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Residential Market Dynamics and Micro-Scale Environmental Quality: A Hedonic Assessment in Transforming Neighborhoods

Dönüşüm Sürecindeki Mahallelerde Konut Piyasası Dinamikleri ve Mikro-Ölçekli Çevresel Kalite: Hedonik Bir Değerlendirme

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ABSTRACT

This paper analyses the links between structural, locational, and micro-scale environmental features and housing prices in two transforming neighborhoods in İzmir, Türkiye: Mansuroğlu (Bayraklı) and Kazımdirik (Bornova). Neighborhood-specific hedonic price models were applied to a dataset of 120 geolocated housing listings, allowing for a comparative assessment of price determinants under different redevelopment dynamics. Micro-scale environmental quality (MSEQ) was evaluated through expert-based street audits using Google Street View and incorporated into the models as a composite indicator reflecting pedestrian-level environmental conditions. The findings indicate that housing prices are primarily influenced by structural characteristics such as floor area, building age, and number of bathrooms, as well as locational attributes, particularly being located within a gated residential complex. These results are consistent across both neighborhood models, highlighting the dominant role of physical housing attributes and redevelopment patterns in shaping market values. Although the MSEQ coefficient is positive in both cases, it is not statistically significant at conventional levels. This suggests that, in rapidly transforming housing markets, structural and redevelopment-related factors outweigh the influence of micro-scale environmental quality in price formation. Nevertheless, the inclusion of environmental indicators provides a more comprehensive understanding of neighborhood dynamics and urban transformation processes. The findings also point to the potential indirect or context-dependent role of environmental quality, indicating the need for further research incorporating larger datasets and alternative methodological approaches.

Keywords: Housing values, hedonic model, urban transformation, neighborhood characteristics, spatial and locational factors

ÖZ

Bu çalışma, İzmir'de dönüşüm sürecindeki iki mahallede—Mansuroğlu (Bayraklı) ve Kazımdirik (Bornova)—yapısal, konumsal ve mikro-ölçekli çevresel özellikler ile konut fiyatları arasındaki ilişkileri incelemektedir. Farklı yeniden gelişim dinamikleri altında fiyat belirleyicilerini karşılaştırmalı olarak değerlendirebilmek amacıyla, 120 adet coğrafi konumu belirlenmiş konut ilanından oluşan veri setine mahalleye özgü hedonik fiyat modelleri uygulanmıştır. Mikro-ölçekli çevresel kalite (MESQ), Google Street View üzerinden gerçekleştirilen uzman temelli sokak gözlemleriyle ölçülmüş ve yaya düzeyindeki çevresel koşulları temsil eden bileşik bir gösterge olarak modellere dâhil edilmiştir. Bulgular, konut fiyatlarının büyük ölçüde metrekare, bina yaşı ve banyo sayısı gibi yapısal özellikler ile site içinde yer alma gibi konumsal nitelikler tarafından belirlendiğini göstermektedir. Bu sonuçlar her iki mahalle modeli için de tutarlıdır ve fiziksel konut özellikleri ile yeniden gelişim süreçlerinin piyasa değerleri üzerindeki baskın rolünü ortaya koymaktadır. MESQ değişkeninin katsayısı her iki modelde de pozitif olmakla birlikte, geleneksel anlamlılık düzeylerinde istatistiksel olarak anlamlı bulunmamıştır. Bu durum, hızlı dönüşüm geçiren konut piyasalarında fiyat oluşumunda mikro-ölçekli çevresel kaliteden ziyade yapısal ve yeniden gelişim odaklı faktörlerin daha belirleyici olduğunu göstermektedir. Bununla birlikte, çevresel göstergelerin modele dâhil edilmesi, mahalle dinamiklerinin ve kentsel dönüşüm süreçlerinin daha bütüncül bir şekilde anlaşılmasına katkı sağlamaktadır. Bulgular ayrıca, çevresel kalitenin dolaylı veya bağlama özgü etkilerine işaret etmekte olup, daha geniş veri setleri ve alternatif yöntemler kullanılarak yapılacak ileri çalışmaların gerekliliğini ortaya koymaktadır.

Anahtar Kelimeler: Konut değerleri, hedonic model, kentsel dönüşüm, mahalle özellikleri, mekânsal ve konumsal faktörler

Introduction

Housing prices have been a significant issue in Türkiye because of its unprecedented increase in the last decade. From a larger perspective, the rapid increase on housing prices can be explained with the mixture of global factors such as COVID-19 effect on global economy and local factors including national economic agendas on the construction industry. Alongside these factors, urban renewal movement has also contributed to the elevation of housing prices. In Türkiye, urban renewal has a long history that date back to the 1950s with the beginning of a migration pattern from rural to urban. This has caused cities growing unsteadily requiring more housing in urban centers. During this process housing stock increased through new apartments in the center areas and squatting at the periphery of the cities.

After the devastating 1999 Düzce earthquake and insufficient building stock for new immigrants in the early 2000s, urban renewal became an important political tool for shaping cities. Balaban (2012) notes that construction activity grew rapidly between 2002 and 2007, and the sector's share of GDP reached 6.5 percent in 2007. During the same period, foreign capital inflows also increased. Urban renewal projects have expanded across country, primarily through gentrification projects of old buildings and privatization of city land by building shopping malls. Gentrification contributed to higher prices in neighborhoods that were previously more affordable (Kuyucu & Ünsal, 2010; Geniş, 2007). At the same time, new housing developments spread toward the periphery of cities, creating a clear contrast between central and outer districts (Lovering & Türkmen, 2011).

