Assessing the Liveability in the European Metropolitan Cities by Interpreting the Property Markets

Federico Stara(✉), Giuseppe Cerullo, Francesco Sica, and Francesco Tajani

Department of Architecture and Design, "Sapienza" University of Rome, 00196 Rome, Italy
federico.stara@uniroma1.it

Abstract. This study examines the functional relationship between urban liveability and residential property values in a sample of 53 European metropolitan cities. The underlying assumption is that housing prices incorporate not only the physical attributes of dwellings, but also the environmental, social, and economic factors of the urban context. To test this hypothesis, two hedonic models are estimated, using as dependent variables the average price per square metre of apartments located in the city centre and in the periphery. The explanatory variables include the Cost of Living, the Quality of Life, the Tree Cover, and the Population. The empirical results show high explanatory power for both models and confirm the statistical significance of all the variables considered. Among them, tree cover emerges as the most influential determinant of housing prices in both urban contexts, indicating the growing relevance of environmental quality in metropolitan housing markets. By contrast, the broader Quality of Life index appears less influential than variables associated with purchasing conditions and demographic pressure. These findings suggest that urban green infrastructure is more directly capitalised into the property values, whereas the social and service-related components of liveability exert a less immediate effect.

Keywords: Urban Liveability · Real Estate Prices · Tree Cover

1 Introduction

The contemporary urban landscape is undergoing a phase of profound transformation, in which the challenge of sustainability is inextricably intertwined with the need to ensure high standards of liveability for a population increasingly concentrated in large metropolitan hubs. In this scenario, European cities do not merely represent nodes of economic production and innovation but are configured as complex ecosystems where the quality of life of residents is constantly tested by conflicting pressures. On the one hand, the globalization and the international mobility have transformed historic centers into strategic assets for the global tourism market; on the other hand, the need to preserve the right to the city for local communities imposes an urgent reflection on the ways in which territory is managed and on the dynamics that regulate access to urban resources.

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Urban liveability, although a multidimensional concept and often difficult to define unambiguously, finds in many cases an effective synthetic indicator in the real estate market. As an expression of the preferences and the ordinary behaviors manifested during the negotiation phases by the actors operating in a given market, property prices can be interpreted as the economic materialization of the perception of social, environmental, and infrastructural well-being in a specific context. In economic terms, the housing prices reflect the capitalization of the so-called amenities: those locational advantages, tangible and intangible, that make one city more or less desirable than another. The subjects that purchase or rent a real estate unit are not simply paying for the physical property measured in square meters, but they are acquiring a "bundle of services" that includes proximity to green spaces, air quality, urban safety, the richness of the cultural heritage, and the social prestige associated with certain areas.

The delicate balance between attractiveness and liveability is now threatened by critical phenomena. The exponential growth of mass tourism (the so-called overtourism phenomenon) generates negative externalities that heavily affect the daily lives of residents [1]. Overcrowding, the rising cost of living, the saturation of public services, and the deterioration of environmental quality act as driving forces of displacement, transforming entire neighborhoods into areas with an exclusively tourist vocation and triggering gentrification processes that alter the original social structure. This friction between the tourism capital and the local social capital is directly reflected in the volatility of the real estate prices, creating increasingly marked spatial disparities between central cores, rich in amenities but congested, and peripheral areas, often characterized by fewer services but subject to different environmental pressures.

Within this framework, the present study aims to comparatively analyze 53 European cities, selected to represent the variety of the continent's development models, in order to interpret the preferences/needs in terms of liveability indirectly expressed in the property prices. The investigation seeks to answer crucial questions for urban planning and public governance: to what extent do environmental endowments, such as urban tree cover, contribute to the formation of real estate prices? Is there a measurable correlation between perceived quality of life and the market value of real estate? How do these dynamics change across different territorial areas within a city?

2 Aim

Through the development of hedonic models and the integration of accessible and open-source datasets, the research aims to make explicit the environmental and social variables that most affect operators' purchasing decisions and to highlight those that are most influential in the formation of property prices. The ultimate objective is not only to provide a statistical snapshot of the European real estate market, but also to offer policy makers and urban planners interpretative tools to promote resilient development models capable of fostering urban liveability and ensuring that economic growth does not occur at the expense of the quality of life of resident communities.

