends. The magnitude of the effect is slightly higher in District 1, which could reflect stronger demand in this area, potentially due to its higher socioeconomic status and better accessibility to amenities in Shiraz.

The age of the apartment is another critical factor affecting apartment prices. In both districts, older apartments tend to have lower prices. Specifically, each additional year of the apartment’s age results in a decrease of 0.012% in District 1 and 0.025% in District 8. The more significant effect in District 8 could be due to the relatively older housing stock in this district, where buyers may prefer newer constructions or renovations due to concerns about building quality or the need for modernization. This age-related depreciation in apartment prices emphasizes the importance of building condition and infrastructure in the decision-making process of potential buyers.

Interestingly, the number of bedrooms does not show a statistically significant impact on apartment prices in either district. This finding suggests that, in these areas, the total floor area of the apartment might be more important to buyers than the specific number of rooms. It is possible that buyers prioritize overall space and layout rather than focusing on the number of bedrooms when choosing a property. This could reflect a shift in urban housing preferences, where buyers increasingly look for open-plan living spaces that can be adapted to different needs.

The proximity to public transportation, particularly subway and bus stations, exhibits mixed results across the two districts. Proximity to subway stations does not significantly impact apartment prices in either district, which could be attributed to the current limitations of Shiraz's metro system in these specific districts. It suggests that the subway may not yet be a decisive factor in the housing market within these areas, possibly due to underdeveloped metro infrastructure or lower awareness of its potential benefits. However, bus stop proximity is significant in District 8, where vehicle ownership is lower, indicating that residents in this district may be more reliant on public transit for daily commuting. The negative coefficient for bus stop proximity in District 8 implies that properties further from bus stops tend to have lower prices, reflecting a stronger demand for housing near accessible public transportation options in this district.

The proximity to amenities such as schools, hospitals, and parks does not significantly affect apartment prices in either district, suggesting that, in this case, the availability of such amenities might not be a major consideration for property buyers in Shiraz. This could be due to a variety of factors, such as the high availability of these amenities across both districts, or the possibility that buyers prioritize other factors, such as transportation access or apartment size, over the presence of nearby schools or healthcare facilities.

Proximity to the CBD is a statistically significant factor in District 1, where being closer to the central area of the city results in higher apartment prices. The positive coefficient for the CBD variable in District 1 suggests that properties closer to the city center are more desirable due to their proximity to commercial, cultural, and recreational amenities. However, this effect is not significant in District 8, which may reflect differences in the overall urban structure and demand patterns between the two districts. In District 8, where vehicle ownership is lower, the presence of other transport infrastructure (such as bus stops) may play a more critical role than proximity to the CBD.

While some variables, such as proximity to subway stations, were statistically insignificant, they were retained in the model due to their theoretical relevance and potential policy implications. For instance, the insignificant impact of subway proximity highlights the limited operational scope of Shiraz's subway system, which might change as the system expands.

6. Discussion

Shiraz, as a principal metropolitan hub in southern Iran, faces a range of transportation challenges that are emblematic of broader issues typically encountered by cities in developing countries. These challenges include inefficiencies in the public transportation system, an overreliance on private automobiles, inadequate accessibility for elderly populations, and elevated rates of traffic accidents and environmental pollution and occasional episodes of environmental pollution, particularly in areas with high traffic density [42]. Additionally, like many rapidly urbanizing cities in developing nations, Shiraz experiences pressure from swift population growth and urban expansion, which further complicates its transportation system and exacerbates existing infrastructure gaps. These challenges provide important context for understanding the dynamics at play in Shiraz's housing market, as the city's unique status as a developing urban center influences how public transportation accessibility impacts property values.

The results support the notion that public transportation accessibility significantly shapes apartment prices, particularly in areas with lower vehicle ownership. In District 8, where car ownership is low, proximity to bus stops significantly impacted apartment prices. This finding aligns with the economic theory of accessibility and is consistent with studies such as Forouhar and Hasankhan [25] and Muñoz-Raskin [29], which report that improved transit access increases property values in low-car communities. Conversely, in District 1, with the highest vehicle ownership rate in Shiraz, public transportation accessibility did not significantly influence apartment prices. This suggests that when private vehicles are readily available, their influence on travel choices weakens the significance of public transportation for property value.

