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Article

The effect of metro stations on housing prices, Istanbul case

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ABSTRACT

Metro lines are economic elements that impact the land and real estate values of the urban area, besides the time benefit they produce. According to the literature, metro lines increase housing prices in the service area. The aim of this study is to reveal metro stations' effect on housing prices, based on the examples of two different metro stations in Istanbul. In this context, within the framework of the metro investment, it is aimed to examine the effect of housing typology and urban transportation opportunities on housing prices as a hybrid model. Within the scope of the study, a field study was conducted to determine the effects of metro in two sample stations selected from İstanbul. Accordingly, it has been examined how the housing prices around the Metrokent and Kirazlı stations of the M3-Kirazlı-Başakşehir Olimpiyat Metro line, which was put into operation in 2013, are affected by the metro station. To make this assessment; hedonic price-based regression analysis was applied. This quantitative method is frequently used in determining the factors affecting house prices. A study was conducted on 349 residences whose sales values were examined from the related websites. The findings show that; housing prices in the Metrokent region are strongly affected by the metro station, while housing prices in the Kirazlı region are limitedly affected. In this study, the way real estate prices are affected by the metro station is examined in terms of housing typology and is expected to be a reference for future studies with different criteria.

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INTRODUCTION

Investments in transport infrastructure require a long process and large budgets. In our country, a significant part of the public sector spending is made for the transport sector needs. Due to its high budget requirements, metro lines are vital for urban transportation. Metro lines, which are expected to be the solution to traffic congestion in major cities, are the main backbone of the transport system with their high capacity, predictable quality of service, and sustainable features. Public rail system investments cost high, but they appear to provide significant social benefits when considered by assessment criteria such as accessibility, comfort, safety, and reliability. The proximity of this system to residential areas, which stands out in terms of social impact and intensity of use, is considered an advantage, especially for users living in large cities. This framework aims to ensure that rail systems serve as broad segments

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of society as possible in accordance with existing land use and urban development plans, beyond their economic and technical efficiency. Railway systems with the character of transport corridors provide an advantage to the area on the route within extensive urban land use. In large cities with limited public transportation facilities, it is attractive to live or work near the rail networks. Time advantage, fuel savings, and quality of obtaining high sustainable transport services affect the prices of residential, working areas, and commercial centers which are in the the impact of the rail system (Kırlangıçoğlu, 2016). This advantage raises land and property prices, especially in residential areas. This resulting increase in value is an important research topic, especially in countries that choose aggressive growth in rail systems and are looking for models to overcome high infrastructure costs. Especially in recent years, there has been a significant increase in the number of such surveys due to the development of access to data sets related to real estate sales prices (Dai et al., 2016). In Turkiye, studies are conducted on the effects of urban rail system services that have gained momentum in major cities, properly Istanbul and Ankara.

Kirazlı-Başakşehir-Olimpiyat Metro, which has been serving since 2013 with 15.9 km long and 11 stations in Istanbul, has been discussed in this article. This study compares two station areas observed residential regions of different qualifications. Metrokent is a residential district with a high socioeconomic level of inhabitants, which is constantly developing, with sufficient equipment areas. Compared to Metrokent, Kirazlı is irregular residential area with a low income level, low quality of life for its inhabitants, and insufficient equipment. The hedonic price method has been used to measure the impact in these areas. In the quantitative model, comparative assessments were made to eight different numerical models. According to the research findings, housing prices in the Metrokent area are strongly influenced by the station service, while the metro has had a rather limited impact on housing costs in Kirazlı station area.

Background of Research Area

One of the elements determining the value of real estate is the opportunities and functions of the cities in walking distance. Especially in cities where unplanned and unbalanced public services are offered, the benefit provided by the transport infrastructure plays a leading role in the pricing of land values. The fact that land prices in the city center reach the highest values, increases the demand for nearby land, and the availability of access from these areas to workplaces and the center is determining in preference (Kılınçarslan, 2010).

Haig (1926) calculated land yield and referred to the total transportation expense as "space friction," stating that this friction would be reduced by increasing the accessibility of transport. Thus, users pay as transportation costs (friction costs) for the distance to the city center while utilizing the land. Accordingly, the physical structure of the city is set to minimize costs. Alonso (1964) approached this issue from similar perspective and predicted that employment in the monocentric city model was concentrated in the city center, according to the assumption that the time spent on commitment is an important factor in determining the price curve (Alonso,1964). Accordingly, the highest land value is in the center because the cost of transportation is the lowest in the city center. As observed in these theories, there is a strong relationship between the phenomena that arise in the interaction of urban structures and transport systems. The cities are connected by transportation networks. Urban functions should be related to each other in such a way that transportation costs are as low as possible (Duvarcı and Alver, 2018).

In value capture theories, the prices of housing located close public transport stations are higher than those away from public transport. Therefore, higher budgets can be paid for housing with high public transportation capabilities (Kilpatrick et al., 2007). According to economic theory, this is reflected in the decrease in travel time in the direction of housing prices rising (Hess and Almeida, 2007). Railway systems are also known to be effective in increasing the value of real estate due to factors such as capacity, speed, and safety (Wardrip, 2011).