The present study arises from the need to decode the complexity of contemporary urban dynamics, placing emphasis on the dialectical tension between urban development and the safeguarding of urban liveability, while assuming the residential real estate market as the principal sensor and indicator of territorial imbalances.

The choice of the real estate market as an interpretative key is not accidental: it represents a "market of amenities" where prices do not merely reflect the physical value of the built environment, but also incorporate and externalize the benefits (or costs) deriving from the environmental, social, and tourist context. In particular, the research intends to verify and quantify the extent to which the different components of Quality of Life and environmental endowments affect the formation of real estate prices in metropolitan contexts subject to high international attractiveness.

The analysis is carried out on a heterogeneous sample of 53 cities with populations exceeding 500,000 inhabitants. The use of a harmonized dataset, integrating socio-economic indices extracted from crowdsourcing platforms with satellite environmental monitoring data, makes it possible to overcome the limits of purely local analyses, offering an overall view of the trends underway across the continent.

The structure of the contribution is articulated into five sections. Chap. 3 (Background) recalls the contributions of the international scientific literature on the themes of liveability, quality of life, and the relationship between amenities theory and real estate value. A specific focus is devoted to the phenomenon of overtourism, a current issue because of its influence on the quality of life of local communities, and to its evolution from an economic variable into a social and urban planning criticality. Chap. 4 (Method) illustrates the scientific basis of the hedonic pricing method, justifying the choice of the log-linear functional form and the use of logarithmic transformations for the dependent variables. Chap. 5 (Case study) presents in detail the constructed dataset: the criteria for selecting the sample of 53 European cities are presented, along with the analytical description of the variables (property prices in the city center, property prices in peripheral areas, cost of living, quality of life, tree cover, population), the data sources, and the normalization procedures applied to ensure the comparability of the estimated coefficients. Chap. 6 (Models) describes and comments on the two hedonic models obtained (one for the central area, the other for the peripheral area), attesting to the statistical and empirical reliability of the results. Finally, in Chap. 7 the conclusions are drawn, summarizing the main findings emerging from the research and outlining the practical implications in support of decisions for the development of public policies and city governance models, with a view to promoting resilient urban development oriented toward social and environmental sustainability.

3 Background

The starting point of the scientific debate on the contemporary city lies in the definition of liveability, a concept that Veenhoven (2011) [2] closely relates to "life satisfaction" and subjective well-being. According to the Author, livability represents the quality of the environmental context in which the individual operates, thus constituting a primary objective for policy makers who aim to guarantee high standards of happiness for the community.

However, the translation of this concept into concrete urban strategies presents significant interpretative challenges. As highlighted by Ruth and Franklin (2014) [3], liveability suffers from significant conceptual limitations due to its multidimensional nature; the Authors underline how the practical implications of planning must contend with the

difficulty of objectively measuring well-being in geographically diverse contexts, suggesting the need for models that go beyond abstract definitions in order to adhere to the real dynamics of the territory.

The economic analysis of liveability finds a solid foundation in amenities theory. According to Brueckner et al. (1999) [4], the spatial structure of cities and the distribution of different income groups depend closely on the relative advantage of the services and environmental endowments present in the urban fabric. In particular, the Authors point out that when the historic center has a strong advantage in terms of amenities compared to the periphery, dynamics of value polarization are triggered that attract the wealthier segments of the population, consolidating the prestige of the central core.

This approach was further developed by Glaeser et al. (2001) [5], who introduced the "Consumer City" paradigm. According to this theory, the success of contemporary metropolises is no longer linked exclusively to their productive function, but to their capacity to present themselves as centers of consumption of a high quality of life. A "livable" city must therefore offer a mix of public goods, architectural beauty, and environmental quality; in this context, the residential real estate market does not exchange only square meters, but reflects the economic value of the "right of use" of such urban amenities.

Environmental quality, however, does not represent a static value, since its perception and its economic impact can be eroded by external pressures and uncontrolled urban dynamics [6]. Jim and Chen (2006) [7] show how environmental elements significantly influence housing prices, but warn that such benefits are extremely sensitive to context: a deterioration of the urban environment or a saturation of public spaces can cancel out the economic "premium" generated by amenities.