Although our current analysis indicates that subway accessibility does not exert a statistically significant influence on apartment prices in the studied districts, this finding should be interpreted in light of the limited operational scope of Shiraz's metro system at present. Currently, only a single subway line is operational, and its restricted coverage may not provide sufficient benefits in terms of reduced travel times or enhanced connectivity to substantially influence property values. However, as the metro network expands—integrating additional lines and covering more urban areas—a more developed subway system could markedly improve public transit accessibility. Enhanced connectivity and increased service frequency are likely to reduce commuting times and boost the overall appeal of living near subway stations. This observation is also supported by research from Kashkooli et al. [42] and similar studies in other developing urban contexts. Research from major cities such as Tehran and Bogotá demonstrates that metro expansions can lead to significant increases in nearby property values once the network reaches critical mass, suggesting similar long-term potential for Shiraz.

These findings underscore the critical importance of considering local contexts, such as vehicle ownership levels and the stage of public transportation development, when analyzing real estate markets, particularly in developing cities like Shiraz. In rapidly urbanizing areas where infrastructure is still developing and where vehicle ownership patterns may differ significantly from more established urban centers, generalizations regarding the impact of public transportation on property values may not hold true. In many developing countries, including Iran, the reliance on private vehicles remains high due to gaps in public transportation coverage and infrastructure. This can create unique dynamics in the real estate market, where public transit access may not be as significant for property values in areas with high vehicle ownership. Such observations parallel urban housing studies in cities like Jakarta and Manila, where car dependency moderated the relationship between transit proximity and property price appreciation.

Further, the context of indefinite property ownership in Iran is essential for future research. Unlike countries such as China, which have limited property ownership duration, Iranian buyers might be more willing to pay a premium for apartments with good public transportation accessibility, knowing that they and their descendants can benefit from this feature for an extended timeframe. This unique aspect of the Iranian housing market could partially explain the patterns observed in our data and warrants further investigation. This cultural and legal distinction in housing markets might partly explain observed pricing sensitivities and has few direct analogues in the comparative literature, thereby offering a promising area for further inquiry.

These findings offer valuable insights for policymakers who aim to improve urban mobility and housing affordability. In areas with lower vehicle ownership, prioritizing and expanding public transportation infrastructure, particularly around key employment and service areas, can enhance residential property values and encourage sustainable development. This aligns with the concept of transit-oriented development (TOD), where land-use planning integrates seamlessly with public transportation networks, maximizing accessibility benefits and creating vibrant communities. Studies from Curitiba, Brazil, and Seoul, South Korea, have shown that such TOD approaches can simultaneously elevate real estate markets and reduce urban congestion, supporting a similar strategy for Shiraz.

The primary limitation of this study was the data-collection process. Due to the absence of an official source of apartment transaction data in Iran, we relied on questionnaires filled out by real estate agents, which resulted in a limited sample size. While the real estate agents were chosen for their local market knowledge, future research could address limitations by using larger datasets, incorporating additional variables such as neighborhood quality and crime rates, and investigating other cities with similar characteristics.

7. Conclusion

This study examined the influence of public transportation accessibility and structural characteristics on apartment prices in two contrasting districts of Shiraz, Iran—District 1, characterized by high private vehicle ownership, and District 8, where car ownership is lower. Employing a hedonic pricing model, our analysis reveals that the determinants of housing prices vary notably across these contexts.

In District 1, the empirical results indicate that property size (area) and building age are the most significant predictors of apartment prices. Larger, newer apartments command a premium, reflecting market preferences for modern and spacious living environments in more affluent, car-dependent areas. Additionally, proximity to the Central Business District (CBD) emerged as a significant factor, suggesting that despite high vehicle ownership, locational advantages still play a crucial role in shaping property values. Notably, the accessibility of public transportation—both bus stops and subway stations—did not significantly affect prices in District 1, implying that residents in this district are less reliant on public transit.

Conversely, in District 8, where private vehicle ownership is lower, accessibility to public transportation, particularly bus stops, significantly influences apartment prices. This finding underscores the importance of transit accessibility in areas where residents depend more on public modes of transport. While structural factors such as area and age remain important in District 8, the magnitude of their effects differs from those observed in District 1.

These results highlight the context-dependent nature of urban real estate markets in developing cities like Shiraz. The differential impact of public transportation on property values across districts suggests that urban planning and policy interventions should be tailored to local socio-economic conditions and mobility patterns. For policymakers, this implies that investments in public transportation infrastructure could yield greater benefits in areas with lower car ownership, whereas in more affluent, car-oriented districts, enhancements in housing quality and locational attributes might be more effective in driving property value improvements.

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