Article

Social Dimensions of Spatial Justice in the Use of the Public Transport System in Thessaloniki, Greece

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Abstract: Greek cities hold important urban issues related to social injustice; lack of open spaces, pedestrian facilities, parks and greenery, access to public amenities, etc. In view of these, we investigated residents’ preferences and choices regarding their walking activities in the urban environment of Thessaloniki, Greece. In specific, we applied research with questionnaires to the residents of the municipality of Ampelokipoi-Menemeni. The research applied the Contingent Valuation Method to investigate residents’ willingness to pay (WTP) for the improvement of the existing infrastructure of public space in view of making walking and the use of local metro stations more attractive. A methodological framework was developed, including Explanatory Factor Analysis and Structural Equation Modelling, along with statistical analysis of the results. The lack of pedestrian facilities and the long walking distances are two main reasons discouraging the use of the metro. CVM application showed that almost half of the residents would be willing to contribute an amount of money for the improvement of pedestrian infrastructure. The main reasons for this were to make the use of the metro more attractive, which would also improve their living conditions and would contribute to a better quality of life. Income restrictions proved highly important to a negative WTP.

Keywords: urban mobility; spatial justice; CVM; explanatory factor analysis; structural equation modelling

1. Introduction

It was very recently, in 2007, that the global urban population exceeded the rural, and the statistics reveal that this growth will continue. By 2050, it is anticipated that more than 2/3 of the global population will live in urban areas, accounting for almost 7 billion people, as the projection for the global population in 2050 is 9.8 billion. Furthermore, people are gathered in highly dense cities, and one in three urban residents lives in a slum [1,2]. Therefore, cities and urban planning, although very young in the context of human history, are at the core interest of social research. The phenomena of rapid urbanization and globalization, especially during the last decades, have given rise to an urban dialogue regarding a variety of new ideas and planning methodologies for the remaking of the city. The most recent of these include policies for environmentally friendly cities [3,4], smart cities [5–7], creative cities that utilize their cultural forces [8–10], etc. Lately, the COVID-19 pandemic brought certain needs to light [11]. Cities must be redesigned once again to be able to meet the need for more open spaces, greenery, athletic activities, and especially the social distance that proved vital during the time of global quarantine. Hence, new forms of urban planning, including concepts of the resilient city and the city based on a circular economy, have appeared, and these concepts are reshaping older ideas of sustainable cities [12–14]. However, one issue still prevails: how can all these urban policies and practices change the living environment of all urban dwellers? Moreover, how can they ensure that urban environments be just for all? The short answer is that cities are highly unjust, that social inequalities still prevail at a very large scale, and that there is still a long
road ahead for urban environments to be transformed in a way that they can provide basic amenities for all citizens equally.

In 1968, Henri Lefebvre [15] was writing about the right of people to participate in the process of remaking the urban environment, the radical idea of a collective right to power over the transformation of the city. At its very core, this right remains true. Furthermore, how equally planned are cities today? Not only in terms of basic urban elements, but in succeeding to provide a safe artificial environment where humans can develop and flourish? Not much, really. In fact, we are still in the process of making our cities “inclusive, safe, resilient, and sustainable”. This is the 11th SDG on the 2030 UN Agenda: “For all of us to survive and prosper, we need new, intelligent urban planning that creates safe, affordable, and resilient cities with green and culturally inspiring living conditions” [16].

Many urban phenomena strongly evidence the unjustness of cities. Migration patterns reveal that the urban poor tend to gather in the least-developed parts of cities, facing spatial segregation, living in the utmost unsafe and unstable conditions, and thus facing an insecure future [17,18]. At the same time, many urban renovation projects lead to the eviction of former inhabitants due to increasing land prices, and this can disrupt any social nets they have formed over the years, all in the name of monetary gain. This issue, called gentrification, is well-known [19,20]. Social inequalities exist in a variety of forms in the cities, including gender–spatial discrimination, segregation of minorities, etc. At the most obvious level, urban dwellers are highly disadvantaged in regards to the spatial distribution of urban elements, such as parks, greenery, sports facilities, walking/biking networks, public transport facilities, etc. For the most part, cities are not planned under a just or socially-conscious urban policy system.

All current urban policies aim at restructuring the city to provide a better standard of living for all residents. The idea of a smart city, for example, is based upon a planning policy aimed at digitizing and improving all separate dimensions of the city: transportation, energy, education, health care, buildings, physical infrastructure, food, water, and public safety [21]. Smart city policies, diffused as an “urban labelling” phenomena, focus also on the role of social capital and social relations in the urban environment. In pursuing more sustainable cities, policies are adopted which aim to: create more urban green (parks, green corridors, pocket parks, etc.), build the “15-min city”, where most services and amenities in a neighborhood are available within 15 min of walking or cycling, promote a cycling economy through reusing and recycling approaches, etc. As for policies aimed at smarter and more equitable mobility, promotion of public transportation, walking, and cycling are at the center of research interest, as well as policies aimed at the participation of citizens in the urban planning of their city.

In view of the above, this paper aims to provide answers to some essential questions. These questions are: How are social and spatial injustices affecting residents’ access to walking/cycling facilities and to public transportation? What factors affect residents’ Willingness To Pay (WTP) for the restoration of the urban environment under a plan to create pedestrian/cycling facilities that will encourage the use of public transportation?

To attempt to answer these questions, this paper investigates the issues of social justice in an urban environment with respect to residents’ access to walking/cycling facilities and to public transportation. In addition, the paper addresses issues of distribution of urban greenery, parks, services, and other facilities by examining the level of social justice the urban environment shows. Furthermore, through the application of the Contingent Valuation Method (CVM) [22], the paper examines the residents’ WTP for the restoration of the urban environment under a plan to create pedestrian/cycling facilities that will encourage the use of public transportation. The municipality of Ampelokipoi-Menemeni in Thessaloniki, Greece, has been used as a case study in this research. A fundamental methodological framework (Factor Analysis and Structural Equation Modelling) was developed for analyzing the WTP of the municipality’s residents. The scenario used in the CVM was the restoration works around the forthcoming metro station. The research focused on issues regarding the local commuters’ safety, comfortability, and satisfaction with respect
to walking/cycling to and from the metro station. Several demographic characteristics were further analyzed with stated views and opinions. The spatial distribution of residents' residences was taken under consideration in the analysis to examine the distribution of basic facilities in the area in terms of social justness. Also, the results of the CVM analysis provide input regarding the ability or inability of residents to participate in the redesigning of their city, thus shedding light on the likelihood of residents to participate in planning these future programs. The findings of this paper could provide significant support to local authorities as they craft policy aimed at the improvement of urban infrastructure in such a way that citizens’ mobility will be enhanced and life in the city will be made more just.

The rest of the paper is organized as follows: Section 2 presents the existing literature; Section 3 demonstrates the methodology that was followed in this paper; Section 4 illustrates the results obtained from the implementation of the methodology; Section 5 provides a discussion based on the obtained results and the final section offers the conclusions and remarks.

2. Literature Review

2.1. How Unjust Are Our Cities?

In social terms, migration and gentrification are the two main elements of injustice in the urban context. Several migration patterns have been documented over the decades, and most European cities developed as the result of previous migration flows. Overall, migrants tend to settle in areas of the city that show heavy signs of decline, such as environmental degradation. These migrants are usually socially isolated, living on the outskirts of cities on land unsuitable for habitation, sometimes next to industrial areas, or in the city center, in abandoned or unwanted basement flats [23,24]. On the other hand, another common urban issue is gentrification caused by radical restoration works in an urban district which cause the out-migration of former residents and the incoming of new ones. The bottom line is that these former residents, typically low-income minorities, are forced to abandon their place in society (their way of life, their social networks, etc.), while high-income residents, office buildings, corporations, etc., come in and replace them. Urban land changes hands and the public becomes private [25].