With regard to the classification of environmental resources, Panduro and Veie (2013) [8] point out that urban green spaces do not constitute a uniform amenity, but rather a set of distinct goods whose impacts on housing prices vary significantly according to factors such as accessibility, maintenance levels, and the type of surrounding land use. In this context, the investigations conducted by Luttik (2000) [9] suggest that the presence of valuable landscape elements, such as trees, bodies of water, or views of open spaces, may determine an increase in the market value of residential properties, quantifiable on average between 8% and 10%.

The scientific literature, through the studies of Tyrväinen and Miettinen (2000) [10], further confirms that the benefits deriving from forest amenities and urban greenery are not only perceived qualitatively, but are translated into a direct increase in residential property prices as proximity to such areas increases. In this perspective, Gough (2014) [11] argues that the guarantee of sustainable well-being must be founded on the centrality of universal human needs, which represent the indispensable prerequisite for defining development policies capable of integrating environmental protection with the liveability of social contexts.

As highlighted by Biagi et al. (2020) [12], the well-being of the local population is closely influenced by urban tourism dynamics, which exert a significant impact on the quality of life of residents and make it necessary to carefully evaluate the trade-off between the economic benefits of the sector and the liveability of everyday life. In this context, Marans (2015) [13] considers it essential to deepen the links between studies on

urban quality of life and those on environmental sustainability, in order to identify new research opportunities that integrate citizens' well-being with the protection of urban ecosystems.

From a methodological point of view, Conway et al. (2010) [14] clarify that the analysis of the effects of green spaces on property values cannot disregard the use of spatial autocorrelation models, indispensable tools for accurately capturing how the geographical configuration of natural areas influences residential market prices.

Lazrak et al. (2014) [15] demonstrate how the application of spatial hedonic pricing models makes it possible to effectively quantify the market value of urban cultural heritage, highlighting how the conservation of historic assets generates an "ensemble effect" capable of significantly increasing the attractiveness and value of surrounding areas.

Within this scenario, the issue of the overtourism fits, which Dodds and Butler (2019) [16] define as the result of excessive tourism growth in areas where management is weak or lacking a long-term strategic vision. This phenomenon acts as a structural criticality that compromises local liveability, transforming residential neighborhoods into areas with an exclusively tourist vocation and generating negative externalities — such as noise, overcrowding, and the increase in the cost of living — that directly affect the quality of life of residents and the long-term stability of the real estate market [17].

In light of the evidence that has emerged, it appears clear that the protection of urban liveability cannot be entrusted to sectoral or emergency interventions. As argued by Capocchi et al. (2019) [18], overtourism and the consequent crisis of liveability are multidimensional phenomena that require a systemic vision. The Authors underline the importance of governance capable of integrating the economic, political, and environmental dimensions, shifting attention from the mere quantitative growth of flows toward the management of urban quality. Only through a profound understanding of the interconnections between the real estate market, environmental endowments, and external pressures is it possible to define resilient development models [19], capable of protecting the right to the city for resident communities and ensuring the sustainability of the urban system in the long term. Building on this literature, the present study contributes by addressing the still limited integration between overtourism assessment and residential market modelling, showing how tourism pressure interacts with socio-economic and settlement-related factors in shaping housing values at the intra-urban scale.

4 Method

Two hedonic price models (center and periphery) are obtained, by considering the market quotations for the two macro-areas as dependent variable. The methodological workflow of the study is summarized in Fig. 1.

Hedonic modelling seeks to explain the price of a complex good as a function of the characteristics that define it [20]. From a theoretical perspective, the observed price of the good can be decomposed into the implicit prices of its individual attributes. Such prices are not directly observable, because market transactions reveal only the overall price of the asset. According to the hedonic pricing principle, therefore, the set of characteristics incorporated into the asset determines its explicit market value [21].

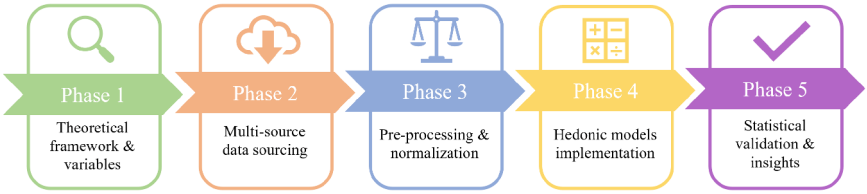

Fig. 1. Methodological workflow of the study. Source: authors' elaboration.

