

Satisfaction with Urban Environment in European Cities: the role of city size, income, location, traffic congestion and pollution tolerance

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Abstract. Satisfaction with the urban environment is among the crucial elements of the quality of urban life. This study examines the results of the most recent wave of the Eurobarometer survey (year 2023), covering 83 European cities, to explore which city characteristics are associated with higher and lower perceived quality of different urban environment areas - air quality, noise levels, green spaces and city cleanliness. Our empirical results reveal that residents of larger European cities are less satisfied with urban environment, even when controlling for actual air pollution and other relevant city characteristics. Higher perceived quality of green spaces, as well as coastal city location (near a sea or major lake), is associated with higher satisfaction with air quality and urban noise conditions. Income level is positively associated with perceived quality of green spaces and satisfaction with city cleanliness. There is also a clear evidence that residents of southern European non-EU cities exhibit high tolerance towards air pollution - satisfaction with air quality in these cities is systematically higher than would be expected given actual air pollution and other relevant city characteristics such as city size, location and green spaces. We conclude that although environmental quality is likely to remain a natural advantage of smaller European cities, improvements in green spaces and reductions in traffic congestion could still generate non-negligible gains in urban environmental satisfaction irrespectively of city size.

Keywords: satisfaction with urban environment, air quality, noise level, green spaces, city size, traffic congestion, pollution tolerance.

Introduction

Raising urban well-being can be recognised as one of the top political priorities for local public administrations. In the literature, quality of urban life is connected to the words “smart city”, “sustainable city” and “urban development”. Although none of these terms have universal definition, urban well-being usually incorporates objective and subjective

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quality of life measures and is generally understood as people's experiences, perceptions and feelings within their living spaces (Senlier et al., 2009).

Satisfaction with the urban environment is one of the crucial elements of urban well-being. Particularly, life satisfaction tends to decrease in urban environments exhibiting pollution, congestion and noise (Grigolon et al., 2014). Studies employing spatial modelling techniques often find people are more satisfied with a landscape view (such as forest or river) than with traffic noise and traffic view (Hasegawa & Lau, 2022). These optic and audio features are important for overall well-being and particularly for mental health (Youssef et al., 2020). It could be one of the reasons why Europeans living in big cities or capital cities tend to be less happy (Piper, 2015; Loschiavo, 2021). Indeed, environmental pollution is among few negative externalities of population size and density which is common in large European cities (Keshavarzi et al., 2021). Although big city residents often are richer as well as enjoy better job opportunities, access to education and healthcare services (Goerlich & Reig, 2021; Nicolas-Martínez et al., 2024), this does not automatically mean higher life satisfaction (Okulicz-Kozaryn & Valente, 2019). That is why clean, authentic and unique environments, with an opportunity to maintain healthy lifestyle are among key non-economic advantages attracting many creative and well-educated people from the centres of multi-million megacities to small cities or even suburbs (Selada et al., 2012).

Cities with shrinking population nowadays are not uncommon in Europe. There is a consensus in the literature that economic development alone (accompanied with inflow of investments and job creation) cannot prevent depopulation of cities. Hospers (2014) argues that improving urban life quality for the current city residents is the most sustainable and suitable strategy to prevent further population decline. In turn, Haase et al. (2021) names environmental upgrading among the key factors of creating more attractive living conditions when aiming to achieve urban regrowth. Indeed, living in a pleasant environment can make people feel happier (Lopez-Ruiz et al., 2019).

The goal of this study is to find out which city characteristics are associated with higher or lower satisfaction with the urban environment in the European cities. Urban environment satisfaction data explored in this study comes from the most recent wave of the Eurobarometer survey (year 2023) on the quality of life covering 83 European cities. The following four urban environment areas are considered – quality of the air, noise level, green areas and city cleanliness. We build several multifactor regression models to link each of these urban environment areas with various city characteristics such as city size, income, location, air pollution, population density, traffic congestion and the capital city status.

