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Urban regeneration VS residential property characteristics: which is the most influential on property values?

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Abstract

Urban regenerations have always been a tool towards the improvement of the urban environment through environmental integration and thereafter the quality of life of citizens. However, all regenerations do not have the same success and impact on the surrounding properties. In this paper, two major urban regenerations of Thessaloniki, the second largest city of Greece, are studied through the scope of their effect on property values in combination with the analysis of the effect of traditional property characteristics on values. This study was necessary to fill the gap of determining that sustainable urban planning and environmental integration are nowadays proven more important than property characteristics, when population gathering in urban areas is at its highest point. The current study applied geographically weighted regression, spatial autocorrelation and hot-spot analysis through the environment of ArcGIS to determine which are the factors that citizens seek in their residential area and if these factors are more important than their property characteristics. The findings of the study indicate that citizens always seek for additional urban green and urban quality even in areas where the urban environment is already at a very good level. The difference appears in the fact that in areas where urban green or open spaces are upsent, the weight leans on the characteristics of the wider area and its citizens (socio-economic characteristics, habits etc.) rather than on the property characteristics, when determining property values. On the other hand, citizens living in areas with urban green and open spaces, move a step forward and seek for larger and more friendly green or regenerated areas as a counterpoint for already increased property values. In general, the result of this research underlines that a targeted urban planning for each sub-area is one of the keys toward property values stabilization against economic variations and towards the improvement of the quality of citizens' lives through environmental integration. Therefore, decision makers and urban designers should take into account all different needs of the citizens in each area setting the goal of maximum possible urban sustainability and resilience and the minimum environmental degradation.

Keywords Urban regeneration · Property values · Property characteristics · Thessaloniki

Introduction

Oswald Spengler's concept emphasizes the profound influence of human activity on shaping cities, underscoring that we not only inhabit these environments but also actively shape them. While Spengler's era did not witness the complexities of today's urban landscapes, his idea resonates with the contemporary challenge of balancing urban development with environmental sustainability.

In light of existing urban infrastructure, complete overhauls are often impractical. Thus, the imperative shifts toward preserving, revitalizing, and augmenting open and green spaces within urban areas. Urban regeneration initiatives target specific zones within cities, aiming to create or enhance public and private spaces, both structured and unstructured.

In essence, Spengler's insight underscores the evolving relationship between humans and their built environment, necessitating a proactive approach to integrating nature and sustainability into urban landscapes through targeted interventions.

Taking into account that urban regenerations take place within the built environment, they tent to affect characteristics of the buildings as well. Apart from the general idea of creating class A (buildings of superior construction within their market, minimum environmental footprint, impeccable aesthetics, top-notch infrastructure, professional management and strategic location) residential, commercial and office buildings especially in areas with a high standard of urban environment, characteristics such as property values are affected significantly. The increase of the quality of life is achieved with the aesthetic and functional upgrade offered by urban regenerations and infrastructures, the higher levels of security, the attraction of new land uses and the increased attractiveness of the area (Mariotti and Riganti 2021). The upgraded environment leads to the attraction of new social groups and the increase in demand for residential, commercial and office real estate. Increased land and property values are natural consequences of increased demand and improved urban environments, leading to increased building activity to meet demand (Cho et al. 2020; Zheng et al. 2020). It must be mentioned that safety and security issues are difficult to translate in numbers and, therefore, the increase or decrease of criminality through citizens' everyday experience is documented and quantified so as to enter the models. Moreover, on qualitative basis, through the interviews and questionnaires many citizens responded their own sense of security/insecurity to the interviewers making it more clear to comment on the effects of a regeneration at such empirical level.

Thessaloniki is the second largest urban area in Greece and the largest urban area in Macedonia in Northern Greece (Fig. 1). Two urban regenerations were studied within Thessaloniki. The regeneration of Rotonda of the Municipality of Thessaloniki and the regeneration of the pedestrian area of Kalamaria of the homonymous Municipality. It is estimated that the percentage of green per person of the municipality district A, where Rotonda belongs, reaches 3.53 m^2/prs (including the Aristotle University of Thessaloniki) and of the municipality of Kalamaria 2.19 m^2/prs (Ganatsas et al. 2002). Both regenerations included improvement in existing green areas, lighting and installation for people with disabilities, increase in urban green and open spaces, if possible, and increase in the general aesthetic attractiveness of each area.

In particular, Rotonda area was upgraded through the reduction of illegal parking, the increase of urban green, the improvement in infrastructure materials and condition and the creation of a unified walking network connecting the archeologic monument of Rotonda with the sea. Unfortunately, due to a long-term gathering of illegal activity in the area (drugs, illegal trade etc.), the regeneration had little success in decreasing these phenomena. Mainly rental property values rest stable due to the proximity to the University and the increased demand in small apartments for students.

Kalamaria has always been a residential municipality with good urban design mostly in recently built areas, where property values documented a significant stability even during the economic crisis. Regarding the demand, commercial and professional properties on both main streets of the regeneration document great demand,
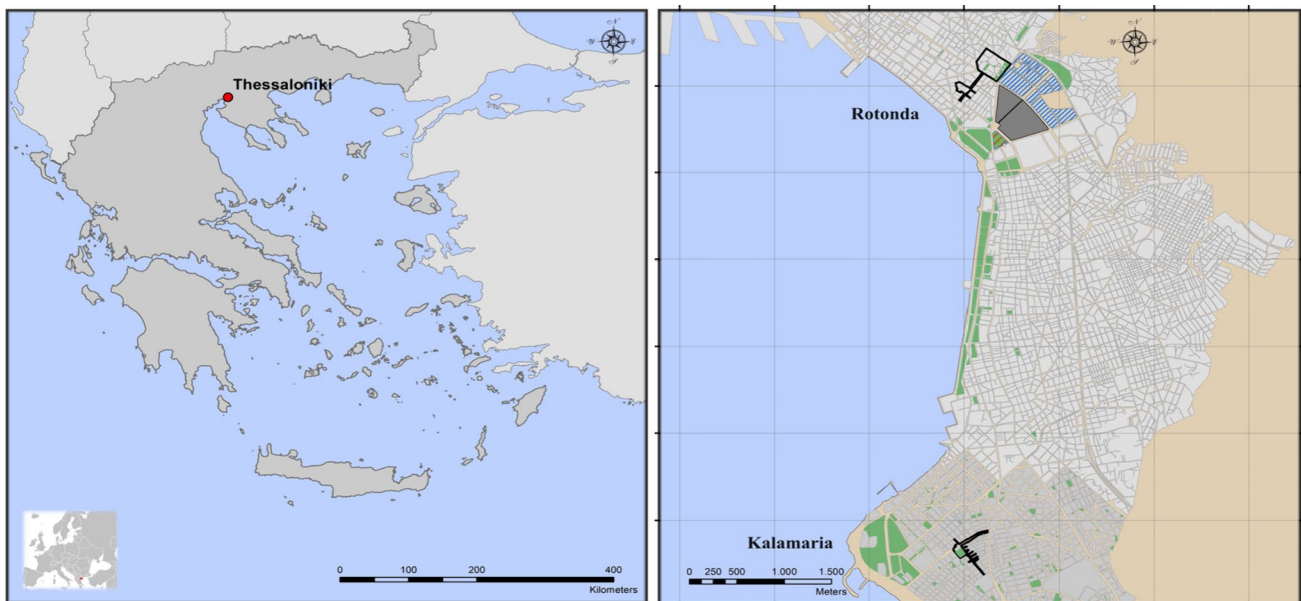

Fig. 1 Thessaloniki within Greece (left) and the regenerations (black line area—right) in study. The Municipality of Thessaloniki (light gray) and the Municipality of Kalamaria (dark gray)

whereas residential properties retain their demand almost all over the municipality.

Although many studies have been reported regarding the investigation of the influence of regenerations on surrounding values (Noor et al. 2015; Bottero et al. 2022; Liu et al. 2023; Kang et al. 2023), there is lack concerning the comparison of this influence with the impact that other characteristics have on property values, so as to determine if these regenerations play such a crucial role or if they are just an additional secondary influential factor. This study was necessary to fill the gap of determining that sustainable urban planning and environmental integration are nowadays proven more important than property characteristics, when population gathering in urban areas is at its highest point. A primary documentation of the factors influencing property values will be presented and, afterward, through the analysis of these factors, it becomes clear whether and why each factor influences values. Through this documentation, it will become clear whether urban regenerations influence values regardless of each property's unique characteristics and, consequently, whether sustainable urban development has become a necessity or is just an overestimated idea.

