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Hedonic Modeling for a Growing Housing Market: Valuation of Apartments in Complexes

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Abstract

The share of apartment complexes in housing stock of major cities in the developing world has been increasing. They represent a different housing submarket whose growing importance necessitates further research. Using survey data on transaction records of real estate agents, we employ a hedonic pricing model to explore the factors influencing apartment prices in the Metropolitan Izmit area. The site of a major reconstruction effort following a strong earthquake, Izmit has been in the forefront of the changes taking place in the Turkish real estate sector in particular, and in urban housing in general. We aim to get better estimates by focusing the study on apartment complexes in Metropolitan Izmit, the major submarket in the area. The results reveal that structural characteristics of an apartment as well as amenities provided in an apartment complex are important determinants of price. Air quality and proximity to a good public school have a major effect on price as well. The findings suggest that the submarket could be segmented further geographically.

Keywords: real estate, asset pricing, housing prices, hedonic model, Turkey

1. Introduction

Rapid urbanization has been a major factor for housing demand in developing countries since the middle of the last century. Urban population in those countries has increased by more than six fold during this period (Pugh, 2001). A major concern of policymakers has been the shortage of healthy and affordable living space in growing cities. City dwellers in better-off developing countries have been luckier in this respect; rising personal incomes and relatively well-functioning real estate and credit markets have allowed them to live in modern units with higher standards. These units are usually apartments, and increasingly, they are being located in a complex of multistoried buildings (Wester et al., 2002; Rabenhorst & Ignatova, 2009; Rosen & Walks, 2013).

Apartment complexes offer several advantages over single-buildings for both developers and residents. Firstly, developers who build many units enjoy economies of scale because of lower input costs, better utilization of resources and employment of capital intensive methods. Their efficiency in construction, and thus low unit cost, allows them to set apartment prices lower compared to their smaller rivals. Secondly, offering buyers a variety of apartment types, layouts and quality becomes less costly as the size of the project increases. Thirdly, limited available land in an urban area makes provision of recreational facilities expensive for developers. Due to much lower cost per unit, large apartment complexes can have swimming pools, club houses and larger green space compared to single-buildings. Lastly, providers of public transportation and infrastructure services are more sensitive to the needs of a large population living in a complex probably because of both the larger demand and more political power (Ho, 2003).

Living in apartment complexes has been gaining popularity in major Turkish cities. This trend has gained momentum as modernization of the urban housing stock has become a policy priority after the 7.4 magnitude earthquake in 1999. The disaster, in which more than 30 thousand buildings became unusable, revealed weaknesses of the aging housing stock. Government responded with the initiation of large housing projects. These early public initiatives, which were mainly oriented towards the victims of the earthquake, gained a higher momentum by the establishment of the Housing Development Administration of Turkey (TOKI) in 2002. TOKI, with its mission of providing modern and affordable dwellings has become a big player in the supply side of the

market, continuously rolling out medium to large scale housing projects (Yuksel & Gokmen, 2008).

Two other developments during 2000s helped increase the dynamism in the Turkish real estate market. The sharp decline in the long term interest rates in the first half of the decade and the mortgage law that took effect in 2007 have substantially increased the demand for housing loans. That there are many first-time home buyers on the market and that the real estate is traditionally seen as a safe investment have also been important demand-side factors. As a result, the housing sector in Turkey has been on a sustained growth trend since the 1999 earthquake, with the construction of a great deal of houses featuring a wide range of characteristics. The rapid growth of the housing sector as well as the requirements of the mortgage law has made housing valuation a topic of great importance (Ayan, 2010).

In spite of the growing importance of apartment complexes in urban housing, there are few studies for Turkey and other developing countries on this dynamic submarket. It is probable that the demand structure for this type of housing is quite different from that for traditional family houses or even from demand for apartments in a single building. This paper aims to make a contribution in this respect by attempting to investigate for Izmit the effects of various housing characteristics on the prices of such apartments.

Metropolitan Izmit, the largest and most populous area in Kocaeli province, is an ideal example to study the type of apartment living this study is concerned with (Note 1). Izmit, Kocaeli's central city, has been in the forefront of the changes in the real estate sector. Kocaeli and Metropolitan Izmit area in particular were hit hardest in the Marmara earthquake. The need for replacing buildings demolished by the quake created a large demand for new housing. Rising personal incomes in the area have continued to feed this demand. The large number of factories operating in the province, a center of manufacturing industry and a major transportation hub, has created relatively high-paying jobs. Growing purchasing power combined with lower borrowing costs in the economy has helped many potential first-time home buyers enter the market. Most of these people have limited budgets; owning a single-family house in an urban area where rapid growth makes land scarce is beyond their means. On the other hand, they can afford the monthly mortgage payment for an apartment. Following the earthquake, housing construction in the area was first in the form of public projects. In time, it has become mostly the private sector's undertaking. A great number of new buildings, almost all of them in the form of apartment complexes, have been added to the housing stock in Izmit within the last decade. The variety of quality-price offerings on the supply side and rapid population growth on the demand side have kept the real estate market thriving. People with lower income tend to buy low to medium quality apartments in larger complexes while others who are better-off or more risk-taking demand luxurious apartments in gated communities. Concern for liquidity, the ability to sell a dwelling relatively easily without a major loss in value, also favors apartments; the majority of market transactions in the metropolitan area have regularly consisted of re-sale of apartments (Note 2).

