



## **Economic Crisis and its Impact on Sustainable Urban Transport**

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### **ABSTRACT**

The paper examines the impact of the Greek economic crisis (2009-2018) and the resulted personal income reduction on the change of commuters' travel behavior. The analysis is based on an extensive questionnaire survey, which took place in six Greek cities representing 49.5% of the total urban population of the country. The questionnaire survey was conducted during the year 2017 on a random sample of 2218 individuals through personal interviews. The aim of the questionnaire survey was to draw useful and practical solutions which would reveal the actual effect of the economic crisis on commuters' travel behavior and their decision to change transport mode for utilitarian or recreational trips, by comparing the years 2008, the year before the beginning of the economic crisis, and the year 2017 when the Greek crisis reached its end. It can be conducted that the personal income reduction has a side effect on the use of private vehicles in favor of the use of public transport and of walking; thus, the crisis has a positive impact on sustainable mobility by changing the way commuters travel in urban areas and favoring more friendly transport modes from both economic and environmental point of view. The results of this survey can be a useful tool for city planners to encourage sustainable transportation so as to increase the quality of life in cities and decrease transport infrastructure investments, energy consumption and environmental degradation.

**Keywords:** Economic Crisis, Transport Elasticities, Commuters Behavior, Transportation, Sustainability

**JEL Classifications:** G01, O18, R41, R42

### **1. INTRODUCTION**

The world economy is changing very fast, so it becomes necessary to follow and adopt transport policies to every change by using the appropriate technological tools and well trained human resources, in order to find the best financial opportunities and business proposals. People and capital can travel more and more freely worldwide in order to find the best value for money and business opportunities in an era of globalization. This fact has an impact on the global financial system, because no country or enterprise can be fully protected against unexpected situations that suddenly occur.

The global financial crisis began with a crisis in the subprime mortgage market in the United States in 2007, and evolved into an international banking crisis. Excessive risk-taking by banks has helped to magnify the financial impact globally. The financial crisis was followed by a global economic downturn. Greek economic

crisis was triggered by the financial crisis of 2007-2008, the global economic downturn and the chronic structural weaknesses of the Greek economy. The Greek economic crisis seriously affected the economy of the country. Between the years 2008 and 2017, the per capita global domestic product (GDP) of Greece was reduced by 30.9% (in constant 2019 prices), compared to -0.59% in the EU-28 member countries (Eurostat, 2019). Unemployment increased in Greece from 7.8% in 2008 to 21.5% in 2017 (27.5% in 2013, 19.3% in 2018) and in the EU-28 member countries from 7.0% in 2008 to 7.6% in 2017 (10.9% in 2013, 6.8% in 2018). Moreover, the youth unemployment significantly increased after the year 2011, reaching 43.6% in 2017 and 39.9% in 2018 (16.8% in 2017 and 15.2% in 2018 for EU-28) (Eurostat, 2019).

Due to the economic crisis in Greece, commuters are willing to reduce the transport cost for both utilitarian and recreational trips, mainly in urban areas. They prefer to use sustainable transport

modes (such as walking, bicycling, car sharing, and public transport) or cancel the trip to their normal working space and rather work from their home (teleworking) in order to balance their available budget. Due to this fact, a new status in travel demand was achieved, and the necessity to invest in large scale transport infrastructure projects has been reduced (Galanis et al., 2017a). Furthermore, examining the period before and after the economic crisis of the year 2008 for the EU-28 member countries, it becomes noticeable that a differentiation of the relation between economic growth and transport-related energy consumption exists, as after the economic crisis the vast majority of EU-28 member countries have passed the threshold of coupling and are subjected to a form of decoupling between economic growth and transport-related energy consumption (Botzoris et al., 2015a; Profillidis et al., 2018).

The present paper examines the impact of the Greek economic crisis on the change of commuters' travel behavior and particularly the use of public transport and walking instead of private car. The survey took place in six Greek cities (Table 1): Athens (the capital and largest city of Greece), Thessaloniki (the second largest city of Greece), and 4 other typical mid-sized cities of Greece, Volos (a coastal port city of central Greece), Xanthi (northeastern mainland Greece), Kozani (northern mountainous Greece), and Karditsa (central mainland Greece). Public transport in Athens comprises an extensive bus network and various rail systems (tram, metro, urban rail). Bus transport is the only public transport mode

available for the citizens in the cities of Thessaloniki, Volos, Xanthi, Kozani and Karditsa. In addition, the cities of Volos and Karditsa are bicycle-friendly places, since they have an extensive network of bicycle lanes. City selection was based on their population and geographical characteristics in order to cover as much as possible the Greek territory and to represent the typical characteristics of coastal, mainland, and mountainous Greek cities, since the selected cities are capitals of corresponding regional units.