Materials and methods

Theoretical approach

During the rapid urbanization period of 1970–1990 in Greece, cities underwent significant growth without adhering to comprehensive urban planning principles or considering environmental factors. This resulted in a landscape dominated by densely packed buildings, traffic congestion, and pollution, with limited green spaces. Urban planning primarily focused on meeting housing demands and supporting the tertiary sector, often at the expense of open areas and greenery. Nowadays, Greek cities, particularly their historic cores, reflect this hasty development with crowded streets, polluted air, and scarce greenery. The lack of open spaces diminishes their ability to regulate microclimates, provide comfort to residents, and support economic activities.

To understand the impact of urban regeneration on real estate values, a multidimensional approach is necessary. This includes analyzing how factors such as urban greenery, aesthetic improvements, parking availability, and socioeconomic demographics influence property prices. However, it is essential to isolate these factors from broader economic forces to accurately assess their effects. This article employs such integrated variables to evaluate the way two urban regenerations influence real estate values (Fig. 2).

Study area

The central urban fabric of Thessaloniki followed the Ernest Hébrard Plan (approved in 1921), which gave most of the city's aesthetic, environmental and urban characteristics, with the only exception being the city's waterfront, which took its basic form in 1970 (Adamogiannis et al. 2006). Similarly, the area of Kalamaria began to take shape with the movement of the Jewish population after the 1917 fire from the city center and with the arrival of the first Caucasians, the refugees of the Asia Minor catastrophe in 1920–1922, and the Pontians (Ioannidou and Rodrigez, 1998). Subsequent changes in open and green spaces were made through urban regenrations.

Rotonda regeneration

The project of 'The regeneration of the surrounding area of Rotonda' was incorporated into the Regional Operational Program of Central Macedonia with a budget of €1,676,000 and was completed in 2005. This area encloses significant historical monuments such as the Rotonda, the Arch of Galerius, the Church of Saint George, etc. The total area of the regeneration is approximately 25,000 sq.m., of which 5500 sq.m. are green spaces. Simultaneously, the roads within the regeneration area were reformed, and a new underground electricity supply network was constructed, which was connected to two new distribution panels. The regeneration included the aesthetic improvement of outdoor spaces and roads within the area aiming at the provision of more public space for pedestrians and tourists visiting the monuments. It is noteworthy that part of the interventions were carried out under the guidance of the Ephorate of Antiquities of Thessaloniki City (Municipality of Thessaloniki 2015).

The main characteristics of the area include excessive urbanization, inconsistency of open spaces, and traffic problems. The wider area of Rotonda is characterized by a dense network of buildings, which in specific areas is prohibitively dense. In addition, inadequate planning regarding parking spaces exacerbates the traffic problems for vehicles and pedestrians. The narrowness of the streets, except for the major roads, makes natural ventilation and sunlight penetration difficult for all floors of buildings, reinforcing the phenomenon of the urban heat island.

The prevailing uses in the study area are commercial and office spaces, followed by residences. On the ground floors, mezzanines, and semi-basements of buildings, commercial and recreational uses are found, while offices are located on higher floors. Residences are usually found on the upper floors. During the last 5 years, there was an intense increase in demand for commercial properties, leading to a reduction in vacant spaces and an increase in rental yields reaching 6.5–7.5%, as the area belongs to the commercial and
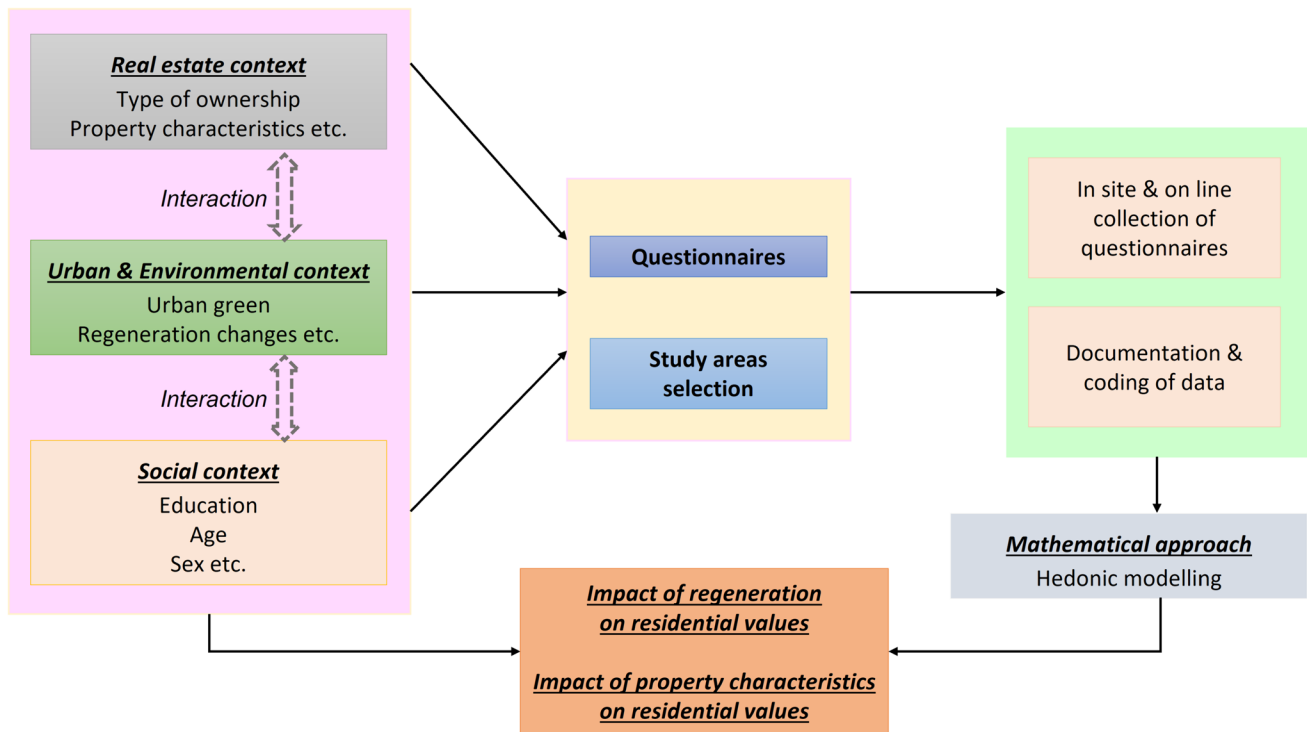
Theoretical framework

Fig. 2 Theoretical framework

economic center of the city and concentrates most administrative functions. The Rotonda area, due to its intense commercial activity (proximity to Aristotle University, student gathering areas, archeologic sites within the regeneration, etc.), documents better tolerance to value changes (due to economic instability periods) (Georgakos 2023). Similarly, residential properties are in demand mainly by older individuals who traditionally lived in the city center or by investors regardless of economic status.

At the north of the regeneration, the urban fabric is considered more densely populated and degraded in some areas, which keeps values at lower levels compared to most areas below Rotonda and Egnatia str. A significant characteristic affecting values and demand negatively is the density of construction and poor lighting in certain streets adjacent to the regeneration, as these streets attract drug or criminal activities. Nonetheless, the area is the most preferred area for students due to its proximity to university campus at the east of Rotonda in less than 150 m.

Kalamaria regeneration

The project of "Regeneration of the commercial center of the Municipality of Kalamaria" was included in the Regional Operational Program of Macedonia — Thrace 2007–2013 with a budget of €4,342,750 and was completed in 2014 (Municipality of Thessaloniki 2015). The total area of the regeneration project amounts to 26,000 sqm., with a significant percentage being green spaces.

Regarding the regeneration of Komninon pedestrian street, particular emphasis is placed on enhancing the street's commercial viability and attractiveness by adding tree plantings, resting areas, pavements, and arranging the placement of seating areas. Similar smaller-scale improvements are made in the main square of Kalamaria, the Greek Refugees square. On the other hand, one of the main roads of the municipality, Metamorfoseos str., transforms from two direction to one-direction str. with the other part being given to pedestrians with wider sidewalks, numerous plantings, bicycle lanes, and increase in linear greenery along the street. The main goal was to increase green spaces and esthetically upgrade the area in combination with enhancing commercial activity.

The rapid development of Kalamaria occurred in the 1980s due to urbanization of the surrounding areas and the relocation of residents from the center of Thessaloniki to Kalamaria, transforming Kalamaria into one of the largest residential municipalities in the city. The center of Kalamaria, which constituted the older area of the municipality, has been formed and maintains until today with four to

seven-story apartment buildings. It must be mentioned that Kalamaria has a relatively high percentage of green space per inhabitant (7 sqm. per inhabitant) – a percentage higher than the majority of Greek cities. Remarkably, the ratio of green space to built-up area (regardless of size and vegetation) is 43% (Xifilidou et al. 2015).