In real estate studies, hedonic price theory has been employed in several fields of application [22]. These include the prediction of property sale and rental prices [23], the measurement of the effects of social, environmental, and urban factors on property values [24, 25], the assessment of the implicit prices associated with specific property attributes [26, 27], and the examination of the role played by housing characteristics in shaping bargaining outcomes [28].

The empirical specification adopted in the present study is the log-linear one. The model is linear in the parameters and takes, as its dependent variable, the natural logarithm of the unit selling price, measured in euros per square meter of the property's floor area. Previous empirical findings indicate that the use of unit prices improves the goodness of fit of the specification [29]. The model can be expressed as follows in Eq. 1:

$$\ln Y = \alpha + \beta X + \varepsilon\# \tag{1}$$

where Y indicates the response variable, α corresponds to the intercept, β is the vector of coefficients to be estimated, $X = (X_1,\ldots, X_n)$ denotes the set of explanatory characteristics. The disturbance term ε accounts for random variation and unobserved stochastic effects, and is assumed to be normally distributed with mean equal to zero and variance σ^2. According to the literature, this functional specification is particularly well suited to the data [30].

5 Case Study

Using data extracted from "Numbeo" [31] for quality-of-life-related indicators [32, 33], from the "European Environment Agency's - Urban Tree Cover dataset" [34] for the environmental dimension, and from "Eurostat" [35] for the demographic variable, the study identified and analysed the main factors shaping the real estate market across 53 European metropolitan cities. The resulting integrated database enabled a comparative assessment of the determinants of housing market dynamics, with particular attention to the interplay between social, environmental, and demographic conditions. The variables included in the model, together with their acronyms, units of measurement, and data collection criteria, are described below.

1. Property prices *(Pc* and *Pp)*: measured in €/m^2, these represent the dependent variables of the study. In order to capture the dual structure of the urban housing market, the dataset distinguishes between the average price per square meter of apartments located in the city centre (Price City Center, Pc) and that of apartments located in peripheral areas (Price Periphery, Pp). This distinction is essential for testing whether environmental amenities exert differentiated effects according to urban location.

2. Cost of living (*C*): measured in euro, this variable is expressed through the indicator *"monthly costs for a single person, excluding rent"*. It is included as a control variable for purchasing power and the general price level in each city, thereby allowing the effects of the other independent variables to be isolated from the local inflationary context.
3. Quality of life (*Q*): this is a multidimensional index *"Quality of Life Index"* designed to estimate the overall quality of life in a city by considering several dimensions, including purchasing power, pollution, housing affordability, safety, healthcare quality, commuting time, and climate. Higher index values indicate better quality of life conditions. The inclusion of Q makes it possible to test the Consumer City hypothesis, assessing the extent to which overall urban well-being is reflected in real estate values.
4. Tree cover (*T*): measured as a percentage (%), this variable constitutes the key environmental indicator of the study. It serves as a proxy for the provision of urban green infrastructure and the ecosystem services delivered by the city, thereby enabling the quantification of the economic premium associated with natural amenities.
5. Population (*Pop*): the demographic dimension is introduced as a control variable for urban scale. It reflects both the pressure of potential demand and the agglomeration economies typically associated with large metropolitan areas.

Overall, the variables *Pc*, *Pp*, *C*, and *Q* were derived from Numbeo [31], *T* from the European Environment Agency [34], and *Pop* from Eurostat [35].

Table 1 reports the descriptive statistics of the variables considered in the analysis, calculated on the sample of 53 European cities. For each variable, the minimum value, maximum value, mean, and standard deviation (SD) are presented.