In addition to the urban renewal process, several economic factors have also shaped the recent rise in housing prices in Türkiye. According to the Turkish Statistical Institute data (TÜİK, 2025), growth accelerated after the second quarter of 2013, reaching 8%, and peaked at 9.1% in the second quarter of 2017. Although the sector experienced fluctuations in the following years, growth rates remained relatively stable between the third quarter of 2018 and the first quarter of 2024, ranging from 4.4% to 6.4% (Ağır & Önder, 2025). By the end of 2024, however, growth rose sharply to 9.9%, marking a new peak for the period (TÜİK, 2025). The stable growth in the sector between 2018 and 2024 can be explained through the COVID-19 period that created supply-chain problems globally (World Bank, 2021). In this period, main construction prices increased sharply. These global pressures and local policies such as credit expansion for housing in the same period pushed many households to purchase a house to protect their savings (IMF, 2022; Özgüler et al., 2023). As a result, the housing demand grew faster than supply in many urban areas especially in İstanbul, Ankara, and İzmir (Kader et al., 2022). These developments marked a turning point and made construction-led growth a key part of Türkiye's urbanization, bringing major physical and socioeconomic changes to many cities.

İzmir, as the third largest city in the country presents an example of elevated housing prices triggered by this recent urban development agenda. Over the past decade, the city's neighborhoods have experienced a shift to denser and taller buildings as well as the rise of gated housing complexes. This shift is most evident in two neighboring districts: Bayraklı and Bornova. Especially in the last decade, old mid-rise apartments have turned into high rises in Bayraklı while new gated residential complexes were located at the periphery of Bornova. Contrasting changes in the urban form created an imbalanced housing market. Even though the current situation of the housing market in Bayraklı and Bornova can be explained with current agenda of national housing policies, micro-scale environmental factors have received less attention in the literature.

Although there is a growing body of research on Türkiye's housing market, most studies focus on İstanbul and often examine prices generally at a macro scale through traditional housing valuation models (Şahin, 2023). While these models often focus on only structural/spatial and locational factors (Yıldırım et al., 2024), others generally emphasize broader accessibility factors, including proximity to transit or the city center (Dökmeci & Erdoğan, 2021). Hedonic model studies examining housing prices in Türkiye indicate that prices are primarily determined by spatial characteristics, locational and neighborhood attributes, and macro/market dynamics. In particular, spatial variables such as size, number of rooms, and physical amenities have strong positive effects on prices, whereas building age and, in some cases, ground-floor location have been found to negative effects in many studies (Altun, 2022; Ebru & Eban, 2011; Hayrullahoğlu et al., 2018; Keskin, 2008; Mağden, 2022; Selim, 2009). With respect to locational and neighborhood-level factors, proximity to the city center and transportation networks, location in prestigious neighborhoods, and environmental quality generate price premiums, while environmental risks and locational disadvantages tend to reduce housing values (Arslanlı, 2020; Güller & Varol Özden, 2022; Kangallı-Uyar & Keten, 2020; Keskin, 2008). In addition, at the regional and national levels, income, population, interest rates, and overall market conditions are emphasized as key determinants of housing price indices; moreover, spatial dependence and regional convergence dynamics have been shown to play a significant role (Ganioğlu & Seven, 2021; Kartal et al., 2023; Kaya & Atan, 2014; Sayın et al., 2022). This study evaluates the importance of spatial and locational variables in a manner consistent with the existing literature. In addition, by incorporating micro-scale environmental factors such as sidewalk quality, pedestrian crossings, street lighting, and perceived safety into the model alongside indoor characteristics, it provides an original contribution to the literature through a more detailed and comprehensive analysis of the effects of neighborhood-level physical environment elements on housing prices.

Housing is a not merely a physical entity in isolation. It should be perceived as a whole with the characteristics of its immediate environment. Not only the quality of structural or spatial features of housing such as size, age, and the number of bedrooms; micro-scale environmental features like pedestrian safety and street comfort contributes to the housing valuation elements (Jim & Chen, 2006; Pivo & Fisher, 2011). In Türkiye's dense and rapidly changing urban areas, even small differences in these features can lead to clear variations in housing values (Keskin, 2008). Therefore, this study investigates how building characteristics, locational, and micro-scale environmental quality factors shape housing prices in two neighborhoods of Bayraklı and Bornova districts in İzmir. Combining real estate data with expert-based environmental assessments, this study aims to contribute to the literature by linking housing prices with micro-scale environmental quality factors in addition to the spatial and locational factors in neighborhoods associated with rapid urbanization pressure.

Material and Methods

Study Area and Research Design

The research focuses on two neighborhoods (Mansuroğlu in Bayraklı and Kazımdirik in Bornova) that have undergone extensive transformation over the past decade. High-rise construction in Mansuroğlu started before the 2020 İzmir earthquake. Dense, gated residences were built. The earthquake accelerated this process. Many older, mid-rise buildings have been replaced by new apartment blocks and residential complexes. In Kazımdirik, the transformation developed in a different way with towers being built next to old residential buildings. This situation has created a significant contrast in the neighborhood where old and new urban texture coexist. As a result, these two neighborhoods reflect the multi-layered transformation of Izmir.