The predominant use is residential, except for the commercial streets, which concentrate commercial activities and entertainment venues. On the upper floors of many apartment buildings on the regeneration, offices and educational activities are recorded. As for the commercial values, the main commercial streets can be categorized according to the type of commercial activity. Within the regeneration, values are increased for entertainment—leisure areas and for small-scale retail stores (clothing, footwear, optics, etc.). Noticeable is the demand for commercial properties leading to a reduction in "vacant" spaces and rental values ranging on the main streets with a yield of approximately 7.25–7.75%. A similar categorization appears in residential properties. Increased activity for purchases is evident at the northwest and southeast of the regeneration while rentals are evenly distributed throughout the municipality.

Due to the morphology of the regeneration and the municipality of Kalamaria, most areas belong to the broader influence zone, and for this reason, the influence of the regeneration is particularly noticeable.

Methods, sample selection and data collection

Urban regenerations involve the revitalization of urban areas through interventions such as in infrastructure upgrades, renewal projects and community initiatives etc. Therefore, they are treated as urban changes with strong spatial reference which have significant impact on many aspects of citizen's lives including property values. There have been numerous studies where OLS regression has been employed to estimate the average or global relationships between regeneration variables and property values (Baumont 2009; Gibbons et al. 2021; Bottero et al. 2022; Jiang et al. 2024). Researchers have analyzed the relationship between investment in public infrastructure and property values at neighborhood scale (Du and Mulley 2012; Manganelli et al. 2014; Yaagoudi et al. 2021; Sisman and Aydinoglu 2022). However due to the fact that regenerations have a spatial scale, GWR is more suitable for such studies as it providing more insights into spatially heterogeneous impacts, account $v\gamma$ for spatial autocorrelation and spatially varying factors which influence property values, enhancing the accuracy of regression results in geographically different urban areas.

Both study areas are selected for two reasons: they have never been analyzed in such way before and the applied methodologies have not been implemented even in similar studies. In the Greek real estate market, limited data availability makes it challenging to conduct comprehensive studies on the impact of environmental and urban planning factors. As a result, researchers often resort to methodologies like Willingness-To-Pay — Willingness-To-Accept (WTP-WTA) and hedonic models in isolation. Although some studies have explored the Greek real estate sector, the application of internationally recognized methodologies such as hedonic and geographically weighted regression models (Goodman 1998; Fotheringham et al. 2002; Abidoye and Chan 2017; Bourassa and Hoesli 2022) remains primarily confined to academic research. The influence of specific environmental and urban factors has been studied individually in the past using simpler correlation methods and later with the assistance of hedonic models. Similar studies have been conducted in Greece, mainly focusing on major urban complexes (Chatzopoulou et al. 1995; Latinopoulos et al. 2016; Karadimitriou et al. 2021). However, the combined study of the degree of regenerations' influence on property values through hedonic and subsequently spatial models is in a primitive stage, especially in Greece. Assessing the non-market benefits of urban parks presents a complex challenge, as it involves quantifying their social and ecological contributions in economic terms. However, neglecting these benefits in decision-making processes can lead to urban planning underestimations of many aspects of everyday life. Traditionally, two approaches have been used to address the correlation of urban parks with property values:

- Stated preference techniques: The contingent valuation method (CVM) through questionnaires (Mitchell 2013; Gelo and Trupie 2021; Zegeye et al. 2023; Schneider et al. 2024) and the choice experiment method (CE) with the concept that all goods and services can be described by their characteristics. The CE method is not widely used and preferred with only a few studies which have been conducted to describe the value of urban green spaces and the implicit value of their attributes (Bullock 2008; Tu et al. 2016; Bottero et al. 2023).
- Revealed preference techniques: The travel cost method and the hedonic pricing models. Examples include studies by Tyrvainen (2000), Jim and Chen (2006), Poudyal et al. (2009), Czembrowski and Kronenberg (2016), Hanauer and Reid (2017) and Cracu et al. (2024).

This paper focuses on analyzing whether the impact of a regeneration plan on residential property values is greater than property characteristics or whether the opposite happens through the analysis of two regeneration areas in two different municipalities.

The methodological approach involves three main steps:

i. Ordinary Least Squares (OLS) Regression: This is a basic statistical method used to estimate the rela-

tionship between independent variables (such as the regeneration, urban and property characteristics) and a dependent variable (residential property values). OLS regression helps identify any overall trends or correlations between these variables.

ii. Spatial Autocorrelation Analysis: Spatial autocorrelation examines whether nearby locations tend to have similar property values. This analysis is important for understanding spatial patterns and dependencies within the dataset. It helps determine if there are clusters or spatial trends in the way the regeneration and property characteristics affect property values.

iii. Geographically Weighted Regression (GWR): GWR is a spatial regression technique that allows for the examination of spatially varying relationships. Unlike OLS, which assumes a constant relationship across the entire study area, GWR recognizes that the relationship between variables may vary from one location to another. This is particularly useful when assessing the localized impacts of the regeneration or property characteristics on residential property values.

By combining these methodologies, the paper aims to provide a comprehensive understanding of how the regeneration and property characteristics influence residential property values in Rotonda and Kalamaria area, including both overall trends and localized variations. This analysis can offer valuable insights for policymakers, urban planners, and real estate professionals involved in the area's development and revitalization.

The data collection methodology is thorough and well-designed so as to capture a comprehensive range of factors. The basic key points are:

i. Questionnaire design: Questionnaires specifically designed to gather information on urban, environmental, property and social factors in the area are used. This approach allows for a holistic understanding of the factors impacting property values.

ii. Distribution method: Both live interviews and emails are used to distribute the questionnaires to residents. This dual approach increases the chances of reaching a wide range of respondents and ensures flexibility in data collection.

iii. Independent variables: The questionnaire covers 43 independent variables for Rotonda area and 42 independent variables for Kalamaria area categorized into five groups: economic, real estate characteristics, urban–environmental/impact of regeneration, social, and spatial factors. This comprehensive categorization enables a detailed analysis of the various aspects influencing property values (Tables 1, 2).

iv. Inclusion of vacant and AirBNB spaces: Vacant spaces were few (less than 1.5% of residential properties in the both municipalities, ie 408 in 28,874 properties) and, therefore, they were not included as they could not have any significant impact on the area's property values. Moreover, Airbnb spaces were excluded due to the fact that their use might easily change and that they are highly affected by factors as tourism and taxation factors. This exclusive approach provides a more accurate representation of the population affected by the regeneration.

v. Sample size and distribution: With an error margin of 8.5% and a level of significant of 95%, the collected sample amounted up to 264, which was over the minimum required sample. In addition, the sample is evenly distributed throughout the entire study areas, enhancing the representativeness of the data collected (Fig. 3).

Overall, the data collection approach is robust and well-suited to achieve the objectives of the paper. The inclusion of diverse factors and a sizable sample size enhances the reliability and validity of the findings, providing valuable insights into the impact of the regenerations on residential property values in both areas.

Overall, the process involves a comprehensive approach to analyzing the impact of regeneration changes on property values, which is summarized as:

i. Data collection and recording: This step involves recording the profile of the sample along with the characteristics of each property, and assessing the impact of the regeneration on residential values. Property, urban and regeneration characteristics were gathered and inserted in a database so as to create specially designed maps that present the variations of spatial distribution regarding property values. Primarily but most importantly, data were collected very carefully so as to minimize any biased data from the beginning. The creation of the database was the most crucial and time-consuming stage.

ii. Digitization and Coding: The collected data is digitized and coded as necessary for analysis. This likely involves converting physical data into digital format and assigning numerical codes for different variables.

iii. Hot-Spot Analysis: The analysis begins with a Hot-Spot analysis using the Inverse Distance Weighted method. This method helps identify areas where similar values are clustered together, providing insights into spatial patterns.

iv. OLS and GWR Analysis: OLS and GWR analyses are conducted to incorporate the spatial interaction of the data. These regression techniques allow for the exami-

Table 1 Descriptive statistics of all variables (Rotonda area)

Context category	Variable	Explanation	Mean	Std. Deviation
Economic context	Value change	Percentage of value change due to the regeneration	– 0.012	0.106
	WTP amount/two months	The amount that citizens are willing to pay every two months for the maintenance of the regeneration	2.978	8.037
Real-estate context	Ownership	Whether the property is owned or leased	1.299	0.459
	Year of construction	What year was the property constructed	1966.873	12.842
	Renovated	Has the commercial property been renovated?	0.694	0.463
	Size	The size of each commercial property	75.894	28.082
	Floor	On which floor is the property	3.164	1.721
	Rooms/bedrooms	Number of rooms of the property	1.918	0.795
	WC	Number of WC of the property	1.067	0.251
	Storage room	Number of storage rooms of the property	0.448	0.542
	Heating	How is the property heated (kind of heating	0.694	0.332
Urban and environmental changes/Impact of regeneration	In the area even before the regeneration	Where you located in the area even before the regeneration or did you move into it afterward	0.612	0.489
	Turnover	Has your turnover increased, decreased or remained stable due to the regeneration	0.112	0.453
	Criminality	Has the criminality of the area increased, decreased or remained stable due to the regeneration	0.388	0.682
	Parking	Has parking issues increased, decreased or remained stable due to the regeneration	0.597	0.550
	Aesthtical beauty	Has the aesthetic beauty of the area increased, decreased or remained stable due to the regeneration	0.515	0.646
	New activities	Have new activities/businesses increased, decreased or remained stable due to the regeneration	0.164	0.707
	More visits	Do you visit the regeneration area more often after its completion	0.470	0.501
	Frequency of visits	Which is the frequency of visits in the regeneration	0.445	0.289
	Pet	Do you own a pet for which you visit the regeneration	0.187	0.391
Social context	Sex	Are you male or female	1.485	0.502
	Family status	Whether you are married or not	1.597	0.492
	Children	Number of children in the family	0.709	1.032
	Age	In which age category are you	2.791	1.561
	Educational level	What is the level of education of each citizen	0.735	0.152
	Occupation	What is your occupation	3.806	1.582
	Average family income (€)	In which category does your income fall	2.716	1.341