Another equally important element of urban inequality is the unjust distribution of services and facilities, such as urban parks and greenery, which are vital for human wellbeing. In pursuing equitable urban living conditions, it is necessary to implement a mixture of land use that serves all residents on an equal basis; for example, a well-developed and widespread walking/cycling network and a well-developed public transportation system with a fair distribution of bus/metro/tram stations that cover effectively the total residential area without creating isolated neighborhoods and deprived populations. Several studies have focused on such issues. Zhang et al. (2021) [26] studied the urban inequalities of community green spaces in Beijing. Certomà and Martellozzo (2019) [27] investigated urban gardening in relation to urban injustice in the city of Rome. Achmani et al. (2020) [28] developed a framework proposal of different indicators regarding land use, accessibility, and allocation of space in order to evaluate urban spatial injustice. Ghasemi et al. (2019) [29] examined issues of unequal distribution of social and cultural services among various districts of Tehran Metropolis. In terms of urban mobility, Chavez-Rodriguez et al. (2020) [30] investigated relations and urban inequalities referring to gender and environmental disparities deriving from mobility and transportation patterns in Monterrey, Mexico. Szell (2018) [31] investigated the issue of car use in comparison to means of train/bicycle mobility and the resulting social inequalities in 23 cities worldwide. Cadena-Gaitán et al. (2021) [32] examined the spatial inequalities regarding access to urban mobility between two districts in Medellín city, Colombia. Guzman et al. (2021) [33] explored issues of unfair distribution of street space in Bogotá, revealing that street users do not have equal access to its use and that private motorization tends to consume more space.
2.2. The Concepts of TOD, POD, and the FM/LM Problem in Urban Mobility

The rapid urban sprawl of recent decades, which has occurred at an unexpectedly high rate, has led to the unscaled expansion of cities, and this brings to light several crucial issues, among which is the need for highly safe, easy, and quick urban mobility. As such, in order to improve equality in cities, mobility must shift towards public means of transportation and towards the improvement of existing means, as well as the introduction of new models of transportation in order to achieve sustainable mobility. The use of monitoring systems may also provide useful information in the planning process [34]. Cities attempt to cope with a variety of new challenges (open spaces, greenery, mixed land use, high quality services and facilities, adaptation of policies based on circular economy processes, etc.). Above all, high-quality and more efficient public transportation is considered a key element for a city’s growth. To those ends, many approaches related to urban services have been based on new technologies, such as ICT (Information and Communication Technology), which has led to the creation of the “smart city” concept [35]. Conventional modes of transport lead to environmental degradation, an increase in traffic, delays, loss of time, noise pollution, etc., thus increasing the need for intermodal connection of the various means of transportation and the shift to alternative forms of transport, such as active mobility.

How can a city be unjust in terms of mobility? One major issue is that of accessibility. The concept of the 15-min city focuses on all citizens being able to access most services and facilities within 15 min of walking or cycling. So in terms of mobility justice, if public means of transportation are not accessible by all in this timeframe, then the city is simply unjust. Furthermore, issues regarding the conditions of accessibility arise. For example, is there an adequate pedestrian/cycling network for all? If not, who are mostly benefited, and who are segregated from such facilities? Also, do vulnerable groups of people (i.e., elders, women, children, people with disabilities) have equal access to urban mobility?

Several definitions regarding issues of accessibility exist in the relevant literature, such as the potential opportunities for interaction [36], the feasibility of reaching any area of activity with a specific transport system [37,38], and the overall benefits provided by a given transport system [39,40], among others. One important issue arising when designing policies to provide better accessibility is the aspect of affordability. Affordability in accessibility can be analyzed by its various components. Van Wee et al. (2001) [41] suggested the concept of employment competition in an area, including generalized travel costs and demand characteristics, the number of households, job clusters, infrastructure, and activity-related and mixed approaches. Geurs and Van Wee (2004) [42] improved this approach with three main elements that are essential in defining accessibility in a more complete way: land use, transport, and individual characteristics. Accessibility is measured by a model of land development, such as the elements in the urban environment. Affordability also refers to issues regarding the financial ability of residents to use the public transportation system, which in turn relates to issues of social inequality.

One important concept in city planning in recent decades is that of the compact city. The compact city develops and depends on the structure of the network of Transit Oriented Development (TOD). TOD is part of the general shift towards sustainable mobility networks and focuses on the protection of the natural environment, health and safety, and serving all mobility needs. TOD-oriented development supports socioeconomic activity, reduces the cost of transportation and infrastructure, promotes the adoption of energy-saving solutions, and ensures the sustainability of the transport system [43]. Travel demands can be managed by applying soft or hard measures. Soft measures are those which are acceptable to the political and social community. These include better information, broadening of travel options, and increased attractiveness. This approach resembles the concept of the smart city in terms of cost, comfort, travel time, and safety. This kind of city comes to be when access to public transport is within a certain threshold. Planning which implements TOD design philosophy is for that purpose; that is, highlighting the importance of smaller urban blocks and of reducing the land area dedicated to car-housing facilities. Two different types of TOD system are developed. The first type concerns the city level (Urban TOD), focusing on
central crossing stops, such as railway stations. The second type concerns the neighborhood (Neighborhood TOD), focusing on light rails or bus stops the maximum time-distance of which is 10 min, with minimum frequency line attendance every 15 min [44]. Again, the spatial distribution of public stations and walking/cycling facilities inform policy making from the perspective of spatial justice.

Another approach in urban mobility is the development of Pedestrian Oriented Transportation System (POD), which, in combination with TODs, form an alternative method for urban planning and development. POD refers to a pedestrian-friendly policy developed to be environmentally friendly, giving priority to pedestrians and providing at the same time comfortable access to commercial and residential areas and transit stops. POD is implemented through a combination of land use, such as compact growth, mixed use, “calm” traffic, pedestrian streets, and public transport. Successful implementation requires a transition from the current automotive-dependent strategies to the development of more traditional design practices that provide safe and convenient opportunities for walking, cycling, and access to a variety of destinations, like school or work. Application of such policies is estimated to eliminate quality-of-life disorders, the loss of open space, the need for expensive road infrastructure, and also the loss of residents’ sense of community [45]. With mixed land use in terms of residential, retail, and wholesale, an individual can take short routes on foot or by bicycle. POD-oriented development has the potential to promote a high level of spatial justice, given that it ensures an equal spatial distribution of related facilities and services.

In regards to the above, an interesting topic in recent years has been the conditions which allow residents’ access to particular means of public transportation. In specific, it refers to the way an individual reaches the public station to move from a point of origin to the destination [46]. This is known as the “first/last mile problem” [47]. FM/LM problems occur when origin/destination is beyond the range typically covered by public transport. The degree to which a mode of public transportation is attractive depends on the ways in which a user may reach or depart from it (e.g., walking, bicycling, bus, car, etc.), as well as the conditions of these means; for example, the pavement network, combinations of other means of transport, mixture of land use, etc. This determines the frequency of its use, which impacts the number of users and, overall, the sustainability of the system [46]. One of the problems regarding the FM/LM is the level of inconvenience for passengers, because the conventional modes of transport for this stage of the trip can, in many cases, be rather slow, inflexible, and not provide a seamless experience to passengers [48]. Many scientists find that the last mile is one of the main deterrents preventing public transportation from being competitive with the car use. Alternative ways of transport (e.g., bicycle, car-sharing programs) have been proposed to solve the last mile problem. However, these alternatives face other challenges, such as weather conditions, slow speed, or costs that are difficult to estimate [49,50]. Fixed infrastructure and a good network density could be helpful, but there are also many other approaches that can be combined to achieve the desired outcome [51]. The question of fair accessibility again arises. To that point, relevant research on buffer zones of 400 m and 800 m around public transport stations may be examined in terms of equal distribution of amenities and facilities that make the first/last trip attractive and feasible for all individuals.