The selection of these two adjacent neighborhoods were made purposefully. Despite the fact that both neighborhoods are situated on the same metropolitan setting, which has gone through a rapid redevelopment over the last decade, these differ in terms of building stock structure, level of redevelopment, and spatial structure. Mansuroğlu has a comparatively uniform, high-rise and more recent housing stock whereas Kazımdirik has a more heterogeneous structure where older structures are mixed with recently built residential compounds. This contrast provides a controlled comparative framework to examine whether the relative importance of spatial and environmental factors varies across different stages and forms of urban transformation within the same urban market.

Empirically, the research follows a stepwise design. First, a unit-level dataset was built from for-sale apartment listings collected from Sahibinden.com for two neighborhoods in İzmir—(Mansuroğlu and Kazımdirik). Second, spatial and housing-related attributes were coded for each unit, including price, floor area, rooms, building age, floor level, total floors, heating type, and key amenities (elevator, parking, balcony), as well as whether the dwelling is located within a gated residential compound. Third, micro-scale environmental quality was operationalized through expert-based street audits conducted via Google Street View: five built-environment professionals independently rated sidewalk continuity, pedestrian crossing safety, street lighting, and perceived safety on a 1–5 Likert scale, and the averaged segment scores were assigned to all listings located on the same street segment. These four indicators were then aggregated into a composite Micro-Scale Environmental Quality (MSEQ) score to represent localized environmental comfort. Finally, the study estimated hedonic price models using linear regression to compare how the relative contributions of spatial, locational, and micro-environmental variables vary across different redevelopment contexts.

Sampling and Data Collection

The empirical data set consists of information on 120 houses advertised for sale, taken from an open source real-estate platform (Sahibinden.com). The reason for choosing this platform was that it is Türkiye's largest and most widely used real estate website. The sampling plan was made in such a way that it considered not only the physical variation between the neighborhoods, but also the price variation within the neighborhoods. To retain the stratified structure, Mansuroğlu and Kazımdirik were treated as independent sampling strata in the analysis.

Houses in Mansuroğlu and Kazımdirik neighborhoods were divided into two groups: low and high priced. A data set consisting of a total of 120 houses was created by selecting 30 advertisements from each subgroup. Figure 1 shows the spatial distribution of the selected houses in Mansuroğlu and Kazımdirik neighborhoods. The map distinguishes both high- and low-priced housing clusters and units located within the development and those outside the development.

During the data collection phase, only houses for sale were included to achieve consistency and ensure data reliability. Additionally, certain exclusion criteria were applied. Studio-type residences, advertisements without a verifiable address or geographical coordinate information, and those without exterior photographs sufficient to determine the building typology were excluded from the data set. These variables constitute the main components of the hedonic pricing model, which represents the basic spatial features that determine the market value of the house (Malpezzi, 2002). For this purpose, detailed spatial features are recorded for each valid advertisement. Table 1 is a summary of the definitions, coding structure and measurement units used in the study.

Table 1.
Variable Definitions, Coding, and Measurement Units

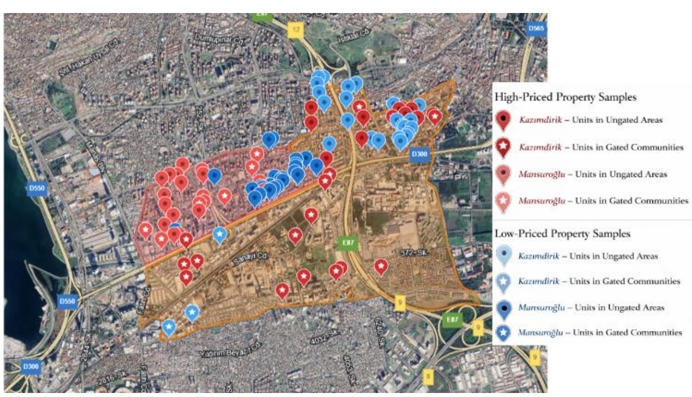
Variable	Definition / Description	Type	Coding	Unit / Scale
Cost (lnPrice)	Natural logarithm of property sale price	Cont.	-	log(₺)
m²	Floor area of the dwelling (gross area)	Cont.	-	m²
room	Number of rooms	Discrete	Actual count (2, 3, 4...)	Count
b-age	Building age category	Ordinal	1 = 0–5 yrs, …, 7 = 31+ yrs	1–7
floor	Floor level of the apartment	Discrete	0, 1, 2,3,..	Count
t-floor	Total number of floors in the building	Discrete	Actual number	Count
heat	Type of heating system	Ordinal	0 = none, 1 = AC, 2 = combi, 3 = central, 4 = floor heating, 5 = VRV	0–5
bathroom	Number of bathrooms	Discrete	1, 2, 3...	Count
kitchen	Kitchen type	Binary	0= closed, 1= open (American)	-
balcony	Balcony availability	Binary	0= no, 1= yes	-
Elevator	Elevator availability	Binary	0= no, 1= yes	-
parking	Parking availability	Binary	0= no, 1= yes	-
furniture	Furnished status	Binary	0 = unfurnished, 1 = furnished	-