Table 1 (continued)

Context category	Variable	Explanation	Mean	Std. Deviation
Spatial context	Distance from main regeneration (around Rotonda)	What is the distance of the property from the main regeneration	263.011	126.204
	Distance from secondary regeneration (south of Rotonda)	Distance from secondary regeneration at the south-southeast of Rotonda	346.847	180.638
	Distance from I.Tsimiski avenue (0–800 m)	Distance of the property from I.Tsimiski avenue (the main city's commercial and business avenue vertical to the regeneration within the CBD (central business district))	435.698	220.911
	Distance from A.Svolou str. (0–500 m)	Distance of the property from A.Svolou str. (one of the main city's commercial and professional str. vertical to the regeneration within the CBD)	244.880	169.744
	Distance from Egnatia avenue (0–400 m)	Distance of the property from Egnatia avenue (one of the main city's commercial and professional avenue with historic importance crossing vertically the regeneration within the CBD)	195.550	105.200
	Distance from A.Dimitriou str. (0–800 m)	Distance of the property from A.Dimitriou str. (one of the main city's str. vertical to the regeneration adjacent to the CBD)	368.404	226.225
	Distance from Aggelaki str. (0–700 m)	Distance of the property from Aggelaki str. (one of the main city str. almost parallel to the regeneration, connecting the University and the Thessaloniki International Fair with the regeneration and the seaside)	337.483	142.255
	Distance from L.Iasonodou str. (0–400 m)	Distance of the property from L.Iasonidou str. (one of the city str. almost parallel to the regeneration, connecting Egnatia avenue with A.Dimitriou str.)	188.324	110.271
	Distance from Eth.Aminis str. (0–500 m)	Distance of the property from Eth.Aminis str. (one of the main city str. parallel to the regeneration, connecting University and the regeneration with the seaside)	244.568	139.897
	Distance from P.P.Germanou str. (0–400 m)	Distance of the property from P.P.Germanou str. (one of the city's commercial and professional str. almost parallel to the regeneration within the CBD)	220.033	117.385
	Distance from urban green of main regeneration (0–350 m)	Distance from the urban green areas within the regeneration around Rotonda	145.699	107.815
	Distance from urban green of secondary regeneration (0–400 m)	Distance from the urban green areas within the regeneration south Rotonda	191.594	137.717
	Distance from urban green of the seaside (200–800 m)	Distance from urban green of the seaside	580.147	224.743
	Distance from urban green of Ano Poli (150–800 m)	Distance from urban green of Ano Poli (the preserved historical part of the city on the foothills of Chortiatis mountain, at the northeast of the city)	372.011	219.257
	Distance from smaller areas of urban green (100–600 m)	Distance from smaller areas of urban green (< 500 sqm.)	440.798	68.067
	Distance from restaurants/entertainment (0–150 m)	Distance of the property from the restaurants/entrainment businesses within the regeneration	57.886	64.667
	Distance from market (0–80 m)	Distance from the market within the regeneration and I.Tsimiski avenue	24.084	26.306

Table 2 Descriptive statistics of all variables (Kalamaria area)

Context category	Variable	Explanation	Mean	Std. Deviation
Economic context	Value change	Percentage of value change due to the regeneration	0.014	0.030
	WTP amount/2 months	The amount that citizens are willing to pay every two months for the maintenance of the regeneration	2.227	3.948
Real-estate context	Ownership	Whether the property is owned or leased	1.662	0.475
	Year of construction	What year was the property constructed	1994.269	10.333
	Renovated	Has the commercial property been renovated?	0.231	0.423
	Size	The size of each commercial property	95.938	36.339
	Floor	On which floor is the property	2.685	1.510
	Rooms/bedrooms	Number of rooms of the property	2.154	0.792
	WC	Number of WC of the property	1.292	0.457
	Storage room	Number of storage rooms of the property	0.438	0.498
	Heating	How is the property heated (kind of heating	0.693	0.294
Urban and environmental changes/impact of regeneration	In the area even before the regeneration	Where you located in the area even before the regeneration or did you move into it afterward	0.923	0.268
	Turnover	Has your turnover increased, decreased or remained stable due to the regeneration	0.223	0.650
	Criminality	Has the criminality of the area increased, decreased or remained stable due to the regeneration	−0.185	0.445
	Parking	Has parking issues increased, decreased or remained stable due to the regeneration	0.408	0.580
	Aesthtical beauty	Has the aesthetic beauty of the area increased, decreased or remained stable due to the regeneration	0.631	0.515
	New activities	Have new activities/businesses increased, decreased or remained stable due to the regeneration	0.162	0.645
	More visits	Do you visit the regeneration area more often after its completion	0.515	0.502
	Frequency of visits	Which is the frequency of visits in the regeneration	0.450	0.253
	Pet	Do you own a pet for which you visit the regeneration	0.200	0.402
Social context	Sex	Are you male or female	1.585	0.495
	Family status	Whether you are married or not	0.615	0.488
	Children	Number of children in the family	0.877	0.981
	Age	In which age category are you	3.200	1.343
	Educational level	What is the level of education of each citizen	0.818	0.145
	Occupation	What is your occupation	3.162	1.413
	Average family income (€)	In which category does you	2.685	1.341

Table 2 (continued)