In this paper, we study the determinants of apartment prices in Metropolitan Izmit. We choose to focus on units in apartment complexes because they constitute most of the new housing construction in the last two decades and the majority of the housing market transactions in the area. Apartments form a separate submarket; their potential buyers are unlikely to consider other types of dwellings like detached or semi-detached houses as viable alternatives in their search. When an urban housing market is segmented, a single price equation might give incorrect results. Better estimates for the factors influencing housing value can be obtained by uniquely modeling each submarket (Thibodeau, 2003). Although later studies on real estate markets in developed countries increasingly incorporate submarket analysis, there are few studies on the issue for developing countries.

While there are a few housing valuation studies carried out for other major metropolitan areas in Turkey, no similar study has been conducted for Izmit. This paper uses a hedonic price function to analyze apartment valuations to fill this gap in the literature. We study the effects on apartment price of its structural characteristics and amenities as well as neighborhood factors such as air pollution and public school quality. As population growth, mainly through migration, continues in the area, basic urbanization problems, primarily those related to air pollution and security, have been attracting greater attention. We proceed as follows: Section 2 gives a brief literature review where the focus is on previous findings reported for Turkey. Section 3 presents a detailed discussion on the dataset and the variables chosen for the study. Section 4 first introduces the hedonic pricing model, and then reports the regression results. Finally, section 5 concludes.

2. Literature Review

Housing prices are determined according to various characteristics, such as quality, area, age and location. Along with this, buyers also assign their own personal criteria to any given house, and thus, the value for a house may present a wide range. Consequently, determining the value of a house, being by its nature a heterogeneous

commodity, is not a simple task. The hedonic pricing method, which is frequently used in the literature on real estate evaluation, views home prices as a composition of its characteristics and tries to measure the marginal effect of the characteristics on the price (Zietz et al., 2008). The hedonic price function usually takes the form of

$$P = X\beta + \varepsilon$$

Where P is the vector of sale prices, X the matrix of explanatory variables, β the vector of regression coefficients and ε the error term.

There exists a large literature on housing valuation, but the scope of most studies has been limited to the industrialized countries in North America, West Europe and the Far East. Sirmans et al. (2005) and Malpezzi (2008) summarize the studies performed for the developed countries. As for the developing countries, a small number of studies have been conducted. Most of these studies focused on a few higher-income developing countries where data are available. The limited research has suggested that housing markets in different countries have many similar characteristics (Malpezzi & Mayo, 1987).

In the studies performed on housing prices, many variables that are believed to affect the price have been employed. The primary variables used include (Sirmans et al., 2005):

- Building characteristics of the house: Plot size, area, age, number of rooms and bathrooms, flooring, kitchen size, availability of balcony.
- Internal characteristics of the house: Floor covering, heating mode, fireplace, air conditioning.
- External characteristics of the unit: Being within an apartment complex, elevator, parking lot, garden, pool, façade.
- Natural environment-related characteristics: Lake, mountain or sea view, open exterior.
- Location and neighborhood characteristics: Distance to downtown, public transportation, touristic areas, social facilities, good neighborly relations, quality of schools, municipal services.
- Other features: The wear of the house, previously occupied or unoccupied status, time passed since it was first offered for sale.

Early studies for developed countries tended view all of a metropolitan area as one housing market and accordingly used a single hedonic pricing equation to characterize it. The belief in the existence of a long-run equilibrium, where price differences between locations in the area would be eliminated as a result of changes in demand for and supply of houses, underpinned this approach (Goodman, 1978). Later studies began questioning the validity of the assumption of long-run equilibrium. Large variety in structural and locational attributes of houses, immobility of capital, inelasticity of housing supply and time-dependent changes in supplier and buyer behavior all suggest that the housing market is not uniform but rather consists of distinct submarkets (Goodman and Thibodeau, 1998). Dwellings that are seen by buyers as close substitutes for one another, but unlikely alternatives for others form a submarket. Each submarket reaches a different equilibrium price that can be sustained over long periods of time (Leishman et al., 2013). Submarkets may be defined by location, structure type, structural characteristics, or neighborhood characteristics. There has been extensive debate in the literature about the validity of different approaches to define and identify submarkets (Allen et al., 1995; Adair et al., 1996; Bourassa et al., 1999; Bourassa et al., 2003).