Table 1. Descriptive statistics of the variables

Variable	Min	Max	Mean	SD
Pc [€/m^2]	2,346.00	12,672.26	5,746.59	2,460.84
Pp [€/m^2]	1,077.32	8,599.05	3,536.09	1,566.55
C [€]	667.32	1,145.10	912.88	141.28
Q [no.]	115.90	213.10	170.93	27.30
T [%]	6.28	57.96	29.81	11.38
Pop [no.]	504,964.00	4,001,242.00	1,046,321.15	751,537.28

The data reported in Table 1 show that *Pc* has a mean value of 5,746.59 €/m^2 (SD = 2,460.84 €/m^2), with a minimum of 2,346.00 €/m^2 recorded in Palermo and a maximum of 12,672.26 €/m^2 observed in Paris. *Pp* exhibits a lower mean value of 3,536.09 €/m^2 (SD = 1,566.55 €/m^2), ranging from 1,077.32 €/m^2 in Genoa to 8,599.05 €/m^2 in Paris. *C* shows a mean of 912.88 € (SD = 141.28 €), with the lowest value registered in Sofia (667.32 €) and the highest in Amsterdam (1,145.10 €). *Q* has a mean value of 170.93 (SD = 27.30), with a minimum of 115.90 in Naples and a maximum of 213.10 in

Rotterdam. Regarding the environmental dimension, *T* records a mean value of 29.81% (SD = 11.38%), with values ranging from 6.28% in Zaragoza to 57.96% in Genoa. Finally, *Pop* presents a mean of 1,046,321.15 inhabitants (SD = 751,537.28), with a minimum of 504,964 in Lisbon and a maximum of 4,001,242 in Berlin.

Overall, the descriptive statistics suggest that the heterogeneity of the sample is most clearly reflected in the demographic and real estate dimensions. In the former case, the standard deviation of *Pop* is particularly high, reflecting the presence in the sample of cities that differ substantially in demographic size. In the latter case, greater variability emerges in *Pc*, which shows a higher standard deviation than that observed for *Pp* and, above all, for *C*. The latter variable instead displays a more contained distribution around its mean value, whereas *Q* and *T* occupy an intermediate position, indicating appreciable differences across cities, though less marked than those observed for *Pop* and for real estate prices.

The graphical analysis of the distributions, presented in Fig. 2, complements the synthetic information provided in Table 1 by offering a visual representation of data dispersion and the concentration of observations. These graphs are particularly useful for capturing the structure of the individual variables and for supporting a more in-depth interpretation of the differences across cities.

Figure 2 provides a graphical representation of the distribution of the variables included in the analysis. *Pc* is concentrated mainly between 4,000 €/m^2 and 8,000 €/m^2, with some observations above 10,000 €/m^2, whereas *Pp* is generally distributed between 2,000 €/m^2 and 4,000 €/m^2. *C* appears more compact, with most values lying between 700 € and 1,050 €, while *Q* is mostly clustered in the medium-high range of approximately 140–210. *T* is largely concentrated between 20% and 40%, whereas *Pop* shows the greatest asymmetry, with most cities below one million inhabitants and only a few observations reaching much higher values.

As required by the methodological protocol for multivariate regression models, the explanatory variables (*C, Q, T, Pop*) were subjected to a Min–Max normalization procedure. This transformation rescaled the original values to the [0, 1] interval, making the estimated β coefficients independent of their original units of measurement and allowing a direct comparison of the relative weight of each variable in shaping real estate prices. The normalization was performed according to Eq. 2:

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}} \# \tag{2}$$

By contrast, the dependent variables (*Pc, Pp*) were log-transformed, as discussed in Chap. 4.

6 Models

The multiple regression analysis performed on the study dataset produced two model specifications, corresponding to the two dependent variables considered: *Pc* and *Pp*. The estimated coefficients and their levels of statistical significance are reported in Tables 2 and 3.

The coefficient of determination of the two models are respectively 0.904 and 0.903. For both models, the *Student's t* test on the significance of the individual explanatory