| Context category	Variable	Explanation	Mean	Std. Deviation
Spatial context	Distance from regeneration	What is the distance of the property from the regeneration	232.824	169.903
	Distance from Aigaiou str. (0–700 m)	Distance from Aigaiou str. (the extension of Metamorfoseos str., one of the regenerated streets)	449.559	228.834
	Distance from Pontou str. (0–600 m)	Distance from Pontou str. (one of Kalamaria's main streets vertical to the regeneration, with metro station in its junction with Metamorfoseos str.)	324.454	216.597
	Distance from Gr.Kidonion-Mitr.Kallidou str. (0–800 m)	Distance from Gr.Kidonion-Mitr.Kallidou str. (one of Kalamaria's main streets parallel to the regeneration, leading to Vas.Olgas avenue to the city center)	418.189	294.912
	Distance from th.Sofouli str. (100–1000 m)	Distance from th.Sofouli str. (one of Kalamaria's greener streets parallel to the regeneration and the seaside)	816.891	364.799
	Distance from Adrianoupoleos avenue (0–800 m)	Distance from Adrianoupoleos avenue (one of the main commercial avenues in Kalamaria, vertical to the regeneration with direct acess to it)	563.201	267.256
	Distance from Metamorfoseos—Chilis str. (0–600 m)	Distance from Metamorfoseos—Chilis str. (the main str. in the municipality which leads to the seaside and its leisure activities)	300.360	187.019
	Distance from I.Passalidi—Perikleous str. (0–600 m)	Distance from I.Passalidi — Perikleous str. (one of Kalamaraia's wider str., vertical to part of the regeneration, exceeding from the seaside to Vas.Olgas avenus to the city center)	339.449	246.396
	Distance from N.Plastira str. (200–1000 m)	Distance from N.Plastira str. (Kalamaria's seaside str. with mainy leisure and entertainement activities)	837.468	250.274
	Distance from Kerasountos str. (0–500 m)	Distance from Kerasountos str. (one of the wider str. of Kalamaria, which directly leads to the regeneration)	349.744	249.308
	Distance from urban green of the center-N.Krini-Aretsou (200–1200 m)	Distance from urban green areas of the central areas (old urban fabric of Kalamaria towards the seaside)	932.658	359.600
	Distance from urban green of Karabournaki-Vyzantio-Camp Kodra (0–400 m)	Distance from urban green areas of the northwest part of Kalamaria and the regeneration (newer urban fabric with better urban design)	246.814	189.945
	Distance from urban green of Kifisia-Votsi-Ag.Panteleimonas-Camp Dalipi (0–400 m)	Distance from urban green areas of the northeast part of Kalamaria and the regeneration (newer urban fabric with better urban design)	248.823	174.451
	Distance from urban green of A.Giannis-Maiami (0–800 m)	Distance from urban green areas of the east part of Kalamaria and the regeneration (most new urban fabric with non continuous urban design, wider streets)	579.307	286.713
	Distance from restaurants/entertainment (0–300 m)	Distance of the property from the restaurants/entrainment businesses within the regeneration	176.584	91.348
	Distance from market (0–250 m)	Distance from the market within the regeneration	136.033	112.563
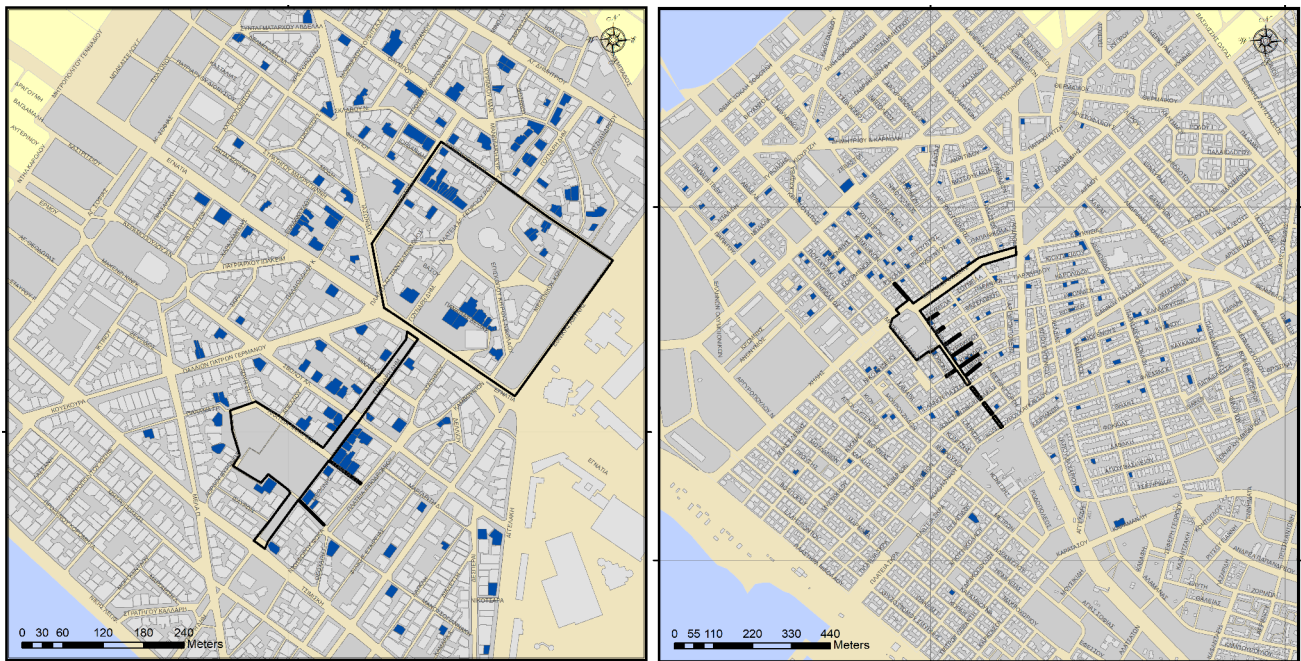
Fig. 3 Sample distribution in Rotonda area (left figure) and in Kalamaria area (right figure)

nation of how variables interact spatially and how they influence real estate values.

v. Model stability and accuracy assessment: The stability and accuracy of the models are ensured through various tests, including tests for spatial autocorrelation and other relevant diagnostics.

vi. Conclusion drawing: Digitally designed urban data such as blocks, buildings, green spaces etc. are combined with the collected primal data as well as, the spatial regression data through specially GIS designed maps. It must be mentioned that the maps were designed in the national reference system EGSA 87, and the corresponding position of the areas in WGS 84 is as follows: Rotonda area (40°37′58.8″N 22°57′09.0″E) and Kalamaria area (40°34′59.7″N 22°57′00.0″E). Based on the analysis conducted, conclusions are drawn regarding changes in residential property values. These conclusions likely provide insights into the effects of environmental and urban changes on real estate within the study areas.

vii. Software utilization: The analysis makes use of two different software tools, IBM SPSS® for statistical analysis and ESRI ArcGIS® for spatial analysis. This highlights the interdisciplinary nature of the study, combining statistical methods with geographic information systems (GIS) technology.

Overall, this approach represents a rigorous and novel investigation into the dynamics of real estate values in response to environmental and urban changes, particularly within the context of two urban regenerations. Through this complex statistical and spatial analysis, the different effect of the urban and property characteristics on residential values is revealed, making it clear which factor/s is the most influential.

Results and discussion

The main goal of the analysis is to highlight that sustainable urban planning and environmental integration are nowadays proven more important than property characteristics, regardless of the location, the socio-economic characteristics of the citizens and the quality of the urban environment, and that it is a necessity for decision makers to take in account a sustainable urban planning behavior.

Interviewed communities

The interviewed sample of Rotonda and Kalamaria is presented so as to identify all community characteristics. The questions are divided in four categories so as to highlight the importance and interpret all responses.

Regeneration of rontonda

Human geography The distribution of the sample appears to be evenly split between genders, with 65.67% being

unmarried and 40.30% being married overall. The majority of the sample have no children. The second most frequent category is those with 1 or 2 children (32.09%). The presence of children usually positively influences the impact of redevelopment, but in this case, the concentration of illegal activities plays a crucial role.

The goal was to show relatively similar percentages for all ages of the sample. However, due to the difficulty for older ages to visit outdoor spaces and the lack of patience in completing surveys, older ages record reduced percentages.

The educational level of respondents recorded a high percentage of individuals with higher education (57%).

Private employees constitute the majority of citizens participating in the research. The second-highest percentage is for the unemployed, reaching 26%. This percentage reflects both the general economic situation of the country and the reduced economic stability of many participants. 18% of respondents are self-employed, an expected outcome as the area attracts commercial and professional spaces.

The average monthly family income is at a low level. The highest percentage belongs to the category of €601–€1000, followed by the categories of €1001–€1600 and < €600, respectively. The fact that income is reported at a family level, meaning the total income of all members of a family, proves that the economic capability of many participants is limited.

Redevelopment's impacts (environmental sensitivity)

Recording the impacts of redevelopment as perceived by citizens is of significant interest. The analysis is done simultaneously with recording the environmental sensitivity of residents through the frequency of visits and increased visits after the completion of the redevelopment.

Initially, the distribution of residents in the area before redevelopment is recorded. The changes caused by redevelopment are even more noticeable to long-term residents of the area. Moreover, the centrality of the area leads to the recognition of changes even by individuals who did not live in the study area before the redevelopment.

Regarding the impacts of the redevelopment, recorded categories include changes in consumption—turnover, crime, parking problems, aesthetic beauty, and new activities/businesses.

Redevelopment does not seem to have significantly altered the residents' consumption. Economic activity was already at high levels. Essentially, the redevelopment contributed to a more esthetically pleasing environment with a greater concentration of leisure and entertainment areas. However, the reduced economic capacity of citizens in recent years does not contribute to increased consumption.

The concentration of illegal activities is clearly reflected in the impacts of the redevelopment in this area. Crime shows a clear increase. Reductions were mainly reported by residents whose properties are close to major roads (Egnatia avenue, L. Iasonidou str,, etc.) where the increase in aesthetic beauty compared to adequate lighting reduced crime rates.

Previously, the area was used as an unorganized parking space, a practice that stopped with redevelopment. However, the lack of designated parking spaces or targeted parking only for the area's residents intensified the problem.

The aesthetic beauty of the area undoubtedly increased with the incorporation of green spaces and pedestrianization of open spaces. The overwhelming majority of citizens responded that the area definitely changed for the better for reasons that vary for each individual.

The frequency of visits to recreational areas for walking, sports, etc., is on average weekly. In general, residents visit similar areas, acknowledging their benefits. The main reason for visiting redeveloped areas like Rotonda is pet ownership. In this particular case, few stated they have pets. This observation further proves the high acceptance of such interventions by citizens.

Property characteristics

The historic center of Thessaloniki is covered by old buildings, with few exceptions. Intense reconstruction took place after the end of World War II until 1980, leading to the coverage of the historic center with old buildings. The construction year of the properties is mainly dated between 1960 and 1979, with a notable percentage still recording even older properties. A characteristic feature is that newer properties account for only 5%.

In addition, 69.40% of the properties are renovated, which is anticipated due to their age. The majority of the properties are of medium size, ranging from 61 to 90 sq.m. In the area, there are many student residences. For this reason, properties ranging from 31 to 60 sq.m. account for 29.85% of the cases. Remarkable percentages are also recorded for properties ranging from 91 to 120 sq.m., while the remaining categories show lower frequencies.