Of the few studies conducted on Turkish housing markets, Ozus et al. (2007) investigated the effect of submarkets on price for Istanbul. Submarkets were defined according to municipal boundaries. They found that at the metropolitan level, floor area, sea view and the submarket the house located in were the most significant variables. Housing prices varied among submarkets depending on locational, socio-economic and the unit-related characteristics. Cingoz (2010), also studying housing prices in Istanbul, confirmed that the districts wherein the apartment complexes were located had a strong differentiating effect on the price. Furthermore, variables such as the number of rooms, house size, availability of parking spaces and presence of ponds tended to have a price-increasing effect; however, being outside of the downtown area affected the price adversely.

Keskin (2008) and Caglayan and Arikan (2009) both studied housing prices in Istanbul by taking the metropolitan area as a single market. Keskin, including socio-economic and neighborhood quality characteristics into her analysis, reported that the average income of the household, the length of time they lived in Istanbul and neighbor satisfaction increased the price while earthquake risk of the area decreased it. Caglayan and Arikan, using quantile regression, found that while cable television, security, heating system, availability of garage, kitchen size and number of rooms had positive impact on price, location on a busy street was a price-decreasing factor. Unlike many other studies, a positive relationship was seen between the age and price of a building.

Moreover, the location of a house on either the European side or the Asian side had a meaningful affect on its price in Istanbul.

Proximity to mass transportation has been a commonly used variable in the house pricing literature. In their study, Yankaya and Celik (2005) investigated the impact of metro investments on housing prices in Izmir. They concluded that metro investments increased the prices of houses within the vicinity of metro stations.

Tekel and Akbarishahabi (2013), investigating the effect on housing prices of urban open green areas, found that proximity to Botanik park in Ankara had a strong impact on apartment prices whereas distance to the other two parks in the area had less effect. Park view also increased apartment prices.

Selim (2008), using nationwide aggregate data collected from urban and rural areas, analyzed the factors affecting the housing prices in Turkey. She concluded that type of building, construction type, floor area, number of rooms, presence of a pool, heating system, and cable access were the most significant factors determining the price. Moreover, a positive relationship was found between the age of the building structure and rent price. This particular finding, contrary to the expectations, was attributed to the central location of older buildings.

3. Data and Variables

The data used in this study was obtained from transaction records of real estate agents in Metropolitan Izmit. Face to face interviews during which agents filled in a questionnaire were conducted between January and April in 2012. Therefore, they represent secondary market transactions between the previous and the new owner, rather than first time sale of an apartment by the developer. Actual sale price data is more advantageous than owners' self-valuation because of the potential bias in the latter.

The first half of 2012, in which our data was collected, was a period of relatively stable prices for the housing market in Metropolitan Izmit. The earthquake in 1999 reduced the housing stock in the area and increased the prices of houses that had withstood the event. Rapid initiation of projects by the state and local authorities mitigated the rise in prices. Nevertheless, real estate prices were rising along with the growing regional economy throughout the first decade of the millennium, providing incentives for the private developers to increase housing supply mainly by building apartment complexes. The aftershocks of the global economic crises on Turkish economy led to falling prices in 2009 and 2010, since which the real estate market has calmed and the prices have stabilized. We think that the market for apartments in Metropolitan Izmit was at or near equilibrium during the period in which transactions in the dataset took place.

The dataset contains information on an apartment's structural characteristics, amenities provided by the complex and its neighborhood characteristics. The variables, their definitions and descriptive statistics are presented in Table 1.

There are 405 apartments located in 34 apartment complexes in the dataset. The distribution of apartments between the three municipalities that make up Metropolitan Izmit (75% in Izmit, 18% in Kartepe, 7% in Basiskele) is close to the distribution of the population; although Basiskele is underrepresented in terms of population share, it is less so in terms of share of population living in apartment buildings rather than in single houses. The size of the apartment complexes shows a large variation ranging from complexes with less than 50 units to major projects with more than 4000 units. Government or municipality initiated projects are relatively larger and older while complexes built by private developers tend to be smaller.

The variables used in the study are among the most frequently tested in the real estate valuation literature (Sirmans et al., 2005; Malpezzi, 2008). We explain below our rationale for choosing the variables to be analyzed and our expectations about their coefficients. On the other hand, we omit some other oft-studied variables like balcony, elevator, heating source, parking space, playground facilities, access to public transportation because they are all common factors and vary little between apartment complexes in Metropolitan Izmit. Even properties of apartment interiors such as floor covering show little variation in type (but not in quality, which we try to control to some extent). We have chosen to exclude number of rooms as it is highly correlated with floor area (0.67).