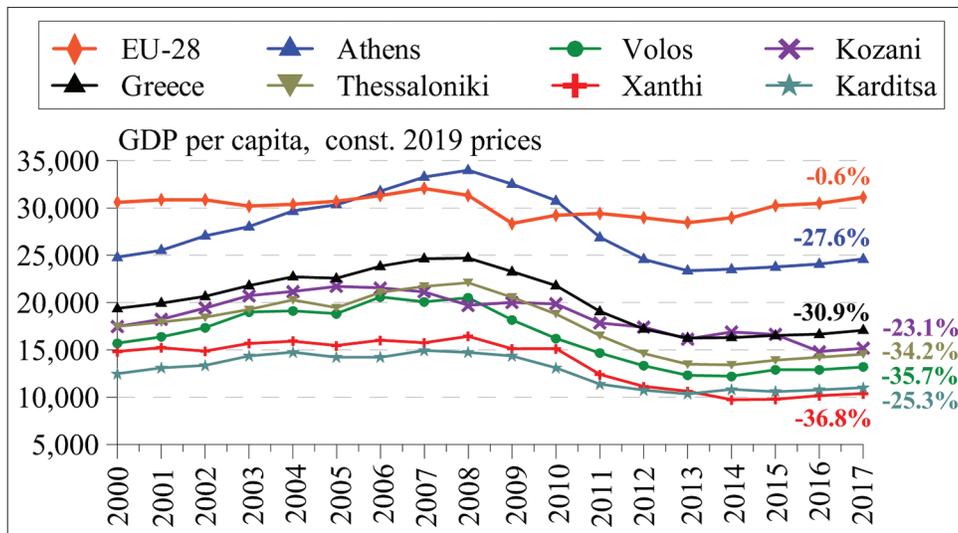
All cities under study are affected by the economic crisis, since the per capita GDP was seriously decreased the years after 2008 (-30.5% on average between 2008 and 2017), although in 2014 a slight increase can be noticed (Figure 1). The research was based on a questionnaire survey, conducted in the form of personal interviews, carried out during the year 2017 on a sample of 2218 commuters of different gender, age, income, and profession.

## 2. LITERATURE REVIEW

### 2.1. Sustainable Transportation

Worldwide, the level of mobility has increased in the last decades and raised concerns about increased car use and its impact on the external cost of transport (Profillidis et al., 2014). A growing number of communities are attempting to improve the sustainability of their transportation systems by shifting car

**Figure 1:** Evolution of per capita global domestic product (GDP) for EU-28, Greece and the cities under study (the percentages on the right indicate the GDP reduction between the years 2008 and 2017)



Source: Compiled by the author based on data available by Eurostat (2019)

**Table 1: Location, population and other characteristics of the cities of the survey**

City	Population	Area (km <sup>2</sup> )	Density (inhabitants/km <sup>2</sup> )	Elevation (in meters) (min–max)	Temperature (°C)	
					Average low	Average high
Athens	3,090,508	412.0	7501	40–180	12.3	22.5
Thessaloniki	788,952	111.7	7063	5–260	9.7	20.4
Volos	125,248	27.7	4525	5–40	10.4	20.8
Xanthi	63,083	153.1	412	70–130	9.0	19.0
Kozani	53,880	366.0	147	665–780	7.0	17.8
Karditsa	44,002	110.1	400	100–110	8.7	20.3



Source: Compiled by the author based on data available by ELSTAT (2019)

travel to public transport, walking and bicycling. Residents of urban areas which offer high quality and well organized public transport own half as many private cars, drive half as many annual kilometers, walk, bicycle and use public transport much more than residents in car-dependent communities (Arrington and Sloop, 2009; Litman, 2019). As stated by the Toronto-based Centre for Sustainable Transportation, a sustainable transportation system is the one that (Mihyeon and Amekudzi, 2005):

- Permits the necessary transport needs of commuters to be met in a manner consistent with human and ecosystem health, safely, and with equity
- Is reasonably priced, operates efficiently, provides choices of substitute transport modes, and enhances the economy
- Limits pollutant emissions within the ecosystem ability to absorb them, reduces energy consumption of non-renewable resources and adjusts the use of renewable resources to a sustainable level, uses recyclable materials, minimizes the landscape degradation and noise emissions.