Table 1. (Continued)
Variable Definitions, Coding, and Measurement Units

usage	Occupancy status	Binary	0 = owner-occupied, 1 = tenant-occupied	-
gated_ residence	Inside or outside a residential site	Binary	0= outside, 1= inside	-
sidewalk_ Quality	Expert score for sidewalk continuity and comfort	Ordinal	1-5	1= poor-5= excellent
crossing_ score	Expert score for pedestrian crossing safety	Ordinal	1-5	1= poor-5= excellent
lighting_ score	Expert score for street lighting adequacy	Ordinal	1-5	1= poor-5= excellent
safety_score	Expert score for perceived street safety	Ordinal	1-5	1= poor-5= excellent
MSEQ score	Composite score of environmental micro-scale quality	Cont.	*mentioned above	1-5

The sale price of each valid listing was converted to a natural logarithm of price (lnPrice) to make it more interpretable and decrease distributional skewness. In the analysis, the two neighborhoods were not interpreted through a single pooled specification; instead, neighborhood-specific hedonic models were prioritized in order to reflect the stratified sampling design and avoid masking subgroup-specific relationships.

Figure 1.
Spatial Distribution of Sampled Housing Units in Mansuroğlu (the yellow polygon) and Kazımdirik (the red polygon) Neighborhoods, Bayraklı and Bornova Districts (İzmir).



Variables and Measurements

In this model, the dependent variable is the natural logarithm of the house sales price (lnPrice). The logarithmic value makes it easier to make proportional interpretations and reduces skewness in data distribution. Independent variables are grouped into three main groups. The first group covers spatial factors. Variables such as floor area, number of rooms and bathrooms, and building age are in this group. The second group includes locational features.

Whether the house is located within the gated-community, parking availability and occupancy status were evaluated in this context. The third group represents environmental factors. Subfactors such as pavement condition, lighting and pedestrian crossing are included in this group (Table 2).

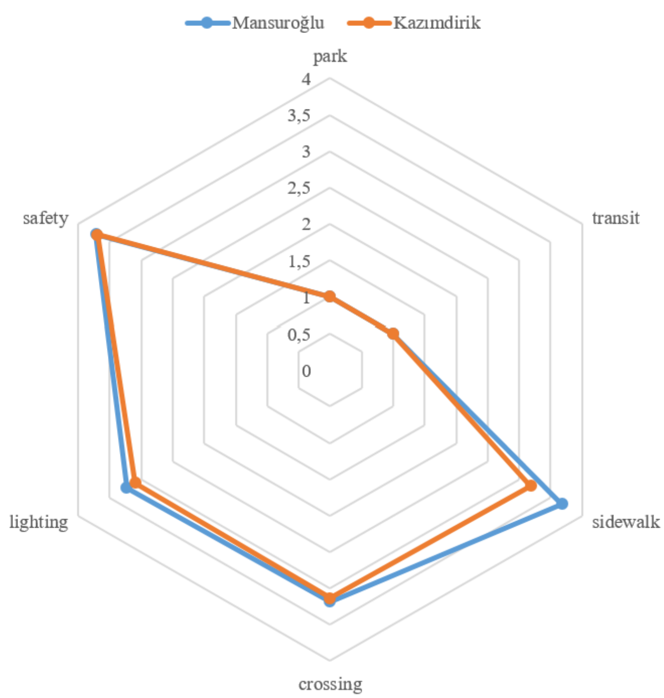
Table 2.
Grouping of Variables in the Hedonic Pricing Framework

Dependent Variable	Variable Group	Variables Included
lnPrice (Natural Log of Sale Price)	Spatial Attributes	Floor Area (m²), Number of Rooms, Number of Bathrooms, Building Age, Floor Level, Total Floors, Heating Type, Kitchen Type, Elevator, Balcony, Furnishing Status
	Locational/ Spatial Attributes	Gated_Residence (Inside/Outside Residential Compound), Parking Availability, Occupancy Status
	Micro-Scale Environmental Quality (MSEQ)	Sidewalk Quality, Crossing Safety, Lighting Quality, Perceived Safety, MSEQ Score (Composite Index)

Recent studies have emphasized the importance of integrating micro-scale livability indicators into hedonic models (Qiu et al., 2022; Wang et al., 2024; Yıldırım et al., 2024). Micro-Scale Environmental Quality Score (MSEQ) was developed based on expert assessments to indicate micro-scale environmental quality of related areas. Five built environment professionals that include two architects, two landscape architects, and one urban planner investigated each associated street using Google Street View images. The study incorporated with the Google Street View images that were captured within the last one year to ensure temporal consistency. This criterion was applied to minimize discrepancies related to outdated visual records and to reflect the most recent physical condition of each street segment. The assessments of all experts were carried out under a single assessment period and using the same set of images so that they could be compared across all the observations. Continuity of pavements, lighting, and safety of crosswalks and perceived safety were measured on a 1-5 Likert scale (1=very poor, 5=excellent). The mean of these scores is the local environmental quality of the neighborhood. The higher scores imply the increased pedestrian comfort and accessibility (Figure 2). The measure is a composite of both the functional and perceptual aspects of the pedestrian environment, and thus, micro-scale livability can be incorporated as a quantitative environmental variable in the hedonic model.