Regarding the floor, the properties do not show any particular concentration at a specific level. Since medium-sized properties constitute the majority, their spaces are limited (1–2 bedrooms). Properties in the study area mainly do not have storage space, as their basement/ground floor spaces are covered by commercial-professional areas.

Finally, the heating type varies among the properties, with the main category being autonomous heating via natural gas. Remarkable percentages are recorded for autonomous heating via storage heaters and autonomous heating via air conditioning. These two methods are mainly found in student properties, which constitute a large percentage of the sample.

Financial assessment

Rental prevails over ownership in terms of property ownership status. Specifically, the ratio of the two types of ownership is 70/30. At this point, it is worth explaining that owner-occupied properties are those acquired by the respondents or their parents and transferred to them. Over 61% of the properties have a lease start year after 1995. The turnover in student properties is the main reason why not only leasing ranks first as a ownership status but also why the majority of leases started after 2005. Similarly, the average monthly rent is average to high despite the small student residences.

Regarding owner-occupied properties, the year of purchase ranges from all decades from 1955 to the present. The phenomenon of the equal distribution of the years of property purchase is justified by the fact that many owners who long-term leased their properties decided at some point to sell them. The construction of new buildings is not a cause of property transaction in the area.

The recorded value at the time of property purchase involves a significant degree of uncertainty. Currency exchange, different conditions in construction activity and the real estate market, as well as the long time span from the purchase, make it difficult to accurately determine the value of the property, leading many to declare the value of their property as they estimate it today. For these reasons, the value as declared was not included in the influence study. Instead, the change in property values after redevelopment was considered more accurate.

The following questions form the basis of the research on residential properties in Thessaloniki. The redevelopment recorded a low percentage of influence on property values and rents according to citizens' estimates. Cases of properties that experienced changes recorded negative percentages to a degree of up to 40% or more. This is exactly where the very negative influence of illegal activities and crime in the area is reflected.

A similar picture is presented regarding the willingness to pay for the maintenance of the redevelopment by residents. Negative responses prevail with many justifications that will be analyzed further below. The few cases willing to contribute some amount are mainly limited to small amounts. However, there are also citizens who declare relatively high amounts. As mentioned, the majority of respondents responded negatively to the offered amount for the maintenance of the redevelopment. The reasons are mainly economic and political. The inability to pay and the belief that the maintenance of the redevelopment is the responsibility of the state cover 69% of the responses. An increased percentage shows the lack of trust in the state that this amount will be used for the purpose offered. Only 13% state that they are not interested in contributing to this purpose.

Regeneration of Kalamaria

Human geography Women make up 58% of the sample population as they were more willing to participate in the research. The percentage of married individuals in the sample is 61.54%, while unmarried individuals constitute 38.46%. The majority of the sample population does not have children. Conversely, among those who do have children, 23.85% have one child, and 21.54% have two children.

Recording the opinions of all age groups is a goal of the study, with a satisfactory distribution achieved. Reduced participation among older individuals is justified by accessibility challenges and a lack of patience. Age categories (26–35, 36–45, 46–55, and 56–65) capable of more accurately assessing the impacts of redevelopment touch 83%.

The educational level of the sample is particularly high, with 56% being university graduates or holders of post-graduate/doctoral degrees. Including graduates of technical institutes, the percentage of individuals with higher education rises to 87%.

Distribution by occupation is relatively evenly spread, with private employees comprising the largest proportion, followed by public servants. Unfortunately, a significant percentage (11%) are unemployed.

The majority of the sample has a family income in the range of €1001–€1600. The next two lower categories follow respectively. Notably, 16.15% of respondents have an income between €1601–€2200, with even higher income categories representing over 7.5% in frequency of appearance.

Redevelopment's impacts (environmental sensitivity)

The population of the sample that resided in the area before the redevelopment amounts to 92.3%. Long-term residency in the area aids in recognizing the changes of the municipality's commercial center following the completion of the redevelopment.

The commercial center of Kalamaria is characterized by moderate commercial activity concerning retail stores and intense attractiveness regarding leisure and entertainment activities. Residents tend to prefer leisure and entertainment spaces over retail spaces. Few individuals reported a decrease in consumption and turnover due to redevelopment.

Kalamaria does not have significant crime problems in the study area. Therefore, it is expected that the redevelopment did not cause significant changes in crime rates. 25.96% of respondents reported a slight decrease in crime, while increases in crime were mainly due to isolated incidents unrelated to the redevelopment.

Parking remains a significant issue in the commercial center of Kalamaria. Previously, when Metamorfoseos str. was a two-way street, parking spaces existed along both traffic lanes. With the current one-way pedestrianization and no

provision for new parking spaces, the problem becomes even more noticeable. This fact is clearly reflected in the research results. Residents who reported no similar problem mainly reside in areas closer to the coastal front where building density is lower and buildings have parking spaces at the ground floor or in their basements.

In the case of the redevelopment of the commercial center of Kalamaria, residents' opinion is that the area's aesthetic beauty has significantly increased. Few reported no change mainly because the area was not an attraction for them even before redevelopment.

The commercial activity of the area intensified with the emergence of new leisure and entertainment businesses. The recorded increase refers to these sectors, while the retail sector did not gain new members. The 17.31% decrease is mainly attributed to some businesses relocating to other streets due to increased rents after the redevelopment.

Overall, the majority of residents recognize that the area has changed and aesthetically improved. Its attractiveness has increased, creating a reference point in eastern Thessaloniki. Regarding visits by residents to the area, 51.54% stated that they visit the redevelopment more frequently. The frequency of visits is quite high, with 45.38% visiting recreational areas for various activities 1–3 times a month, while 27.69% increase their frequency on a weekly basis. Only 20% of respondents have pets. The frequency of visits to the redevelopment and similar recreational areas, combined with the reduced pet ownership, demonstrates the level of acceptance of these spaces by citizens.

Property characteristics

Kalamaria began to take shape after the Asia Minor Catastrophe and the arrival of refugees. Subsequent population exchanges and the influx of refugees at various times led to their settlement in areas of Kalamaria. The increasing population of the area contributed to the reconstruction of some refugee plots during the period 1960–1979. However, Kalamaria experienced more intense reconstruction during the period 1980–1999, when construction activity was very intense, shaping many areas of the municipality as they are today. The decrease in buildable plots in the study area contributed to the decline in construction activity after 2000, until the last 5 years when construction has restarted intensively.

New properties reduces the need for renovation, resulting in only 23% of them being renovated. The plots allocated for reconstruction or exchange were not large. A characteristic of refugee plots is their abundance and small size, aiming to serve the huge population arriving in the area. In contrast, properties in Kalamaria are quite large. Many neighboring refugee plots were merged and reconstructed through the exchange method. This practice was particularly widespread

during the period 1980–1999. At the same time, demand in the area was largely limited to large properties because families chose the municipality due to its more organized urban fabric with urban greenery and easy access to the city center.

The sample residences are located on various floors, with the majority reaching up to the 4th floor. Older properties opted for maximum coverage of the plot and lower height construction. In contrast, newer properties choose exactly the opposite practice mainly due to small plots and the desire to create multiple apartments within a multi-story building.

Properties with 2 or 3 rooms cover over 75% of the sample. The remaining 23.08% have one room, while only 1.5% have 4 rooms. Storage spaces are mainly found in the basements of newer buildings.

The dominant heating method is autonomous natural gas via radiators. 20% of the properties have central gas heating via metering, while a percentage (13.08%) have central oil heating. The remaining heating methods are distributed across various categories.

Financial assessment

Residents of Kalamaria choose property ownership over renting, which accounts for 34% of the sample cases. The start year of property rental dates after 2005 is 36.36% of cases. Only 20.45% opted for long-term property rental. Moving on to owned properties, the majority were acquired after 1985. A characteristic is that only 6.98% were purchased before 1984. Properties with very old purchase years are inherited properties of refugee families.

The value of properties at the time of purchase is recorded with greater accuracy in the case of Kalamaria due to the large number of newly acquired properties. However, older properties were valued based on the owners' belief in the equivalence of their value at the time of purchase and the present economic situation. For this reason, the results are viewed with some skepticism. It should be noted that the values are inflated because Kalamaria was and continues to be one of the most expensive areas in Thessaloniki in terms of residential properties. Easy access to the city center, esthetically upgraded environment, demand, and the few remaining buildable plots increase the values of residential properties. For these reasons, the value as declared was not included in the influence study. Instead, the change in property values after redevelopment was considered more accurate.

The increased value of residential properties, and even more so, the already aesthetically upgraded environment, leave little room for positive changes in rent/property value after the redevelopment. However, 24% reported some change.