Sustainable urban mobility implies to enhance policies that promote public transport and reduce private transport dependence in urban areas (Profillidis et al., 2014). There is a wide range of factors that affect the demand for public transport such as the influence of fares, quality of service, income and car ownership (Paulley et al., 2006; Profillidis and Botzoris, 2018). An attractive and efficient public transport system should provide a level of service to its users in order to switch from private vehicles to public transport (Botzoris et al., 2015b). The improvement of service quality can be achieved by a clear understanding of travel behaviour and commuters' needs and expectations (Beirão and Cabral, 2007). It is also useful to understand the psychological and other factors that influence mode choice and the measures needed to reduce car dependence. This understanding can be achieved through qualitative methods which can provide insights into people's attitudes and perceptions towards transport (Guiver, 2007). If public transport is perceived from commuters to be both good and cheap, it can reduce the demand for cars (Cullinane, 2002).

High quality and well organized public transport affect travel activity in ways that provide health benefits, including reduced traffic crashes and pollution emissions, and increased affordability which reduces financial stress to lower income households (Litman, 2018).

Walking is a sustainable transport mode available to everyone at no cost. It is the fundamental transport mode and the way that every route starts and ends (Krambeck and Shah, 2008). The safer and more convenient the walking environment is, more citizens will prefer walking rather than using other transport modes, mainly for short distance urban trips. There are major benefits drawn from the promotion of walking at urban level. Pedestrians do not consume fuel to travel, they do not pollute the air and they do not create noise. In urban areas the choice to walk depends on many factors. Shay et al. (2003) propose two groups of factors that influence walking: ability and motivation. Motivation factors relate to personal or social characteristics. However, only with the presence of the ability factors can the motivation factors be operational in order to promote walking.

The travel distance and time that is necessary for a commuter to reach his destination are major factors affecting the decision to travel on foot (Mackett, 2001). Pedestrians travel slowly, about 5 km/h for males and 3.5 km/h for females (Bohannon and Andrews, 2011), resulting to a limited distance that they cover daily on foot, between 0.5 km and 1.2 km (Yang and Diez-Roux, 2012). Issues like personal image and the value of time are also critical for the choice of a commuter to walk. For example, professionals with high salaries cannot afford to lose working time by selecting to travel on foot or to use public transport modes. Personal safety is also a major issue for many commuters who opt for walking. Especially women avoid walking during night time, preferring a different transport mode or choosing not to travel. Many parents consider that their children face not only road safety problems (as passengers) but also personal security problems when they walk (Easton and Smith, 2003; Giles-Corti et al., 2009).

In addition, an extensive literature has developed on the relationship between the built environment and travel behavior. Pedestrian travel behavior differs among various urban road types. Within the neo-traditional neighborhood, walk trips drop off quickly with increasing distance to destinations, while drive trips increase (Shay et al., 2006). The pedestrian infrastructure maintenance problems and accessibility issues incite pedestrians to walk in the street and not in the sidewalk or cross the street outside designated crosswalks, thus reducing their road safety level (Galanis et al., 2017b).

## 2.2. Transport Mode Choice and Income

### 2.2.1. Transport demand and elasticities

Elasticity reflects the sensitivity of a good or service to changes in the essential characteristics of this (or another substitute) good or service. Elasticities are essential inputs in many transport demand forecasts, as they reflect the effects on demand of changes (realized in the past) in one or more of the characteristics of a transport service (fare, frequency of services, income of users, etc.). If a change in a characteristic of a transport service results in a proportionally greater change in demand, the demand is termed elastic in relation to the specific characteristic and the absolute value of elasticity is  $>1.0$ . If the change in a characteristic of a transport service results in a proportionally smaller change in demand, then the demand is termed inelastic and the absolute value of elasticity is smaller than 1.0. Elasticities may refer to those taking place in the long run (more than 1 year) or to the short run (up to 1 year) (Profillidis and Botzoris, 2018).