In addition to the positive aspects of being close to public transport stations, there can also be negative aspects. Especially in the immediate vicinity of public transportation stations, it is necessary to mention negative externals such as noise, pollution, traffic, or traffic jams. For example, disturbing effects in residential areas close to metro stations may cause the price of housing to be lower than a sample located at a reasonable distance from the station. (Wardrip, 2011).

Parameters such as: External factors, needs, and public transport facilities are important elements for housing prices. A large part of the literature prepared with the neoclassical economic concepts deal with the impact of development in transportation facilities on increasing real estate prices.

In this article, research on the impact of the rail system on real estate prices has been gathered into five topics.

Location According to City Center

The impact of the rail system varies depending on the location in the city. New rail system infrastructure affects the value of nearby residential areas. According to the results of this group's research, improved transportation opportunities in the city center reduce the marginal impact of each additional infrastructure investment. However, more intense feeling of transportation needs in the suburbs has more impact on property prices near a newly constructed rail system.

Seasonal Effects of Rail Systems
There are three main stages for railway systems such as the presentation of the project, the construction process, and the operation stages of the railway system are affecting housing prices at different levels. To summarize, the announcement of the rail system project appears to have a shock effect, rapidly positively affecting short-term real estate prices. However, conditions during the construction period (noise, pollution, physical constraints, etc.) can turn this increase downward. Finally, when the construction is completed and the rail system gives service, the real benefit can be measured (Ge et al., 2012).

Land Use Effect
The urban morphology is shaped by the way of people living in the city, physical possibilities, and economic conditions. For example, the access requirement of a house owner in a city varies from the service sector staff. Thus, the impact of the rail system is directly affected by differences in land use and needs.

The Diversity and Size of Economic Activity of Cities
Factors such as income level, car ownership, economic activities, and GDP differentiate the impact of rail systems on real estate prices. Transportation is a field of activity that develops due to economic and social activities. The impact on real estate of the rail system in the city is different. A strong economic and social life, which is diminished or not growing by the impact of the city's railway system, is different.

Infrastructure Typology
In the research area, forms of settlement, transportation facilities, and the efficient integration of these opportunities with urban settlement have been developed in this framework. In essence, the issue is again explained by the balance of supply and demand, which is the basic principles of the economy.

Each group examined in this section is basically dealt with by the value of users in the transport activity. From this perspective, it is clear that each example has its own dynamics. Many factors, such as demographic structure, socioeconomic characteristics, land use, or the type of transportation system, affect housing prices differently. Thus, while each example is similar, it is unique in terms of results and effects.

THE AIM AND METHODOLOGY

In this research, two different residential areas were selected on the M3-Kirazlı-Başakşehir Olympic metro line. The field study area Kirazlı is a residential area that develops irregularly, subsequently legalized, with its narrow streets, limited equipment areas, and low-rise structures that appeal to the middle-lower income level. Metrokent is an area consisting of high-rise, large-volume blocks, developing in the form of sites, where equipment areas are offered within the site, where car ownership is high and residential are middle-upper group.

Detecting the change in housing prices in the area has been the most important challenge of this study. Such data can be obtained through various channels, including from official agencies, large-scale companies serving the real estate market, real estate valuation firms, and web scans. However, because there is no reliable corporate infrastructure for the archiving of real estate sales data in our country, the data used in the study has been provided by the authors.

The supply of data has been collected by a "section analysis" approach covering 2019, before the pandemic. The global pandemic that emerged at the end of 2019 and the ongoing economic crisis have caused a serious rise in overall price levels both globally and nationally. This rise has also affected seriously the housing market in Istanbul, causing prices to rise artificially. Therefore, we believe that the period data considered as the latest realistic data reflects the actual market values.

On the transport side, which is the second important dimension of the study, the "metro system" was chosen as the most powerful social impact producing and widespread example of urban transportation. In this way, the socioeconomic impacts will be achieved more clearly. In this direction, the station areas located in M3-Kirazlı-Başakşehir-Olympic Metro Line have been delimited as a case study. The M3 Metro Line not only serves the residential area but also serves a complex part of the city that includes various service and working area functions. Therefore, it offers an alternative assessment possibility in the form of preferences. In summary, this research aims to address the impact of housing typology and urban transportation opportunities on housing prices within the framework of metro stations.

There are various methods to analyze the impact of rail system capabilities on housing prices. Quantitative methods were frequently and strongly preferred in literature. There are a number of parameters that influence the price of the property. The housing market consists of heterogeneous products due to the uniqueness of the parties interacting in the real estate market and also the structural, physical, and localizational differences of housing in the market (Gündoğmuş et al., 2019). As a heterogeneous commodity, the "Hedonic Price" approach is often used where multiple parameters have an effect on the price. The hedonic pricing method is preferred in this research because it allows an effective assessment in the distinction of many factors such as the qualification, physical characteristics, or location of the housing that constitutes the housing price.

