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Towards a Hedonic Pricing Method for the Bucharest Private Housing Market

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Abstract

This paper aims at exploring the drivers of dwellings'sale prices in Bucharest, Romania, over the period 2014-2018. Several housing structural attributes are covered, such as the number of rooms, useful and constructed surface, type of comfort, floor, the number of bathrooms, balconies and parking, the seniority from construction, as well as from renovation, structure type, height regime, and the duration until completion of the real estate transaction. By estimating a standard hedonic price model via OLS regression for a sample of 765 transactions, we notice that all the selected variables, except the floor level and seniority from construction, positively influence the property prices. However, in case of useful and constructed surface, nonlinear relationships with property prices were acknowledged. Robustness checks in form of quantile regressions reinforce the empirical findings.

Keywords: hedonic regression; OLS; quantiles; structural attributes.

JEL classification: C21; R30.

1. INTRODUCTION

The pecuniary value of nonmarket goods and services may be estimated via multifarious ways such as the contingent valuation method, the travel cost method, or the hedonic pricing method (Dahal *et al.*, 2019). Among them, the hedonic pricing method is widely used (Selim, 2009; Z. Z. Huang *et al.*, 2017), having as the main supposition that a homebuyer does not only

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pay for the dwelling itself but also for other related features (Liang *et al.*, 2018). Houses may be viewed as a bunch of attributes, both physical and spatial (Conroy and Milosch, 2011 Efthymiou and Antoniou, 2013; Kim *et al.*, 2015;McCord *et al.*, 2018). Usually, a classic hedonic model at market equilibrium covers structural, locational, and spatial correlation attributes (Conroy and Milosch, 2011; Li *et al.*, 2019; Wen *et al.*, 2014).The hedonic housing price model is grounded on the theory of value and a supply-demand equilibrium model, assuming the balance between the house sellers' willingness to accept and homebuyers' willingness to pay (Tian *et al.*, 2017). The pioneers regarding hedonic pricing models are Lancaster (1966) and Rosen (1974). The knowledge engendered by hedonic research is beneficial to planners, policy makers, and real-estate agents on understanding the conduct of the housing market (Fernandez and Bucaram, 2019). Despite structural attributes (Ligus and Peternek, 2016; Tian *et al.*, 2017; Wu *et al.*, 2017; Yuan *et al.*, 2018; Dahal *et al.*, 2019; Laszkiewicz *et al.*, 2019; Li *et al.*, 2019; Wen *et al.*, 2019; Xiao *et al.*, 2019), there are considered other characteristics that that cause utility or satisfaction to homebuyers (Kim *et al.*, 2015), such as environmental amenities (Czembrowski and Kronenberg, 2016; Dahal *et al.*, 2019; Fernandez and Bucaram, 2019; Laszkiewicz *et al.*, 2019), transport infrastructure (Efthymiou and Antoniou, 2013; Liang *et al.*, 2018; Yang *et al.*, 2019), educational facilities (Feng and Lu, 2013; Wen *et al.*, 2014; Wen *et al.*, 2017a; Liang *et al.*, 2018; Wen *et al.*, 2018; Wen *et al.*, 2019), commercial facilities (Liang *et al.*, 2018; Lin and Yang, 2019) or landscape (Wen *et al.*, 2015; Liang *et al.*, 2018; Xiao *et al.*, 2019).

This paper aims at empirically investigating the drivers of dwellings' sale prices in Bucharest. Previous papers explored the determinants of house price, but in other settings such as Australia (Mulley *et al.*, 2016; Mulley *et al.*, 2018), France (Brecard *et al.*, 2018), Greece (Efthymiou and Antoniou, 2013), China (Chen and Jim, 2010; Feng and Lu, 2013; Liang *et al.*, 2018), Hong Kong (Jim and Chen, 2009), Italy (D'Acci, 2019), Korean (Kim *et al.*, 2015), Northern Ireland (McCord *et al.*, 2018), Poland (Czembrowski and Kronenberg, 2016; Ligus and Peternek, 2016; Laszkiewicz *et al.*, 2019),Singapore *(*Ooi *et al.*, 2014*)*, Spain (Ibeas *et al.*, 2012), Sweden (Wilhelmsson, 2002), Switzerland (Baranzini and Schaerer, 2011), Turkey (Keskin, 2008; Selim, 2009), United States of America (Conroy and Milosch, 2011; Conroy *et al.*, 2013; Tian *et al.*, 2017; Dahal *et al.*, 2019). To the best of our knowledge, no previous study was undertaken for the Bucharest private housing market. Hence, current manuscript contributes to the existing literature by providing evidence for the case of Romania.

The rest of this paper is organized as follows. Section 2 discusses existing studies on the effects of various attributes on housing price. Section 3 reveals the empirical framework of this study, including sample, variable selection, and model specification. Section 4 shows the empirical findings. Section 5 concludes the study.

2. LITERATURE REVIEW

Several factors influence the value of a property, namely housing features (number of rooms and quality of construction), neighborhood specifics (level and quality of social infrastructure, housing density, and presence of other facilities), as well as the quality of the environment (air pollution, noise level) (Damigos and Anyfantis, 2011).

An overview of earlier studies on structural attributes and property value

Keskin (2008) investigated the transactions of single-family homes sold in Istanbul and found that property characteristics (living area being in a low store building, being in a secured site with swimming pool and garage), socio-economic features (the length of time the inhabitants have lived in Istanbul, average income of the household) and neighbor satisfaction positively influence housing prices, whereas the age of the building and earthquake risk reveal a negative effect. Selim (2009) found the most significant drivers of house prices, namely water system, pool, type of house, number of rooms, house size, locational characteristic and type of the building. Chen and Jim (2010) confirmed for Shenzhen that usable floor area, number of bedrooms and floor height positively influence apartment price. Ooi *et al.* (2014) noticed for Singapore that a one standard deviation betterment in the construction Quality Assessment System score lift the selling price of an average home by 2.92%. For transactions undertaken in Wroclaw, Ligus and Peternek (2016) documented that larger floor area and the presence of a garage positively influence the transaction price, the rise in the distance from the city center and older building diminish the price and, floor level does not show any significant impact on price.

Wilhelmsson (2002) concluded that if living area increases by 1%, price will rise by 0.51%. Conroy and Milosch (2011) noticed that 100 square foot rise in structure is tied with a 2.29% higher price. Conroy *et al.* (2013) proved that 7.5 percent increase of price occur with every 100-foot rise in square footage. Kim *et al.* (2015) revealed that apartment prices augment as size is near 134.5 square metres and then drops. Z. Z. Huang *et al.* (2017) proved for Shanghai a positive influence of the total floor area on housing prices, the strongest effect being registered in downtown extent, while the weakest one in suburban zones. McCord *et al.* (2018) explored the Belfast Housing market and confirmed the positive influence related to the size of the property on sale price, but the valuation was different across the quantiles.

Conroy and Milosch (2011) revealed that an extra bathroom is related with a 4.3% upper sales price and Ibeas *et al.* (2012) documented that the presence of an additional bathroom rises prices by 12%, having a garage lift prices by 10% and if the building is equipped with a lift the price rise by 20%. Conroy *et al.* (2013) found that a supplemental bathroom generates a 5.3 percent lift in sales price, while an extra bedroom increases price by 9.9 percent. Also, Zhang and Yi (2017) contended that house price rises by 9.77% in case of one more bedroom and by 14.47% in case of one more living room.

Inhabitants living on inferior floor levels evaluate their sights differently from residents on upper floor levels (Hui *et al.*, 2012). Therefore, Conroy *et al.* (2013) documented that rising the floor by one level is related with a 2.2 percent increase in sales price. Xiao *et al.* (2019) explored the housing market in Hangzhou and found at first instance that the price of house lift at a lower rate and then falls with the increase in floor level, the turning points of multi-storey and high-rise buildings being the 3rd and 8th floor.

The age of a building is largely related with devaluation and obsolescence (Hui *et al.*, 2012). By employing the OLS model without any spatial effects, Wilhelmsson (2002) concluded that price will decrease by 0.04% if age increases by 1%. Kim *et al.* (2015) found for Seoul that age declines the price till 8.7 years after construction and rises the price subsequently.

Benson *et al.* (1998) established for Bellingham, Washington, that a poor partial ocean view rise the property value by 8.2%, for a lake view by 18.1%, for a good partial ocean view by 29.4%, for a better partial ocean view by 30.8% and, for an unobstructed ocean view by 58.9%. Jim and Chen (2009) argued for private housing in Hong Kong that a limited harbor sight could rise price by 2.18%, but a an extensive mountain view diminish apartment price by 6.7%, while a narrow mountain view was not statistically significant. Lu (2018) estimated a premium of 14% on the property value for the general south view orientation.

Previous findings regarding transport infrastructure and house prices

Location influence the access of a household to jobs, resources, alongside various social and urban facilities, generating suitable accessibility, but also noise and air pollution caused by vehicles (Baranzini and Schaerer, 2011; Larsen and Blair, 2014; Tian *et al.*, 2017). By using data from Athens, Greece, Efthymiou and Antoniou (2013) revealed that the vicinity to transportation infrastructure show a direct effect on house and apartment purchase prices, as well as rents, namely positive influence related to metro, tram, suburban railway and bus stations, but a negative impact of ISAP (the oldest rail in Greece) and national rail stations, airports and ports. Larsen and Blair (2014) examined Kettering, south-western Ohio and noticed that the value of a detached single-family house settled on an arterial street is less by 7.8 per cent than kindred houses located differently, but multi-unit housing placed adjacent to an arterial street showed a 13.75 percent upper sale price. Mulley *et al.* (2016) highlighted for Brisbane, Australia, that being close to bus rapid transit (BRT) systems adds a premium to the housing price of 0.14%, for every hundred meters closer to the BRT station. As well, Mulley *et al.* (2018) reinforced that the values of properties located in Sydney benefit from the existence of light rail (LRT) services. For Xiamen, China, Yang *et al.* (2019) remarked that the price of a property is 0.5% upper for every bus stop within 500 m. Cordera *et al.* (2019) proved that a supplementary minute of journey time to the city centre via public transport in Rome lead to a drop of 0.6% in property prices and of 1% in Santander. D'Acci (2019) confirmed that for each 1% increase of the distance from the downtown, the housing value declines 0.23%. On the contrary, Brecard *et al.* (2018) documented public transport network and air quality has no significant impact on apartment prices in Nantes Métropole, France, even if the closeness to city centre show a positive influence.Camins-Esakov and Vandegrift (2018) pointed out the lack of effect on annual house price appreciation related to the Eighth Street Station. Also, Liang *et al.* (2018) found that rail transit stations reveal a negative impact on housing prices.