The willingness to contribute to the redevelopment did not receive a positive response. 32% are willing to contribute to the redevelopment, while the rest of the sample expressed

negative views for reasons that will be analyzed below. The main reason for refusing to offer an amount for redevelopment is the belief that it is the state's obligation to maintain its projects. Distrust that the amount will be used for this purpose is the second reason. The inability to pay records almost the same percentage as citizens who stated that they are not interested at all in the way with which the redevelopment is maintained. General distrust in the state and the already burdened economic situation of citizens contribute negatively to the desire to pay.

Regenerations and property values

Rotonda area

The regeneration of Rotonda was one of the most important urban changes in the CBD (central business district) of the city and it was anticipated to affect many aspects of citizens lives on economic, social and environmental scale. After gathering all responses and representing them on spatial level, the first finding was that most illegal activities (illegal trade, drugs etc.) gathered at the southeast of the area were relocated at the center of the regeneration, even closer to the University campus, without documenting any significant elimination due to the aesthetic upgrade of the area. Combining this fact with the dense and old urban fabric, the regeneration caused a decrease in the sense of security with certain roads surrounding the regeneration being too dangerous to cross especially at night. This finding was clearly stated by citizens during the interviews and through questionnaires. Especially in the case of university students and their families, the responses were even clearer, stating that the safety criterion was very important during their rental research and that they have observed differences in offered rental values between properties on less safe with inadequate lighting locations (Fig. 4).

Due to the prementioned negative effects of the regeneration of Rotonda, property values documented two different trends. Despite the fact that most regenerations are created in scope of improving the urban fabric and the life of the citizens, the effect of this urban intervention on values was documented mostly outside of its boundaries. The west part of the surrounding area was the most effected part followed by the north and northeast part which also documented value changes. In contrary, negative-value changes (red within the circle in Fig. 5b) were documented on the regeneration area from northeast to southwest, giving proof that not taking into account social phenomena in an area can lead to unsuccessful urban changes.

Citizens from the areas of positive-value change (dark colors in Fig. 5a) stated that they acknowledged the fact that they had a regenerated area with urban green and open spaces very close to their residence, while not being in
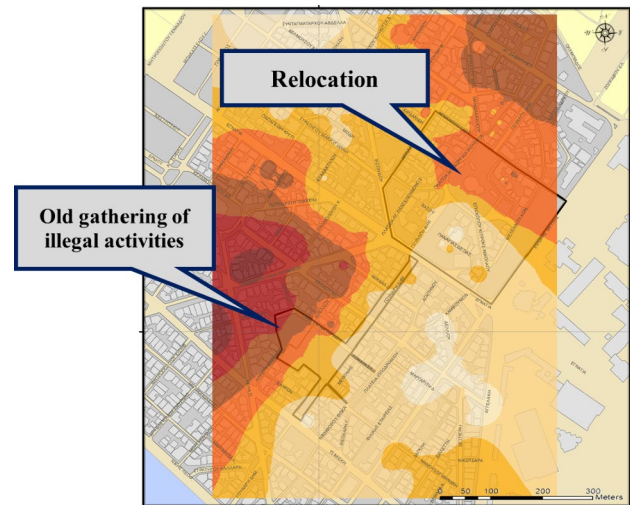

Fig. 4 Social effects of the urban regeneration of Rotonda. In darker colors: significant positive-value changes, light yellow: significant negative-value changes

contact with illegal activities after exiting the front door of their building. Meanwhile, the sense of security increases as distance from the regeneration increases and distance from other main roads of the CBD decreases.

What really happened in the case of Rotonda was that urban designers believed that the urban regeneration would be so powerful that any long-term social problems (illegal activities etc.) would cease to exist after its creation. However, in urban planning the designer must look at the surrounding area as well. The fact that the regeneration is next to the University campus where the university asylum forbites the police of entering the campus without a district's attorney decision should have been taken in account as the campus is frequently used for the "protection" of persons from being arrested for any kind of illegal activity. Therefore, first, decision makers and designers should have taken certain actions toward the elimination and solution of this social phenomena within the area of the regeneration, leaving some time for the citizens to acknowledge the change in their sense of security and their everyday life in the neighborhood at a subsequent time. In consequence, stronger foundations would be set for the successful outcome of the regeneration.

On the other hand, the regeneration of Kalamaria was one of the most important urban interventions in a historically residential municipality with citizens of medium to high average monthly income and a CBD with visitors both from the municipality and surrounding areas. In this case, during the construction of the regeneration many small commercial businesses from str. Metamorfoseos, which is one of the two roads where the regeneration extends, closed down. The combination of the long-term construction of the
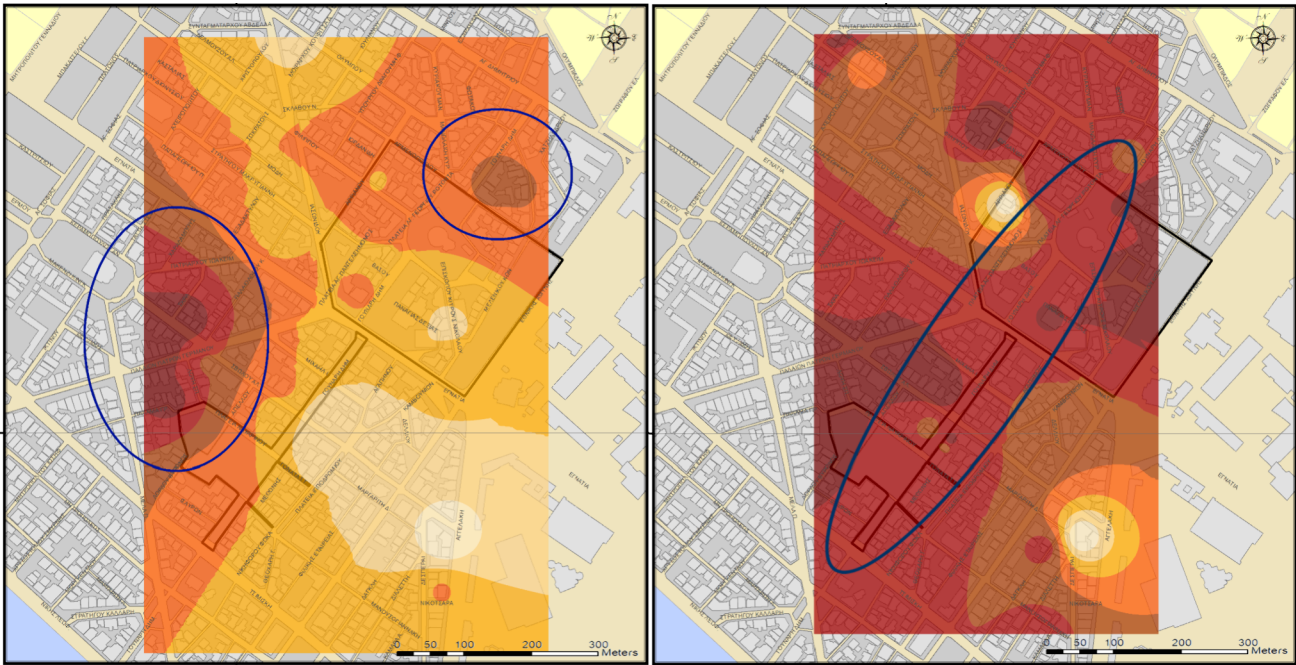
Fig. 5 a Blue circle: most significant positive-value change in darker color (left figure), **b** Blue circle: most significant negative-value change in red color (right figure)

metro station at the beginning of str. Metamorfoseos with the construction of the regeneration caused an extended period of decreased visitors and, therefore, a significant revenues decrease. However, after the construction of the regeneration the area was upgraded esthetically and became more attractive to citizens. The increase in urban green and open spaces and the decrease in traffic (change in one-way street from two-way street) affected the number of visitors, which increased revenues by the commercial and leisure businesses.