Three hypotheses are tested:

H1: Residents of larger European cities are less satisfied with urban environment even after controlling for actual air pollution and other relevant city characteristics.

H2: Coastal city location (near a sea or major lake) is associated with higher urban environment satisfaction even after controlling for actual air pollution, city size and other relevant city characteristics.

H3: Pollution tolerance is high in some European cities, which is reflected in significantly higher urban environment satisfaction than would be expected given the actual pollution levels and other relevant city characteristics.

The contribution of this article to the literature is that we formally test simultaneous effect of several city characteristics on perceived quality of urban environment (while differentiating four separate urban environment areas – air quality, noise level, green spaces and city cleanliness), by employing multifactor regression analysis method to the most recent wave of the Eurobarometer survey on the quality of life.

The remaining part of this paper is structured as follows. Section 1 reviews the literature, Section 2 discusses Eurobarometer survey data as well as the data analysis methods employed in this study, while Section 3 presents empirical results and discussion.

Literature review

Most Europeans live in cities. Air pollution, high noise levels and crowdedness are among the factors negatively affecting health, life expectancy and overall life satisfaction of urban residents.

Particularly, air pollution in European cities costs about 50 thousand lives every year, with the highest mortality burden recorded in Poland, Czechia and the Northern Italy (Khomenko et al., 2021). Big cities usually are more exposed to air pollution, which is often related to heavy traffic, particularly in Czechia (Brani & Linhartova, 2012). Apart from private car transport congestions, high air pollution in some European cities can reflect still insufficient use of renewable energy in production and heating (Karpinska & Smiech, 2020; Gara et al., 2024). Air pollution negatively relates with life satisfaction in Europe, with especially large health costs coming from small particulate matters in the air (Rodriguez-Alvarez, 2021). Self-reported life satisfaction also tends to be lower in those European countries exhibiting higher sulphur dioxide concentrations in the air (Ferreira et al., 2013). Moreover, the impact of air pollution on life satisfaction can be stronger in countries with higher income inequality, possibly reflecting a segregation of low income households to heavily polluted areas (Jorgenson et al., 2021).

The majority of European urban population is exposed daily to undesirably high level of noise (Lawrence, 2013). Urban noise pollution in Europe, mostly from road traffic, costs about 12 thousand lives every year. Traffic noise can lead to stress reactions contributing to cardiovascular diseases, obesity, diabetes, breast cancer, decreasing birth rates and mental disorders (Veber et al., 2022; Dzambas et al., 2024).

A destructive impact of air pollution and high noise levels might not be recognised in full, particularly in lower-income societies. At low income levels, environmental problems are not among key priorities and often regarded as a by-product of faster economic growth bringing higher employment and business dynamism, in line with the pollution haven hypothesis (Beka et al., 2024). For instance, even many Central and Eastern European citizens have too high tolerance towards urban air pollution (Chiarini et al., 2021). Environmental dimension might be still unappreciated by many European citizens, compared to the economic and social

quality of life dimensions (Lopez-Ruiz et al., 2019). Indeed, higher socio-economic status tends to increase ecological awareness of residents – with biodiversity and ecology being more important for richer and more educated respondents (Hardi et al., 2024).

Green space is one of the powerful tools to reduce air and noise pollution in a city (Giannico et al., 2021). Public parks can also encourage physical activities and social interactions. Besides, natural environments can reduce mental distress by helping to relax and providing a mental escape (Bahr, 2024). Therefore, public green spaces in cities may generate positive externalities by improving health of urban residents as well as raising environmental quality and city's attractiveness (Coisnon et al., 2024). Particularly, close and accessible green spaces reduce an incidence of cardiovascular diseases, obesity and overall mortality. Access to green spaces can decrease anxiety, while improving social interaction and cohesion. Some European cities could significantly decrease mortality rate simply by complying with the World Health Organization recommendations regarding an access to green spaces (Barboza et al., 2021). The ability of green spaces to benefit people and improve urban quality of life crucially depends not only on their quantity, but also quality, design and location (Hardi et al., 2024). However, green urban areas are usually constrained due to very limited and expensive space in cities (Bahr, 2024).