Prior related studies on neighborhood characteristics and property value

When small size and locally owned local stores are superseded by boutique shops, chain stores, or high-priced retailers appear commercial gentrification (Lin and Yang, 2019). Li *et al.* (2019) noticed for Shanghai's residential market that parks, schools, hospitals, banks, alongside entertainment, shopping, and residential service facilities lift house prices in the inner-city and expanded inner-city areas, while better access to bike sharing, bus stops, and metro stations the main priorities in suburbs. Nevertheless, by exploring apartment sales' transactions in Lodz, Czembrowski and Kronenberg (2016) emphasized the negative effect of regarding the short distances to cemeteries. Yuan *et al.* (2018) revealed that closeness to farmers' markets can reduce the housing values due to their location within periphery, but vicinity to a convenience store can enhance property prices. Also, Liang *et al.* (2018) documented that department stores show a positive effect on housing prices.

The quality and accessibility of educational facilities appeared as a significant driver of housing price (Wen *et al.*, 2019). Therefore, Wen *et al.* (2014) found for Hangzhou that the housing price rises by 0.5% if a kindergarten exist within 1 km from the community and by 2.8% and 3.4% in case of senior high school and university. D. J. Huang *et al.* (2015) pointed out that Chinese city-level property prices would be 0.401 standard deviations upper if the social development component concerning higher education, green coverage, and population density has a score bigger by one standard deviation. Likewise, Wen *et al.* (2018) reinforced that prices growth by 0.7%/0.9% with every supplementary kindergarten within 1 km from the community, whilst the prices of houses near to key universities are 12.8% higher than those not neighboring to main universities.

With reference to educational quality, Feng and Lu (2013) revealed that the existence of an supplemental Experimental Model Senior High Schools of the best quality per square kilometer rises Shanghai housing prices by 17.1%. Wen *et al.* (2014) emphasized an increase of prices by 3.7% and 6.2% with every one-degree rise in the quality of primary and junior high school. As well, Wen *et al.* (2017a) confirmed that the quality of education exert a positive impact on house prices, the OLS regression coefficients related to primary school quality varying from 0.029 to 0.044, as well as from 0.044 to 0.062 in case of junior high school quality. Wen *et al.* (2018) highlighted that each improvement of the primary school quality will cause a 5.8% increase in housing prices and 4.4% for junior high school. Wen *et al.* (2019) strengthened that each grade rise in the quality of junior high school will determine a 7.16% growth in housing price.

Previous literature concerning landscape features and housing price

The quality and quantity of natural landscapes influence the value of the amenity (Jim and Chen, 2009). As such urban parks and forests, water resorts, lake shores, farmlands, and land use are residential amenities that add to the welfare of urban households (Baranzini and Schaerer, 2011). Hence, Conroy and Milosch (2011) documented for San Diego County that 10% increase in distance from the coast lead to a reduction of price by 1.46%. (Ooi *et al.*, 2014; Wen *et al.*, 2014), Wen *et al.* (2015) demonstrated for the case of Hangzhou that the housing price lessens by 0.229% and 0.052% when the distance to the West Lake and to a nearly park rises by 1%. Wu *et al.* (2017) emphasized that a one-degree rise in accessibility from an address to the closest city park is related with a 32.23% growth in housing price in Shenzhen, but the housing price declines by 4.04% with every 1-degree increase in the accessibility to a forest park. Wen *et al.* (2017b) documented that each 1% rise in the distance to the Grand Canal drops housing prices in Hangzhou by 0.019% or 0.016%. Wang *et al.* (2017) confirmed that the housing prices of coastal counties are also higher than those of inland counties.

Liao and Wang (2012) identified a 4% premium on the house price at the 90th percentile when getting 1 km near to an urban park, even if the premium was insignificant around the10th percentile. Tian *et al.* (2017) supported that each 1% rise in green surface around the house is linked with 0.15-0.19% rise in housing prices in Utah. Yuan *et al.* (2018) concluded that proximities to parks positively influence the house prices in Nanjing. As well, Laszkiewicz *et al.* (2019) analyzed the apartment market in Lodz (Poland) and pointed out that proximity to parks and forests exert a positive impact on apartment prices, whereas Fernandez and Bucaram (2019) highlighted for Auckland, New Zealand that beaches and volcanic parks may add price premiums or price discounts, depending on the price distribution. In the same vein, Dahal *et al.* (2019) confirmed for real estate sales for the coastal Alabama, USA, that vicinity to bays, streams, and rivers is positively valued by inhabitants. Nevertheless, Liang *et al.* (2018) argued that lakes should show a certain size or quality in order to reveal a positive impact on housing prices.

3. RESEARCH METHODOLOGY

3.1 Sample and variables

The empirical analysis in this paper is based on apartment transactions undertaken in Bucharest, Romania, over the period 2014-2018.The variables employed in current research are depicted in Table no. 1.

Table no. 1–Variables' description

Variables	Description
	Dependent variable
(1) Price	Sale price of the apartment (log values)
	Explanatory variables (Structural Attributes)
(2) No_rooms	The number of rooms out of the apartment
(3) S_useful	The useful surface of the apartment
(4) S_constructed	The constructed surface of the apartment
(5) Comfort	If the apartment is Comfort 1 = 1 If the apartment is not Comfort 1, being Comfort 2 = 0
(6) Floor	Floor level
(7) No_bathrooms	The number of bathrooms out of the apartment
(8) No_balconies	The number of balconies in the apartment
(9) No_parking	The number of parking related to the apartment
(10) Seniority_construction	The number of years since construction
(11) Seniority_renovation	The number of years since renovation
(12) Structure	If the structure is made ofconcrete = 1 If the structure is not made of concrete, being of brick = 0
(13) Height_regime_1	If height regime isGround Floor + 10 Floors= 1 If height regime is not Ground Floor + 10 Floors = 0
(14) Height_regime_2	If height regime is Ground Floor +11 Floors = 1 If height regime is not Ground Floor +11 Floors = 0
(15) Height_regime_3	If height regime is Ground Floor +2 Floors = 1 If height regime is not Ground Floor +2 Floors= 0
(16) Height_regime_4	If height regime is Ground Floor +3 Floors = 1 If height regime is not Ground Floor +3 Floors= 0
(17) Height_regime_5	If height regime is Ground Floor +4 Floors= 1 If height regime is not Ground Floor +4 Floors= 0
(18) Height_regime_6	If height regime is Ground Floor +5 Floors= 1 If height regime is not Ground Floor +5 Floors = 0
(19) Height_regime_7	If height regime is Ground Floor +6 Floors = 1 If height regime is not Ground Floor +6 Floors= 0

Variables	Description
(20) Height_regime_8	If height regime is Ground Floor +7 Floors = 1 If height regime is not Ground Floor +7 Floors = 0
(21) Height_regime_9	If height regime is Ground Floor +8 Floors = 1 If height regime is not Ground Floor +8 Floors = 0
(22) Height_regime_10	If height regime is Ground Floor +9 Floors = 1 If height regime is not Ground Floor +9 Floors = 0
Explanatory variables (Controls)	
(23) Duration	Duration until transaction completion

Source: Authors' own work

Hence we consider the sale price of the apartment, alongside several structural attributes similar to previous papers such as number of rooms (Keskin, 2008; Czembrowski and Kronenberg, 2016; Ligus and Peternek, 2016 Selim, 2009; Baranzini and Schaerer, 2011), house surface (Wilhelmsson, 2002; Jim and Chen, 2009; Selim, 2009; Chen and Jim, 2010; Hui *et al.*, 2012; Ibeas *et al.*, 2012; Efthymiou and Antoniou, 2013; Ooi *et al.*, 2014; Zhang and Leonard, 2014; Kim *et al.*, 2015; Czembrowski and Kronenberg, 2016; Ligus and Peternek, 2016; Tian *et al.*, 2017; Wu *et al.*, 2017; Brecard *et al.*, 2018; McCord *et al.*, 2018; Yuan *et al.*, 2018; Dahal *et al.*, 2019; Laszkiewicz *et al.*, 2019; Yang *et al.*, 2019), comfort, floor level (Keskin, 2008; Jim and Chen, 2009; Chen and Jim, 2010; Baranzini and Schaerer, 2011; Hui *et al.*, 2012; Ibeas *et al.*, 2012; Efthymiou and Antoniou, 2013; Ooi *et al.*, 2014; Ligus and Peternek, 2016; Wu *et al.*, 2017; Li *et al.*, 2019), number of bathrooms (Conroy and Milosch, 2011; Ibeas *et al.*, 2012; Larsen and Blair, 2014; Zhang and Leonard, 2014; Mulley *et al.*, 2016; Tian *et al.*, 2017; Wu *et al.*, 2017; Mulley *et al.*, 2018; Dahal *et al.*, 2019), number of balconies, parking availability (Efthymiou and Antoniou, 2013; Dahal *et al.*, 2019), age (Wilhelmsson, 2002; Keskin, 2008; Jim and Chen, 2009; Selim, 2009; Conroy and Milosch, 2011; Hui *et al.*, 2012; Kim *et al.*, 2015; Czembrowski and Kronenberg, 2016; Ligus and Peternek, 2016; Tian *et al.*, 2017; Wen *et al.*, 2017b; Brecard *et al.*, 2018; Wen *et al.*, 2018; Dahal *et al.*, 2019; Laszkiewicz *et al.*, 2019; Wen *et al.*, 2019; Yang *et al.*, 2019), number of years since house has significant restoration (Zhang and Leonard, 2014), structure (Selim, 2009), height regime. Besides, duration until transaction completion is included as control variable.