2.3. Willingness to Walk

Walking is the most common mode of travel to public transport in Western countries [52]. In terms of social justice, we would also add that it is the fairest, since everyone can walk. However, walking in the city requires a minimum level of infrastructure and services. Their existence and spatial distribution bring issues of inequalities into light. The decision to walk to reach a station of public transport is affected by plenty of urban and demographic characteristics, i.e., the trip’s purpose, the structure of the urban environment, the local geography, and the availability of public transport [53,54]. The most important factor is the mode of public transport. In typical surveys and relevant guidelines, specific
assumptions are suggested about the distances that people are willing to walk. They are called “rules of thumb”, and they have been used by transport planners to determine the spacing of stops in bus lines, as well as by land-use planners for finding an appropriate urban design focusing on the objectives of the TOD system. These distances are from 400 m to 800 m (the same distances that are also taken into consideration in an FM/LM analysis) [52,55,56]. In general, people are willing to walk up to 400 m to reach their destination (i.e., a public transport station). However, they are willing to bike up to 800 m for the same purpose. Zhao et al. (2003) [57] showed that this willingness declines when the distance is almost 580 m (as 400 m is the minimum-walking-distance threshold), while Loutzenheiser (1997) [58] found that for every additional 500 m (1640 ft) of distance from a station, the likelihood that a person will walk decreases by 50%. Ayvalik and Khisty (2002) [59] showed walking to be the major mode up to 1600 m (eight blocks) in urban conditions.

The type of public transportation also affects the willingness to walk. It is shown that people are generally willing to walk shorter distances to get to the nearest bus station, but the maximum acceptable walking distances to/from bus stops can be higher than the typical 400 m considered suitable for the public. Overall, the better the coverage and frequency of the means of transport, the greater willingness people have to walk to get to it [60].

2.4. Willingness to Walk in Ampelokipoi Urban District in Thessaloniki

A survey of travel habits was conducted to assess the value of walking in Thessaloniki in 2019, before the beginning of the pandemic, which examined the way in which the inhabitants carried out their movements in relation to the surrounding infrastructure and territory within a certain radius of influence around a subway station [61]. The distances examined were 400 m and 800 m, which corresponds to 5 to 10 min of walking. These distances values are representative of those commonly used in all FM/LM investigations. This study examined peoples’ movement habits with respect to new modes of transportation (e.g., the metro subway) as well as older methods (e.g., buses and taxis). The results demonstrate the need for individuals to walk in their neighborhoods and turn to active movement in the presence of suitable infrastructure. The decision to walk depends on many factors beyond mere infrastructure. Demographic characteristics (e.g., age) and the trip’s purpose are also critical determining factors.

The aim of this study was to assess, using the circular buffer method, public transport accessibility for residents of the urban district of Ampelokipoi (municipality of Ampelokipoi-Menemeni, Thessaloniki Metropolitan Area, Greece). Another goal was to examine their behavior regarding a new mode of transportation (metro subway), its relation to their everyday movement, and its effect on their relationship with their own car.

2.5. Solving Possible Injustices for the Promotion of Sustainability

The solution to many injustices concerning public services can be found in Mobility as a Service (MaaS), which focuses on the idea of putting users at the core of transport services based on their individual needs. Several studies have implemented different transport system models for estimating the effects of decision makers’ actions on Maas [62–64]. Different evolutions of MaaS (e.g., T-MaaS and I-MaaS) take into account additional aspects of the matter. For example, S-MaaS considers network design and demand management classes [65]. In general, MaaS is an opportunity to address mobility challenges as they relate to sustainability [66]. Therefore, the MaaS concept not only can assist possible social and spatial injustices, but it can also promote the sustainability that every city should strive for.

Furthermore, the injustice in public services forces people towards the use of private vehicles. Additionally, many delivery services are forced to use the roads, a fact that creates negative impacts on society in terms of emissions, crashes, noise, and vibration. Therefore, several studies have been developed concerning city logistics [67,68] in order to promote sustainability in the city.
2.6. Analyzing Attitudinal Variables

Attitudes, behaviors, and other variables that may not be directly observed (such as willingness) create measurement difficulties, especially when they are requested to be included in an analysis. These indirectly observed or unobserved variables are also called latent variables. They are indirectly measured through other variables that are sometimes recorded through the answers to attitudinal questions in surveys.

In several analyses, the initial steps are focusing on uncovering structure in the data that can then be used to formulate and specify statistical models. In some cases, these situations arise in observational settings when the study is exploratory, and there are not well-articulated theories regarding the structure of the data [69]. There are several methods for uncovering the data structures. Some of the most well-known method pairs used for examining the structure in multivariate data and for dealing with the latent variables are Exploratory Factor Analysis (EFA) and Structural Equation Modeling (SEM). For instance, Liu et al. (2018) [70] implemented EFA and SEM for examining the risk factors for the safety of metro construction in Wuhan, China, and Dimitriou et al. (2016) [71] implemented different SEM models for investigating the global road fatalities in 121 countries.

EFA has been implemented in several studies for identifying latent constructs. For example, Majumdar and Mitra (2015) [72] used EFA for constructing a theory concerning the latent factors that influence bicycle mode choice in a small Indian city (Kharagpur). Another implementation of EFA was in the study of Opuni et al. (2022) [73], where they used this method for analyzing self-reported questionnaires of 625 residents in the Accra Metropolitan Area (Accra Metro), Ghana for identifying any association between pro-environment behaviors and consumption and between pro-environment behavior and neighborhood walkability.

SEM is a trustworthy method that can incorporate multiple relations of attitudinal, social, economic, and demographic factors and provide estimates of the relationships. A similar implementation of this method has been followed by [74] for capturing the influence of attitudes and objective walking accessibility on perceived walking accessibility and the consequences for realized walking behavior. Triches Lucchesi et al. (2021) [75], used SEM models for evaluating whether there was an impact of walkability on multifamily residential property prices in two Brazilian cities where pedestrian-oriented urban environments were scarce and where modal choice is conditioned by economic constraints. They also used SEM to explore the relationship between various constructs using data collected by means of a survey of public transit users in the Metropolitan Area of Lisbon, Portugal. An extended form of SEM, namely the Partial Last Square-SEM (PLS-SEM) was used in [76], which analyzed the interrelationships among service quality factors of the Metro Rail Transit System in Delhi, India.

Overall, both methods are trustworthy for analyzing different datasets that are obtained from surveys. The combination of both methods is also implemented in this paper for the case study of an area in Thessaloniki, Greece (municipality of Ampelokipoi-Menemeni).

2.7. Contribution to the Existing Literature

The current study has developed a straightforward methodology for analyzing the factors that affect the WTP of the residents in the municipality of Ampelokipoi-Menemeni for the restoration of the urban environment under a plan aimed at creating pedestrian/cycling facilities that will encourage the use of public transportation. Furthermore, this study deepens its analysis by investigating the groups that are unwilling to pay towards this purpose. This analysis focuses on the social and spatial aspects of injustice that the residents may feel. The overall investigational techniques and methods contribute to the existing literature and provide support to studies that analyze datasets that may include latent factors and also for investigating injustices in public services.
3. Methodology

3.1. Framework

Analyzing the characteristics of intention or preference of the people towards financial contribution to the local authority for the improvement of the infrastructure cannot be directly analyzed with a classic linear model. The challenges that arise from the analysis of behavioral factors, such as intention, are that those variables are not directly measured and are named latent variables.

Interest might also be centered on the role of education or socioeconomic status, which are also difficult to measure directly. In many analyses, the initial steps attempt to uncover structure in the data that can then be used to formulate and specify statistical models [69].

There are several methods that can be used for revealing data structures, such as Principal Component Analysis (PCA) and Exploratory Factor Analysis (EFA). However, EFA is based on a specific statistical model, whereas PCA is not. Additionally, EFA relies on the correlation matrix, and thus EFA is suitable for variables measured on interval and ratio scales [69]. Furthermore, for dealing with the unobserved or latent variables, an appropriate method should be developed. Structural equation modeling is designed for the analysis of relationships between latent variables, which can also estimate the factor scores for individual subjects. Therefore, this study uses both methods for the analysis of the WTP in the municipality of Ampelokipoi-Menemeni [77].

3.1.1. Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) reduces the variables’ number to a smaller set of parsimonious variables. In detail, it identifies possible latent structures in a dataset by describing the covariance between many variables. Besides this, EFA relies on correlation analysis, and thus it is suitable for variables measured on interval and ratio scales [69]. The EFA model is formulated in Equation (1):

\[(X - \mu)_{p \times 1} = L_{p \times m}F_{m \times 1} + \epsilon_{p \times 1}\]  

where \(F\)’s are factors, \(l_{ij}\)’s are the factor loadings. The \(\epsilon\)’s are associated only with the \(X_i\)’s, and the \(p\) random errors and \(m\) factor loadings are unobservable or latent. With \(p\) equations and \(p + m\) unknowns, the unknowns cannot be directly solved without additional information. Factor loadings that are either close to one or close to zero are sought. A factor loading close to one suggests that a variable \(X_i\) is largely influenced by \(F_j\) [69].