Data and methods

We apply multifactor regression analysis to explore which city characteristics are associated with higher or lower satisfaction with urban environment. Our dependent variables represent satisfaction with four urban environment areas – air quality, noise level, city cleanliness and green spaces. In turn, independent variables or regressors consist of actual quality of urban environment and other relevant city characteristics. For instance, for the case of three regressors, equation takes the following form:

$$S = b_0 + b_1 \cdot F_1 + b_2 \cdot F_2 + b_3 \cdot F_3 + \varepsilon$$

where S is satisfaction with a particular urban environment area.

F_1 , F_2 and F_3 – regressors representing actual quality of urban environment and various city characteristics;

b_0 , b_1 , b_2 and b_3 – parameters to be estimated.

ε – error term.

Dependent variables: perceived quality of urban environment

Our measure of perceived quality of urban environment comes from the most recent wave of the Eurobarometer survey on the quality of life in European cities. This survey takes place every four years. Last time (in 2023) it covered 83 European cities - mainly located within the European Union, but also in the United Kingdom, Norway, Switzerland, Iceland, Turkey and Balkan countries. From 800 to 900 respondents were surveyed in each city. Respondent-specific weights were applied to ensure a sample representative of the general population in a given city by age and gender (as well as education level at the NUTS-2 region level).

Eurobarometer survey contains about 50 questions on satisfaction with different urban quality of life areas, such as safety, infrastructure, city governance and many others. Four of these questions are related to urban environment, and therefore are the focus of this study. Particularly, respondents rated their satisfaction using a 5-point Likert scale (from very satisfied to not at all satisfied) to rate their satisfaction with quality of the air, noise level, green spaces and city cleanliness.

While survey data directly observes urban environmental well-being, it has several limitations. First, survey data reflect the subjective perception of the respondents relative to an imagined ideal situation. Individuals may have different interpretations of this ideal, and it is subject to change. For example, a decline in perceived air quality might be driven by reduced tolerance for urban air pollution rather than an actual decline in air quality. Second, there is no precise definition of what the satisfaction with, for instance, “green spaces such as parks and gardens” really entails. It could measure the quantity, subjective quality, design, safety, location, availability, ease of access to green spaces or some combination of these or other factors. Therefore, a response to this question may reveal satisfaction also with other urban quality of life areas such as physical safety, general infrastructure or even public transport services. The inability to distinguish these effects is important limitation of this research.

We create one variable for a given environmental quality area in a given city. This transformation is in line with Okulicz-Kozaryn and Valente (2019). The respective variable ranges from a theoretical 0, when all respondents are very unsatisfied, to 100, when all respondents are very satisfied. A usual caveat applies: this approach intrinsically assumes the same distance between Likert scale points, which may not always be the case. One could create alternative variable reflecting satisfaction with, for instance, quality of the air, by counting only the share of those respondents who are “very satisfied”, “very or rather satisfied” or “very or rather dissatisfied”. These alternative variables, however, have their own drawbacks. For instance, the share of respondents which are “very or rather satisfied” does not distinguish neither between “very satisfied” and “rather satisfied”, nor between “very unsatisfied”, “rather unsatisfied” and “no answer”, which is a significant information loss. Therefore, we believe that the balance of replies employed in this study is adequate way to measure satisfaction with urban environment at the city level.

Independent variables: actual quality of urban environment and city characteristics

This study employs several sources of hard data on the quality of the urban environment in European cities. We use IQAir air pollution data to control for the actual quality of the air in a city. IQAir collects data from air monitoring stations around the globe and publishes an index which reflects PM2.5 concentration in the air, with larger values indicating more severe air pollution. Actual urban noise levels are reflected by the share of urban inhabitants exposed to unhealthy road traffic noise, published by the European Environmental Agency. In turn, the quantity of green spaces is represented by the share of green, natural and agricultural spaces in city land area, published by Eurostat.