3.2 Quantitative framework

With reference to the estimation strategy, previous papers used Box-Cox transformed models (Yang *et al.*, 2019), fixed-effects model and random effects model (Feng and Lu, 2013), geographically weighted regression (Liang *et al.*, 2018; Mulley *et al.*, 2018; Yuan *et al.*, 2018), hierarchical linear modeling (Tian *et al.*, 2017), quantile regression (Liao and Wang, 2012; Zhang and Leonard, 2014; Kim *et al.*, 2015; Zhang and Yi, 2017; McCord *et al.*, 2018; Fernandez and Bucaram, 2019; Wen *et al.*, 2019), OLS (Wen *et al.*, 2014; Czembrowski and Kronenberg, 2016; Mulley *et al.*, 2016; Tian *et al.*, 2017; Wang *et al.*, 2017; Liang *et al.*, 2018; Yuan *et al.*, 2018; Fernandez and Bucaram, 2019; Li *et al.*, 2019; Wen *et al.*, 2019; Wilhelmsson, 2002; Liao and Wang, 2012; Wen *et al.*, 2014; Zhang and Leonard, 2014; D. J. Huang *et al.*, 2015; Kim *et al.*, 2015; Zhang and Yi, 2017; McCord *et al.*, 2018; Wen *et al.*, 2019; Yang *et al.*, 2019), random intercept multi-level regression (Li *et al.*, 2019), semi-log fixed effects regressions (Conroy and Milosch, 2011), spatial autoregressive model

(Wilhelmsson, 2002; Ibeas *et al.*, 2012; Laszkiewicz *et al.*, 2019), spatial Durbin model (Hui *et al.*, 2012), spatial error model (Wilhelmsson, 2002; Baranzini and Schaerer, 2011; Wen *et al.*, 2014; Mulley *et al.*, 2016; Wang *et al.*, 2017), spatial lag model (Li Wen *et al.*, 2014; Mulley *et al.*, 2016; Tian *et al.*, 2017; Wang *et al.*, 2017; Wu *et al.*, 2017; Li *et al.*, 2019). Hence, at first glance, a standard hedonic price model will be estimated using OLS as in Wen *et al.* (2014), Mulley *et al.* (2016), Wen *et al.* (2017a). Generally, the usual function forms agreed in the hedonic price model are linear, logarithmic, semi-logarithmic, and logarithmic linear (Conroy *et al.*, 2013; Wen *et al.*, 2014, 2015). The basic hedonic pricing model is an OLS regression of the natural log of housing price on the set of value-bearing characteristics (Yang *et al.*, 2019), depicted as follows:

$$\ln(\text{Price}) = \alpha + \beta_1\text{No\_rooms} + \beta_2\text{S\_useful} + \beta_3\text{S\_constructed} + \beta_4\text{Comfort} + \beta_5\text{Floor} + \beta_6\text{No\_bathrooms} + \beta_7\text{No\_balconies} + \beta_8\text{No\_parking} + \beta_9\text{Seniority\_construction} + \beta_{10}\text{Seniority\_renovation} + \beta_{11}\text{Structure} + \beta_{12}\text{Height\_regime}_i + \beta_{13}\text{Duration} + \varepsilon_i \quad (1)$$

where the parameter α is entitled the constant or intercept and show the expected response when the structural attributes are equal to zero, β_1 - β_{13} are the coefficients to be estimated, ε is the error termthat represents all unmeasured effects and i denotes the transaction. The second and the third equations below comprise the square term of the useful surface, as well as the constructed surface in order to catch potential nonlinear relationships with sale price.

$$\ln(\text{Price}) = \alpha + \beta_1\text{No\_rooms} + \beta_2\text{S\_useful} + \beta_3\text{S\_useful\_sq} + \beta_4\text{Comfort} + \beta_5\text{Floor} + \beta_6\text{No\_bathrooms} + \beta_7\text{No\_balconies} + \beta_8\text{No\_parking} + \beta_9\text{Seniority\_construction} + \beta_{10}\text{Seniority\_renovation} + \beta_{11}\text{Structure} + \beta_{12}\text{Height\_regime}_i + \beta_{13}\text{Duration} + \varepsilon_i \quad (2)$$

$$\ln(\text{Price}) = \alpha + \beta_1\text{No\_rooms} + \beta_2\text{S\_constructued} + \beta_3\text{S\_constructed\_sq} + \beta_4\text{Comfort} + + \beta_5\text{Floor} + \beta_6\text{No\_bathrooms} + \beta_7\text{No\_balconies} + \beta_8\text{No\_parking} + \beta_9\text{Seniority\_construction} + \beta_{10}\text{Seniority\_renovation} + \beta_{11}\text{Structure} + \beta_{12}\text{Height\_regime}_i + \beta_{13}\text{Duration} + \varepsilon_i \quad (3)$$

Afterwards, in order to ensure the robustness of our approach, we will estimate quantile regressions as in Liao and Wang (2012), Zhang and Yi (2017), Wen *et al.* (2019). According to Zhang and Leonard (2014), “quantile effects” take place when housing features are assessed differently across the conditional distribution of house prices.

4. EMPIRICAL FINDINGS

4.1 Summary statistics, correlations, and frequency analysis

Table no. 2 reveals summary statistics for the selected variables. Hence, the mean number of rooms is equal to 2.35, showing close values to houses in Lodz 2.94 (Czembrowski and Kronenberg, 2016), but different than those from Istanbul 3.21 (Keskin, 2008) or Geneva 3.602 (Baranzini and Schaerer, 2011).

Table no. 2 – Descriptive statistics (raw data) for the entire period (2014-2018)

Variables	#	Mean	Median	Min	Max	Std.Dev.	Skewness	Kurtosis
Price	765	6,6236.18824	59,500	17,900	450,000	35,096.6268	3.83021	27.63025
No_rooms	765	2.34771	2	1	4	0.8573	0.11686	-0.63441
S_useful	760	59.61842	57	19	165	22.0582	1.17485	2.82437
S_constructed	762	64.24409	60	20	191	25.1238	1.37282	3.71437
Comfort	734	0.91553	1	0	1	0.2783	-2.99460	6.98664
Floor	765	4.40261	4	0	10	2.7107	0.46640	-0.88552
No_bathrooms	765	1.24837	1	1	3	0.4501	1.42336	0.69937
No_balconies	706	1.18414	1	0	3	0.4328	1.76575	3.11051
No_parking	317	0.94953	1	0	2	0.3782	-0.53680	3.82553
Seniority_construction	685	35.04088	38	0	132	19.7118	0.12882	0.72568
Seniority_renovation	451	6.50998	4	0	53	8.3305	2.79616	8.87880
Structure	669	0.88640	1	0	1	0.3176	-2.44080	3.96935
Height_regime_1	765	0.35556	0	0	1	0.4790	0.60470	-1.63863
Height_regime_2	765	0.03007	0	0	1	0.1709	5.51462	28.48554
Height_regime_3	765	0.02484	0	0	1	0.1557	6.11844	35.52825
Height_regime_4	765	0.07974	0	0	1	0.2711	3.10894	7.68561
Height_regime_5	765	0.16471	0	0	1	0.3712	1.81148	1.28483
Height_regime_6	765	0.05229	0	0	1	0.2228	4.03037	14.28118
Height_regime_7	765	0.03791	0	0	1	0.1911	4.84880	21.56725
Height_regime_8	765	0.03007	0	0	1	0.1709	5.51462	28.48554
Height_regime_9	765	0.17647	0	0	1	0.3815	1.70067	0.89462
Height_regime_10	765	0.04837	0	0	1	0.2147	4.21856	15.83766
Duration	765	153.19608	76	0	1113	191.9941	2.15710	4.97857

Source: Authors' computations

The useful surface shows an average value of 59.62 square metres and the constructed surface of the apartment exhibits a mean value of 64.24 square metres. The figures are higher than those identified for Lodz 52.65 (Czembrowski and Kronenberg, 2016), but lower than those established for Shenzhen 93.04 (Wu *et al.*, 2017), Seoul 93.606 (Kim *et al.*, 2015), Stockholm 119 (Wilhelmsson, 2002), Singapore 122.35 (Ooi *et al.*, 2014), Xiamen 135.12 (Yang *et al.*, 2019), Shanghai 136.30 (Lu, 2018), Istanbul 170.08 (Keskin, 2008). In case of floor level, we notice a mean of 4.4, higher than Santander 2.38 (Ibeas *et al.*, 2012) or Geneva 3.433 (Baranzini and Schaerer, 2011), but lesser than Hangzhou 7.59 (Wen *et al.*, 2015), Shenzhen 9.950 (Chen and Jim, 2010) or Hong Kong 19.41 (Jim and Chen, 2009). The mean number of bathrooms is 1.25, quite close to Sydney 1.46 (Mulley *et al.*, 2016), Shenzhen 1.63 (Wu *et al.*, 2017), San Diego 1.64 (Conroy *et al.*, 2013), Ohio 1.65 (Larsen and Blair, 2014), Santander 1.86 (Ibeas *et al.*, 2012), Brisbane 2 (Mulley *et al.*, 2016), Dallas County Texas 2.296 (Zhang and Leonard, 2014), Utah 2.36 (Tian *et al.*, 2017). The mean number of balconies and parking is almost one. The average number of years since construction is equal to 35.04, higher than previous papers undertaken for San Diego 7.36 (Conroy *et al.*, 2013), Xiamen 10.33 (Yang *et al.*, 2019), Istanbul 12.22 (Keskin, 2008), Shanghai 14.24 (Lu, 2018), Seoul 14.658 (Kim *et al.*, 2015), Hangzhou 16.019 (Wen *et al.*, 2017b), Hong Kong 17.71 (Jim and Chen, 2009), but lower than Utah 40.07 (Tian *et al.*, 2017) and Stockholm 53 (Wilhelmsson, 2002). The mean number of years since renovation is equal to 6.51 which is double than Dallas County Texas 3.667 (Zhang and Leonard, 2014). Besides, roughly 153 days were required for transaction completion.

The frequencies of housing structural attributes are showed in Table no. 3. We reinforce the fact that the Bucharest apartment transactions registered over 2014-2018 have two rooms, being of Comfort 1 and hold one bathroom, alongside a single balcony and parking. As well, the floor levels 1-4 were the most looked up. With reference to structure, 77.52% of the explored houses are made of concrete. Concerning height regime Ground Floor + 10 Floors, Ground Floor + 4 Floors and, Ground Floor + 8 Floors register the highest frequency, whilst Ground Floor + 2 Floors shows the lowest frequency.