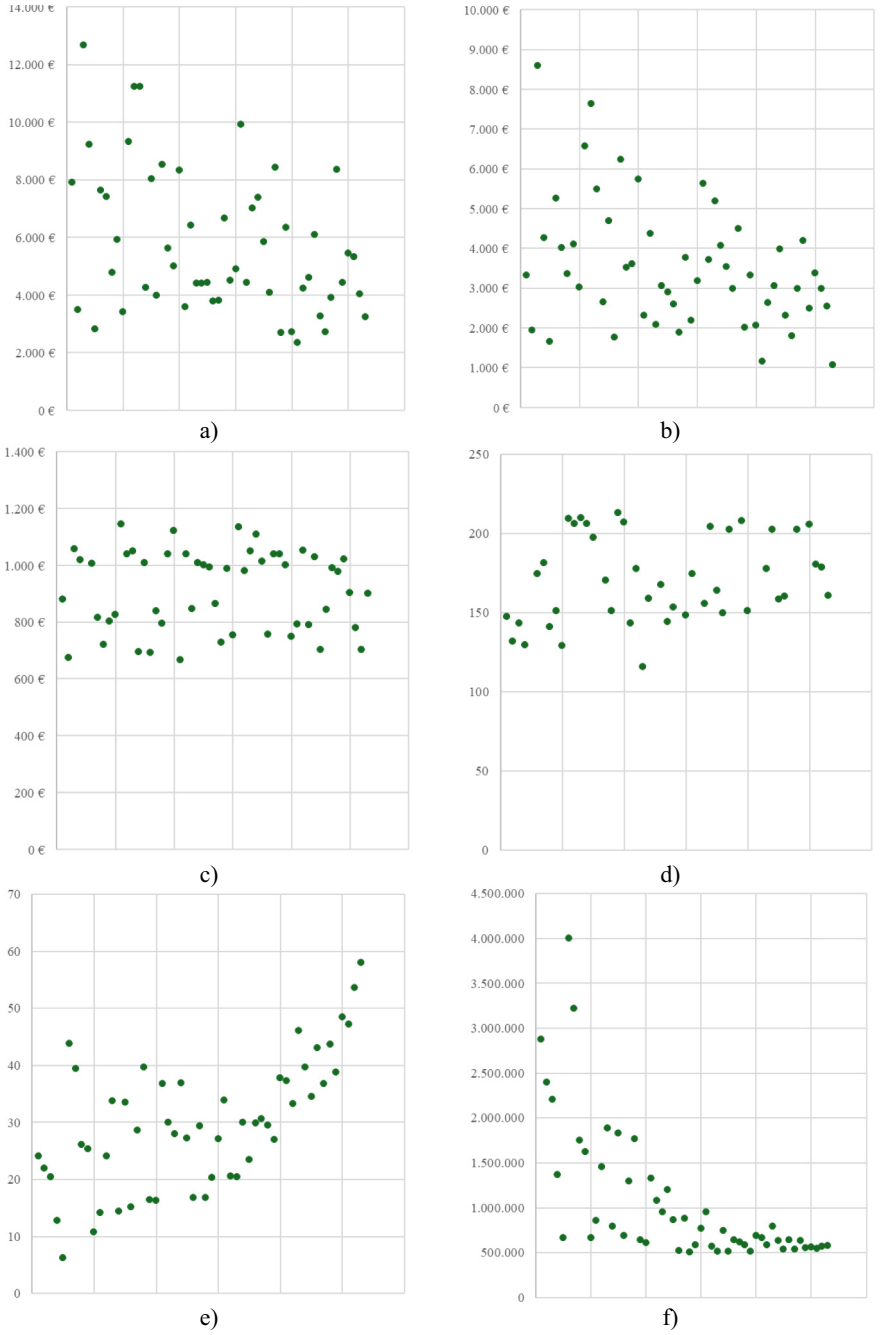

Fig. 2. Scatter plots of the variables included in the analysis: a) *Pc*, b) *Pp*, c) *C*, d) *Q*, e) *T*, and f) *Pop*. Source: authors' elaboration.

Table 2. Regression results on the sample for the center macro-area of the European metropolitan cities considered

Variable	Coefficient	Significance
Cost of living	4.606	***
Quality of life	4.023	**
Tree cover	5.945	***
Population	4.222	**

Notes: "***" is for <0.01, "**" is for <0.05, "*" is for <0.1.