Hedonic Price Model and Variables

The hedonic pricing method is a way for distinguishing the elements that determine the prices of commodities consisting of many components. One of the first to analyze the hedonic price method and housing prices is Rosen. Rosen (1974), used this method because he regarded housing as a heterogeneous asset consisting of the combination of different characteristics. In measuring the impact of empirical accessibility on price, the hedonic price model is the most common analysis technique. The model is a statistical method widely used in the identification of urban value in general and in the modeling of the impact of investment in real estate values in transport infrastructure in particular (Yankaya and Çelik, 2005).

According to Kaya (2012), the hedonic price function is determined according to whether the relationship between the dependent variable and the independent variables is linear. The hedonic price function is basically defined in two different ways as follows: (I) Linear Hedonic Price Function: The house price is the dependent variable and the properties that determine the house price are the independent variables, and it is assumed that there is a linear relationship between them. (II) Non-linear Hedonic Price Function: A nonlinear relationship is mentioned between the dependent variable, the house price, and the independent variables, which include the features that make up the house price. To determine the hedonic price function correctly, it is necessary to determine whether the relationship between the dependent variable, the price of the house, and the independent variables (the year of construction of the house, its quality, the location of the house, etc.) are linear. Kaya (2012) mentions four different functional structures in the analysis of determining the hedonic price function pattern:

- Linear Form
- Double Logarithmic Form
- Linear Logarithmic Form
- Logarithmic Linear Form.

These four forms have been used in various studies to analyze the shift in real estate prices. The independent variable factors used in this study were filtered so that they converged to the normal distribution. On the other hand, multicollinearity in an independent variable is taken into account. In line with these assumptions and precautions, the linear form of the hedonic price function, which is mostly preferred in the literature, has been used. In this framework, the multiple linear regression structure and variables are shown in Equation 1 and explained in Table 1. Accordingly, the dependent variable house/flat sales price (P) and the independent variables are given below;

Phouse price = α+βsize X size + βnumber of room X number

Table 1. Variables in the hedonic price function.

Variables		Explanation
$\mathbf{P}_{houseprice}$	House Price (TL/m^2)	Sales price of the sample house on m^2 basis
$\mathbf{X}_{size}$	Size	Size of the sample house (m^2)
$\mathbf{X}_{number\ of\ room}$	Number of room	Number of rooms in the sample house
$\mathbf{X}_{building\ floors}$	Building floors	Number of building floors of the sample house
$\mathbf{X}_{house\ floorI}$	House floor	On which floor is the sample house located
$\mathbf{X}_{building\ age}$	Building age	The age of the building where the sample house is located
$\mathbf{X}_{using\ status}$	Using status	Whether the sample house is in use or empty
$\mathbf{X}_{parking}$	Parking Garage	Whether the sample house has a parking garage
$\mathbf{X}_{kindergarten}$	Kindergarten	Presence of a kindergarten within 1000 m of the sample house
$\mathbf{X}_{primary}$	Primary School	Presence of a primary school within 500 m of the sample house
$\mathbf{X}_{secondary}$	Secondary School	Presence of a secondary school within1000 m of the sample house
$\mathbf{X}_{high}$	High School	Presence of a high school within 1500 m of the sample house
$\mathbf{X}_{mall}$	Mall	Presence of a mall within 1000 m of the sample house
$\mathbf{X}_{health\ clinic}$	Health clinic	Presence of a health clinic within 1000 m of the sample house
$\mathbf{X}_{hospital}$	Hospital	Presence of a hospital within 5000 m of the sample house
$\mathbf{X}_{busstop}$	Bus stop	Presence of a bus stop within 500 m of the sample house
$\mathbf{X}_{loan}$	Suitability for loan	Whether the sample house is suitable for loan use
$\mathbf{X}_{station}$	Distance to the Station	The distance of the sample house to the metro station in meters

of room + βbuilding floors X building floors + βflat floor X flat floor + βbuilding age X building age+ βusing status X using status+ βparking X parking (1)+ βkindergarten X kindergarten + βprimary X primary+ βsecondary X secondary+ βhigh X high+ βmall X mall+ βhealth clinic X health clinic+ βhospital X hospital+ βbusstop X busstop+ βloan X loan+ βstation Xstation +εi

Both the dependent and explanatory variables related to the sample houses within the scope of the study were handled separately, and the diversity of the data was simplified in accordance with the normal distribution, and the extreme values were removed from the data set.

FIELD STUDY AND DATA COLLECTION

It was previously stated that Kirazlı and Metrokent stations on the M3-Kirazlı-Başakşehir-Olimpiyat Metro Line were selected for the study area. Metrokent Station is in Başak District, one of the most important residential area of Başakşehir, which was opened to settlement in the 2000s.

Metrokent Station is a planned and developing settlement on a high-density, multi-storey, and mostly residential complex with approximately 1000 residences.

In addition, the metro station also serves other mass housing areas in the region such as Başakşehir 5th Stage, Earthquake Residences, Göcmen Residences. Various functions such as retail trade areas, bank branches, social and cultural facilities, and recreational areas have been created around the station. Due to the fact that the Metrokent is far from the city center, office-type service, and working areas are very limited. The fact that the recreation areas are within walking distance of the residences and that the commercial units are close and sufficient. In line with the preference of these structural features, the number of rooms of three or more is planned in the building stock. The physical environment does not allow much to establish and develop strong kinship and neighborly relations. In this sense, residents lead an introverted and nuclear family-oriented life. In the nuclear family living in this region, the fact that both parents are usually involved in working life and being away from home during long working hours shortens the time spent in the residence.