Table no. 3 – Frequency analysis regarding the drivers of sale price for the entire period (2014-2018)

Variables	Value	Count	Cumulative - Count	Percent	Cumulative - Percent
No_rooms	1	126	126	16.47059	16.4706
	2	315	441	41.17647	57.6471
	3	256	697	33.46405	91.1111
	4	68	765	8.88889	100
	Missing	0	765	0	100
Comfort	0 (Comfort 2)	62	62	8.10458	8.1046
	1 (Comfort 1)	672	734	87.84314	95.9477
	Missing	31	765	4.05229	100
Floor	0	2	2	0.26144	0.2614
	1	131	133	17.12418	17.3856
	2	93	226	12.15686	29.5425
	3	117	343	15.29412	44.8366
	4	102	445	13.33333	58.1699
	5	61	506	7.97386	66.1438
	6	68	574	8.88889	75.0327
	7	59	633	7.71242	82.7451
	8	58	691	7.5817	90.3268
	9	38	729	4.96732	95.2941
	10	36	765	4.70588	100
	Missing	0	765	0	100
No_bathrooms	1	581	581	75.94771	75.9477
	2	178	759	23.26797	99.2157
	3	6	765	0.78431	100
	Missing	0	765	0	100
No_balconies	0	5	5	0.65359	0.6536
	1	574	579	75.03268	75.6863
	2	119	698	15.55556	91.2418
	3	8	706	1.04575	92.2876
	Missing	59	765	7.71242	100
No_parking	0	31	31	4.05229	4.0523
	1	271	302	35.42484	39.4771
	2	15	317	1.96078	41.4379
	Missing	448	765	58.56209	100
Structure	0 (Brick)	76	76	9.93464	9.9346
	1 (Concrete)	593	669	77.51634	87.451
	Missing	96	765	12.54902	100
Height_regime_1	0	493	493	64.44444	64.4444
	1	272	765	35.55556	100
	Missing	0	765	0	100
Height_regime_2	0	742	742	96.99346	96.9935
	1	23	765	3.00654	100
	Missing	0	765	0	100
Height_regime_3	0	746	746	97.51634	97.5163
	1	19	765	2.48366	100
	Missing	0	765	0	100
Height_regime_4	0	704	704	92.02614	92.0261
	1	61	765	7.97386	100
	Missing	0	765	0	100
Height_regime_5	0	639	639	83.52941	83.5294

Variables	Value	Count	Cumulative - Count	Percent	Cumulative - Percent
	1	126	765	16.47059	100
	Missing	0	765	0	100
Height_regime_6	0	725	725	94.77124	94.7712
	1	40	765	5.22876	100
	Missing	0	765	0	100
Height_regime_7	0	736	736	96.20915	96.2092
	1	29	765	3.79085	100
	Missing	0	765	0	100
Height_regime_8	0	742	742	96.99346	96.9935
	1	23	765	3.00654	100
	Missing	0	765	0	100
Height_regime_9	0	630	630	82.35294	82.3529
	1	135	765	17.64706	100
	Missing	0	765	0	100
Height_regime_10	0	728	728	95.1634	95.1634
	1	37	765	4.8366	100
	Missing	0	765	0	100

Source: Authors' computations

The output related to independent samples t test towards the sale price and structural attributes is exhibited in Table no. 4. We notice that there is a significant difference in price between apartments that are comfort 1 and those comfort 2. Therewith, significant differences in price are registered between apartments showing height regime Ground Floor + 10 Floors and the rest of dwellings. Similar statements are valid for Ground Floor + 2 Floors, Ground Floor + 5 Floors and, Ground Floor + 6 Floors.

Table no. 5 exposes the results of independent samples t test regarding the duration until transaction completion and structural attributes. Thus, there is a statistically significant difference between the mean duration of apartments comfort 1 and those comfort 2. In the same vein, significant differences in duration occur between dwellings with height regime Ground Floor + 10 Floorsand the rest of apartments. Analogous remarks are true for Ground Floor + 3 Floors and Ground Floor + 5 Floors.

The correlations between variables are pointed out in Table no. 6. Thereby, sale price is highly correlated with the useful (0.73) and constructed surface of the apartment (0.74).

Likewise, we notice high correlations between the number of rooms and useful surface (0.80), the number of rooms and the constructed surface (0.75), as well as between the useful surface and constructed area (0.97). As such, the previously mentioned variables will be employed in distinct regression equations in order to avoid the multicolinearity issue.

4.2 The outcomes of hedonic pricing regressions

The impact of each housing structural attributes on the sale price is reported in Table no. 7. Thus, most of the housing structural characteristic exert a positive influence on the housing price. The comfort exhibits the highest positive influence on price (Eq. 4), but the lowest impact is registered in case of surface, both useful (Eq. 2) and constructed (Eq. 3).

Table no. 4 – The outcomes of independent samples t test regarding the sale price and structural attributes (2014-2018)

Dependent variables	Grouping variable	Mean 0	Mean 1	t-value	df	p	# 0	# 1	Std. Dev. 0	Std. Dev. 1	F-ratio Variances	p Variances
Price	**Comfort**	**37,930.16**	**65,370.41**	**8.141912**	**732**	**0.000000**	**62**	**672**	**10,262.86**	**26,339.77**	**6.586985**	**0.000000**
Price	Structure	61,074.61	66,345.90	-1.20604	667	0.228229	76	593	31,775.23	36,359.94	1.309390	0.145580
Price	**Height_regime_1**	**72,560.58**	**54,773.23**	**6.912390**	**763**	**0.000000**	**493**	**272**	**40,179.40**	**18,358.66**	**4.789882**	**0.00**
Price	Height_regime_2	65,821.27	79,621.74	-1.86021	763	0.063241	742	23	34,834.86	41,366.86	1.410188	0.200566
Price	**Height_regime_3**	**65,624.38**	**90,257.89**	**-3.03740**	**763**	**0.002468**	**746**	**19**	**34,521.65**	**48,294.21**	**1.957072**	**0.020105**
Price	Height_regime_4	66,412.88	64,197.03	0.472796	763	0.636494	704	61	35,657.48	27,977.89	1.624319	0.019895
Price	Height_regime_5	65,879.63	68,044.43	-0.632537	763	0.527226	639	126	36,020.58	30,038.39	1.437964	0.012899
Price	**Height_regime_6**	**64,816.83**	**91,962.00**	**-4.83119**	**763**	**0.000002**	**725**	**40**	**30,306.96**	**79,765.54**	**6.927012**	**0.000000**
Price	**Height_regime_7**	**65,421.58**	**86,910.34**	**-3.25433**	**763**	**0.001187**	**736**	**29**	**33,381.60**	**62,437.95**	**3.498510**	**0.000000**
Price	Height_regime_8	65,954.70	75,317.39	-1.26049	763	0.207879	742	23	34,414.20	52,883.04	2.361335	0.000890
Price	Height_regime_9	65,391.93	70,176.07	-1.43830	763	0.150760	630	135	37,241.79	22,216.34	2.810063	0.000000
Price	Height_regime_10	66,399.84	63,016.22	0.571822	763	0.567611	728	37	35,379.89	29,182.80	1.469803	0.152504

Source: Authors' computations

Table no. 5 – The outcomes of independent samples t test regarding the duration until transaction completion and structural attributes (2014-2018)

Dependent variables	Grouping variable	Mean 0	Mean 1	t-value	df	p	# 0	# 1	Std. Dev. 0	Std. Dev. 1	F-ratio Variances	p Variances
Duration	**Comfort**	**59,43548**	**155,7292**	**-3.93543**	**732**	**0.000091**	**62**	**672**	**79,36007**	**191,0525**	**5.795640**	**0.000000**
Duration	Structure	187,5658	143,6054	1.849934	667	0.064765	76	593	214,4143	192,4477	1.241315	0.184965
Duration	**Height_regime_1**	**169,6268**	**123,4154**	**3.205968**	**763**	**0.001402**	**493**	**272**	**202,5776**	**167,4365**	**1.463802**	**0.000510**
Duration	Height_regime_2	152,8922	163,0000	-0.248507	763	0.803809	742	23	191,6069	208,4124	1.183109	0.509831
Duration	Height_regime_3	151,3539	225,5263	-1.66484	763	0.096355	746	19	189,1919	278,3079	2.163942	0.006915
Duration	**Height_regime_4**	**143,3026**	**267,3770**	**-4.91472**	**763**	**0.000001**	**704**	**61**	**185,0142**	**232,1747**	**1.574779**	**0.009427**
Duration	Height_regime_5	154,0986	148,6190	0.292618	763	0.769893	639	126	195,3431	174,6723	1.250685	0.122514
Duration	**Height_regime_6**	**146,2772**	**278,6000**	**-4.29151**	**763**	**0.000020**	**725**	**40**	**183,9455**	**277,4135**	**2.274452**	**0.000046**
Duration	Height_regime_7	153,1984	153,1379	0.001662	763	0.998675	736	29	192,7389	175,0869	1.211802	0.549038
Duration	Height_regime_8	154,3302	116,6087	0.927890	763	0.353758	742	23	193,2488	144,2680	1.794295	0.099365
Duration	Height_regime_9	157,4603	133,2963	1.327714	763	0.184670	630	135	194,1756	180,8254	1.153110	0.311323
Duration	Height_regime_10	155,0838	116,0541	1.206628	763	0.227950	728	37	194,6533	125,0291	2.423825	0.001633

Source: Authors' computations

Table no. 6– Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
(1) Price	1																						
(2) No_rooms	0.51***	1																					
(3) S_useful	0.73***	0.80***	1																				
(4) S_constructed	0.74***	0.75***	0.97***	1																			
(5) Comfort	0.29***	0.10**	0.29***	0.30***	1																		
(6) Floor	-0.16***	0.01	-0.09*	-0.11**	-0.03	1																	
(7) No_bathrooms	0.49***	0.62***	0.64***	0.60***	0.13***	-0.08*	1																
(8) No_balconies	0.27***	0.35***	0.39***	0.40***	0.14***	-0.01	0.36***	1															
(9) No_parking	0.21***	0.24***	0.27***	0.26***	0.09	-0.07	0.12*	0.21***	1														
(10) Seniority_construction	-0.25***	-0.07†	-0.28***	-0.29***	-0.15***	0.13***	-0.25***	-0.04	-0.12†	1													
(11) Seniority_renovation	-0.05	0.09†	-0.01	-0.03	-0.15**	0.02	-0.03	-0.03	-0.02	0.14**	1												
(12) Structure	0.05	0.06	0.03	0	-0.03	0.11**	0.06	-0.06	0.21***	-0.30***	-0.02	1											
(13) Height_regime_1	-0.24***	-0.08*	-0.23***	-0.26***	-0.24***	0.36***	-0.17***	-0.14***	-0.04	0.19***	0.05	0.14***	1										
(14) Height_regime_2	0.07†	0.03	0.09*	0.09*	0.05	0.16***	0.02	0.01	0.02	-0.11**	-0.03	0.06	-0.13***	1									
(15) Height_regime_3	0.11**	0.02	0.07†	0.09*	-0.01	-0.18***	0.01	0.06	0.02	0.16***	0.03	-0.22***	-0.12**	-0.03	1								
(16) Height_regime_4	-0.02	0	0.07†	0.10**	0.07†	-0.25***	-0.03	0.06	0.10†	-0.19***	-0.08†	-0.12**	-0.22***	-0.05	-0.05	1							
(17) Height_regime_5	0.02	0.05	0.04	0.05	0.04	-0.31***	0.06†	0	0.13*	-0.13***	0.09†	-0.01	-0.33***	-0.08*	-0.07†	-0.13***	1						
(18) Height_regime_6	0.17***	0.02	0.18***	0.17***	0.07†	-0.06†	0.09*	-0.01	0.16**	-0.21***	-0.08†	0.06	-0.17***	-0.04	-0.04	-0.07†	-0.10**	1					
(19) Height_regime_7	0.12**	-0.04	0.09*	0.10**	-0.03	-0.11**	0.07*	0.02	-0.22***	-0.04	0.01	-0.11**	-0.15***	-0.03	-0.03	-0.06	-0.09*	-0.05	1				
(20) Height_regime_8	0.05	-0.03	-0.02	0.01	0.02	-0.04	-0.01	-0.06	0.02	0.15***	-0.01	-0.11**	-0.13***	-0.03	-0.03	-0.05	-0.08*	-0.04	-0.03	1			
(21) Height_regime_9	0.05	0.06†	0.02	-0.01	0.12**	0.05	0.13***	0.06	-0.14**	0.01	-0.02	0.07†	-0.34***	-0.08*	-0.07*	-0.14***	-0.21***	-0.11**	-0.09*	-0.08*	1		
(22) Height_regime_10	-0.02	-0.01	-0.05	-0.04	0.07†	0.15***	-0.07†	0.11**	-0.03	0.10*	-0.06	-0.03	-0.17***	-0.04	-0.04	-0.07†	-0.10**	-0.05	-0.04	-0.04	-0.10**	1	
(23) Duration	0.18***	0.13***	0.19***	0.21***	0.14***	-0.02	0.08*	0.09*	0.17**	-0.18***	0.03	-0.07†	-0.12**	0.01	0.06†	0.18***	-0.01	0.15***	0	-0.03	-0.05	-0.04	1