Overall, EFA is an appropriate method for identifying latent structures in the dataset and for identifying and dealing with collinear variables. Therefore, only statistically significant variables that explain latent constructs will be identified throughout this analysis.

3.1.2. Structural Equation Modeling

Structural Equation Modeling (SEM) is designed for dealing with several difficult modeling challenges, especially in some cases where the variables of interest to a researcher are unobservable (latent) and are measured using one or more exogenous variables, endogeneity among variables, or complex underlying social phenomena [69].

Some of these social phenomena are attitudinal characteristics that affect decision-making policies but are not directly observed. Therefore, observed variables which are answers to attitudinal questions can reflect on these latent variables.

When measurement errors in independent variables are incorporated into a regression equation, the variances of the measurement errors in the representatives are transmitted to the model error, thereby inflating the model error variance. The estimated model variance is thus larger if no measurement errors are present. Therefore, this has a detrimental effect on standard errors of coefficient estimates, and goodness-of-fit (GOF) criteria. If the parameters are estimated using Ordinary Least Square, then parameter estimates are biased and are a function of the measurement error variances. The SEM framework resolves potential problems by incorporating measurement errors into the modeling framework,
and it can also accommodate a latent variable as a dependent variable, which cannot be done by a classic regression model [69].

A dependent variable in an SEM diagram is a variable that has a one-way arrow pointing to it. The set of these variables is collected into a vector $\eta$, while independent variables are collected in the vector $\xi$ [69]. The formation of the SEM equation is provided in Equation (2):

$$h = \beta \eta + \gamma \xi + \epsilon$$

where $\beta$ and $\gamma$ are estimated vectors of coefficients that contain regression coefficients for the dependent and independent variables, respectively, and $\epsilon$ is a vector of regression errors.

### 3.2. Description of the Survey

In this case study, the circular buffer method was used by a particular subway stop at a distance of 400 to 800 m. The attitude studied was citizens’ intention to walk to reach the station or to use another means of transport, such as the bus. The study also investigated the effect of land use, the location of the station, and various infrastructure that could be constructed to improve the conditions for movement, such as sidewalks or pedestrian pathways, curb ramps, street lighting, street crossings, or resting places. In a more general context, the existence of pedestrian-friendly zones, through the perspective of the pedestrians themselves, were studied as to their ability to encourage citizens to walk.

In the first stage we present our research on existing infrastructure, such as roads or sidewalks leading to the station. Later, qualitative research is carried out using a questionnaire given to a suitable sample of residents in the area, which includes people with different demographic features (age, educational level, income, and ownership) who reside different distances from the station. Emphasis was placed on residents who live permanently in the area and have their own place of residence as opposed to those who are temporarily staying in the area and renting their place of residence. The number of residents was selected around the station with an interview request.

### 3.3. Methods

Traveling to a destination in a city on foot or deciding to ride public transit $i$ is influenced and based on many factors and a complex set of abilities and circumstances, including personal mobility, availability of alternatives, cost of service, safety in getting from origin to stop and stop to destination [78], travel barriers along pedestrian paths, and other factors. All of these can affect the method chosen in a study of public transport accessibility. Generally, it depends on the factor that is crucial for the expected results, but it also depends on the scale of the space studied.

An important aspect of spatial accessibility is the time that pedestrians must spend reaching a bus station or, in this case, the metro station. This time is variable for the individual and depends on many different factors, such as the distance of the station, the pedestrian’s mobility, and the duration of time spent waiting at traffic lights. The importance of these factors has to do with the surrounding area. The presence of sidewalks increases the potential number of trips [79] and the likelihood of walking [80–83]. The quality of a pedestrian environment is a strong predictor of walking behavior and travel on foot [84]. Conversely, difficult walking conditions reduce the likelihood of walking in lieu of driving [85]. The circular buffer method model of spatial accessibility to public transport considers the factor of the distance as the only barrier to reaching the destination. The field of influence is two different circles (two bands). The first one is about 400 m from the station (in many studies it is referred to as $\frac{1}{4}$ of the mile), and the other circle is about 800 m from the station (in many studies it is referred to as $\frac{1}{2}$ of the mile), each defined as the time it takes a pedestrian to reach the station by walking. The first boundary is a line about 400 m long, which indicates that the individual must walk about 5 to 7 min (high accessibility), and the second boundary (800 m) is about 5 to 10 min of walking, characterized as a moderate accessibility level.
The methodology in this study was real-time interviews of people who live in Ampelokipoi urban district. Every interview was about 7–12 min. The questionnaire was anonymous and given to people who agreed to participate after they were informed about the purpose of the investigation. The questionnaire was simple and comprehensive, with questions that had a degree of preference as to the existing infrastructure, their desire to improve them, their opinion, and their behavior with respect to the metro in combination with the bus network. The interview was accompanied by a map of the area with the populated areas in the city. This kind of approach, with the suggestion on a map, can help substantially in the later evaluation of the results in terms of their correlation between the distance that is farthest from the point of interest (the station) and the person’s likelihood to walk or cycle that distance, as well as an estimation of the level of accessibility.

Appendix A presents the questions included in the questionnaire and the variables that are created based on them.

3.4. Case Study

In this paper, we investigate the urban district of Ampelokipoi in Thessaloniki. It belongs to the municipality of Ampelokipoi-Menemeni and is located at the western part of the city of Thessaloniki, which is the second largest city of Greece. According to 2011 census data, the population of the Metropolitan area of the city of Thessaloniki was 1,012,013 residents. The city occupies approximately 1712 km$^2$. The district of Ampelokipoi covers a total area of 19.8 km$^2$ with 52,127 residents (in 2011). It is one of the most densely populated areas in the city.

Ampelokipoi urban district is home to a low- and medium-income population [86,87]. Unplanned development led to the creation of a district that lacks open spaces, greenery and parks, adequate walking networks, and urban facilities. In 2010, Ampelokipoi and Menemeni were combined into one municipality. The district is next to the industrial area of Thessaloniki, with the railway line to the southwest and other residential areas to the northeast (Figure 1).

![Figure 1. This is a figure. Schemes follow the same formatting (Background map: © OpenStreetMap contributors [88]).](image-url)
Thessaloniki is constantly growing. Although the areas that are developing more slowly tend to acquire independence from the city center, many residents are inextricably linked to the center and the use of its land, either for work or entertainment purposes. Therefore, the transit system that has developed unites the surrounding areas with the center, which is a point of attraction for many people, in the most compatible way, improving access to public transport and freeing citizens from the need for use of a private car. The city has had to provide its residents the opportunity to reach their desired destinations easily, safely, and quickly. Many studies have shown that the accessibility is defined by land use, transport, and the characteristics of each individual [42]. In 1957, Thessaloniki began its network of buses for the separation of its inhabitants, which continues to this day. Since 1976, the process of building an underground urban metro transit system began to improve the existing situation of the movement of citizens to and from the city center. Thus, with the metro system being under construction and the bus network as the only source of transportation, combined with the rapid development and sprawl of the city, individuals are now confronted by many challenges and often resort to the use of a private car in order to ensure safety, comfort, and convenience, regardless of potential time loss due to road traffic. Overall, Thessaloniki, as a modern city, faces the major challenge of instituting more sustainable urban development strategies, including restriction of car use, institution of public transport of various types, and provision of opportunities to pedestrians to get to places and facilities essential for everyday life in a reasonable time, using appropriate infrastructure and means.