Similarly to survey data, hard data on the urban environment also have important limitations. For instance, air pollution data are significantly affected by the location of monitoring stations and weather conditions. In turn, data on the quantity of green spaces are not available for many cities in our sample, as they are reported for only 34 out of 83 cities.

The list of other city characteristics employed in this study includes city size (proxied by population), population density (the number of city residents per km²), average income level in a city (measured as gross domestic product per capita, purchasing power parity adjusted, expressed as a percentage of the European Union average), as well as dummy variables representing capital city status and coastal city location (near a sea or a major lake). Moreover, traffic congestion is measured as the average additional time (in percent) lost in traffic within a given metropolitan area, compared to driving under free-flow conditions (TomTom data).

Descriptive statistics for all variables used in this study is summarized in Table 1.

Table 1. Descriptive statistics of the variables used in this study

Variable	Mean	Standard deviation	Minimum value	Maximum value	Data availability (number of cities)
Satisfaction with air quality	56.0	14.7	15.2 (Skopje)	80.4 (Rostock)	83
Satisfaction with noise level	57.4	10.4	33.5 (Tirana)	73.1 (Oulu)	83
Satisfaction with green areas	68.6	12.4	13.4 (Naples)	85.1 (Malmo)	83
Satisfaction with city cleanliness	55.0	13.6	11.7 (Palermo)	82.5 (Luxembourg)	83
Air pollution index	11.0	4.2	3.9 (Reykjavik)	24.6 (Skopje)	83
Share of people exposed to unhealthy road traffic noise (%)	43.4	15.6	13.5 (Valletta)	89.8 (Lefkosia)	68
Share of green, natural and agricultural spaces (% of area)	52.2	18.6	22.7 (Paris)	86.4 (Aalborg)	34
Population (thousand)	1339	2315	113 (Piatra Neamt)	15660 (Istanbul)	83
Population density	534	522	50 (Burgas)	2539 (Naples)	68
GDP per capita	114	46	31 (Diyarbakir)	273 (Dublin)	83
Capital city	0.41	0.49	0	1	83
Coastal location	0.52	0.50	0	1	83
Traffic congestion	27.1	6.8	13 (Malmo)	46 (Bucharest)	70

Source: author's elaboration based on Eurobarometer, Eurostat, UK National Statistics Office, IQ Air, European Environmental Agency and TomTom data.

Empirical results and discussion

Tables 2-5 show multifactor regression results linking the perceived quality of the urban environment in 83 European cities (satisfaction with air quality, noise level, green spaces and city cleanliness) with various city characteristics. To test the robustness of the results,

we add regressors one by one and examine whether the sign and statistical significance of the coefficients change as additional regressors enter the equation. The results presented in the tables below are robust – both the sign and the statistical significance of the coefficients do not change when other regressors are added to or dropped from the equation.

We document a negative link between actual air pollution, measured by air monitoring stations, and satisfaction with air quality in a given city. While this result is robust to econometric specification and statistically significant at least at the 1% level, the relationship is far from perfect, implying that actual air pollution is not the only determinant of air quality satisfaction in European cities (Table 2).

Table 2. Relationship between the satisfaction with air quality and different city characteristics (83 European cities; in 2023)

	Model 1	Model 2	Model 3	Model 4	Model 5
Actual air pollution	-2.11*** (0.31)	-1.33*** (0.33)	-1.35*** (0.30)	-1.10*** (0.32)	-1.69*** (0.32)
Green spaces satisfaction		0.51*** (0.11)	0.47*** (0.10)	0.51*** (0.10)	0.54*** (0.09)
Population			-3.98*** (1.02)	-3.62*** (1.01)	-4.40*** (0.94)
Coastal				4.65** (2.33)	4.77** (2.10)
South non-EU					16.00*** (3.74)
Constant	79.22*** (3.71)	35.65*** (9.86)	92.20*** (17.07)	79.01*** (18.01)	92.22*** (16.58)
R2	0.36	0.50	0.58	0.60	0.68
Observations	83	83	83	83	83

Notes. ***, ** and * reflect statistical significance at the 1%, 5% and 10% significance level respectively. Standard errors are in parentheses. Dependent variable is satisfaction with air quality (index; 0-100 point scale). Population enters equation in natural logarithms. Coastal is a dummy variable with values 1 if a city is located near a sea or a major lake, and 0 otherwise. South non-EU is a dummy variable with values 1 if a city is located in a Southern European country which is not a member of the European Union, and 0 otherwise.