The attractiveness increase caused property values to accent on the regeneration for newly built and older residential buildings. It must be noted that the most significant value change was documented at the area where the regeneration begins and the metro station is constructed (Fig. 6). Even before the regeneration and the metro, the neighborhood was one of the most desirable areas to live due to the organized urban fabric (large roads, large pedestrian areas, urban green and good transportation means). Therefore, it is totally justified that property values increased. The second higher effect on property values is documented at the southwest neighboring are of the regeneration. Citizens in this densely built area seeked for more open and green spaces at a close distance to their residence. Therefore, from the point of the construction of the regeneration and then on, property values in the area were affected positively at a smaller extent than the previously mentioned area (Fig. 7). It would be an omission not to mention that no negative-value change was documented
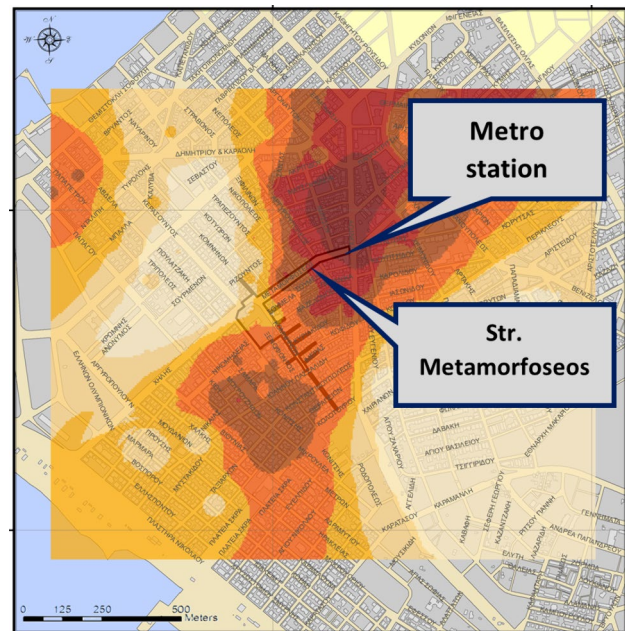

Fig. 6 Economic effects of the urban regeneration of Kalamaria. In darker colors: significant positive-value changes, light yellow: insignificant or zero-value changes

due to the regeneration, as even before that the CBD of Kalamaria was very popular and Kalamaria was one of the most preferable areas to live in the city of the Thessaloniki. As
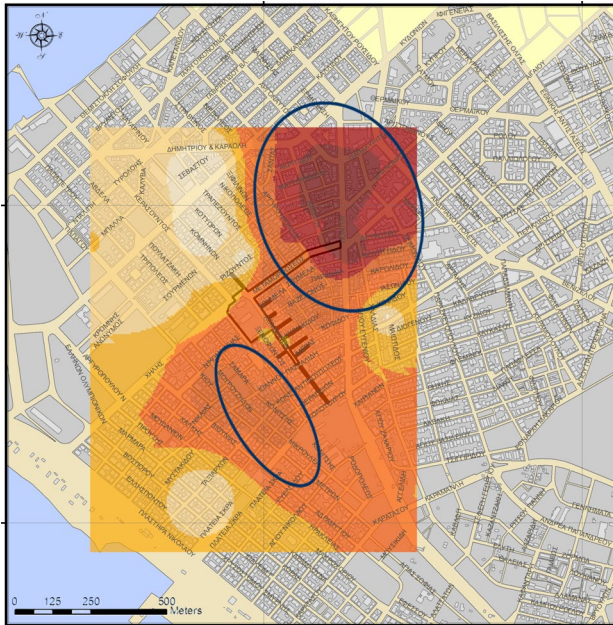
Fig. 7 Positive-value change in Kalamaria areaNorthern circle: most significant positive-value change in darker color, south circle: less significant positive-value change in orange color, light yellow: insignificant or zero-value change

Table 3 Variables entered in the statistical hedonic model (Rotonda area)

Hedonic model variables	Unstandardized Coefficients B
(Constant)	– 1.866
Year of construction	0.001
New activities-businesses	0.052
Pet ownership	0.043
Education level	– 0.091
Occupation	– 0.015

Table 4 Variables entered in the spatial GWR model (Rotonda area)

Variable	Coefficient
Intercept	– 2.78
Ownership/ on rent	– 0.11
Year of construction	– 0.50
New activities-businesses	0.04
Occupation	– 0.02

far as the sense of security, Kalamaria never had significant problems with criminality as its percentages in thefts and illegal activites are one of the lowest in Thessaloniki.

The attractiveness of the municipality is not a result of good practices of decision makers of present times. Its urban fabric was organized at a later date and gradually incorporated all new urban planning ideas and politics. Therefore, its urban development in almost all areas except the older part, follows the sealine and combinates the built environment with green areas and open spaces. Most recent decision makers despite that fact that they found good foundations for possible urban changes, they rested quiescent.

Residential property characteristics and property values

Apart from any urban and environmental effects on values, the most traditional aspects that affect residential values are property characteristics. Through hedonic modelling, check for spatial autocorrelation and other statistical errors and conduction a geographically weighted regression, findings were very interesting.

Beginning with Rotonda area, both the hedonic model and the geographically weighted regression highlighted the year of construction as the only property characteristic that affects values. All other variables entered in the models were socio-economic variables. This fact is explained through citizens responses during interviews and questionnaires as

they stated that open/green spaces are more important than property characteristics, as they are absent for the urban fabric. Moreover, they seek for safer open/green spaces, which unfortunately was not a successful outcome of the regeneration. Lasltly, the year of construction is important as after 1985 the new improved anti-seismic regulation was implemented.

The increase of new activities — businesses increase the attractiveness and increase values and pet ownership is documented as crucial in the decision of offering more money for renting a property close to the regeneration due to the absence of other open spaces used by the pets in the surrounding area. Open/green spaces are twice more important for families with children up to 12 years old and pet owners. The educational level and the occupation appear with a negative coefficient as it is more obvious for higher income and higher educated residents that this regeneration has more reasons for decreasing property values rather than increasing them (Tables 3, 4).

The responds for Kalamaria are totally different. Regarding property characteristics, the size of the property and whether it is renovated or not are the only common variables in both model. People seeking to buy of rent a property in Kalamaria have in most cases medium to high income, so the demanded properties are larger and renovated. It is proven that the size of residence is more important in residential areas (areas where residents will be living more than 10 years) as the municipality of Kalamaria and that in case of renovation, the property records more demand.

Table 5 Variables entered in the statistical hedonic model (Kalamaria area)

Model	Unstandardized coefficients B
(Constant)	0.642
WtP for regeneration	0.003
Year of construction	0.054
Renovated/not	0.021
Size	0.026
Storage room	– 0.009
Turnover/consumption	0.01
Criminality	– 0.015
Sex	0.007
Distance from regeneration	– 0.004
Distance from main road	0.013
Distance from central green spaces	0.033
Distance from eastern green spaces	0.044
Distance from southern green spaces	0.001
Distance from entertainment businesses/cafeterias	0.062

Evaluating more closely all variables, it is clear that the most influential are environmental and urban variables and not traditional property variables. This is justified by the fact that citizens stated that in general the larger percentage of residences are of average to higher level and state and neighborhood characteristics are in average satisfactory. As a consequence, residents categorize property characteristics as very important but continue to seek not only for open/green spaces at a close distance, but to evaluate the quality of amenities offered in such spaces, which is also documented by the questionnaires and interviews. Specifically, in open spaces and more important playgrounds, shades and dense trees are two of the first characteristics that residents seek. Safe and large pavements and continuous paths for and to open/green spaces with materials which are not rough (especially for parents with strollers) are extremely demanded. The amenities (rest areas, playground toys suitable for all ages etc.) and construction materials (playground and pet safe materials etc.) are characterized as very important.

In other words, they move a step forwards towards evaluation the existing spaces and, consequently, the quality and effectiveness of designers and decision makers. Kalamaria's citizens are more willing to pay both for the sustainability of the regeneration and for a residence close or even next to a green or open space and to an area of larger pedestrian pavements and squares (Tables 5, 6).

Table 6 Variables entered in the spatial GWR model (Kalamaria area)

Variable	Coefficient
Intercept	– 0.3232
WtP for regeneration	0.003
Renovated/not	0.0176
Size	0.0003
Distance from eastern green spaces	0.0001

Conclusions

Urban planning has undergone many stages reaching the present idea of incorporating environmental integration in every new area or new regeneration. It is understandable that apart from the traditional property characteristics, urban quality and aspects can significantly affect property values. This study highlights that residents seek for quality of urban environment both in areas where open/green spaces exist and areas of dense construction. The difference appears in the fact that in areas where urban green or opens spaces are upsent, the weight leans on the characteristics of the wider area and its citizens (socio-economic characteristics, habits etc.) rather than on the property characteristics, when determining property values. On the other hand, citizens living in areas with urban green and open spaces, move a step forward and seek for larger and more friendly (better infrastructure and amenities) green or regenerated areas as a counterpoint for already increased property values.

Unfortunately, most Greek cities and metropolitan areas were not designed with sustainable and environmental scale and all recent urban interventions/changes/regenerations are designed at a local scale and not a holistic one. As far as property values are concerned, values have been ascending as a consequence of to the Ukrainian and energy crisis, mainly due to the increased production and transportation costs of materials and equipment used for construction which increase the overall construction cost. However, property values have always been very high in Greece (high percentage of homeowners meant high demand) in comparison to the salaries and the ability of a household to acquire a property.

A targeted urban planning for each sub-area is one of the keys towards property values stabilization against economic variations and towards the improvement of the quality of citizens' lives through environmental integration. Therefore, decision makers and urban designers should take into account all different needs of the citizens in each area setting the goal of maximum possible urban sustainability and resilience and the minimum environmental degradation. Moreover, future research could focus on integrating advanced spatial-modeling techniques and incorporating

additional contextual factors to enhance our understanding of the complex dynamics shaping urban property markets in regenerated areas.

Declarations

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