In order to analyze MSEQ subfactors in Figure 2, Mansuroğlu is illustrated to have a better profile of micro environmental quality as compared to Kazımdirik. It scores higher particularly on continuity of the sidewalks and lightings. In terms of the crossing, the park, the transit and the safety, the two neighborhoods have similar values. However, more heterogeneous texture of the buildings in Kazımdirik dilutes the role of the subfactors on the overall environmental quality. Hence, Mansuroğlu has a more balanced and high quality of the environment whereas Kazımdirik shows a more moderate and changing performance of all the sub factors.

Figure 2.
MSEQ Score subfactors in Mansuroğlu and Kazımdirik



Analytical Framework and Data Analysis

In this study, the Hedonic Price Model, which assumes that the market value of the house is equal to the sum of its measurable features, was applied to collected data (Rosen, 1974). This study divided housing prices into components that reflect spatial, locational and environmental factors. The model is as follows (Eq. 1):

$$\ln (P_i) = \beta_0 + \Sigma \beta_k X_{ki} + \Sigma \gamma_m Z_{mi} + \varepsilon_i \quad \text{(Eq. 1)}$$

where;

P_i: price of house;

X_{ki}: spatial factors;

Z_{mi}: locational and environmental factors;

ε_i random error term.

Accordingly, two separate linear regression models were conducted to examine the effects of housing characteristics in different contexts:

1. Model A (Mansuroğlu Subset): only 60 houses in Mansuroğlu,
2. Model B (Kazımdirik Subset): only 60 houses in Kazımdirik.

In hedonic modeling, the linear regression method has been preferred because it provides a suitable and interpretable prediction framework for housing data (Malpezzi, 2002; Rosen, 1974). While this method allows evaluating the contribution of each factor, it also enables normality, multicollinearity and heteroskedasticity tests to be performed (Gujarati & Porter, 2009; Malpezzi, 2002). It is also used in current studies examining the integration of built environment quality into quantitative housing valuation models (Ben et al., 2023; Qiu et al., 2022; Wang et al., 2024). In this context, the proposed model, consisting of two sub-models, comparatively reveals how housing value determinants differ between neighborhoods. Prior to analysis, data were checked for outliers, normality, and multicollinearity (VIF<5). Moreover, residual values are also checked for independence and variance consistency.

The choice between pooled and subgroup-specific regression models depends on the degree of heterogeneity across groups. When relationships differ between subpopulations, imposing a single pooled regression may produce biased or misleading estimates (Franzese, 2005; Pesaran et al., 1999). In housing market studies, spatial heterogeneity across neighborhoods often leads researchers to estimate location-specific hedonic models rather than relying solely on pooled specifications (Malpezzi, 2002; Song & Knaap, 2004). Given the stratified structure of the dataset and potential differences between neighborhoods, this study prioritizes neighborhood-specific hedonic regressions to better capture context-dependent price determinants.

Results

Before regression estimation, descriptive statistics were calculated for each neighborhood separately in order to make the stratified structure of the dataset explicit. Further group comparison tests were performed to find out whether the two subsamples vary in terms of the selected structural, locational, and environmental variables (Tables 3 and 4).

Table 3 shows the descriptive statistics of the full and the two neighborhood subsamples. In general, housing features seem to be rather similar in Mansuroğlu and Kazımdirik as it can be concluded that both neighborhoods belong to the same segment of the local housing market despite the fact that they have different redevelopment trends. The average number of logarithmic sale price (lnPrice) equals 15.81 (SD=0.73) across the entire sample, and dwelling size is around 119 m², yet there is a significant variability in listings. The Mansuroğlu units are slightly larger (averagely 125.95 m²) as compared to Kazımdirik (111.85 m²), and placed on slightly higher floors and buildings with slightly higher total floor counts. Such differences are in accordance with more recent high-rise development pattern of Mansuroğlu. The structural variables such as the number of rooms, type of building age, and the number of bathrooms indicate very similar means between the two neighborhoods. In Mansuroğlu (2.63) the average Micro-Scale Environmental Quality (MSEQ) is slightly better than in Kazımdirik (2.52), which means that the street level condition of continuity of the sidewalks, lighting, and pedestrian safety are a little better, but the difference is not considerable.

Table 4 further examines whether these observed differences are statistically meaningful. Independent-samples t-tests show that none of the continuous variables—including price, unit size, number of rooms, building age, floor level, total floors, bathroom count, and MSEQ score—differ significantly between the two neighborhoods ($p>.05$). For categorical variables, chi-square tests indicate that most housing attributes are distributed similarly across the subsamples. The only statistically significant differences appear in balcony availability and parking availability ($p<.05$), which likely reflect variations in building typologies and development styles between the two areas.