The second selected study area, Kirazlı, is one of the oldest settlements in Bağcılar and was formed in 1992 by the merger of Güneşli and Mahmutbey districts. The district of Kirazlı, which gave its name to the station, is a residential area composed of mostly low-rise apartments. In the station area, the number of floors is increasing, but the apartments, which generally vary between 3 and 8 floors, constitute an important part of the district. In addition, there is a large parking lot next to the station in accordance with the "park and ride" concept. On the other hand, there are production workshops and commercial usage on the first floors of the houses between the neighborhoods. Kirazlı neighborhood has an important potential in terms of producing home-based work and school trips. The selected residential areas and the rail system network relationship are given in Figures 1 and 2.

Unlike Metrokent, there are low-rise and adjacent flats in the Kirazlı Station area. This situation brings with it a social structure that tends to establish relations with each other. Compared to the Metrokent, people with lower incomes came together to support each other using their hometown bond. Citizens who migrated from Eastern Anatolia in the Kirazlı region are concentrated in certain districts and streets. In this building, it has been observed that a residential area where social relations are strong especially neighborly relations.

Data Collection

The most difficult part of this research was the data-finding phase since real estate valuation reports or housing sales/rent data were not recorded in a regular database. Therefore, it is quite difficult to conduct a numerical analysis based on real estate sales or rental data in our country. The most objective and powerful data set in this sector is the street

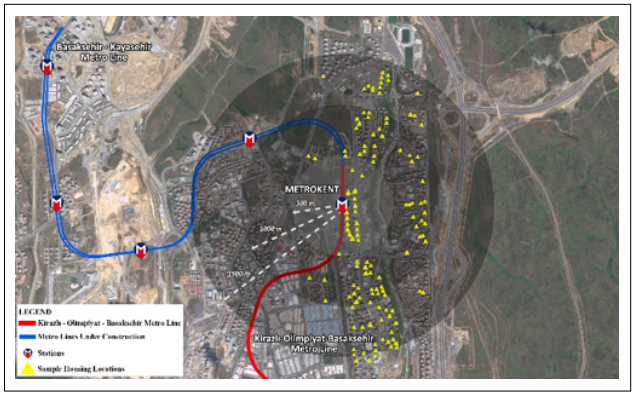

Figure 1. Distance relationship between housing sample and station in Metrokent region.

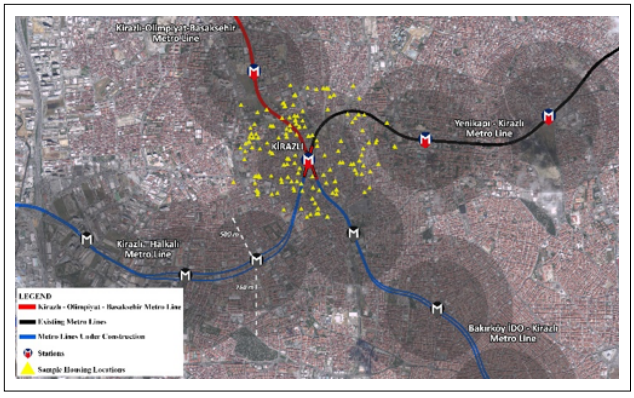

Figure 2. Distance relationship between housing sample and station in Kirazlı region.

fair values determined by local governments for property tax collection. These rates are updated every 4 years by valuation commissions established under the control of tax offices and under the leadership of municipalities. However, the fact that these data determine a very general price without going into the specifics of the building/flat constitutes another dimension of the problem. As a result, clear and fully accurate information regarding with the change in housing prices and the real market value cannot be accessed.

Another source of real estate sales data is the reports prepared by licensed valuation firms. Real estate appraisal firms undertake an important function, especially in the use of bank loans, which is one of the financing resources in housing sales. In this context, there are many valuation reports in both company and bank databases. However, the details of the housing and sales data included in these reports are kept confidential by the institutions within the framework of the Law on the Protection of Personal Data.

Apart from this, there are enterprises that provide services to those who want to invest in the real estate sector by following the real estate markets and determining the sector dynamics. These types of organizations make evaluations using especially brand projects, reports of real estate appraisal companies, investment projects in the city, or field research data. However, this generalized information is far from providing the necessary data for academic research.

In these conditions, the data used in the research were compiled from the primary source, on-site investigation, and internet search. In this way, both a large sample size could be reached and real-like sales amount data could be determined with its location. While compiling the sales data on the internet, the location of each sample was determined exactly. Some of the characteristic and environmental variables used in the hedonic price method were obtained directly from the analysis in the field. In September–October 2019, the sales data of 199 residences for the Metrokent region and 150 for the Kirazlı region were arranged according to date order. In these data obtained from the Internet; sales data, location, and the characteristics of the houses obtained through field. The distance between the sample houses and the stations was calculated with the help of the network analysis module in the GIS software. Environmental parametric variables related to the sample houses within the scope of the research were provided from Istanbul Environmental Plan and Istanbul Transportation Master Plan and the environmental factors determining the price were included in the numerical model as independent variables. Accordingly, the equipment functions and socioeconomic and sociodemographic data in the study area were created by utilizing upper-scale studies such as the 1/100.000 scaled Istanbul Environmental Plan and the Istanbul Transportation Master Plan.