The floor area of a residential unit (AREA) is consistently found to be an important factor in its price. We also add the square of the area, AREA2, to the model because of a probable nonlinear relationship between price and area, as suggested by visual inspection.

Age (AGE) is another most frequently included feature in hedonic price functions. Most studies report a negative effect on price, though there are studies that find a non-significant or positive effect. If land or redevelopment value increases in time more than the decrease in use value of a unit, then age could have a positive effect on price (Clapp & Salavei, 2010).

Existence of additional bathrooms is consistently found to increase the value of a unit. In their survey article, Sirmans et al. (2005) report that in 40 studies where a variable for multiple bathrooms appeared, it had the expected sign in 39 of them, and was significant in 34. The binary variable BATHROOM takes value of 1 if an apartment has more than one bathroom. In the dataset, 56 apartments have two bathrooms and only one has three.

Table 1. Descriptive statistics of data set (N = 405)

Variable	Description	Mean (Std. Dev.)
PRICE	The sale price of the apartment (TL)	107216 (44847)
AREA	The floor area of the apartment (m^2)	111.22 (27.55)
AREA2	The square of the floor area of the apartment (m^2)	13128 (7420)
CNSTR_LQ	Binary: the construction quality is below average	0.16 (0.37)
AGE	The age of the apartment building (years)	7.14 (5.21)
BATHROOM	Binary: there is more than 1 bathroom	0.14 (0.35)
BLW_GRND	Binary: the apartment is located below the ground floor	0.02 (0.13)
GROUND	Binary: the apartment is located on the ground floor	0.25 (0.43)
NRTH_WST	Binary: the apartment faces north and/or west	0.49 (0.50)
POOL	Binary: there is a swimming pool in the apartment complex	0.06 (0.24)
SECURITY	Binary: security guards are present in the apartment complex	0.15 (0.36)
DISTANCE	Binary: the distance from the city center (kilometers)	5.77 (3.56)
YHYKPTN	Binary: the apartment is in Yahyakaptan apartment complex	0.11 (0.31)
SCHOOL	Binary: there is a high quality public school within 1 kilometer	0.25 (0.43)
AIR	Binary: air is clean in the neighborhood	0.32 (0.47)
KARTEPE	Binary: the apartment building is located in Kartepe	0.18 (0.38)
BASISKELE	Binary: the apartment building is located in Basiskele	0.07 (0.25)

There is considerable variation in construction quality, especially for apartment interiors, between the complexes in our data set. Even though the buildings are considered to be safe in the sense that they can withstand to a high magnitude earthquake similar to the one in 1999, the quality of materials used, such as roofing materials, heat and sound insulation, paint, floor coverings, kitchen countertops, wall tiles and toilet in bathroom, as well as the workmanship might differ significantly. Most of the apartments with poor quality interiors are located in complexes built by private contractors commissioned by the state enterprise TOKI. We designated a binary variable (CNSTR_LQ) that takes value of 0 if real estate agents consider interior construction quality of an apartment to be low.

Metropolitan Izmit is located on a plain and the hills around it. Some apartments in a building located on a hill could be below the ground level. Such apartments are sold at a major discount compared to those above the ground level in the same building because they have low sunlight and no scenery. Ground level apartments also carry a price penalty, although not as much as those below them, because of limited view and noise created by people coming in and going out of the building. Binary variables BLW_GRND and GROUND are included to measure these price impacts.

An apartment facing only north has lower sunlight and requires more energy to heat during colder months. North-side apartments could be less preferred because of health and heating cost concerns. Since apartment buildings in complexes are not attached like those in downtown, there is no apartment in the data set that faces only north. Therefore, we have created a binary variable (NRTH_WST) that takes a value of 1 if the apartment faces north and west.

Demand for private residential security services in Metropolitan Izmit has been rising with the increasing number of gated communities. Although crime rate for the area is not above those of similar-sized cities, residential security services, probably signaling prestige and social rank, are seen as a selling point by developers

and used in their marketing. Another amenity that is featured prominently in developer ads is swimming pools. Previous studies found that existence of a swimming pool increases the value of apartments in a complex (Sirmans et al., 2005). Therefore, the binary variables SECURITY and POOL are also included in the analysis.

We take as the central business district the area around Anıtpark in downtown Izmit. It is the most visited site in the city due to government agencies, banks, a large number of stores, cafes and restaurants as well as the largest weekly one-day market located there. The variable DISTANCE measures how far in kilometers a particular apartment complex is from the central business district.