Table 3. Regression results on the sample for the peripheral macro-area of the European metropolitan cities considered

Variable	Coefficient	Significance
Cost of living	4.300	***
Quality of life	3.961	**
Tree cover	5.416	***
Population	3.999	**

Notes: "***" is for <0.01, "**" is for <0.05, "*" is for <0.1.

variables indicates that all the variables offer a significant contribution to the explanation of the price. The F-Fisher test, performed at a confidence level of 95%, leads to the rejection of the hypothesis that the vector of the coefficients of the regression is zero. The standard error of the models is very good. The regression equation specification error tests, which reports any errors in the specification of the function adopted, the White test, relative to the absence of heteroskedasticity, and the Chow test, which verifies the existence of a structural break, have all p-values higher than 0.05, so that confirms the reliability of the two models. The values of the variance inflation factors (VIF) are all lower than 5, which endorse the absence of collinearity among the independent variables.

The estimated outputs give rise to several relevant considerations. In both models, tree cover emerges as the most influential variable in the formation of housing prices, followed by cost of living, population, and quality of life. These results suggest that, in large European cities, particular importance is attached to the environmental dimension, especially to the presence of urban greenery. At the same time, although quality of life is positively associated with property values, its influence appears slightly weaker than that of the variable linked to income and general purchasing conditions (cost of living) and that associated with potential housing demand (population).

Overall, the findings reveal a widespread and consolidated awareness of the strategic role played by urban green infrastructure in metropolitan contexts, particularly in relation to current environmental challenges such as the urban heat island effect [36]. By contrast,

factors contributing to the broader concept of quality of life appear to be less directly perceived in the housing market, despite their recognized importance. In this respect, the components underlying the Numbeo quality of life index — such as purchasing power, pollution levels, housing affordability, safety, healthcare quality, commuting time, and climate — seem to exert a more indirect effect on real estate values than the more immediately visible and spatially tangible contribution of urban tree cover.

7 Conclusions

The study conducted on a sample of 53 European metropolitan cities made it possible to outline a complex picture of the determinants of property values, offering relevant insights for urban governance and planning [37]. These results may also support property asset enhancement strategies based on the identification of suitable urban functions [38]. The research has investigated how liveability, interpreted through economic and environmental variables, is translated into market value, highlighting a hierarchy of parameters that reflects the priorities of residents and investors within the European context.

The overall analysis has shown that, in large cities, there is a clear sensitivity to the environmental quality. At the same time, it is noteworthy that the quality of life, considered in its broader multidimensional sense, appears to be slightly less influential than the variable associated with income conditions (Cost of Living) and that linked to demographic pressure (Population). The latter, in particular, continues to represent a major driver of housing demand, reflecting the persistent attractiveness of metropolitan centres despite the challenges affecting urban liveability. Overall, the results have revealed a widespread awareness of the importance of urban greenery — also in connection with the growing relevance of urban heat island issues — while the social and service-related factors embedded in the Quality of Life index appear to be less directly perceived in the housing market.

These findings also require further reflections on the composition of the indicators employed. The adopted Quality of Life index, based on Numbeo parameters, aggregates heterogeneous dimensions such as safety, healthcare, purchasing power, and pollution. Its comparatively lower statistical influence suggests that not all of its components weigh equally in housing decisions or in price formation [39]. This points to the need for future research to disaggregate this indicator in order to identify the individual components with stronger or weaker effects, which in turn requires an expansion of the database.

The study has also highlighted marked territorial disparities that urban planning cannot ignore [40]. Although tree cover emerges as a key factor in shaping property values, the data reveal critical contexts such as Rome, where tree cover remains particularly low compared with other European capitals. In such cases, housing demand may become disconnected from environmental quality, generating high-cost but low-liveability markets, with direct consequences for the long-term well-being of residents.

Within this framework, the issue of overtourism, already introduced in the opening sections, becomes especially relevant. The resilience of European cities depends on their capacity to protect the amenities that make them desirable. If green spaces and urban services become merely factors of valorisation for the tourism market or for elite

segments, there is a concrete risk of triggering displacement processes that progressively erode the residential function of cities.

In conclusion, the challenge for future urban policies lies in reconciling environmental enhancement with the social protection of quality of life. Only through a more granular monitoring of liveability factors and a management of tourism flows that does not undermine the residential market will it be possible to ensure that European metropolitan areas remain spaces of inclusion rather than mere arenas of speculation. A further line of research should therefore focus, on the one hand, on the construction of a broader dataset, and, on the other, on a more disaggregated examination of the variables underlying the Quality of Life index itself.

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