Real walking distances were taken into account in numerical models using the network analysis module in the GIS software to reveal the distance relationship of the sample houses with the urban facilities. Sample house-metro station distances; for Metrokent, distance was determined as three stages, 500 m, 1000 m, and 1500 m, and for Kirazlı, it was determined as two stages, 500 m and 750 m. To produce more realistic results, the sample house-station distances used in the numerical analysis were based on walking distances instead of air distances.

In this direction, the air distances between the house and the station were converted into walking-based, real distances by taking into account parameters such as topography, walking path, slope, or aspect by using the network analysis module in the GIS software. In the framework of sustainable transportation, when a pedestrian leaves the house, they can directly go to the bus stop, market, etc. It is stated that the walking distance should be between 400 and 800 meters (Schiller et al., 2010). Although distance is an important criterion affecting the preference of walking, creating a quality walking environment in a quality, spacious, and safe environment is at least as important as distance (Cirit, 2014). Accordingly, the walking distance and air distances calculated with the help of GIS for each sample house were calculated one by one. Considering the whole sample size, the ratio between walking distance and air distance was determined as 1.43. While this coefficient was reflected to the air distance levels used for the sample, the value of 1.5 was used by rounding and the levels given in Table 2 were formed. Thus, regression analyzes were made by considering the actual walking distance and it was aimed to calculate more accurate results. The air distance and walking-based zone distances for the study areas are given in Table 2.

RESEARCH FINDINGS

In this research, sales data of 199 houses for the Metrokent region and 150 houses for the Kirazlı region were obtained and tested with the hedonic price model. Accordingly, in the analysis, a total of eight numerical models, four of which are Metrokent, three of which are Kirazlı, and one of which are mixed, were established. In this section, it is aimed to evaluate the results of the analyzes comparatively.

Table 2. Distance assumptions considered in the analysis

	Air distance stage	Walking based stage
Metrokent Region	0–500 m	0–750 m
	500–1000 m	750–1500 m
	Over 1000 m	Over 1500 m
Kirazlı Region	0–500 m	0–750 m
	Over 500 m	Over 750 m

Table 3. Descriptive statistics of all factors for the distance-based metrokent model

	n	Minimum	Maksimum	Mean	Standard Deviation
Size	199	64.0	237.0	140.040	39.0159
Number of room	199	2.0	6.0	3.985	0.7281
Building floors	199	2.0	27.0	11.302	4.4312
House floor	199	0.0	20.0	6.000	5.2281
Building age	199	4.0	23.0	11.930	4.1188
Using status	199	0.0	1.0	0.829	0.3905
Parking Garage	199	0.0	1.0	0.161	0.3683
Kindergarten	199	0.0	1.0	0.53	0.500
Primary School	199	0.0	1.0	0.171	0.3773
Secondary School	199	0.0	1.0	0.482	0.5010
High School	199	0.0	1.0	0.930	0.2564
Mall	199	0.0	1.0	0.849	0.3587
Health clinic	199	0.0	1.0	0.417	0.4943
Hospital	199	1.0	1.0	1.000	0.0000
Bus stop	199	0.0	1.0	0.935	0.2477
Suitability for loan	199	0.0	1.0	0.995	0.0709
House Unit Price (TL/m^2)	199	3048.0000	7886.5979	4779.0691	1007.3283
Distance to the Station	199	110.7882	2311.3821	1268.9406	576.9742
N (List)	199				

Table 4. Factor coefficients in the distance-based model of Metrokent

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	SE	Beta		
5	Constant	4245.130	261.875		16.211	0.000
	Building age	−67.859	13.516	−0.277	−5.021	0.000
	Size	11.132	1.189	0.431	9.362	0.000
	House floor	51.199	9.081	0.266	5.638	0.000
	Distance to the Station	−0.372	0.089	−0.213	−4.156	0.000
	Primary School	−297.600	129.265	−0.111	−2.302	0.022

Table 5. Factor Coefficients for Metrokent Close Stage Model (0–750 m).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	SE	Beta		
4	Constant	3792.214	268.225		14.138	0.000
	Building age	−76.114	12.396	−0.311	−6.140	0.000
	Size	10.758	1.172	0.417	9.183	0.000
	House floor	44.659	9.475	0.232	4.713	0.000
	0–750 m Stage	**570.055**	**132.060**	**0.232**	**4.317**	**0.000**

Table 6. Factor coefficients for Metrokent middle stage model (750m–1500m)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	SE	Beta		
5	Constant	4245.130	261.875		16.211	0.000
	Building age	−67.859	13.516	−0.277	−5.021	0.000
	Size	11.132	1.189	0.431	9.362	0.000
	House floor	51.199	9.081	0.266	5.638	0.000
	Distance to the Station	−0.372	0.089	−0.213	−4.156	0.000
	Primary School	−297.600	129.265	−0.111	−2.302	0.022