Source: author's elaboration based on Eurobarometer survey, Eurostat and UK Office for National Statistics data.

Our results confirm a negative relationship between the perceived quality of the urban environment and city size. Residents of larger European cities exhibit lower satisfaction with all areas of urban environment (air, noise, green areas, cleanliness) and this effect is statistically significant at least at the 1% level even after controlling for other relevant city characteristics. The negative effect of city size on urban environmental well-being is well in line with the literature (for, instance, see Loschiavo (2021) and Keshavarzi et al., 2021).

Our results also confirm the role of green spaces in reducing air and noise pollution (in line with Giannico et al., 2021). Satisfaction with green spaces is associated with

higher satisfaction with air quality and noise level at the 1% statistical significance level (Tables 2 and 3). Moreover, we find that a coastal city location (near a sea or a major lake) is associated with higher satisfaction with air quality and noise level. This effect is statistically significant at least at the 5% level.

Table 3. Relationship between the satisfaction with noise level and different city characteristics (83 European cities; in 2023)

	Model 1	Model 2	Model 3
Population	-4.77*** (0.95)	-3.94*** (0.55)	-3.61*** (0.51)
Green spaces satisfaction		0.61*** (0.05)	0.61*** (0.04)
Coastal			4.46*** (1.08)
Constant	121.42*** (12.85)	68.79*** (8.48)	61.90*** (7.92)
R2	0.24	0.75	0.79
Observations	83	83	83

Notes. ***, ** and * reflect statistical significance at the 1%, 5% and 10% significance level respectively. Standard errors are in parentheses. Dependent variable is satisfaction with noise level (index; 0-100 point scale). Population enters equation in natural logarithms. Coastal is a dummy variable with values 1 if a city is located near sea or major lake, and 0 otherwise.

Source: author's elaboration based on Eurobarometer survey, Eurostat and UK Office for National Statistics data.

There is a clear indication that Southern European non-EU cities have a high tolerance toward air pollution. Satisfaction with air quality in these cities is systematically higher than would be expected given actual air pollution and other city characteristics such as city size, location and green spaces; this effect is statistically significant at the 1% level (Table 2). While this finding is broadly in line with the literature (Beka et al., (2024), Lopez-Ruiz et al., 2019), contrary to Chiarini et al. (2021) we do not find a high tolerance toward air pollution in Central and Eastern European (CEE) cities. This may point to growing awareness of CEE residents of how detrimental air pollution is to health.

We also do not find evidence that tolerance toward a poor urban environment decreases with income level. In fact, GDP per capita is positively associated with the perceived quality of green spaces and satisfaction with cleanliness (Tables 4 and 5). This may reflect a situation in which higher GDP per capita translates into higher tax revenues per capita, which in turn provide greater resources for local authorities to maintain green spaces in adequate quantity and quality. This result also implies that higher GDP per capita, through advances in green spaces, can indirectly raise satisfaction with air quality and noise level. This finding is in line with the environmental Kuznets curve hypothesis, according to which at medium-to-high income levels further economic growth can improve environmental quality.

Although residents of Southern European non-EU cities tend to be more satisfied with city cleanliness than would be expected given city characteristics, this effect is only at the borderline statistical significance (Table 4).