Table 3.
Descriptive Statistics for the Full Sample and Neighborhood Subsamples

Variable	Full Sample Mean (SD) [Min-Max]	Mansuroğlu Mean (SD) [Min-Max]	Kazımdirik Mean (SD) [Min-Max]
lnPrice	15.81 (0.726) [15-17]	15.86 (0.685) [15-17]	15.76 (0.768) [15-17]
m^2	118.90 (50.383) [30-276]	125.95 (46.864) [45-230]	111.85 (53.128) [30-276]
room	3.73 (0.968) [2-6]	3.80 (0.898) [2-5]	3.67 (1.036) [2-6]
b_age	3.91 (2.520) [1-7]	3.93 (2.442) [1-7]	3.88 (2.617) [1-7]
floor	4.44 (4.751) [0-27]	5.10 (4.835) [0-27]	3.78 (4.611) [0-27]
t_floor	8.01 (5.562) [3-31]	8.53 (6.432) [3-31]	7.48 (4.523) [3-28]
bathroom	1.47 (0.621) [1-4]	1.52 (0.504) [1-2]	1.43 (0.722) [1-4]
MSEQ	2.58 (0.476) [1-4]	2.63 (0.490) [2-4]	2.52 (0.459) [1-4]

Note. Full-sample MSEQ mean and standard deviation were derived from the two equal-sized neighborhood subsamples. Neighborhood code: 0 = Mansuroğlu, 1 = Kazımdirik.

Table 4.
Group Comparisons Between Mansuroğlu and Kazımdirik

Panel A. Continuous variables	t	*p*
Constant (lnPrice)	0.735	.464
m^2	1.542	.126
room	0.753	.453
b_age	0.108	.914
floor	1.527	.130
t_floor	1.034	.303
bathroom	0.733	.465
MSEQ	1.251	.213
Panel B. Categorical variables	**Chi-square**	*p*
usage	2.256	.133
balcony	4.138	.042
gated_residence	0.040	.841
parking	4.357	.037
elevator	0.058	.810
kitchen	0.043	.835
furniture	0.323	.570

Table 5 provides the summary of the diagnostic statistics of the neighborhood-specific hedonic regression models. These two models have a high level of explanatory performance. The Mansuroğlu model has a R^2 value of 0.972 and adjusted R^2 value of 0.963, meaning that the variation in housing prices is approximated to 96.3% of the variation in the spatial, locational and environmental factors. On the same note, the Kazimdirik model has an R^2 of 0.938 and an adjusted R^2 of 0.917 implying that the model explains over 91 percent of the price change. The overall model significance is attested by the high F-statistics of both neighborhoods ($p<.001$). The values of Durbin-Watson (1.866 in Mansuroğlu and 1.452 in Kazımdirik) are not too large, and it is possible to assume that there is no significant autocorrelation in the residual. Multicollinearity diagnostic shows that some size-related variables of housing have moderate overlap with each other and the largest values of VIF are less than the generally accepted value of 10.

Residual normality was assessed using the Shapiro–Wilk test; while the Kazımdirik model does not deviate from normality (p=.913), the Mansuroğlu model shows a mild deviation (p=0.006). However, given the sample size and the robustness of linear regression to minor normality violations, this result does not materially affect model interpretation.

Table 5.
Diagnostic Summary for the Neighborhood-Specific Hedonic Models

Model	R	R^2	Adj. R^2	F	Durbin-Watson	Max VIF	Shapiro-Wilk *p*
Mansuroğlu	0.986	0.972	0.963	110.749*	1.866	9.163	.006
Kazımdirik	0.969	0.938	0.917	44.593*	1.452	7.421	.913

*Note. *** p < 0.001. Collinearity diagnostics indicate moderate overlap among some size-related housing variables; these variables were retained because they represent conceptually distinct attributes within the hedonic framework.*

In this study, Hedonic Price Model approach is applied separately for the Mansuroğlu and Kazımdirik neighborhoods. Table 6 displays the ANOVA estimates of the hedonic regression models estimated independently in Mansuroğlu and Kazımdirik. In the two cases, both models are highly significant (p=.001), which means that the set of explanatory variables explain a significant part of the variation in housing prices. The F-statistic itself of the Mansuroğlu model is quite high as well (F=109.78), indicating the existence of very strong overall relationship between the independent variables and a high level of housing strong statistical significance (F=44.60) but the low F may reflect more heterogeneous urban structure and housing stock of this region. In general, the output of ANOVA shows that the chosen spatial, locational and environmental variables offer any explanatory value on housing price variation in both neighborhoods.

Table 6.
ANOVA Results for the Hedonic Price Models

Model	Regression Sum of Squares (SS)	df	Mean Square	F	Sig. (*p*)
Mansuroğlu Subsample (n=60)	26.930	14	1.924	109.778	<.001
Kazımdirik Subsample (n=60)	32.676	15	2.178	44.603	<.001

Table 7 is a regression coefficient of Mansuroğlu subsample (n=60). The findings suggest that a number of housing structural and location variables have a significant impact on the prices of houses in this neighborhood. The strongest standardized effect is observed in terms of the number of bathrooms (β=0.413, p<.001), which implies that the unit with more bathrooms is likely to cause higher price in the market. Age building also comes out as an important predictor that is negatively related to price (β =-0.260, p<.001), meaning that older buildings have a tendency to lose their value. The overall number of building floors (t-floor) has a positive statistically significant impact (β=0.146, p=.012) which means that taller residential buildings have higher-valued apartments in them. Also, a positive and significant value is present in the gated_residence variable (β=0.144, p<.001), which shows that units in gated residential complexes are likely to attract a price premium in the Mansuroğlu housing market. In this subsample, other variables, which are floor area, number of rooms, floor level, type of heating, type of kitchen, the availability of elevators, parking, furnishing status and occupancy status do not have statistically significant effects. The coefficient of the MSEQ score is also positive (β=0.074), but the value is not statistically significant at normal levels (p=.073).