A good education is seen as the key to a good job, and thus access to quality schools is very competitive in Turkey. Students who have completed 8th grade are first allocated to high-schools and then to universities according to their scores on nationwide centralized exams. A student's success in the university entrance exam is thought to be largely dependent on the high school she graduated from, and, in turn, her allocation to a high school to be dependent on the quality of her primary education. Access to public primary school is decided according to the location of the family. Parents either have to send their children to a public school in their school district or they have to choose a private school. The second option is only available to a minority since tuition and other expenses of private primary education could easily add up to half of the mean annual family income, about $12000 in 2012. On the other hand, there aren't many high quality public primary schools given their performance at the high school entrance exam, SBS. Of 85 public primary schools in Izmit, only 6 was in the top 10% and 24 in the top 100 among 350 primary schools in Kocaeli according to a province-wide SBS trial test in 2012. Average test scores of high performing schools were nearly 30% higher than other schools'. Families with school aged children are known to move to neighborhoods with quality public schools so that their children can be enrolled to these schools. This could drive up the rents and apartment prices around quality public primary schools. We have chosen a public primary school's performance in 2012 SBS trial test as a proxy for its educational quality (whether it was among the top 100 schools in Kocaeli). Since we don't have data about school district boundaries, we created a binary variable (SCHOOL) that takes 1 if an apartment is within 1 km distance from a good public primary school. This definition of a school district is conservative; the implied school districts will probably be smaller than real ones.

The effect of air quality on price is consistently found to be negative, though some studies reported the effect to be small (Smith et al., 1995). Later studies with more robust econometric methods found that air pollution had a large negative effect on residential unit prices (Zabel & Kiel, 2000; Chay & Greenstone, 2005). As an industrial center, Metropolitan Izmit is home to many factories producing a large variety of commodities ranging from chemicals, steel, machines, cars to construction materials. As it is also a major transportation hub, one of the most heavily used routes in Turkey passes through the city. Therefore, people living in the area have increasingly been concerned about the levels and possible effects of air pollution. Lacking an objective factor to measure air quality, we use a binary variable, AIR, to reflect real estate agents' perceptions of air cleanness in a neighborhood. Chasco and Gallo (2013) show subjective evaluation measures of air quality can effectively explain part of the variation in housing prices.

Apartments in Yahyakaptan complex, the largest and oldest in Metropolitan Izmit, are priced higher than apartments of similar quality in other complexes. The community has a higher proportion of professionals and well educated, upper middle class, white color workers (public servants, university employees, engineers, doctors and teachers). It has a theater, a shopping center and various cafes and restaurants, and is richer in green space and recreational opportunities compared to other large complexes. Although all apartment complexes have access to public transportation, Yahyakaptan is better connected to every major community in the area. Omitting a variable for the complex could create an upward bias for older complexes, thus we include the binary variable YHYKPTN in the estimation.

Kartepe and Basiskele differ from Izmit in several aspects. Both municipalities have lower population density and limited service sector activity compared to Izmit. Until recently, agriculture has been the main economic activity but is being replaced with service jobs in Izmit and industrial jobs in the two municipalities. As a result, there is abundance of land available for development, especially in Kartepe, which is reflected in lower land values. In order to account for the probability that Metropolitan Izmit area has geographical submarkets as well, we include the binary variables KARTEPE and BASISKELE in the analysis. We prefer this method instead of dividing data into subsamples and performing F tests for coefficient equality because of the small size of our dataset. The variables could also proxy for some of location specific missing variables (those highly correlated with the municipality variables) in the model.

We expect the coefficients for AREA, BATHROOM, POOL, SECURITY, YHYKPTN, SCHOOL, AIR to be

positive and for AREA2, CNSTR_LQ, AGE, BLW_GRND, GROUND, NRTH_WST, DISTANCE, KARTEPE, BASISKELE to be negative.

4. Methodology and Results

The hedonic pricing model, which evaluates the price of an asset as a function of the values of the different components constituting the asset, was first used by Court (1939) in reference to automobile prices. Since then, it has been applied to a wide range of commodities which are difficult to value otherwise. Lancaster (1966) and Rosen (1974) laid the theoretical foundations of the hedonic pricing approach. Starting from the premise that products were heterogeneous, they suggested that demand for any product depends on the qualifications of the product, not the product itself. The price of a heterogeneous product, such as a house, is evaluated as the sum of its total characteristics. Each characteristic has a benefit for the consumer, and the level of benefit to the consumer from any product depends on the different characteristics contained in such products. When deciding to buy or not to buy a product, the consumer compares the total benefit to be acquired with its cost. Accordingly, in equilibrium the cost of any product is equal to the sum of the values (implicit or hedonic prices) of its characteristics.