Under these circumstances, controlled parking in the city center is applied, separating areas, giving priority to the permanent residents of the center with appropriate marking and limited parking time to visitors. Separate parking spaces are also applied for motorcycles and bicycles to avoid parking on the sidewalks and in the effort to increase quality space for pedestrian movement and preservation of the long-term space of the sidewalks. This aims to reduce private car use in the city center, which involves preventing its extensive use, thus contributing to the reduction of emergencies caused in urban spaces, reducing traffic on road axes, improving bus traffic by making shortening routes, and more generally the prosperous development of the city center. Previously, the creation of pedestrian spaces on central axes had been studied in the center to effectively reduce the use of the private car to central urban areas. Clearly, this is currently not implemented, except in minimal ways, given the fact that improvement of the bus network is required, including the stations, the maintenance of vehicles, the increase in routes, reduction of standby time at the stations as well as the density of individuals, etc.

4. Results

The dataset that was collected from the survey included answers from 402 participants. Prior to any implementation of the methodology, it was decided to remove inconsistent records from the dataset. In particular, some of the participants provided contradictory answers at the time of the survey, which created problems in the outcomes of the analysis and especially for the interpretation of the results. Therefore, a test question was added to the survey (Question 7). This question included contradictory answers, and participants were asked to provide two answers. As a result, 164 of the 402 participants provided contradictory answers to this question, and thus these 164 records were omitted from the dataset as untrustworthy for inclusion in the analysis.

In general, the sample size is determined by two factors: the confidence interval and the confidence level. The confidence interval measures the degree of uncertainty in the survey, the level of confidence of the given results when these are reflected to the entire population of the study. The confidence level refers to the percentage of certainty that the confidence interval would contain the true population parameter if a random sample were drawn many times. A confidence interval of 95% and a margin of error between 5% and 7% are considered appropriate for a reliable sample size in studies regarding WTP and factor analysis. Therefore, for the given total population of 52,127 residents of the municipality,
a 95% confidence interval and 5% confidence level (regarded as the basis of the margin of error calculation for the most unfavorable distribution of answers, which is 50%—50% in absence of bias) require a sample size of 382 participants. Also, for a 95% confidence interval and a 6.5% confidence level (distribution of 50%—50% in absence of bias), a sample size of 227 participants is required. Hence, both of the sample sizes, 402 and 238 in each case, are above the minimum required levels.

The following sections present the results of the analyses implemented for the purposes of this study.

4.1. Analysis of the Willingness to Pay

After concluding with the dataset, the methodological framework was developed. The first stage of this study’s methodological framework was the implementation of the Exploratory Factor Analysis (EFA). As described in the previous section, EFA is an appropriate method for identifying latent structures inside a dataset that can be drawn from the observations obtained from the attitudinal questions of the survey and for cleaning the dataset of collinearities. For identifying these latent structures, a straightforward process must be followed by implementing different tests.

The first tests are the Kaiser–Meyer–Olkin (KMO) measure of Sampling Adequacy and the measure of Bartlett’s Test of Sphericity. The rule of thumb for the KMO measure suggests that it should be above 0.5 and the measure of Bartlett’s Test of Sphericity to be significant. For meeting both rules, some of the variables had to be omitted from the analysis, and the final set of variables appeared to meet both rules (Table 1).

| Table 1. KMO and Bartlett’s Test. |
|-------------------------------|
| Kaiser–Meyer–Olkin Measure of Sampling Adequacy | 0.516 |
| Bartlett’s Test of Sphericity | Approx. Chi-Square | 132,637 |
| | df | 10 |
| | Sig. | 0 |

After the validation of the dataset’s significance, the next step was the identification of the number of latent variables that exist in the dataset. The number of factors can be extracted from the factors that have an eigenvalue equal to and above one. Therefore, based on the eigenvalues, the extracted number of latent factors was two. Table 2 presents the remaining variables in the analysis, which of the two factors are related, and the extent of their relation (coefficients). As can be seen, the observations obtained from questions 6B, 5C, 6A, 4B, and 4C from the questionnaire (Appendix A) are those related to the two latent factors. Latent Factor 1 seems to be related to questions 6B, 5C, and 6A, and thus Factor 1 will be called “Route Selection”. As for latent Factor 2, it is related to questions 4B and 4C, and thus the name we give to Factor 2 based on the two variables (questions) is “Encouragement Towards Walking”.

| Table 2. Latent Factors Obtained and their Relationship with the Observed Variables. |
|-------------------------------|
| Factor | 1 | 2 |
| Route Selection 2 | 0.737 |
| Discourage Walking 3 | 0.411 |
| Route Selection 1 | 0.586 |
| Encourage Walking 2 | 0.984 |
| Encourage Walking 3 | 0.416 |
It must be also noted that the demographic variables were not included in the EFA; instead, they were used directly in SEM.

After the implementation of the EFA, the next step was the development of an SEM model that would be able to analyze the relationships between these latent factors and their overall relationship with the intention/willingness to provide financial assistance to the local authority for improving the infrastructure close to the metro station.

The SEM measurement model that was developed reflects where a latent variable is posited as the common cause of items and the causal action flows from the latent variable to the indicators. In the SEM reflective model, the demographic variables, where included, are explained as a third latent factor. However, due to the statistical insignificance of the SEM model in its initial form, several changes were implemented form a more robust model, which led to the omission of several observed variables and even one of the latent variables.

Figure 2 presents the final form of the SEM reflective model after omitting the nonstatistically significant variables. At this stage, it appeared that the second latent factor, which is explained in questions 4B and 4C, has a negative effect on the model’s fit, and thus it was omitted from the model.

![Figure 2. Diagram of the SEM Reflective Model.](image)

As can be observed from the figure, there are two latent factors. The first one was obtained from the EFA (Factor 1—“Route Selection and Discouragement Towards Walking”), and the second one included the economic and demographic characteristics of the participants (Factor 3—“Economic/Demographic Characteristics”).

The results of this model can be used to inform the policy-making strategy that the local authority must follow for collecting, voluntarily, money from the people and investing in the infrastructure in the region around the metro station. However, prior to the interpretation of the model for policy-making purposes, it is essential to confirm that the model is robust and trustworthy, in terms of statistical significance. In order to do that, Goodness-of-Fit (GoF) measures were used, as presented in Table 3. As can be seen from the table, the final SEM reflective model is robust and thus can be used for interpretations with the support of the local authority.

Table 4 presents the regression weights of the relationships between observed and unobserved variables with their significance (Standard Error (SE), Z-value, and p-value). As can be seen from this table, both latent factors seem to have a positive effect on people’s intention to voluntarily offer money to the local authority for investing in the infrastructure close to the metro station within the area of the municipality of Ampelokipoi-Menemeni.

Regarding the observed variables of the first latent factor (“Route Selection and Discouragement Towards Walking”, or F1), it appears that the variable “Route Choice 1” has a negative direct effect on the latent factor (“Economic/Demographic Characteristics”, or F2) and thus a negative indirect effect on the intention for financial support of the local authority for investing in the infrastructure. The interpretation of the variable “Route Choice 1” is the first criterion that people use for the selection of their route. Based on
the responses provided by the participants, 71% of them answered that this criterion is that their origin and destination must be very close together. Therefore, the negative value here can be interpreted to mean that those people who prefer their route to be within the minimum distance are not interested in financially supporting the local authority. As for the other variables, such as “Route Choice 2” and “Discourage Walking 3”, they have a positive indirect effect on the intention to financially support the local authority.

Table 3. GoF measures of the SEM reflective model.

| Fit Statistics                  | Cut off Criterion | Obtained |
|--------------------------------|-------------------|----------|
| $\chi^2$                       | -                 | 8.496    |
| degrees of freedom (d.f.)       | -                 | 7        |
| $\chi^2$/d.f.                  | <3.0              | 1.214    |
| Goodness-of-Fit Index (GFI)     | >0.95             | 0.99     |
| Adjusted Goodness-of-Fit Index (AGFI) | >0.90         | 0.97     |
| Comparative Fit Index (CFI)     | >0.95             | 0.99     |
| Root Mean Square Error of Approximation (RMSEA) | <0.08         | 0.03     |

Table 4. Regression Weights $\leftarrow$.

|                       | Estimates | SE  | Z-Value | p-Value |
|-----------------------|-----------|-----|---------|---------|
| Discourage Walking 3 $\leftarrow$ F1 | 1.00      |     |         | ***     |
| Route Choice 2 $\leftarrow$ F1   | 1.36      | 0.41| 3.30    | ***     |
| Route Choice 1 $\leftarrow$ F1   | -0.82     | 0.20| -4.19   | ***     |
| Age $\leftarrow$ F2             | 1.00      |     |         |         |
| Income $\leftarrow$ F2          | 0.24      | 0.08| 3.03    | 0.002   |
| Intention for Financial Support $\leftarrow$ F1 | 0.05    | 0.05| 1.04    | 0.298   |
| Intention for Financial Support $\leftarrow$ F2 | 0.19    | 0.06| 3.00    | 0.003   |

Note: ***: Significance level at 0.001. F1: Route Selection and Discouragement Towards Walking. F2: Economic/Demographic Characteristics.