*Source: Authors' computations.† $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$*

The number of rooms show a positive impact (Eq. 1) as in Selim (2009), Baranzini and Schaerer (2011). Likewise, if useful surface and constructed area increases by 1%, price will increase by 0.01%, the association being alike previous studies (Wilhelmsson, 2002; Keskin, 2008; Jim and Chen, 2009; Selim, 2009; Chen and Jim, 2010; Conroy and Milosch, 2011; Hui *et al.*, 2012; Efthymiou and Antoniou, 2013; Z. Z. Huang *et al.*, 2017; Wu *et al.*, 2017; Yang *et al.*, 2019). In addition, the number of bathrooms positively influence sale price (Eq. 6) alike D Dahal *et al.* (2019), Mulley *et al.* (2016), Mulley *et al.* (2018), Tian *et al.* (2017), Conroy *et al.* (2013), Conroy and Milosch (2011), Larsen and Blair (2014), Ibeas *et al.* (2012), alongside the number of parking (Eq. 8) similar Mulley *et al.* (2018) and the number of balconies (Eq. 7). The effect of structure on price is positive (Eq. 11), opposite to Selim (2009). The floor level shows a negative impact on sale price (Eq. 5), contrary to Jim and Chen (2009), Chen and Jim (2010), Baranzini and Schaerer (2011), Hui *et al.* (2012), Ibeas *et al.* (2012), Efthymiou and Antoniou (2013), Wu *et al.* (2017) . The number of years since construction exhibit a negative impact on price (Eq. 9), as in earlier studies (Wilhelmsson, 2002; Jim and Chen, 2009; Selim, 2009; Hui *et al.*, 2012; Conroy *et al.*, 2013; Czembrowski and Kronenberg, 2016; Tian *et al.*, 2017; Wen *et al.*, 2017b; Brecard *et al.*, 2018; Lu, 2018; Laszkiewicz *et al.*, 2019; Li *et al.*, 2019; Yang *et al.*, 2019). In case of the number of years since renovation, the impact is not statistically significant (Eq. 10), as opposed to Zhang and Leonard (2014). The highest goodness of fit is registered in case of Eq. 1 and Eq. 2, whereas the lowest explanatory power is depicted by Eq. 10 and Eq. 11.

Table no. 7 – OLS regressions' results regarding the impact of each housing structural attributes on the sale price (duration until transaction completion not included)

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
No_rooms	**0.31*****										
	(22.75)										
S_useful		**0.01*****									
		(36.13)									
S_constructed			**0.01*****								
			(35.20)								
Comfort				**0.52*****							
				(11.05)							
Floor					**-0.02*****						
					(-4.26)						
No_bathrooms						**0.49*****					
						(17.23)					
No_balconies							**0.29*****				
							(8.71)				
No_parking								**0.30*****			
								(4.74)			
Seniority_construction									**-0.01*****		
									(-7.60)		
Seniority_renovation										-0.00	
										(-1.23)	
Structure											**0.08**†
											(1.65)
_cons	**10.29*****	**10.12*****	**10.17*****	**10.50*****	**11.11*****	**10.40*****	**10.70*****	**10.79*****	**11.21*****	**11.00*****	**10.92*****
	(304.83)	(386.15)	(399.40)	(235.16)	(393.12)	(277.26)	(259.13)	(169.27)	(357.95)	(471.73)	(230.38)
F statistic	**517.48*****	**1305.34*****	**1239.18*****	**122.17*****	**18.16*****	**296.74*****	**75.84*****	**22.44*****	**57.76*****	**1.50**	**2.72**†
R-sq	0.40	0.63	0.62	0.14	0.02	0.28	0.10	0.07	0.08	0.00	0.00
#	765.00	760.00	762.00	734.00	765.00	765.00	706.00	317.00	685.00	451.00	669.00

Source: Authors' computations. $\dagger$ $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

The impact of every housing structural feature on the sale price, when controlling for the duration until transaction completion, is pointed out in Table no. 8. The results are matching with those displayed in Table no. 7.

Table no. 8 – OLS regressions' results regarding the impact of each housing structural attributes on the sale price(duration until transaction completion included)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
No_rooms	**0.30*****										
	(22.31)										
S_useful		**0.01*****									
		(35.48)									
S_constructed			**0.01*****								
			(34.56)								
Comfort				**0.51*****							
				(10.72)							
Floor					**-0.02*****						
					(-4.23)						
No_bathrooms						**0.48*****					
						(17.01)					
No_balconies							**0.28*****				
							(8.47)				
No_parking								**0.28*****			
								(4.39)			
Seniority_construction									**-0.01*****		
									(-6.98)		
Seniority_renovation										-0.00	
										(-1.32)	
Structure											**0.10***
											(1.97)
Duration	**0.00***	-0.00	-0.00	0.00	**0.00*****	**0.00*****	**0.00****	**0.00†**	**0.00****	**0.00****	**0.00*****
	(2.45)	(-0.26)	(-0.79)	(1.56)	**(4.19)**	**(3.55)**	**(2.73)**	**(1.67)**	**(3.05)**	**(3.05)**	**(4.20)**
_cons	**10.27*****	**10.12*****	**10.17*****	**10.50*****	**11.06*****	**10.37*****	**10.68*****	**10.77*****	**11.16*****	**10.95*****	**10.86*****
	(301.99)	**(384.10)**	**(397.60)**	**(234.22)**	**(362.92)**	**(273.54)**	**(255.30)**	**(167.85)**	**(313.43)**	**(401.74)**	**(220.55)**
F statistic	**263.46*****	**651.90*****	**619.59*****	**62.43*****	**18.05*****	**156.90*****	**41.99*****	**12.68*****	**33.89*****	**5.40****	**10.24*****
R-sq	0.41	0.63	0.62	0.15	0.05	0.29	0.11	0.07	0.09	0.02	0.03
#	765.00	760.00	762.00	734.00	765.00	765.00	706.00	317.00	685.00	451.00	669.00

Source: Authors' computations. † $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Table no. 9 and Table no. 10 exposes the effect of each height regime on the sale price. We notice mixed relationships, namely negative in case of the Ground Floor + 10 Floors (Eq. 1), but positive in case of Ground Floor + 11 Floors (Eq. 2), Ground Floor + 2 Floors (Eq. 3), Ground Floor + 5 Floors (Eq. 6), Ground Floor + 6 Floors (Eq. 7), Ground Floor + 8 Floors (Eq. 9). As well, the regression coefficients do not differ when controlling for duration until transaction completion).

Table no. 11 and Table no. 12 exhibits the impact of the entire range of housing structural attributes on the sale price. Similar to previous estimations, the positive impact related to the number of rooms (Eq. 1 and Eq. 2), comfort (Eq. 1 – Eq. 10), number of bathrooms (Eq. 1, Eq. 7 and, Eq. 8) and parking (Eq. 1, Eq. 2, Eq. 4 – Eq. 6, Eq. 8 and, Eq. 10), alongside structure (Eq. 3, Eq. 7, Eq. 9 and, Eq. 10), maintains its statistical significance. Therewith, the negative influence of the floor level (Eq. 1, Eq. 4, Eq. 6, Eq. 8 and, Eq. 10) and seniority from construction (Eq. 1, Eq. 2, Eq. 6 and, Eq. 10) is strengthened. However, the effect of the number of balconies (Eq. 7 and Eq. 9) and seniority from renovation (Eq. 4) turn out to be negative, but the statistical significance is week.