When hedonic pricing is considered for the real estate market, it is assumed that the value of a house, essentially a heterogeneous commodity having many different components, can be estimated by focusing on a smaller set of its components, or attributes. Say, P is the selling price of an individual house and C is a set of attributes assumed to affect the price of the house. Then, the hedonic pricing model is $P = f(C)$. The hedonic price of the i^{th} attribute in set C is $\partial P/C_i$, the marginal price of that attribute (Goodman, 1978). Although a house's price and its characteristics can be observed, the marginal values of the characteristics cannot be directly seen and have to be estimated through the regression analysis. In the analysis, the housing price becomes the dependent variable and the physical properties of the unit, its socio-economic, locational and environmental characteristics are included as independent variables.

We use for estimation the semi-logarithmic form of the hedonic price function,

$$\ln P = X\beta + \varepsilon$$

Where P is the vector of sale prices, X the matrix of explanatory variables, β the vector of regression coefficients and ε the error term.

Even though the theory hints at no specific functional form, the semi-logarithmic function is one of the most preferred forms among hedonic price models. The estimates obtained from the semi-log regression can be interpreted intuitively as the percentage change in the price. Value added by a characteristic, say the number of rooms, varies proportionally with the size and quality of an apartment unlike the unrealistic case in the linear model where each additional unit of the characteristic changes the price with the same amount. The semi-log form also gives more reliable estimates in the presence of heteroscedasticity, which is frequently the case for cross-section datasets used in real estate research (Malpezzi, 2008).

We estimate the price function by using ordinary least squares, still another common practice in the literature. The results are reported in Table 2. Four models are estimated in order to differentiate the effects on price of different categories of characteristics. The dependent variable for the four models in columns (1) to (4) is the natural log of the apartment's sale price. In order for the coefficients to accurately reflect percentage changes in price, they have to be transformed by $\left(e^{\beta_i} - 1\right)$, where β_i is the regression coefficient of the i^{th} variable (Halvorsen & Palmquist, 1980). Table 3 presents the transformed values for the coefficients of the full model.

The models do not show any significant sign of multicollinearity; the coefficient estimates remain quite stable through the models. Individual VIF values are less than 5 (except DISTANCE in the full model with the municipality variables) and average variance inflation factor for each specification is less than 3 once the obvious high correlation between the floor area and its square is taken into account. Heteroscedasticity is present in all models; Breusch-Pagan (1979) test rejects the null hypothesis of constant variance at the 1% level. In order to remedy the bias in the variance of estimated parameters, White-Eicker heteroscedasticity robust standard errors are used in the estimation (White, 1980).

Column (1) is the base model including the structural attributes of the apartment, the amenities offered in the complex and the distance from the central business district. Second model adds the largest and oldest apartment complex in Izmit, Yahyakaptan (YHYKPTN). Two neighborhood variables, the presence of a quality public school in close proximity (SCHOOL) and the air quality in the neighborhood (AIR) are included in column (3). Column (4) presents the full model which accounts for the probable effect of geographic submarkets in Metropolitan Izmit with the inclusion of KARTEPE and BASISKELE variables.

All variables in models (1)–(4) have the expected sign and most are highly significant. Successive improvement from the base to the full model is observed with *t* values remaining significant, R^2 increasing and both Akaike (AIC) and Bayesian (BIC) information criterion values consistently dropping (Note 3).

The floor area is the variable with the most explanatory power; regressing the log of price on the floor area and its square alone explains 61% of the variation around the mean. Both AREA and AREA2 are consistently significant through the models with little change in their coefficients. Cost of construction is highly correlated with floor area; the availability of land for development especially in Kartepe and Basiskele could be a factor in keeping apartment prices close to construction costs. The relationship between the log price and the floor area is nonlinear as might be expected: % increase in price drops as area increases. In the full model, an additional m^2 increases price by 0.84% at 80 m^2 but only by 0.26% at 200 m^2. When calculated at respective mean prices, the elasticity of price with respect to floor area is relatively constant around 0.7 up to 150 m^2 and then drops to 0.5 around 200 m^2.

Apartments with poor build quality are penalized on average by a 10% drop in price. A similar finding, albeit conceptualized in the opposite way, is reported for Izmir: an above-average build quality increases the price by 15.8% (Yankaya & Celik, 2005). An apartment on the ground floor is discounted by 8.4% compared to apartments on upper floors in the same building. The discount reaches up to 23% for apartments below the ground level. Apartments facing northwest might be slightly less preferred, even though the effect is marginally significant only in the full model.