Table 7. Factor coefficients for Metrokent far stage model (over 1500 m)

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	SE	Beta		
5	Constant	4245.130	261.875		16.211	0.000
	Building age	−67.859	13.516	−0.277	−5.021	0.000
	Size	11.132	1.189	0.431	9.362	0.000
	House floor	51.199	9.081	0.266	5.638	0.000
	Distance to the Station	−0.372	0.089	−0.213	−4.156	0.000
	Primary School	−297.600	129.265	−0.111	−2.302	0.022

The explanatory statistical values of the variables in the models created for the Metrokent Region are given in Table 3. In addition, the results of the four models created for the Metrokent region are given in Tables 4-7, respectively.

The factor coefficients of the distance-based model for the Metrokent region are given in Table 4.

In Table 5, the factor coefficients of the model created for the houses located at the stage of 0–750 m from the station in the Metrokent region are given.

In Table 6, the factor coefficients of the model created for the houses located at the stage of 750-1500 m from the station in the Metrokent region are given.

In Table 7, the factor coefficients of the model created for the houses located at the stage of over 1500 m from the station in the Metrokent region are given.

The factor coefficients for the numerical models created for Metrokent are given above. The beta coefficients here show the degree of importance of the factors that determine the housing price and are ranked accordingly. The factor that best explains housing prices is considered to be the age of the building. There is an inverse relationship between the age of the building and its unit price. In other words, housing unit m^2 prices decrease by 67 TL every year as the building ages. The size of the house is the second most important factor affecting the prices. Accordingly, as the size of the houses increase, it is seen that there is an increase of 11 TL in unit prices. The most important reason for this is that the residences allow for quality, luxury, and comfortable use as they grow. The floor of the house is also one of the important parameters that determine the price of the houses. Especially in Başakşehir region, the increasing view with the rising floor and the decreasing degree of exposure to the external environment create effects that increase prices. Accordingly, each floor rise of the house increases the m^2 unit price by 51 TL. The factor of proximity to the metro station ranks first among all urban equipment opportunities and 4th in general, after the physical features of the house. In line with the general expectation and the literary, the housing prices in the Metrokent region increase as they approach the station.

According to the regression results, the m^2 unit prices of residences in the Metrokent region increase by approximately 37 TL for every 100 m approached to the metro station. The last statistically significant factor of the hedonic price-based model is the evaluation of the primary school facility located at the 500 m border of the samples in terms of its effect on prices. An urban equipment facility such as a primary school was added to the regression as a dummy variable. According to this, the presence of a primary school in the borders mentioned in the Metrokent region affects the housing m^2 unit prices positively by 297 TL.

For the Metrokent region, the fact that the users in the houses located at a distance of 0–750 m can reach the metro line with a 10-min walking distance and without using any vehicle, is

Table 8. Descriptive statistics of all factors for the distance-based Kirazlı Model

	n	Minimum	Maksimum	Mean	Standard Deviation
Size	150	60.0	250.0	119.593	33.0747
Number of room	150	2.0	7.0	3.667	0.9317
Building floors	150	3.0	18.0	6.173	3.7573
House floor	150	0.0	13.0	3.127	3.0659
Building age	150	1.0	28.0	8.133	8.2971
Using status	150	0.0	1.0	0.627	0.4853
Parking Garage	150	0.0	1.0	0.353	0.4796
Kindergarten	150	0.0	1.0	0.91	0.292
Primary School	150	0.0	1.0	0.62	0.487
Secondary School	150	1.0	1.0	1.00	0.000
High School	150	1.0	1.0	1.00	0.000
Mall	150	0.0	0.0	0.00	0.000
Health clinic	150	0.0	1.0	0.76	0.429
Hospital	150	1.0	1.0	1.00	0.000
Bus stop	150	1.0	1.0	1.00	0.000
Suitability for loan	150	0.0	1.0	0.900	0.3010
House Unit Price (TL/m2)	150	1760.	4888.	3271.	778.0
Distance to the Station	150	195.4	1187.2	687.4	220.2
N (List)	150				

statistically significant in terms of housing prices, and creates effects that increase the housing prices. According to the results of the Close Stage Model (0–750 m), it can be said that if a 100 m^2 house is located in the 0–750 m range, the house price will increase by 57.000 TL. However, when the distance of the houses from the station is above the walking distance limit values of 750 m, the power of the station to affect the prices gradually decreases and it starts to produce statistically insignificant results after 1500 m.

The explanatory statistical values of the variables in the models created for the Kirazlı Region are given in Table 8. In addition, the results of the three models created for the Kirazlı region are given in Tables 9-11, respectively.

The factor coefficients of the distance-based model for the Kirazlı region are given in Table 9.

In Table 10, the factor coefficients of the model created for the houses located at the stage of 0–750 m from the station in the Kirazlı region are given.

In Table 11, the factor coefficients of the model created for the houses located at the stage of over 750 m from the station in the Kirazlı region are given.