Table no. 9 – OLS regressions' outcomes towards the influence of each height regime on the sale price (duration until transaction completion not covered)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Height_regime_1	**-0.23***** **(-7.75)**									
Height_regime_2		**0.18*** **(2.06)**								
Height_regime_3			**0.30**** **(3.09)**							
Height_regime_4				-0.01 (-0.23)						
Height_regime_5					0.04 (1.04)					
Height_regime_6						**0.23***** **(3.37)**				
Height_regime_7							**0.17*** **(2.19)**			
Height_regime_8								0.06 (0.71)		
Height_regime_9									**0.13***** **(3.38)**	
Height_regime_10										-0.05 (-0.66)
_cons	**11.09***** **(617.04)**	**11.00***** **(725.05)**	**11.00***** **(729.38)**	**11.01***** **(704.72)**	**11.00***** **(671.37)**	**10.99***** **(719.60)**	**11.00***** **(722.30)**	**11.00***** **(723.52)**	**10.98***** **(670.13)**	**11.01***** **(716.89)**
F statistic	**60.04*****	**4.24***	**9.54****	0.05	1.08	**11.35*****	**4.79***	0.50	**11.45*****	0.43
R-sq	0.07	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.00
#	765.00	765.00	765.00	765.00	765.00	765.00	765.00	765.00	765.00	765.00

*Source: Authors' computations.† p < 0.10. * p < 0.05. ** p < 0.01. *** p < 0.001*

Table no. 10 – OLS regressions' outcomes towards the influence of each height regime on the sale price (duration until transaction completion covered)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Height_regime_1	**-0.22***** **(-7.35)**									
Height_regime_2		**0.18*** **(2.04)**								
Height_regime_3			**0.27**** **(2.87)**							
Height_regime_4				-0.05 (-0.99)						
Height_regime_5					0.04 (1.09)					
Height_regime_6						**0.19**** **(2.78)**				
Height_regime_7							**0.17*** **(2.21)**			
Height_regime_8								0.07 (0.86)		
Height_regime_9									**0.14***** **(3.63)**	
Height_regime_10										-0.03 (-0.48)
Duration	**0.00***** **(3.48)**	**0.00***** **(4.21)**	**0.00***** **(4.06)**	**0.00***** **(4.32)**	**0.00***** **(4.23)**	**0.00***** **(3.76)**	**0.00***** **(4.23)**	**0.00***** **(4.24)**	**0.00***** **(4.42)**	**0.00***** **(4.19)**
_cons	**11.05***** **(503.69)**	**10.95***** **(573.98)**	**10.95***** **(578.31)**	**10.96***** **(573.84)**	**10.95***** **(544.66)**	**10.95***** **(578.05)**	**10.95***** **(572.31)**	**10.95***** **(570.65)**	**10.93***** **(541.08)**	**10.96***** **(566.22)**
F statistic	**36.53*****	**11.02*****	**13.09*****	**9.38*****	**9.49*****	**12.84*****	**11.39*****	**9.25*****	**15.63*****	**9.00*****
R-sq	0.09	0.03	0.03	0.02	0.02	0.03	0.03	0.02	0.04	0.02
#	765.00	765.00	765.00	765.00	765.00	765.00	765.00	765.00	765.00	765.00

*Source: Authors' computations.† p < 0.10. * p < 0.05. ** p < 0.01. *** p < 0.001*

Table no. 11 – The output of OLS regressions regarding the impact of the entire range of housing structural attributes on the sale price (duration until transaction completion not included)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
No_rooms	**0.23*****	**0.24*****								
	(9.19)	**(9.95)**								
Comfort	**0.34*****	**0.31*****	**0.26*****	**0.14***	**0.20****	**0.12***	**0.26*****	**0.15***	**0.21****	**0.12***
	(5.79)	**(5.21)**	**(4.33)**	**(2.54)**	**(3.32)**	**(2.07)**	**(4.28)**	**(2.51)**	**(3.26)**	**(2.06)**
Floor	**-0.01***	-0.01	-0.01	**-0.01****	-0.01	**-0.01***	-0.01	**-0.01***	-0.01	**-0.01***
	(-2.03)	(-1.49)	(-1.45)	**(-2.66)**	(-1.37)	**(-2.42)**	(-1.20)	**(-2.09)**	(-1.35)	**(-2.19)**
No_bathrooms	**0.09**†	0.03	0.07	0.06	0.04	0.03	**0.09**†	**0.08**†	0.06	0.05
	(1.92)	(0.70)	(1.52)	(1.41)	(0.90)	(0.80)	**(1.80)**	**(1.85)**	(1.14)	(1.19)
No_balconies	-0.03	-0.04	-0.05	-0.02	-0.06	-0.03	**-0.08**†	-0.05	**-0.09**†	-0.05
	(-0.71)	(-0.89)	(-1.12)	(-0.60)	(-1.41)	(-0.82)	**(-1.81)**	(-1.21)	**(-1.97)**	(-1.30)
No_parking	**0.21****	**0.23****	0.09	**0.16***	**0.13**†	**0.19****	0.06	**0.16***	0.09	**0.16***
	(3.05)	**(3.15)**	(1.35)	**(2.53)**	**(1.71)**	**(2.83)**	(0.82)	**(2.43)**	(1.12)	**(2.23)**
Seniority_construction	**-0.00*****	**-0.01*****	-0.00	-0.00	-0.00	**-0.00**†	-0.00	-0.00	-0.00	**-0.00***
	(-3.76)	**(-4.57)**	(-0.43)	(-1.20)	(-0.89)	**(-1.83)**	(-1.03)	(-1.55)	(-1.34)	**(-2.02)**
Seniority_renovation	-0.00	-0.00	-0.00	**-0.00***	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(-1.27)	(-0.76)	(-1.12)	**(-1.99)**	(-1.04)	(-1.50)	(-0.81)	(-1.55)	(-0.85)	(-1.26)
Structure	0.07	0.09	**0.14**†	0.04	0.12	0.04	**0.24****		**0.20***	**0.14**†
	(0.92)	(1.09)	**(1.90)**	(0.60)	(1.51)	(0.61)	**(3.14)**		**(2.45)**	**(1.83)**
Height_regime_1		0.05			0.05	0.09			-0.00	0.02
		(0.43)			(0.39)	(0.85)			(-0.04)	(0.21)
Height_regime_2		0.02			-0.02	0.05			-0.04	0.01
		(0.11)			(-0.14)	(0.35)			(-0.24)	(0.05)
Height_regime_3		0.27†			0.09	**0.22**†			-0.05	0.08
		(1.86)			(0.65)	**(1.67)**			(-0.34)	(0.54)
Height_regime_4		0.03			-0.01	0.04			-0.09	-0.04
		(0.20)			(-0.07)	(0.36)			(-0.61)	(-0.34)
Height_regime_5		0.09			0.09	0.09			0.04	0.03
		(0.69)			(0.74)	(0.81)			(0.33)	(0.25)
Height_regime_6		0.12			0.03	0.08			-0.00	0.02
		(0.75)			(0.18)	(0.62)			(-0.02)	(0.17)
Height_regime_7		0.24			-0.09	0.11			-0.10	0.03
		(1.44)			(-0.56)	(0.74)			(-0.58)	(0.16)
Height_regime_8		0.00			0.00	0.00			0.00	0.00
		(.)			(.)	(.)			(.)	(.)
Height_regime_9		0.19			0.18	**0.19**†			0.13	0.13
		(1.59)			(1.50)	**(1.76)**			(1.06)	(1.13)
Height_regime_10		**0.25**†			0.22	**0.27***			0.16	0.19
		(1.82)			(1.60)	**(2.16)**			(1.12)	(1.45)
S_useful			**0.01*****	**0.03*****	**0.01*****	**0.03*****				
			(9.63)	**(9.82)**	**(10.24)**	**(9.54)**				
S_useful_sq				**-0.00*****		**-0.00*****				
				(-6.58)		**(-6.15)**				
S_constructed							**0.01*****	**0.03*****	**0.01*****	**0.02*****
							(8.86)	**(9.93)**	**(9.37)**	**(9.28)**
S_constructed_sq								**-0.00*****		**-0.00*****
								(-6.82)		**(-5.77)**
_cons	**10.00*****	**9.96*****	**9.92*****	**9.49*****	**9.91*****	**9.42*****	**9.90*****	**9.61*****	**9.97*****	**9.53*****
	(65.73)	**(53.81)**	**(66.69)**	**(64.32)**	**(54.27)**	**(51.69)**	**(64.74)**	**(69.58)**	**(52.63)**	**(50.59)**
Turning points				**116,15**		**117,77**		**126,04**		**134,33**
F statistic	**38.18*****	**22.13*****	**40.08*****	**49.78*****	**22.84*****	**28.81*****	**36.84*****	**50.63*****	**20.78*****	**25.56*****
R-sq	0.68	0.72	0.69	0.75	0.73	0.78	0.67	0.72	0.71	0.76
#	173.00	173.00	173.00	173.00	173.00	173.00	173.00	183.00	173.00	173.00

Source: Authors' computations. $\dagger$ $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Table no. 12 – The output of OLS regressions regarding the impact of the entire range of housing structural attributes on the sale price (duration until transaction completion included)

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
No_rooms	**0.23*****	**0.25*****								
	(9.05)	**(9.70)**								
Comfort	**0.34*****	**0.31*****	**0.26*****	**0.14***	**0.20****	**0.12***	**0.26*****	**0.14***	**0.21****	**0.12***
	(5.81)	**(5.23)**	**(4.32)**	**(2.47)**	**(3.30)**	**(2.05)**	**(4.26)**	**(2.50)**	**(3.25)**	**(2.03)**
Floor	**-0.01***	-0.01	-0.01	**-0.01****	-0.01	**-0.01***	-0.01	**-0.01***	-0.01	**-0.01***
	(-2.01)	(-1.47)	(-1.44)	**(-2.64)**	(-1.36)	**(-2.41)**	(-1.20)	**(-1.98)**	(-1.35)	**(-2.18)**
No_bathrooms	0.08	0.03	0.07	0.05	0.04	0.03	**0.09**†	0.07	0.06	0.05
	(1.65)	(0.55)	(1.48)	(1.14)	(0.90)	(0.64)	**(1.79)**	(1.59)	(1.15)	(1.04)
No_balconies	-0.04	-0.04	-0.05	-0.03	-0.06	-0.04	**-0.08**†	-0.06	**-0.09**†	-0.06
	(-0.82)	(-0.97)	(-1.12)	(-0.73)	(-1.39)	(-0.92)	**(-1.78)**	(-1.38)	**(-1.92)**	(-1.40)
No_parking	**0.21****	**0.23****	0.09	**0.16****	**0.13**†	**0.20****	0.06	0.16*	0.09	**0.17***
	(3.11)	**(3.19)**	(1.35)	**(2.63)**	**(1.69)**	**(2.92)**	(0.81)	(2.52)	(1.10)	**(2.30)**
Seniority_construction	**-0.00*****	**-0.01*****	-0.00	-0.00	-0.00	**-0.00**†	-0.00	**-0.00**†	-0.00	**-0.00***
	(-3.87)	**(-4.61)**	(-0.43)	(-1.37)	(-0.88)	**(-1.91)**	(-1.01)	**(-1.73)**	(-1.32)	**(-2.09)**
Seniority_renovation	-0.00	-0.00	-0.00	**-0.00**†	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(-1.18)	(-0.70)	(-1.10)	**(-1.89)**	(-1.03)	(-1.43)	(-0.81)	(-1.40)	(-0.86)	(-1.19)
Structure	0.06	0.08	**0.14**†	0.02	0.12	0.03	**0.25****		**0.21***	0.12
	(0.72)	(0.91)	**(1.85)**	(0.32)	(1.48)	(0.34)	**(3.11)**		**(2.44)**	(1.57)
Duration	-0.00	-0.00	-0.00	-0.00	0.00	-0.00	0.00	**-0.00**†	0.00	-0.00
	(-0.93)	(-0.69)	(-0.11)	(-1.37)	(0.05)	(-1.08)	(0.09)	**(-1.73)**	(0.19)	(-0.97)
Height_regime_1		0.06			0.05	0.11			-0.01	0.04
		(0.51)			(0.38)	(1.00)			(-0.06)	(0.34)
Height_regime_2		0.03			-0.02	0.06			-0.04	0.02
		(0.18)			(-0.15)	(0.47)			(-0.26)	(0.15)
Height_regime_3		0.27†			0.09	0.22†			-0.05	0.08
		(1.89)			(0.65)	(1.72)			(-0.34)	(0.56)
Height_regime_4		0.04			-0.01	0.06			-0.09	-0.03
		(0.28)			(-0.08)	(0.49)			(-0.62)	(-0.23)
Height_regime_5		0.10			0.09	0.11			0.04	0.04
		(0.78)			(0.72)	(0.95)			(0.30)	(0.37)
Height_regime_6		0.12			0.03	0.09			-0.00	0.03
		(0.78)			(0.18)	(0.67)			(-0.02)	(0.20)
Height_regime_7		0.25			-0.09	0.13			-0.10	0.04
		(1.52)			(-0.56)	(0.87)			(-0.59)	(0.27)
Height_regime_8		0.00			0.00	0.00			0.00	0.00
		(.)			(.)	(.)			(.)	(.)
Height_regime_9		0.20			0.18	**0.20**†			0.13	0.14
		(1.65)			(1.48)	**(1.87)**			(1.03)	(1.22)
Height_regime_10		**0.26**†			0.22	**0.28***			0.16	0.20
		(1.86)			(1.59)	**(2.25)**			(1.10)	(1.52)
S_useful			**0.01*****	**0.03*****	**0.01*****	**0.03*****				
			(9.42)	**(9.89)**	**(9.96)**	**(9.53)**				
S_useful_sq				**-0.00*****		**-0.00*****				
				(-6.74)		**(-6.25)**				
S_constructed							**0.01*****	**0.03*****	**0.01*****	**0.03*****
							(8.65)	**(10.13)**	**(9.09)**	**(9.20)**
S_constructed_sq								**-0.00*****		**-0.00*****
								(-7.03)		**(-5.84)**
_cons	**10.03*****	**9.97*****	**9.92*****	**9.50*****	**9.91*****	**9.42*****	**9.90*****	**9.61*****	**9.97*****	**9.53*****
	(64.51)	**(53.63)**	**(65.47)**	**(64.39)**	**(53.99)**	**(51.67)**	**(63.55)**	**(69.98)**	**(52.33)**	**(50.55)**
Turning points				**115,63**		**117,20**		**125,93**		**133,54**
F statistic	**34.42*****	**20.92*****	**35.86*****	**45.67*****	**21.50*****	**27.45*****	**32.95*****	**46.40*****	**19.56*****	**24.32*****
R-sq	0.68	0.72	0.69	0.76	0.73	0.78	0.67	0.73	0.71	0.76
#	173.00	173.00	173.00	173.00	173.00	173.00	173.00	183.00	173.00	173.00