As for the latent factor “Economic/Demographic Characteristics”, it is measured by the observed variables “Age” and “Income”, which have a positive indirect effect on the intention to financially support the local authority.

The results above have revealed several aspects that a local authority/community should address for creating a just environment for all commuters using the metro station and thus contributing, in financial terms, to the improvement of the infrastructure in its surrounding region. As shown in the analysis, several factors determine the way residents use the public space and, in specific, the area surrounding the metro station. For example, there are factors that encourage or discourage walking that play a significant role in people’s mobility decisions and route choices. These factors derive from urban characteristics, such as the condition of the sidewalks, the existence of greenery along the routes, the degree of mixed land use, etc. Not all of these elements are evenly distributed over the case study area. Greenery is limited and restricted to specific sections, mixed land use is high along certain routes, while others suffer from total absence of it, sidewalks are mostly in bad condition, with the exception of certain routes, etc. In this context, not all residents of the area enjoy the same quality of public facilities in their artificial environment. Many of them may even live in parts of the area deprived of any such amenities. In addition, several demographic elements, such as age and income, have also been shown to play an important role in people’s decisions. If, for example, age or income is a factor that discourages residents from certain mobility choices, this leads to the conclusion that several factors in urban planning should be reconsidered, in order for people to be able to enjoy walking regardless of their age or their income. In these terms, spatial injustice is explained and further investigated.
Besides the above investigation, it is also considered important to analyze the “measure” of injustice that exists in relation to the people not financially contributing to the community or towards the improvement of the infrastructure around the metro station. Therefore, the next section was developed to provide a thorough analysis of injustice within the area of the municipality of Ampelokipoi-Menemeni.

This injustice is reflected through the residents’ expressed WTP. Therefore, all of the factors previously presented affect either the positive or negative WTP. Hence, the willingness to contribute financially is a decision connected to the existing spatial distribution of amenities and, therefore, reflects the spatial injustice involved in it.

These elements also need a more elaborate analysis presented on maps, as they appear in the specific urban environment of the municipality of Ampelokipoi-Menemeni. Geospatial analysis that shows residents’ spatial distribution along with the design of public amenities is a useful tool for documenting the existing spatial injustice in the area. This analysis is presented in the two following sections.

### 4.2. Spatial Injustice

This section analyses the injustice that people feel, and thus it represents their unwillingness to pay for improving the existing infrastructure in the area around the metro station. The first analysis was focused on identifying those residents who live farthest from the metro station, for whom it would be difficult to travel to the metro station. Due to this distance, these residents would possibly decline to willingly pay for improving the infrastructure around the metro station. The identification of these areas was achieved with a geovisualization of the municipality and inside a buffer zone around the metro station in terms of time and distance. For example, Figure 3 presents three different buffer zones of 200 m, 400 m, and 800 m which appear to cover almost all of the residential area of Ampelokipoi (east side of the municipality) but not the area of Menemeni (west side of the municipality). However, the residential areas that are outside the buffer zones appeared to be serviced the least from the bus system, and thus some people there may use the bus system to travel to the metro station, while others would not even consider using the metro if they are already satisfied with the bus system.

![Figure 3. Buffer zones of 200 m, 400 m, and 800 m around the metro station (Background map: © OpenStreetMap contributors [88]).](image-url)
Besides the buffer zone, it is important to know the distance an average person covers from the metro station around the region by walking. Figure 4 represents the walking distance around the metro station in 5 min, 10 min, and 15 min. As in the buffer zones and the isochronic area, it seems that a very small area of the Ampelokipoi region and a larger region of Menemeni are not covered, which again are areas of injustice for the local commuters.

**Figure 4.** Walking distance of 5 min, 10 min, and 15 min from the metro station (Background map: © OpenStreetMap contributors [88]).

Based on Figure 5, in order to cover all of the residential areas of the municipality inside the 15 min range, the local commuters must consider the alternative of using a bike instead of walking. However, this assumes the use of a bicycle where no cycling infrastructure exists. However, based on the answers in the survey, only 4% of the participants use a bike for their commute, and only 2% are willing to use a bike for traveling from their home to the metro station, which does not help the problem of injustice.

Furthermore, according to the participants, the third most important reason for walking instead of using an alternative mode of transportation is if the route has a variety of land uses (e.g., supermarkets, shops, services, etc.) and thus is a pleasant route. Also, their second criterion for selecting a route is that the route should include shops and services even when the route is longer than normal. Therefore, Figure 6 represents the Points of Interest (POIs) of the region and a buffer zone of 50 m as an intermediate space between consecutive POIs, making the route more and more likely to be used for walking and to reach the metro station. It seems from this figure that the POIs inside the 800 m buffer zone around the metro station are very densely packed, a fact that creates a “picture” of the possible routes that people may used for reaching the metro station. Instead, the west area of the municipality (Menemeni’s area) does have some POIs which are sparsely scattered but can be used by a proportion of the population for the creation of routes toward the metro station.
These areas of injustice include most of the west side of the municipality (inside the area of Menemeni) and a small part of the east side of the municipality (Ampelokipoi). Therefore, to make these areas more just in terms of mobility, it is important to consider even those areas outside the 800 m buffer zone. One measure that could be helpful towards this shift towards justice is the pedestrianizing of some roads and thus the creation of a more pleasant area that people would choose to include in their route to the metro station.

Figure 5. Walking distance of 5 min, 10 min, and 15 min from the metro (Background map: © OpenStreetMap contributors [88]).

Figure 6. Points of Interest in the area (Background map: © OpenStreetMap contributors [88]).

Overall, the geovisual analysis of the information of the residential areas in the municipality of Ampelokipoi-Menemeni revealed areas of injustice in which the people are most possibly unwilling to pay for improving the infrastructure in the area near the metro station. These areas of injustice include most of the west side of the municipality (inside the area of Menemeni) and a small part of the east side of the municipality (Ampelokipoi). Therefore, to make these areas more just in terms of mobility, it is important to consider
even those areas outside the 800 m buffer zone. One measure that could be helpful towards this shift towards justice is the pedestrianizing of some roads and thus the creation of a more pleasant area that people would choose to include in their route to the metro station.

4.3. Social Injustice

This section analyses the social injustice that exists for the people who are financially incapable of contributing to the local authorities for improving the existing infrastructure around the metro station. For this purpose, a cluster analysis was performed using only the income and the residential status (owner or renter) of the people who said they would not financially contribute to the local authorities for improving the infrastructure around the metro station. Two clusters were created based on this information, and they are depicted in Figure 7. As can be observed from this figure, “Cluster 1” comprises only renters (residential status) with low and medium income, and “Cluster 2” comprises only owners (residential status) with a variety of incomes.

Figure 7. Clustering of the socioeconomic status of the participants who are unwilling to pay.

Therefore, both groups face social injustices, to different extents. For example, people that belong in the first cluster have the characteristic of a relatively low income and a residence that could possibly change on an annual base. Therefore, this group of people could be considered financially able to pay, but more importantly, most of the people in this group may think themselves likely to move to another region, and thus this metro station will not be of interest to them.

As for the second group, the people in Cluster 2 have more reason to contribute financially towards the improvement of the existing infrastructure around the metro station due to the added value that their property will gain. However, the injustice here is that these people may believe they will have to make this payment on behalf of the others who are unwilling or unable to pay, and they may be hesitant to pay due to that notion, with the result that the community will ultimately not proceed with the improvement of the existing infrastructure.