Finally, residents of capital cities tend to have lower satisfaction with green areas and cleanliness, even after controlling for other city characteristics (Tables 4 and 5). This result is likely to reflect urban congestion effects. In particular, capital cities may have more limited and expensive space, which constraints the quantity of parks (Bahr, 2024). Empirically we find that residents living in cities with higher population density and traffic congestion are less satisfied with green areas and cleanliness.

Table 4. Relationship between the satisfaction with cleanliness and different city characteristics (83 European cities; in 2023)

	Model 1	Model 2	Model 3	Model 4	Model 5
Population	-4.61*** (1.33)	-6.17*** (1.28)	-5.57*** (1.31)	-6.35*** (1.36)	-6.10*** (1.76)
GDP per capita		13.05*** (3.31)	14.61*** (3.38)	18.11*** (3.81)	18.75*** (4.19)
Capital city			-5.09* (2.86)	-6.09** (2.87)	
South non-EU				8.91* (4.74)	
Population density					-3.67* (1.93)
Traffic congestion					-0.46** (0.22)
Constant	116.93*** (17.88)	77.11*** (19.32)	63.83*** (20.47)	57.50*** (20.43)	83.07*** (24.87)
R2	0.13	0.27	0.30	0.33	0.47
Observations	83	83	83	83	62

Notes. ***, ** and * reflect statistical significance at the 1%, 5% and 10% significance level respectively. Standard errors are in parentheses. Dependent variable is satisfaction with cleanliness (index; 0–100 point scale). Population, population density and GDP per capita enter equation in natural logarithms. Traffic congestion level is the average additional time (in percent) lost in traffic within a respective metropolitan area, compared to driving in free-flow conditions. South non-EU is a dummy variable with values 1 if a city is located in a Southern European country which is not a member of the European Union, and 0 otherwise. Similarly, capital city is a dummy with values 1 and 0. Different number of observations reflect unavailability of traffic congestion and population density data for some cities.

Source: author's elaboration based on Eurobarometer survey, Eurostat and UK Office for National Statistics and TomTom data.

Table 5. Relationship between the satisfaction with green areas and different city characteristics (83 European cities; in 2023)

	Model 1	Model 2	Model 3	Model 4
GDP per capita	0.28*** (0.10)	0.39*** (0.10)	0.40*** (0.09)	0.46*** (0.10)
GDP per capita squared (*1000)	-0.55 (0.35)	-0.87** (0.34)	-0.80** (0.32)	-0.95*** (0.32)
Population		-3.82*** (1.15)	-2.81** (1.12)	
Capital city			-7.90*** (2.41)	-6.38*** (2.32)
Population density				-6.27*** (1.23)
Traffic congestion				-0.41*** (0.15)
Constant	44.89*** (6.47)	88.48*** (14.43)	76.53*** (14.10)	80.92*** (8.63)
R2	0.25	0.35	0.43	0.58
Observations	83	83	83	62

Notes. ***, ** and * reflect statistical significance at the 1%, 5% and 10% significance level respectively. Standard errors are in parentheses. Dependent variable is satisfaction with green areas (index; 0-100 point scale). Population and enters equation in natural logarithms. Capital city is a dummy with values 1 and 0.

Source: author's elaboration based on Eurobarometer survey, Eurostat and UK Office for National Statistics data.

We do not find a statistically significant relationship between the satisfaction with noise level and the share of urban inhabitants exposed to unhealthy road traffic noise, therefore the latter variable was not included in table 2. Also, we do not find any relationship between the satisfaction with green areas and the actual quantity of green spaces in a city (therefore the latter variable was not included in table 4). Although this result is based on a limited sample of cities (quantity of green spaces is available for less than half of cities in our sample), it is in line with the literature emphasizing the crucial role of quality, design and location of green spaces (Hardi et al., 2024).

One should be careful in interpreting empirical results of this article as a causal inference. The fact that two things happen together (e.g., cities exhibiting higher satisfaction with green spaces also tend to show higher air quality and noise satisfaction) does not necessarily mean that former causes the latter. Researchers aiming to determine true cause-and-effect relationships from data should go beyond regression analysis techniques performed in this study. The inability to make a causal inference is important limitation of many social science studies, and this research is not an exception.