Source: Authors' computations. $\dagger$ $p < 0.10$. $*$ $p < 0.05$. $**$ $p < 0.01$. $***$ $p < 0.001$

Further, when adding the squared term of the useful surface (Eq. 4 and Eq. 6) and constructed surface (Eq. 8 and Eq. 10), we notice a concave association between the latter and the price of the apartment, similar to Ooi *et al.* (2014), Brecard *et al.* (2018). Consequently, the threshold for useful surface is located between 115-117 square meters and between 125-134 squared meter in case of constructed surface.

4.3 Robustness checks

A broad description of various distributions may be gathered via quantile regression which considers the overall conditional distribution, not just the conditional mean effect (Wen *et al.*, 2019).As different to linear regression, which estimates a conditional mean function, quantile regression estimates a conditional quantile function, in which a quantile of the response variable's conditional distribution is showed as a function of covariates (Liao and Wang, 2012). As well, quantile regression estimates are more informative and robust to outliers (Zhang and Yi, 2017). The influence of the entire range of housing structural attributes on the sale price, except constructed surface, estimated via quantile regressions is exhibited in Table no. 13.

Table no. 13 – The outcomes of quantile regressions towards the impact of the entire range of housing structural attributes (except constructed surface) on the sale price

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Quantile	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**.9**
S_useful	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****
	(6.85)	**(6.34)**	**(9.78)**	**(14.08)**	**(14.41)**	**(9.20)**	**(6.82)**	**(6.47)**	**(5.62)**
Comfort	0.14	0.12	**0.18****	**0.18*****	**0.20*****	**0.24*****	**0.26****	**0.29****	**0.30***
	(1.51)	(1.26)	**(2.73)**	**(3.91)**	**(4.09)**	**(3.86)**	**(3.25)**	**(2.91)**	**(2.57)**
Floor	0.00	-0.00	-0.01	-0.00	-0.01	-0.00	-0.01	-0.01	-0.02
	(0.30)	(-0.42)	(-0.95)	(-0.65)	(-1.30)	(-0.55)	(-1.04)	(-1.52)	(-1.60)
No_bathrooms	0.03	0.10	0.07	**0.07***	0.05	**0.12***	**0.13***	0.07	0.07
	(0.35)	(1.25)	(1.31)	**(2.07)**	(1.30)	**(2.32)**	**(2.10)**	(0.96)	(0.72)
No_balconies	0.01	0.00	0.01	-0.02	-0.02	-0.04	-0.05	-0.06	-0.02
	(0.11)	(0.05)	(0.12)	(-0.69)	(-0.59)	(-0.95)	(-0.92)	(-0.88)	(-0.23)
No_parking	-0.07	0.06	0.04	0.03	0.02	0.10	0.09	0.06	0.10
	(-0.59)	(0.50)	(0.53)	(0.65)	(0.27)	(1.37)	(0.92)	(0.51)	(0.76)
Seniority_construction	0.00	-0.00	0.00	-0.00	-0.00	0.00	-0.00	0.00	-0.00
	(0.13)	(-0.45)	(0.02)	(-0.46)	(-0.44)	(0.16)	(-0.37)	(0.53)	(-0.11)
Seniority_renovation	-0.00	-0.00	**-0.00***	**-0.01****	**-0.00***	**-0.00**†	-0.00	-0.00	0.00
	(-0.96)	(-1.27)	**(-1.98)**	**(-3.34)**	**(-2.44)**	**(-1.91)**	(-1.00)	(-1.05)	(0.13)
Structure	**0.87*****	-0.02	0.06	0.04	0.07	**0.14**†	0.08	-0.09	-0.02
	(7.22)	(-0.16)	(0.76)	(0.74)	(1.12)	**(1.78)**	(0.82)	(-0.75)	(-0.16)
Duration	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(-1.05)	(-0.34)	(-0.02)	(-0.24)	(-0.86)	(-0.06)	(-0.13)	(-0.62)	(-0.61)
_cons	**9.09*****	**9.97*****	**9.90*****	**9.97*****	**9.97*****	**9.83*****	**9.98*****	**10.20*****	**10.15*****
	(37.81)	**(40.26)**	**(60.83)**	**(86.47)**	**(82.78)**	**(62.00)**	**(49.16)**	**(41.19)**	**(34.79)**
Pseudo R-sq	0.4887	0.5165	0.5270	0.5213	0.5132	0.5084	0.4991	0.4787	0.4593
#	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00

Source: Authors' computations. $\dagger$ $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Thus, the outcomes provide support for a positive influence of useful area (Eq. 1 – Eq. 9) as in Liao and Wang (2012), McCord *et al.* (2018), comfort (Eq. 3 – Eq. 9), number of bathrooms (Eq. 4, Eq. 6 and, Eq. 7) similar Zhang and Leonard (2014), structure (Eq. 1 and

Eq. 6). The seniority from renovation reveals a negative influence, as opposed to Zhang and Leonard (2014). In addition, the floor level does not reveal a statistically significant relation with sale price, on the contrary to Liao and Wang (2012). Besides, opposite to Wen *et al.* (2019), the number of years since construction is not statistically significant.

Table no. 14 shows the quantile regression outcomes when adding the squared term of useful surface. Therefore, similar to Kim *et al.*, 2015, the non-linear relationship between surface and sale price is confirmed. The identified thresholds are decreasing gradually from the first to the last quantile, being located between 104 and 117 square meters.

Table no. 14 – The outcomes of quadratic quantiles regressions towards the impact of the entire range of housing structural attributes (except constructed surface) on the sale price

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Quantile	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**.9**
S_useful	**0.03*****	**0.03*****	**0.03*****	**0.03*****	**0.03*****	**0.03*****	**0.03*****	**0.04*****	**0.04*****
	(5.56)	**(9.94)**	**(10.65)**	**(10.89)**	**(8.98)**	**(8.31)**	**(6.46)**	**(6.84)**	**(7.50)**
S_useful_sq	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****
	(-3.73)	**(-6.99)**	**(-7.35)**	**(-7.54)**	**(-6.15)**	**(-5.83)**	**(-4.57)**	**(-4.92)**	**(-5.69)**
Comfort	0.11	**0.10†**	**0.11***	**0.10***	**0.13***	**0.16***	**0.18***	0.16	0.03
	(1.14)	**(1.82)**	**(2.15)**	**(1.98)**	**(2.27)**	**(2.46)**	**(2.15)**	(1.65)	(0.24)
Floor	-0.01	**-0.01***	**-0.01****	-0.01	-0.00	-0.00	-0.01	**-0.02†**	**-0.03****
	(-1.24)	**(-2.02)**	**(-2.73)**	(-1.50)	(-0.15)	(-0.68)	(-1.37)	**(-1.88)**	**(-3.32)**
No_bathrooms	0.08	**0.08***	**0.08***	**0.08***	**0.10***	**0.12***	**0.11†**	0.03	0.04
	(1.17)	**(2.09)**	**(2.19)**	**(2.13)**	**(2.38)**	**(2.47)**	**(1.75)**	(0.48)	(0.47)
No_balconies	-0.05	-0.00	-0.02	-0.01	-0.01	-0.02	-0.03	-0.05	-0.02
	(-0.86)	(-0.02)	(-0.54)	(-0.20)	(-0.37)	(-0.56)	(-0.45)	(-0.72)	(-0.30)
No_parking	0.11	**0.23*****	**0.18*****	**0.25*****	**0.23*****	**0.22****	**0.29****	**0.27***	0.12
	(1.05)	**(3.90)**	**(3.38)**	**(4.65)**	**(3.59)**	**(3.01)**	**(3.20)**	**(2.56)**	(1.00)
Seniority_construction	-0.00	**-0.00†**	**-0.00†**	**-0.00†**	-0.00	-0.00	0.00	0.00	0.00
	(-1.00)	**(-1.87)**	**(-1.74)**	**(-1.73)**	(-0.60)	(-0.19)	(0.43)	(1.29)	(0.26)
Seniority_renovation	**-0.01†**	**-0.01****	**-0.01****	**-0.00****	**-0.00***	**-0.00†**	-0.00	-0.00	-0.00
	(-1.83)	**(-2.97)**	**(-3.05)**	**(-2.93)**	**(-2.25)**	**(-1.66)**	(-0.94)	(-1.36)	(-0.84)
Structure	-0.04	-0.01	0.02	0.04	0.09	0.06	0.06	-0.10	-0.07
	(-0.33)	(-0.21)	(0.29)	(0.60)	(1.19)	(0.81)	(0.58)	(-0.86)	(-0.55)
Duration	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	**-0.00†**
	(-1.46)	(-0.94)	(-0.82)	(-0.70)	(-0.09)	(-0.59)	(-0.87)	(-1.39)	**(-1.73)**
_cons	**9.58*****	**9.38*****	**9.45*****	**9.34*****	**9.26*****	**9.27*****	**9.25*****	**9.36*****	**9.52*****
	(39.52)	**(66.34)**	**(73.17)**	**(72.48)**	**(60.77)**	**(54.64)**	**(42.84)**	**(37.43)**	**(34.37)**
Turning points	**117.44**	**112.23**	**114.21**	**113.81**	**115.25**	**112.43**	**111.68**	**109.68**	**104.02**
Pseudo R-sq	0.5844	0.6082	0.5934	0.5710	0.5546	0.5453	0.5363	0.5186	0.5181
#	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00