Table 9. Factor coefficients in the distance-based model of Kirazlı

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	SE	Beta		
6	Constant	4099.060	211.611		19.371	0.000
	Parking Garage	599.949	89.453	0.370	6.707	0.000
	Building age	−38.111	5.086	−0.406	−7.493	0.000
	Size	−7.436	1.032	−0.316	−7.207	0.000
	House floor	55.121	12.162	0.217	4.532	0.000
	Health clinic	−305.909	78.767	−0.168	−3.884	0.000
	Suitability for loan	244.486	122.322	0.095	1.999	0.048

Table 10. Factor coefficients for Kirazlı close stage model (0–750 m)

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	SE	Beta		
6	Constant	4099.060	211.611		19.371	0.000
	Parking Garage	599.949	89.453	0.370	6.707	0.000
	Building age	−38.111	5.086	−0.406	−7.493	0.000
	Size	−7.436	1.032	−0.316	−7.207	0.000
	House floor	55.121	12.162	0.217	4.532	0.000
	Health clinic	−305.909	78.767	−0.168	−3.884	0.000
	Suitability for loan	244.486	122.322	0.095	1.999	0.048

The effect of the metro station on the housing prices in the Kirazlı Region seems to be quite limited. Although Kirazlı is closer to the city center compared to Metrokent, it is a district with diversified public transportation infrastructure. The possibility of accessing the metro station from any point in the Kirazlı region and its balanced distribution to almost every part of the district have resulted in similar benefits for almost all the residences in the region. Most of the residential areas of the district have access to the rail system within walking distance. For this reason, the residences in the study area are already priced with the effect of the metro station. This ease of access to the rail system does not affect the housing prices in the immediate vicinity of the metro at a high level. The rail system factor ranks lower in terms of housing price components and does not even have a statistically significant effect. For this reason, factors such as the age of the building, the size of the house, and its suitability for loan determine the housing price much more dominantly.

The most important factor determining the housing prices in Kirazlı region is the "Parking Garage" in Table 9. The irregular and old houses in this area are being rebuilt on a parcel basis instead of an comprehensive urban transformation approach. The inadequacy of the car parks and the requirement of parking garage due to the regulation increased the effect of this factor. The parking garage is regressed as a dummy variable and if it exists, it increases the m^2 unit price of the house by approximately 600 TL.

The age of the building is the second most important parameter affecting the housing prices in the Kirazlı region, similar to the car park factor. According to the results of the regression analysis, the age of the building also affects the housing price in the opposite direction as stated before, and the housing unit price decreases by 38 TL for each additional age. In other words, the renovation process of the buildings in the Kirazlı region, which has a very old building stock built in the 1970s, is the most important factor that determines the prices.

Another important factor affecting the housing price in Kirazlı is the size of the house. Unlike Metrokent, it is possible to talk about a decrease in the price of 7.5 TL per m^2 as the size of the house increases. One of the most important reasons for this is the duplex houses in this location. The unit price of the upper floor of the duplex house is lower than the normal floor. The average unit prices of the duplex apartments in the samples are lower

Table 11. Factor coefficients for Kirazlı middle stage model (over 750 m).

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	SE	Beta		
6	Constant	4099.060	211.611		19.371	0.000
	Parking Garage	599.949	89.453	0.370	6.707	0.000
	Building age	−38.111	5.086	−0.406	−7.493	0.000
	Size	−7.436	1.032	−0.316	−7.207	0.000
	House floor	55.121	12.162	0.217	4.532	0.000
	Health clinic	−305.909	78.767	−0.168	−3.884	0.000
	Suitability for loan	244.486	122.322	0.095	1.999	0.048

than the normal apartments on a single floor. This situation is reflected in the regression as a reverse effect.

The factor related to the floor level of the house is parallel to Metrokent and the general opinion. Accordingly, an increase in the floor of the house increases the unit price of the house by 55 TL.

The issue of "suitability for loan" is also among the factors that increase the housing price and are statistically significant. A significant part of the residences in Kirazlı region do not have settlement or construction permission. For this reason, many apartments are not suitable for loan. Therefore, the suitability of the house for credit also creates effects that increase the unit prices by 244 TL. In other words, the fact that the house was built with its legal status is considered among the important parameters that affect its price.

Housing prices for Kirazlı Region were also analyzed by dividing into two stages with the distance-based model. Both the close-range and middle-range model results give parallel results with the distance-based model. This situation can be explained as follows. Kirazlı region is in a very good condition in terms of rail system infrastructure due to both existing metro lines and metro lines under construction. There is rail system access within walking distance in almost every part of the region. For this reason, the residences in the study area are already priced with the effect of the metro station. In other words, since there is access to the rail system from all sides, this factor ranks lower in terms of housing price components and even does not have a statistically significant effect. For this reason, factors such as the age of the building, the size of the house, and its suitability for loan determine the housing price much more dominantly.

Within the scope of the study, the results of the regression that focused on the relationship between the housing price and the metro station of the Metrokent and Kirazlı regions, which have different settlement characteristics, were given above. Apart from this, the numerical analysis results of the heterogeneous data pool, in which both Metrokent and Kirazlı sample data are handled together, are given in Table 12.