Table 2. Hedonic price estimates. dependent variable: log (PRICE)

	(1)	(2)	(3)	(4)
CONSTANT	10.563*** (0.079)	10.599*** (0.081)	10.692*** (0.074)	10.610*** (0.072)
AREA	0.012*** (0.001)	0.012*** (0.001)	0.012*** (0.001)	0.012*** (0.001)
AREA2	-2.39E-05*** (0.47E-05)	-2.45E-05*** (0.49E-05)	-2.10E-05*** (0.38E-05)	-2.42E-05*** (0.37E-05)
CNSTR_LQ	-0.140*** (0.021)	-0.104*** (0.023)	-0.104*** (0.025)	-0.102*** (0.021)
AGE	-0.001 (0.001)	-0.009*** (0.002)	-0.018*** (0.002)	-0.018*** (0.002)
BATHROOM	0.135*** (0.030)	0.144*** (0.030)	0.123*** (0.033)	0.151*** (0.030)
BLW_GRND	-0.205*** (0.050)	-0.191*** (0.045)	-0.237*** (0.057)	-0.266*** (0.051)
GROUND	-0.075*** (0.016)	-0.078*** (0.016)	-0.086*** (0.015)	-0.088*** (0.014)
NRTH_WST	-0.011 (0.014)	-0.013 (0.014)	-0.014 (0.012)	-0.019* (0.011)
POOL	0.233*** (0.045)	0.234*** (0.046)	0.217*** (0.039)	0.190*** (0.041)
SECURITY	0.196*** (0.023)	0.174*** (0.024)	0.134*** (0.024)	0.148*** (0.024)
DISTANCE	-0.018*** (0.003)	-0.018*** (0.003)	-0.030*** (0.003)	-0.010** (0.005)
YHYKPTN		0.158*** (0.029)	0.100*** (0.025)	0.134*** (0.024)
SCHOOL			0.200*** (0.029)	0.151*** (0.028)
AIR			0.141*** (0.020)	0.091*** (0.022)
KARTEPE				-0.185*** (0.032)
BASISKELE				-0.041 (0.072)
R^2	0.851	0.861	0.894	0.908
N	405	405	405	405

Note: White-Eicker heteroscedasticity robust standard error estimates in parentheses. Significant at 10% (*), at 5% (**), at 1% (***).

Apartments having a second bathroom sell at a large premium, 16.3%; the effect is close to Tekel and Akbarishahabi (2013)'s estimate for apartments near Botanik Park in Ankara, 17.9%. Similarly, security on site and having access to a swimming pool increases the price on average by 16% and 20.9%, respectively. Selim's (2008) estimate for swimming pool is more than 3 times larger, 54%, probably due to the heterogeneity in her nationwide sample where shanty houses are grouped with luxury apartments. Caglayan and Arikan (2011) find

for Istanbul that security adds on price a premium of 16–22% but this might be an overestimate since pool is not included in their estimation. Even though the estimates reported here are lower, there could still be overestimation to some extent. These features are most common to more luxurious apartment complexes with high build quality and upper social class environment, both of which are not captured in our data.

Distance to the central business district has a significant negative effect on price. The effect decreases significantly with the inclusion of municipality variables because apartments in Kartepe and Basiskele are on average 11.0 and 10.9 kms away from the center while those in Izmit are only 4.1 kms away. Nevertheless, the penalty for being away from the central business district in the full model is not marginal; a 5-km distance decreases the price by 5%.

Proximity to a good public primary school and thus the option to enroll one's child in there has a large impact on price, 16.3%. Our definition of proximity to being within 1 km distance from the school might slightly overestimate the average effect for the whole school district. Apartments farther away from the school but still in the same district could be priced less because parents living in those apartments would incur additional transportation costs in sending their children to the school. Haurin and Brasington (1996) and Downes and Zabel (2002) find the elasticity of house price with respect to school test score between 0.5 and 1 for US: a 10% increase in the average test score of a school raises house prices in the neighborhood by 5 to 10%. Zheng and Kahn (2008) report for Beijing that cutting distance to a core high school by half increases home prices by 7%.

Table 3. Transformed regression coefficients (percentage change in price)

AREA (at 100 m^2)	0.007
CNSTR_LQ	-0,097
AGE	-0,018
BATHROOM	0,163
BLW_GRND	-0,234
GROUND	-0,084
NRTH_WST	-0,019
POOL	0,209
SECURITY	0,160
DISTANCE	-0,010
YHYKPTN	0,143
SCHOOL	0,163
AIR	0,095
KARTEPE	-0,169
BASISKELE	-0,041

Air quality is another neighborhood factor capitalized in apartment prices; apartments in areas perceived to have clean air sell at a premium of 9.5%. The stronger effect in (3) is reduced with the inclusion of Kartepe and especially Basiskele, the municipalities where air quality is generally superior.