Table 7.

Regression Coefficients of Mansuroğlu Subsample (n = 60)

Variable	**B**	**Std. Error**	**Beta**	**t**	***p***
Constant	14.267	0.211	-	67.671	<.001
m²	0.002	0.001	0.106	1.485	.145
room	0.099	0.061	0.130	1.627	.111
b-age	-0.073	0.016	-0.260	-4.673	<.001
floor	-0.002	0.007	-0.013	-0.271	.788
t-floor	0.016	0.006	0.146	2.627	.012
heat	-0.010	0.020	-0.018	-0.469	.641
bathroom	0.562	0.094	0.413	6.006	<.001
kitchen	0.008	0.065	0.005	0.118	.906
balcony*	-	-	-	-	-
elevator	0.003	0.063	0.002	0.049	.961
parking	0.037	0.064	0.017	0.574	.569
furniture	-0.059	0.062	-0.030	-0.949	.348
usage	-0.040	0.042	-0.029	-0.946	.349
gated-residence	0.217	0.062	0.144	3.508	.001
MSEQ score	0.104	0.057	0.074	1.834	.073

**The balcony variable was not presented in the Mansuroğlu model because of insufficient variation within this subsample.*

Table 8 presents the regression coefficients for the Kazımdirik subsample (n=60). The results indicate that several structural and locational variables significantly influence housing prices in this neighborhood. Floor area (m²) has a positive and statistically significant effect on price (β=0.338, p=.002), suggesting that larger units tend to command higher market values. Similarly, the number of rooms shows a positive and statistically significant association with housing prices (β=0.216, p=.033). Building age also emerges as a significant determinant, displaying a negative coefficient (β=−0.295, p=.002), indicating that older buildings tend to be valued less in the Kazımdirik housing market. In addition, the gated_residence variable has a positive and statistically significant effect (β=0.233, p=.002), suggesting that properties located within gated residential complexes receive a price premium in this neighborhood. Other variables do not reach statistical significance at conventional levels. The coefficient for floor level is negative (β=−0.028, p=.663), the coefficient for total number of floors in the building is positive (β=0.071, p=.408), and the coefficient for the number of bathrooms is positive (β=0.124, p=.191), but none are statistically significant at conventional levels. Similarly, the coefficients for kitchen type (β=−0.078, p=.261), balcony availability (β=0.052, p=.226), elevator availability (β=0.053, p=0.317), parking availability (β=−0.090, p=.092), furnishing status (β =−0.008, p=.853), and occupancy status (β=−0.082, p=.095) are not statistically significant at conventional levels. Finally, the coefficient for the MSEQ score is positive (β=0.054, p=.268), but it is not statistically significant at conventional levels, indicating that micro-scale environmental quality does not show a statistically reliable association with housing prices in the Kazımdirik model.

Table 8.

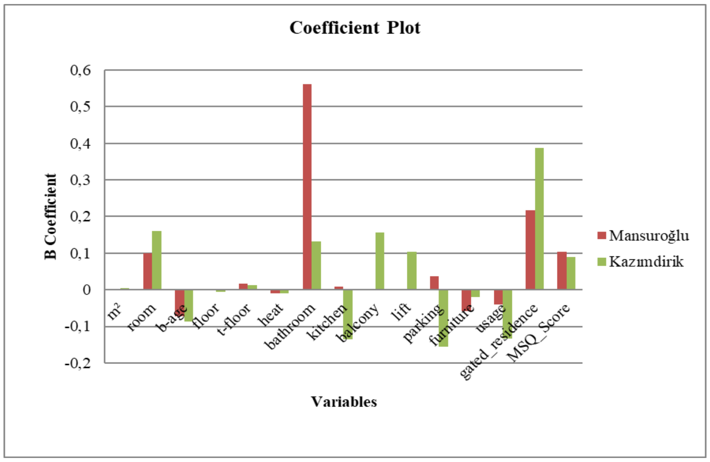
Regression Coefficients of Kazımdirik Subsample (n = 60)

Variable	**B**	**Std. Error**	**Beta**	**t**	***p***
Constant	14.334	0.320	-	44.806	<.001
m²	0.005	0.001	0.338	3.316	.002
room	0.160	0.073	0.216	2.200	.033
b-age	-0.087	0.027	-0.295	-3.265	.002
floor	-0.005	0.011	-0.028	-0.438	.663
t-floor	0.012	0.014	0.071	0.835	.408
heat	-0.009	0.026	-0.016	-0.333	.740
bathroom	0.132	0.100	0.124	1.328	.191
kitchen	-0.135	0.118	-0.078	-1.140	.261
balcony	0.157	0.128	0.052	1.227	.226
elevator	0.104	0.103	0.053	1.013	.317
parking	-0.155	0.090	-0.090	-1.725	.092
furniture	-0.020	0.108	-0.008	-0.186	.853
usage	-0.134	0.078	-0.082	-1.705	.095
gated-residence	0.388	0.121	0.233	3.213	.002
MSEQ score	0.090	0.080	0.054	1.123	.268

When the B coefficients are used instead of beta, it is possible to observe the unit-based contributions of the factors (Figure 3). Figure 3 shows the variation in the contribution of each variable in the two neighborhood-specific models. Generally, structural housing features have a more robust and stable impact compared to the environmental variables. The most significant positive factor in the Mansuroğlu model is the number of bathrooms, whereas the age of buildings is affected negatively on the prices of housing. On the contrary, floor area (m²) and the gated residence variable have stronger positive effects in the Kazımdirik model as opposed to the Mansuroğlu model. The undesirability of the age of the building shows a consistent trend in both neighborhoods, which means that buildings of greater age are likely to decrease the value of houses irrespective of the context.