In this research, 199 house sales data were collected in three stages at a distance of 0–1500 m from the metro station in the Metrokent region, and 150 house data varying in two stages between 0 and 750 m in the Kirazlı region were examined in terms of measuring the effect of the metro station on the house price.

In this framework, in the mixed model results, in case the spatial data is differentiated and analyzed in a heterogeneous structure, the dependent variable of the housing unit price can be explained by much more factors, and the number of important factor components increases. From this point of view, being close to the metro station did not create statistically significant results in the mixed model.

To summarize, the outputs in the Metrokent region have shown parallel results with the literature. Mainly the metro creates effects that increase the housing prices. Contrary to the literature, metro stations in the Kirazlı region do not have a statistically significant increase or decrease in the housing price.

The limited public transportation facilities in the Metrokent region have strongly affected the housing prices, especially at the 0–750 m stage of the metro station, this result is important. The strength of this effect decreases as you move away from the station, and it starts to disappear as you go above the walking distance. On the other hand, the possibility of accessing the metro station from any point in the Kirazlı region, evenly dispersing it to almost every part of the district, has caused similar benefits for almost all of the residences in the region. Most

Table 12. Factor coefficients for mixed model

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	SE	Beta		
9	Constant	3285.986	248.494		13.224	0.000
	Building floors	61.322	12.869	0.253	4.765	0.000
	Mall	976.014	103.429	0.414	9.437	0.000
	Building age	−37.149	6.553	−0.205	−5.669	0.000
	Size	5.682	0.969	0.182	5.866	0.000
	Kindergarten	−281.877	84.054	−0.110	−3.354	0.001
	Primary School	−262.907	80.602	−0.107	−3.262	0.001
	Parking Garage	417.862	132.337	0.152	3.158	0.002
	High School	−475.787	203.178	−0.079	−2.342	0.020
	House floor	20.315	10.049	0.080	2.022	0.044

of the residential areas of the district have access to the rail system within walking distance. For this reason, the residences in the study area are already priced with the effect of the metro station. This ease of access to the rail system does not affect the housing prices in the immediate vicinity of the metro at a high level. The rail system factor ranks lower in terms of housing price components and does not even have a statistically significant effect. For this reason, factors such as the age of the building, the size of the house, and its suitability for credit determine the housing price much more dominantly.

DISCUSSION AND CONCLUSION

In the article, Metrokent and Kirazlı regions, which are two settlements with different characteristics and located in the corridor of the M3-Kirazlı-Başakşehir-Olimpiyat Metro Line, are examined in terms of the effect of the metro station on the housing prices. According to this;

Metrokent is a satellite city settlement and was formed with a legal construction process. It is a developed residential area in the form of high-rise, multi-block sites. The residents are generally in the middle and upper middle-income level. Due to its distance from the city center, transportation opportunities are limited. For this reason, housing prices very close to the metro station are more affected by the station, and the effect of the metro line on the price decreases as you move away from the station. In the Metrokent region, proximity to the station ranks first among the environmental opportunities that can be evaluated within the scope of external elements such as hospitals, schools, and shopping malls, after the physical features of the residences. Accordingly, in parallel with the literature, housing prices in the Metrokent region increase as they approach the station. According to the results of the hedonic price model, the m^2 unit prices of housing in the study area increase by approximately 37 TL for every 100 m approached to the metro station. In addition, for the close-stage model, it can be said that if a 100 m^2 house is located in the 0–750 m range, the house price will increase by 57.000 TL. In other words, this value reveals an effect that increases the average housing unit price value by approximately 12%. This effect is particularly strong in terms of houses close to the station and decreases inversely with walking distance away from the station.

The Kirazlı example presents different results than Metrokent. According to Metrokent, Kirazlı has a construction story that is located in the center of the city and developed illegally in the 1970s and later became legal. Due to the fact that it is an old and dense settlement, a transportation system has developed on the axis of the rail system with public investments. For this reason, it has a transportation network that offers more variety in terms of both rubber-tired and rail systems. In the area where the middle and lower-middle-income social segments live, diversified public transportation opportunities are used intensively. Under these conditions; the effect of a new metro station on housing prices seems rather limited. The metro station can be accessed by walking from any point in the Kirazlı region. This access has resulted in similar benefits for almost all houses in the region. In other words, since most of the houses in the district have the opportunity to access any rail system within walking distance, they are already priced with the effect of the metro station. In this context, this ease of access to the rail system did not statistically affect the housing prices in the immediate vicinity of the metro. There are other dominant factors affecting prices in this region. For example, parameters such as the newness of the building and its suitability for loan largely determine the price. Therefore, the increase in transportation opportunities with a new metro did not produce a high marginal benefit for the people living in the region.

The metro station does not cause the same level of benefit to every settlement it serves. According to the results of the numerical analysis in the research, the different effects of the stations on the housing prices in the Metrokent and Kirazlı regions limit the approaches to generalize the subject. In this respect, each location needs to be examined within its own dynamics and according to changing conditions. In summary, the results of the analysis revealed parallel results with the literature in the Metrokent region and the metro station increased the housing prices in this region. However, in the Kirazlı region, on the contrary, metro stations did not have a statistically significant effect on the housing price.

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