AGE has the expected negative sign but is statistically significant only after the effect of Yahyakaptan complex is controlled in models (2)–(4). Yahyakaptan buildings are the oldest in the data, but the apartments there sell at a large premium, around 14%, thanks to a unique set of favorable factors explained above. The increase in the adverse impact of age on price from 0.9 % in model 2 to 1.8 % in models 3 and 4 could be largely due to addition AIR to the specification because older projects, due to their location on the hills around the downtown, tend to have cleaner air.

The results point to the existence of possible geographical submarkets in Metropolitan Izmit area. Kartepe has a large negative coefficient which is highly significant. Apartments in Kartepe are valued on average 16.9% less than those in Izmit. The coefficient for Basiskele is also negative but the hypothesis that it is not different from 0 cannot be rejected even at 10% level. A similar apartment can be built and sold for less in Kartepe compared to one in Izmit because the availability of large tracts of undeveloped agricultural land in Kartepe results in lower land prices and lower construction costs, which must be reflected in apartment prices there. Another factor pulling down the prices in the suburbs could be the capitalization of transportation costs: many people living in Kartepe and Basiskele have to commute daily to their jobs in Izmit.

To our knowledge, this set of results is the first to be reported for Izmit. Our modeling strategy, focusing on the

market for apartments located in complexes, is also distinct from most other housing valuation studies on Turkey. Their results are derived from more heterogeneous samples. The coefficient estimates in this study should be closer to the true values for the relevant submarket in urban housing.

5. Conclusion

Demand for modern dwellings, mostly apartments, has been growing as a result of rapid urbanization and rising household incomes in Turkey; the 1999 earthquake has increased the pace and the scope of this transformation. An apartment in a complex is becoming the typical urban housing unit. In the last two decades most of the new housing supply, especially in mid to large sized cities, has consisted of this type of housing. Increasing land prices, economies of scale in construction, amenities and the social environment provided by apartment complexes and an association with modern life might be some of the other factors behind this trend.

Metropolitan Izmit area presents a good example of the changes that have been taking place in the Turkish housing market. As an industrial center, the area has had a high per capita income and a growing population mainly due to migration. The earthquake magnified the already existing need for new housing. Public initiatives and, later, private sector projects, almost all apartment complexes, have transformed the urban landscape in a relatively short period of time. The variety of the supply in quality has made living in apartment communities appealing for every income group.

A hedonic price model, where apartment sale price is the dependent variable, is estimated by using survey data obtained from real estate agents. The results suggest that construction quality, floor area, having an additional bathroom and being on the ground floor or below are the most influential structural characteristics in determining an apartment's price. Furthermore, swimming pool and security on site are highly valued amenities in an apartment complex. Parents seem to appreciate the value of an option to send their children to a good public school since it is priced similarly to more luxurious attributes. Buyers are also willing to pay as much as 10% more to live in a clean-air environment. Location has a significant impact on price. Apartments closer to the business district are valued more; there is a price penalty for being located in the suburbs, particularly for Kartepe.

Even though we think that our narrow research scope allows us to obtain more accurate coefficient estimates for the particular housing market in Izmit, it also points to the shortcomings of the study. It remains to be seen whether our results can be informative for similar submarkets in other cities. There is a need to carry out within-submarket studies with larger datasets for both Turkey and other developing countries. Studies taking into account all of an urban housing market in order to investigate its probable submarkets and the structural differences between them also will be very valuable. Finally, systematic use in housing valuation studies of a richer set of variables including socio-economic factors, public goods and environmental effects would deeply enrich our understanding of the demand side in developing country housing markets.

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Notes

Note 1. Until recently, Metropolitan Izmit was the central one among Kocaeli's 7 districts and consisted of three municipalities: the central city, Izmit, and two suburbs, Kartepe and Basiskele. In 2008, the number of districts in Kocaeli was increased to 12 by dividing up existing ones, changing 90 year-old borders due to administrative concerns. Metropolitan Izmit was divided into three units according to municipal boundaries. We study the market for apartments in the pre-2008 district; this administrative change must have had little impact in a few years time on the long-held economic and social connections in Metropolitan Izmit area.

Note 2. In the last decade, 96% of newly built dwelling units in Turkey were apartments (www.tuik.gov.tr). Moreover, an analysis of a popular real estate listings website (http://www.hurriyetemlak.com) for Metropolitan Izmit showed that of more than 1300 dwellings on sale in December 2013, 72% were apartments. 57% of those apartments were located in complexes. The share of apartments in concluded transactions would certainly be higher. Private communication with the real estate agents surveyed also supports this conclusion.

Note 3. AIC and BIC values drop from -1.161 and -1.042 to -1.617 and -1.449, respectively from model 1 to 4.