Several other possible directions for further research could be identified.

First, note that some relevant city characteristics were not available for many European cities. For instance, share of green, natural and agricultural spaces is published by Eurostat with a substantial time lag (the most recent data corresponds to 2012-2014) and

is not available for majority of cities in our sample. One possible research direction could be the use of satellite or Google maps data to estimate the current share of green, natural and agricultural spaces in cities.

Second, one may explore the time dimension of the potential determinants of satisfaction with urban environment in European cities by employing panel data regressions. However, the small number of time periods (the Eurobarometer survey runs once every four years and data are available only since 2006) may limit the opportunity to establish a casual relationship even in a panel data setup.

Third, the reasons for urban environment satisfaction can be explored at the individual respondent level. Note, however, that also in this case several relevant variables will not be observed. For instance, respondents' income is not included in the Eurobarometer survey and thus should be proxied by other factors.

Conclusions

This study employs multifactor regression analysis to examine which city characteristics are associated with higher or lower perceived quality of the urban environment – in particular, satisfaction with air quality, noise level, green spaces and city cleanliness – in 83 European cities included in the most recent wave (year 2023) of the Eurobarometer survey on quality of life.

Our empirical results imply a negative relationship between the perceived quality of the urban environment and city size. Residents of larger European cities exhibit lower satisfaction with all dimensions of the urban environment (air, noise, green areas, cleanliness), and this effect is statistically significant at least at the 1% level even after controlling for other city characteristics such as actual air pollution, city location and urban congestion effects. Thus, our first hypothesis is confirmed.

We find that a coastal city location (near the sea or a major lake) is associated with higher satisfaction with air quality and noise level. This effect persists after controlling for other city characteristics and is statistically significant at least at the 5% level. However, coastal city location has no significant effect in satisfaction with city cleanliness and green spaces. Therefore, our second hypothesis is confirmed partially.

The empirical results of this study also indicate that Southern European non-EU cities exhibit a high tolerance toward air pollution. Satisfaction with air quality in these cities is systematically higher than would be expected given actual air pollution and other relevant city characteristics such as city size, location and green spaces; this effect is statistically significant at the 1% level. We also find similar effect for city cleanliness, although it is smaller in magnitude and only of borderline statistical significance. We do not find a pollution tolerance effect for satisfaction with noise levels and green spaces. Thus, our third hypothesis is also partially confirmed.

Furthermore, this study formally demonstrates the role of urban green spaces in mitigating air and noise pollution. Satisfaction with green spaces in a city is associated with higher satisfaction with air quality and noise level at the 1% statistical significance level.

Moreover, residents of capital cities and cities with stronger congestion effects (measured by population density and transport congestion) report lower satisfaction with green spaces and city cleanliness.

We also show that cities with higher GDP per capita tend to exhibit higher satisfaction with green spaces and city cleanliness. This result implies that higher GDP per capita, through improvements in green spaces, can indirectly raise satisfaction with air quality and noise level. This finding is in line with the environmental Kuznets curve hypothesis, according to which at medium-to-high income levels (as currently observed in European cities) further economic growth can improve environmental quality.

Overall, although environmental quality is likely to remain a natural advantage of smaller European cities, improvements in green spaces and reductions in traffic congestion could still generate non-negligible gains in urban environmental satisfaction irrespectively of city size.

Policy recommendations

- Policy makers should acknowledge the significant health costs associated with urban environmental pollution, particularly in cities where quality of the urban environment is still low.
- Economic growth is one of the tools to improve urban environmental quality in European cities, in line with the environmental Kuznets curve hypothesis.
- Environmental quality is likely to remain the natural advantage of smaller European cities. However, development of green spaces and reductions of traffic congestion could still bring a non-negligible improvement of urban environmental satisfaction irrespectively of the city size.

Data Availability Statement

All data will be made available upon reasonable request.

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