A number of features including the type of heating, type of kitchen, elevator presence, and furnishing status have comparatively small coefficients in both the models, implying a minimal contribution to the price difference. The coefficient of the MSEQ score in both neighborhoods is positive, but its value is relatively small, in comparison with the essential structural factors. The coefficient plot, in general, brings to the fore the fact that although there are determinants of housing prices in the two neighborhoods, the proportionality of some variables differs depending on the local urban environment.

Figure 3.
The coefficient plot compares the raw coefficients (B).



Discussion

The results of the study demonstrate that housing prices in two transforming neighborhoods in Izmir are largely determined by spatial factors. Building age is one of the strongest factors in both models. Older buildings steadily lose value, possibly due to post-earthquake safety concerns and natural deterioration. Floor area also shows a positive relationship with housing prices, although the effect is statistically significant only in the Kazımdirik model. The model presents that larger dwellings tend to command higher prices in Kazımdirik. In line with the literature on housing economics, unit size remains one of the most stable and universal predictors of property value across different urban contexts (Ben et al., 2023; Jim & Chen, 2006; Song & Knaap, 2004). This suggests that the relative importance of housing attributes may vary depending on neighborhood context.

Aside from building age and unit size variables of spatial factors, being in a gated community as a locational factor consistently exhibits a positive and significant relationship with housing prices in both neighborhood models. This finding confirms the literature that points out growing preference for secure and managed housing in Türkiye (Atkinson & Blandy, 2005; Geniş, 2007; Türkün, 2011). The MSEQ variable has a positive coefficient in both neighborhood models; however, it does not reach statistical significance at conventional levels. In Kazımdirik, the coexistence of older buildings, newly transformed parcels, and residential complexes creates a complex structure, and the impact of environmental factors is overshadowed by stronger spatial features. In Mansuroğlu, due to the newer and more homogeneous housing pattern, the coefficient for MSEQ is positive, but it is not statistically significant at conventional levels. Therefore, the results do not provide statistical evidence that micro-scale environmental quality directly affects housing prices in the current models.

Among the notable results of the analysis is that the micro-scale environmental quality (MSEQ) variable fails to gain statistical significance in both the neighborhood models. This finding could be attributed to a number of factors. First, in fast changing neighborhoods, the price of houses is probably to be motivated by structural features like the unit size, the age of the building, and availability of gated residential areas, with more direct and more noticeable impacts on market prices. Second, the MSEQ scale in this study is based on expert evaluations derived from Google Street View imagery, which may capture observable physical conditions but may not fully reflect residents' lived experiences or long-term neighborhood reputation effects that are capitalized into housing prices. Third, the sample size is relatively small, and the study concentrates on two neighborhoods, and thus, it might not be effective in determining more obscure environmental impacts. Lastly, but not the least, it is also possible that micro-scale environmental attributes are indirectly reflected in transaction prices, in that micro-scale environmental qualities are indirectly reflected in housing preferences by way of perceived livability or neighborhood satisfaction. Collectively, these points indicate that the lack of statistical significance should be viewed with some care and possibly indicate contextual and methodological limitations, as opposed to the absolute lack of environmental effects.

Conclusion

The results show that housing prices in the studied neighborhoods of İzmir are mainly based on the structural housing features. More than 90 percent of the variation in the housing price is explained by the hedonic models, which is a good overall fit of the model. Floor area, building age, and the number of bathrooms become the principal price determinants and locational features, especially the existence of a gated residential complex, are also significantly statistically significant in both neighborhood models. The price premium observed with gated developments is an indication of an increasing market preference towards the concept of private and controlled residential setting. Conversely, micro-scale environmental quality indicators show positive coefficients but none of them attains statistical significance in either of the models. That implies that in fast changing housing markets, the dynamics of the micro-scale environmental conditions may be dwarfed by structural and redevelopment-related factors that govern the price formation.

There are a number of limitations that must be noted when reading out the results. One, the scale of micro-scale environmental quality is founded on the judgments of experts, which can bring some subjectivity. Even though images that were taken during the past year were used to assure that images were taken within the same period of time, the assessment may have been affected by the differences in the conditions of image capture or the visual surroundings. Second, the environmental indicators that were used in this research mainly consider observable physical features and might not cover the perceptions of residents, behavioral reactions, and long-term reputation of the neighborhood which can be capitalized in the housing prices. Third, the small sample size and the two neighborhoods used can decrease the statistical strength to follow more hidden environmental factors. To overcome these limitations, future studies may include larger data sets, longitudinal housing prices data, and resident-based perception surveys that will help to better define the correlation between quality of environment and housing values. Moreover, spatial econometric analysis or machine learning can be used to determine indirect or context-specific impacts of micro-scaled environmental aspects that cannot be observed using standard regression models. It would also be interesting to expand the study to more cities or various phases of urban change to get a more holistic picture of the interaction between the quality of the environment and the housing market dynamics.

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