Overall, the social injustice that the people from each cluster feel is adequately justified. However, the local authority/community should find ways for providing privileges to the people from both groups to increase their willingness to pay for the improvement of the existing infrastructure around the metro station. For instance, the people in the first group
(Cluster 1) could be afforded a lower rate for using these metro stations if they contribute to the metro station in the municipality of Ampelokipoi-Menemeni, and the people from the second group (Cluster 2) can be reassured that the metro station is likely to increase the commercial activity of the area and thus increase the overall value of the area (e.g., [89]). Therefore, the resolution of these injustices is vital for achieving these goals and collecting the necessary amount for the investments that the municipality needs in order to proceed with these improvements.

5. Discussion

The present study examined the factors influencing the willingness of the residents of the municipality of Ampelokipoi-Menemeni (Thessaloniki, Greece) to voluntarily contribute funds to the local authority to be invested in improving the existing infrastructure in such a way that will encourage residents to walk to the metro station, thus addressing the First and Last Mile problem. For the purposes of this study, a survey was conducted in the municipality, and a total of 402 questionnaires were completed.

The structure of the questionnaire was designed in such a way that it would be possible to identify faulty completions, i.e., questionnaires that were completed by the participants in a rushed manner, which we detected by the use of contradictory answers. Based on this structure, it was possible to identify 164 faulty completions, and these were omitted from the final dataset. The question that was developed for identifying these misleading answers was Question 7 (Table A1, Appendix A) where each participant was asked at the beginning if they intended to use the metro for their travel and to declare the reason. Then each participant was again asked the same question, but then was asked to provide a second answer to the same question at their pace. Some of the participants kept their original response/intention (yes/no to using the metro) but changed the reason; these were considered acceptable questionnaires. But those that changed their intention were considered “fault cases”.

Therefore, the final dataset included attitudinal information from the participants; thus, it was believed that this sample may also include unobserved (latent) structures that might be related to the willingness to financially contribute to the local authority. In order to uncover the possible existence of latent structures, Exploratory Factor Analysis (EFA) was implemented, which indeed revealed the existence of two latent structures that have interrelationships with some of the observed variables. Additionally, EFA is a suitable method for recognizing the possible existence of collinear variables which were omitted from the dataset. The variables that remained in the sample were “Route Selection 2”, “Discourage Walking 3”, and “Route Selection 1”, all three connected with the first latent factor, and the variables “Encourage Walking 2” and “Encourage Walking 3”, which were connected with the second latent factor.

Afterward, the uncovering of the latent factors in the dataset the analysis continued with the estimation of the direct effect of the latent variables and the indirect effect of the observed variables on peoples’ willingness to voluntarily pay. A straightforward method that can provide these estimations is Structural Equation Modeling (SEM). In addition to the two latent factors, one extra latent factor was added to the analysis which relates to six observed variables (socioeconomic and demographic characteristics of the participants: Questions 14–19). These observed variables were not included in the EFA, since they are formative measures. The obtained SEM model was statistically evaluated based on some Goodness-of-Fit indices (e.g., RMSEA), and it appeared that some of the observed and even latent variables were cut off from the model. The concluded variables that remained in the SEM model were “Route Selection 1”, “Route Selection 2”, and “Discourage Walking 3”, which related to the first latent factor. The other latent factor had connections with the observed variables “Age” and “Income”. Based on the meaning of the observed variables, a name was provided for each of the latent factors. For example, the first latent factor was named “Route Selection and Discouragement Towards Walking”, or “F1”, and the second latent factor was named “Economic/Demographic Characteristics”, or “F2”, respectively.
The results showed that both latent factors have a positive direct effect on the willingness of the people to pay. Concerning the observed variables of the latent factor “Route Selection and Discouragement Towards Walking”, it seems that “Route Selection 1” has a negative, indirect, relationship with the willingness to pay, in contrast with the other variables, which have a positive relationship. In detail, based on Table A1 (Appendix A), on question 6A (variable “Route Selection 1”), most of the participants answered that the shortest path is their first criterion for selecting a route. Therefore, people prefer to walk shorter distances. As for question 6B (variable “Route Selection 2”), most of the participants answered that as a second criterion for selecting a route, they prefer that their route should include shops and services, even when the route is longer than normal. Gupta et al. (2022) [90] also identified that land-use diversity and neighborhood design positively influence people’s choice of walk mode using the metro station in Delhi, India. In the third observed variable (“Discourage Walking 3”), most of the participants answered that an unsafe route is the third most discouraging thing that prevents them from walking to get somewhere. Safety and security are also identified by the people in Delhi, India as important factors for walking to the metro station [91].

Age and income appeared in the SEM model to have a positive, indirect relationship with the willingness to pay. This means that older people with higher incomes are more willing to pay. However, perceptions of walking accessibility are not directly affected by individual circumstances such as age, income, education, or gender [74].

As shown in the work of Campisi et al. (2020) [92], walkability is inseparably related with the infrastructure. Also, based on the study of Basbas et al. (2020) [93], the construction of a metro station in the municipality of Kalamaria (Thessaloniki Metropolitan Area, Greece) is expected to further increase the pedestrian flows. Therefore, improving pedestrian infrastructure around the metro station can enhance the perception of walkability and therefore the willingness to pay an amount towards this target. However, some of these attributes cannot be easily changed for improving walkability, and even in case of those willing to pay, this amount is not enough for enhancing all the pedestrian structures in the municipality. Therefore, it is essential that local authorities be able to identify the most important factors that the residents of the municipality require to increase their willingness to pay. However, there will be always a proportion of the people who will not willingly pay for this purpose due to different injustices (e.g., spatial and social injustice). For instance, the people that live far from the metro station are not willing to pay because long distances are considered a barrier to walking. Notwithstanding this fact, there is also a very high percentage of people who are willing to walk a long distance if the route includes shops, services, etc., and thus integrating these shops or services into pedestrian routes would mean increasing their willingness to pay. Based on that, there are some roads that include a high density of Points of Interest (POIs), a fact that makes the people more willing to walk on these roads/areas and thus to pay. There is also the social injustice, where there are people with different financial backgrounds and different property statuses (owner and renter) who might consider it unfair to pay when other people are not paying. There is a group of people with low income who are renting in the area and are unwilling to pay due to their low income, but also because they probably consider themselves to be impermanent residents of the area. Therefore, the group of people with better financial conditions who are also property owners feel injustice, because they will have to financially contribute a larger amount to cover for those who cannot pay.

6. Conclusions and Remarks

Based on the results of this study, it seems that the local authorities must ensure the safety of the resident’s routes, since the feeling that walking is dangerous is limiting their WTP. This can be achieved by installing more streetlights, traffic signs, etc. As for those who select only short distances to walk, local authorities should install share modes of transportation (e.g., a bike-sharing system) so that commuters will use bikes or other alternative modes travel. Furthermore, the local authorities should pay attention to how to
make the area around the metro station more pleasant so that people, even from distant locations, will find the route more friendly and choose to walk to the metro station.

Moreover, the local authority should consider approaching more elderly people with higher incomes as a possible strategy for collecting the funds needed to create pedestrian/cycling facilities that will encourage the use of public transportation.

Besides the above conclusions drawn from the results of this study, it is evident that the local authority should also support the groups of residents that feel a social or spatial injustice, and thus are unwilling to pay. There are several countermeasures that the local authorities of the municipality can take to overcome this injustice. For instance, owners can be reassured that the worth of their property will increase, and renters could be given a discount for using the metro in Thessaloniki.

Overall, this study’s analysis revealed the policy-making strategy that local authorities should follow for achieving an increased willingness of the people to pay for the improvement of the infrastructure around the metro station, thus resolving the critical problem of the First and Last Mile.

With the outbreak of COVID-19, it is more important than ever to investigate the factors influencing people’s WTP. In order to be able to proceed with this analysis, it will be necessary to compile a robust dataset through surveys of the residents of the municipality. Additionally, future research will analyze the possible existence of injustice and how this is moderated compared to the period prior COVID-19.