*Source: Authors' computations.† $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$*

The impact of the entire range of housing structural attributes on the sale price, except useful surface, assessed via quantile regressions is exhibited in Table no. 15. The outcomes confirms the positive influence of constructed surface (Eq. 1 – Eq. 9), comfort (Eq. 2 – Eq. 9), the number of bathrooms (Eq. 3, Eq. 6 and, Eq. 7) and structure (Eq. 1 – Eq. 5) on sale price. The number of balconies (Eq. 1, Eq. 5 and, Eq. 6) shows a negative, but weak, negative impact on dwellings' price. In case of the number of parking (Eq. 1 and Eq. 5) the influence is mixed, but its statistical significance is weak.

Table no. 16 reveals the output of quantile regressions when adding the squared term of constructed surface. Thereby, kindred with the outcomes from Table no. 14, the non-linear association is consolidated. The computed thresholds are located between 117 and 145 square meters.

Table no. 15 – The outcomes of quantile regressions towards the impact of the entire range of housing structural attributes (except useful surface) on the sale price

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Quantile	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**.9**
S_constructed	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****	**0.01*****
	(6.74)	**(6.59)**	**(8.25)**	**(9.41)**	**(9.90)**	**(8.45)**	**(7.48)**	**(6.12)**	**(3.84)**
Comfort	0.14	**0.16**†	**0.20****	**0.20****	**0.21****	**0.25*****	**0.25*****	**0.30****	**0.31***
	(1.42)	**(1.81)**	**(2.80)**	**(3.21)**	**(3.25)**	**(3.65)**	**(3.38)**	**(3.23)**	**(2.08)**
Floor	0.00	-0.00	-0.01	-0.00	-0.00	-0.00	-0.01	-0.01	-0.02
	(0.06)	(-0.42)	(-1.41)	(-0.28)	(-0.18)	(-0.62)	(-1.08)	(-1.40)	(-1.24)
No_bathrooms	0.02	0.05	**0.10**†	0.06	0.06	**0.12***	**0.17****	0.11	0.11
	(0.23)	(0.79)	**(1.78)**	(1.33)	(1.12)	**(2.25)**	**(2.84)**	(1.44)	(0.92)
No_balconies	**-0.12**†	-0.02	-0.06	-0.07	**-0.10***	**-0.08**†	-0.07	-0.03	-0.01
	(-1.67)	(-0.37)	(-1.08)	(-1.44)	**(-2.10)**	**(-1.67)**	(-1.29)	(-0.39)	(-0.08)
No_parking	**-0.26***	-0.01	-0.09	0.03	**0.13**†	0.07	0.04	0.05	0.06
	(-2.14)	(-0.12)	(-1.11)	(0.38)	**(1.76)**	(0.90)	(0.43)	(0.42)	(0.34)
Seniority_construction	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.12)	(-0.15)	(-0.34)	(-1.00)	(-1.36)	(-0.59)	(-0.71)	(-0.31)	(-0.01)
Seniority_renovation	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00
	(-1.42)	(-1.31)	(-1.20)	(-1.21)	(-0.89)	(-1.04)	(-1.04)	(-1.30)	(0.53)
Structure	**0.84*****	**0.46*****	**0.25****	**0.25****	**0.27****	0.13	0.09	0.05	0.07
	(6.52)	**(4.17)**	**(2.79)**	**(3.17)**	**(3.30)**	(1.52)	(0.99)	(0.43)	(0.37)
Duration	-0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.00	-0.00
	(-0.37)	(0.75)	(0.31)	(-0.12)	(-0.44)	(-0.07)	(-0.06)	(0.29)	(-0.10)
_cons	**9.45*****	**9.60*****	**9.91*****	**9.87*****	**9.79*****	**9.93*****	**10.01*****	**10.08*****	**10.06*****
	(37.15)	**(43.72)**	**(55.86)**	**(63.36)**	**(60.99)**	**(57.76)**	**(53.26)**	**(43.33)**	**(26.71)**
Pseudo R-sq	0.4729	0.4941	0.4960	0.4844	0.4753	0.4788	0.4792	0.4667	0.4491
#	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00

Source: Authors' computations. $\dagger$ $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Table no. 16 – The outcomes of quadratic quantile regressions towards the impact of the entire range of housing structural attributes (except useful surface) on the sale price

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Quantile	**.1**	**.2**	**.3**	**.4**	**.5**	**.6**	**.7**	**.8**	**.9**
S_constructed	**0.03*****	**0.02*****	**0.02*****	**0.02*****	**0.03*****	**0.03*****	**0.02*****	**0.03*****	**0.03*****
	(7.03)	**(8.59)**	**(7.78)**	**(8.25)**	**(7.54)**	**(8.96)**	**(6.11)**	**(7.48)**	**(6.27)**
S_constructed_sq	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****	**-0.00*****
	(-4.70)	**(-5.31)**	**(-4.66)**	**(-5.28)**	**(-5.13)**	**(-6.43)**	**(-4.49)**	**(-5.30)**	**(-4.63)**
Comfort	0.04	0.09	**0.14***	**0.14***	**0.15***	**0.17****	**0.21***	**0.19***	0.13
	(0.47)	(1.59)	**(2.31)**	**(2.45)**	**(2.04)**	**(2.78)**	**(2.42)**	**(2.19)**	(1.08)
Floor	-0.00	**-0.01**†	**-0.01***	-0.01	0.00	-0.00	-0.01	**-0.02***	**-0.02***
	(-0.34)	**(-1.72)**	**(-2.09)**	(-1.12)	(0.10)	(-0.58)	(-1.45)	**(-2.18)**	**(-2.32)**
No_bathrooms	0.07	**0.10***	**0.09**†	**0.10***	**0.13***	**0.15****	**0.14***	0.07	0.11
	(1.13)	**(2.45)**	**(1.97)**	**(2.21)**	**(2.37)**	**(3.27)**	**(2.09)**	(1.08)	(1.20)
No_balconies	**-0.12***	-0.03	-0.05	-0.03	-0.08	-0.02	-0.01	-0.04	-0.06
	(-2.09)	(-0.86)	(-1.22)	(-0.71)	(-1.60)	(-0.55)	(-0.09)	(-0.69)	(-0.68)
No_parking	0.15	0.10	0.06	**0.23*****	**0.22****	**0.21****	**0.26****	**0.17**†	0.06
	(1.58)	(1.49)	(0.84)	**(3.48)**	**(2.73)**	**(2.99)**	**(2.68)**	**(1.73)**	(0.42)
Seniority_construction	**-0.00***	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00
	(-2.06)	(-1.15)	(-1.13)	(-1.14)	(-1.59)	(-0.60)	(0.03)	(1.58)	(0.60)
Seniority_renovation	**-0.00**†	**-0.00**†	**-0.00**†	**-0.00***	-0.00	-0.00	-0.00	**-0.01**†	-0.00
	(-1.75)	**(-1.96)**	**(-1.72)**	**(-2.35)**	(-1.19)	(-1.58)	(-0.99)	**(-1.78)**	(-0.91)
Structure	0.11	**0.21****	**0.23****	**0.17***	0.05	0.06	0.04	0.03	0.04
	(1.10)	**(2.92)**	**(3.17)**	**(2.44)**	(0.56)	(0.83)	(0.37)	(0.31)	(0.24)
Duration	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
	(-0.68)	(0.27)	(-0.01)	(-0.86)	(-0.73)	(-0.52)	(0.02)	(-1.29)	(-0.96)
_cons	**9.47*****	**9.40*****	**9.51*****	**9.38*****	**9.46*****	**9.34*****	**9.37*****	**9.35*****	**9.50*****
	(44.30)	**(63.29)**	**(61.86)**	**(62.97)**	**(51.45)**	**(58.64)**	**(41.71)**	**(40.68)**	**(30.96)**
Turning points	**130.35**	**141.10**	**145.46**	**136.23**	**127.84**	**121.34**	**118.38**	**122.88**	**117.77**
Pseudo R-sq	0.5574	0.5769	0.5539	0.5284	0.5185	0.5133	0.5152	0.5028	0.5006
#	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00	173.00

Source: Authors' computations. $\dagger$ $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

5. CONCLUDING REMARKS

Current study aimed to explore the influence of the structural attributes related to an apartment on its sale price in Bucharest, Romania, over 2014-2018. Several structural attributes were selected, among which OLS regression outcomes provide support for a positive impact, respectively the number of rooms, comfort, the number of bathrooms, the number of parking, the number of balconies and, structure. On the contrary, in case of floor level and seniority from construction, the OLS estimates reveals a negative relationship. Nevertheless, we notice concave links between useful surface and sale price, as well as between constructed surface and sale price. When estimating via quantile regressions, the associations are reinforced.

The main limitation of current study is driven by OLS estimation regardless of the spatial effects (Z. Z. Huang *et al.*, 2017). The issue with traditional hedonic pricing models is the insufficiency towards depicting the fundamental link between property price and geographical spatial interaction (Hui *et al.*, 2012). Therefore, as future research avenues, spatial econometric modeling will be considered.

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