Author Contributions: Conceptualization, O.T., S.G., A.A. and S.B.; methodology, O.T., P.N., S.G., A.A. and S.B.; software, P.N.; validation, O.T., P.N., S.G., A.A. and S.B.; formal analysis, O.T., P.N., S.G., A.A. and S.B.; investigation, O.T., P.N., S.G., A.A. and S.B.; resources, O.T., S.G., A.A. and S.B.; data curation, O.T., S.G., A.A. and S.B.; writing—original draft preparation, O.T., P.N., S.G., A.A. and S.B.; writing—review and editing, O.T., P.N., S.G., A.A. and S.B.; visualization, P.N.; supervision, S.G., A.A. and S.B.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Informed Consent Statement: Informed consent was obtained from all who were involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Questions included in the questionnaire.

| Abbreviation       | Description                          | Measurement Scale                                                                 | Descriptive Statistics |
|--------------------|--------------------------------------|-----------------------------------------------------------------------------------|------------------------|
| Residency          | Residency in study area              | 1: Live here since birth; 2: Live here >10 years; 3: Live here <10 years          | 1: 37%; 2: 47%; 3: 16% |
| Mode               | Most frequent transportation mode     | 1: Walking; 2: Bicycle-Lime; 3: Private vehicle/motorcycle; 4: Bus; 5: Other       | 1: 5%; 2: 4%; 3: 51%; 4: 40%; |
| Av. Walking Time   | Average daily walking time            | 1: 0’–15’; 2: 16’–30’; 3: >30’                                                 | 1: 32%; 2: 55%; 3: 14% |
| Encourage Walking 1| Location characteristics that encourage walking (Most important) | 1: Sidewalks’ net; 2: Safe route; 3: Land use mix; 4: Pleasant route; 5: Clean route; 6: Greenery on route; 7: Use of shortcuts | 1: 82%; 2: 13%; 3: 3%; 4: 1%; 5: 1%; 6: 0%; 7: 0% |
| Encourage Walking 2| Location characteristics that encourage walking (Second most important) | 1: Sidewalks’ net; 2: Safe route; 3: Land use mix; 4: Pleasant route; 5: Clean route; 6: Greenery on route; 7: Use of shortcuts | 1: 16%; 2: 61%; 3: 10%; 4: 4%; 5: 0%; 6: 0%; 7: 9% |
Table A1. Cont.

| Abbreviation | Description | Measurement Scale | Descriptive Statistics |
|--------------|-------------|-------------------|------------------------|
| Encourage Walking 3 | Location characteristics that encourage walking (Third most important) | 1: Sidewalks’ net; 2: Safe route; 3: Land use mix; 4: Pleasant route; 5: Clean route; 6: Greenery on route; 7: Use of shortcuts | 1: 3%; 2: 8%; 3: 20%; 4: 31%; 5: 13%; 6: 0%; 7: 25% |
| Discourage Walking 1 | Location characteristics that discourage walking (Most important) | 1: No sidewalks’ net; 2: Sidewalks in bad condition; 3: Unsafe route; 4: No land use mix; 5: Unpleasant route; 6: Unclean route; 7: No greenery; 8: “blind” distances, parking lots; 9: No frequent pedestrian crossing | 1: 82%; 2: 14%; 3: 1%; 4: 0%; 5: 0%; 6: 1%; 7: 1%; 8: 1%; 9: 0% |
| Discourage Walking 2 | Location characteristics that discourage walking (Second most important) | 1: No sidewalks’ net; 2: Sidewalks in bad condition; 3: Unsafe route; 4: No land use mix; 5: Unpleasant route; 6: Unclean route; 7: No greenery; 8: “blind” distances, parking lots; 9: No frequent pedestrian crossing | 1: 11%; 2: 66%; 3: 11%; 4: 7%; 5: 0%; 6: 4%; 7: 1%; 8: 0%; 9: 0% |
| Discourage Walking 3 | Location characteristics that discourage walking (Third most important) | 1: No sidewalks’ net; 2: Sidewalks in bad condition; 3: Unsafe route; 4: No land use mix; 5: Unpleasant route; 6: Unclean route; 7: No greenery; 8: “blind” distances, parking lots; 9: No frequent pedestrian crossing | 1: 4%; 2: 15%; 3: 33%; 4: 11%; 5: 14%; 6: 7%; 7: 2%; 8: 14%; 9: 0% |
| Route Selection 1 | Route selection criterion (First) | 1: Shortest path; 2: Land use mix even with longer route; 3: Pleasant route even if longer; 4: Safe route; 5: Clean route | 1: 71%; 2: 10%; 3: 4%; 4: 15%; 5: 1% |
| Route Selection 2 | Route selection criterion (Second) | 1: Shortest path; 2: Land use mix even with longer route; 3: Pleasant route even if longer; 4: Safe route; 5: Clean route | 1: 18%; 2: 34%; 3: 8%; 4: 31%; 5: 9% |
| Intention of using metro | Reasons for using/not using metro | 1: No, far from home; 2: No, it will not serve my destinations; 3: Yes, for going to work; 4: Yes, for school; 5: Yes, for entertainment | 1: 12%; 2: 24%; 3: 64%; 4: 0%; 5: 0% |
| Mode from Home to Metro | Mode of transportation home to metro | 1: Private vehicle/motorcycle; 2: Walking; 3: Bus; 4: Bicycle; 5: None | 1: 17%; 2: 62%; 3: 19%; 4: 2%; 5: 0% |
| Discourage Walking to Metro Station 1 | Discouragement of walking to metro station (Most important) | 1: Sidewalks’ bad condition, barriers, trash; 2: Unsafe crossings; 3: Long distance from parking/bus stop; 4: Bad signing on route | 1: 65%; 2: 5%; 3: 29%; 4: 1% |
| Discourage Walking to Metro Station 2 | Discouragement of walking to metro station (Second most important) | 1: Sidewalks’ bad condition, barriers, trash; 2: Unsafe crossings; 3: Long distance from parking/bus stop; 4: Bad signing on route | 1: 35%; 2: 35%; 3: 29; 4: 1% |
| Willingness to move | Willingness to relocate if it is closer to metro | 1: No, I am close; 2: No, I can’t afford it; 3: Yes, willing to pay higher rent | 1: 43%; 2: 29%; 3: 28% |
| Willingness to Pay | Willingness to pay in support of infrastructure facilities around metro station | 1: Yes; 2: No | 1: 45%; 2: 55% |
| Reasons for Supporting | Positive WTP | 1: More frequent use of metro; 2: More people will use it—reduction of car usage; 3: Improvement of the whole area and of quality of life; 4: Area improvement will have economic benefit for the residents; 5: A better place for our children | 1: 35%; 2: 30%; 3: 23%; 4: 11%; 5: 1% |
| Reasons for not Supporting | Negative WTP | 1: Financial disability; 2: Obligation of the state and municipality; 3: Not interested; 4: Other more important priorities; 5: Disbelief on money allocation | 1: 11%; 2: 28%; 3: 41%; 4: 10%; 5: 10% |
Table A1. Cont.

| Abbreviation | Description | Measurement Scale | Descriptive Statistics |
|--------------|-------------|-------------------|------------------------|
| Gender       | Gender      | 1: Male; 2: Female | 1: 50%; 2: 50%         |
| Age          | Age         | 1: 18–29; 2: 30–39; 3: 40–49; 4: 50–59; 5: 60–69; 6:70–79; 7: >80 | 1: 30%; 2: 16%; 3: 23%; 4: 17%; 5: 13%; 6: 1% |
| Education    | Educational level | 1: No education; 2: Elementary; 3: High school (3rd grade); 4: High school; 5: Vocational school graduates; 6: Technical Educational; 7: Higher Education; 8: MSc/PhD | 1: 0%; 2: 2%; 3: 2%; 4: 18%; 5: 17%; 6: 15%; 7: 41%; 8: 5% |
| Job          | Professional situation | 1: Employee; 2: Unemployed; 3: Household; 4: Retired; 5: Student | 1: 45%; 2: 18%; 3: 5%; 4: 14%; 5: 18% |
| Residence    | Owner or renter | 1: Owner; 2: Renter | 1: 37%; 2: 63% |
| Income       | Annual family income | 1: <10.000€; 2: 10.000–20.000€; 3: 20.000–30.000€; 4: 30.000–40.000€; 5: >40.000€ | 1: 41%; 2: 57%; 3: 2%; 4: 0%; 5: 0% |

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