### 2.2.2. Transport related income elasticities

Income elasticity is the ratio of the change in demand to the change in income of the customers of a transport service. It reflects how users of a transport service react to a change in their income. Values of income elasticities  $>1.0$  identify so-called luxury services or goods, whereas values of elasticities smaller than 1.0 identify so-called normal (or essential) services or goods (Standish et al., 1997; Hartzenberg et al., 2005; Profillidis and Botzoris, 2018).

The annual distance travelled by private vehicles is clearly dependent on personal income. Small and Van Dender (2007) estimated the United States (US) income elasticity with respect

to distance travelled in the short run of 0.11 and in the long run of 0.51. In a similar research, Dong et al. (2012) estimated that the elasticity of household distance travelled by private vehicles with respect to income has a value of 0.18 for US urban households and a value of 0.17 for urban population. Based on a household survey in Singapore, Li et al. (2011) calculated the income elasticity for private transport to be equal to 1.4 and the income elasticity for car ownership equal to 0.6.

However, Pyddoke and Swärdh (2015) underlined that income elasticities tend to decrease with increasing personal income. Thus, it seems that there is a difference in the elasticity for rising and falling incomes. Dargay (2007) proved that when personal income increases, the long run elasticity with respect to private vehicle usage has a value of 1.09, but when the personal income decreases, the elasticity is about 0.86. This means that an increase in income followed by an equivalent decrease does not bring back private vehicles usage to its previous level.

Bresson et al. (2003) compared public transport elasticities with respect to income in England between 1988 and 1996. They indicate that ridership decreases when income increases, with short run income elasticity between  $-0.62$  and  $-0.70$ , and long run between  $-0.86$  and  $-0.97$ . In a similar research, Holmgren (2007) estimated that US public transport short run elasticities with respect to income are in the range of  $-0.60$ . Comparing US and United Kingdom (UK), Giuliano and Dargay (2006) found that UK residents own fewer private cars and make fewer and shorter trips due to a combination of lower personal incomes, higher vehicle costs, better travel alternatives (walking conditions, public transport services), and more local shops.

Karlaftis and Golias (2002) illustrated that for a household the purchasing of the first vehicle is mainly dependent on income level and employment; however, the purchasing of additional vehicle depends primarily on the transportation system and its characteristics. If cycling and walking infrastructures are poor or unsafe and the driving is faster and cheaper than public transport, the households tend to own more than one vehicle. Goodwin et al. (2004) estimated the short and long run elasticity of vehicle ownership with respect to income and conducted that it is of 0.32 and 0.73 respectively.

Concerning walking elasticities with respect to income, there is no clear evidence. Frank et al. (2008) estimated that a 1% increase of fuel or other vehicle operating costs increases the demand for walking of about 0.1%. A study of the European Commission regarding the relationship between cost and travel time and the demand for private car use provided estimates of walking elasticity with respect to fuel cost of 0.19 for utilitarian purposes (TRACE, 1999).

### 3. QUESTIONNAIRE SURVEY

#### 3.1. Methodology of the Survey

In the present survey, the sample was 2218 commuters, as follows: 732 in Athens, 446 in Thessaloniki, 293 in Volos, 273 in Xanthi, 244 in Kozani, 230 in Karditsa. An attempt was made to obtain a

representative sample, as the key issue in questionnaire surveys is the extent to which the snapshot of the sample represents the population as a whole. The sample size of the present research was calculated to ensure a confidence level of 95% for a margin of error of 5%, the previous numbers being typical confidence level and error margin in most transport related questionnaire surveys (Profillidis and Botzoris, 2018).

Despite the fact that the sample was random and included respondents of different gender, age, personal income, and profession, an effort was made to select the participants as representatively as possible, based on demographic data of Greece. Since the questionnaire survey was based on the voluntary consent of commuters to participate and express freely and responsibly their point of view, the answers of the survey were anonymous so the respondents could express more easily, especially in questions regarding their personal income. In addition, and due to personal interview, commuters were able to ask questions to the survey interviewer and receive clarifications regarding the scope of the survey and of each question.

The questionnaire was divided into two parts. In the first part, the respondents answered about their demographic data, personal income, and possession (and number) of a private vehicle. In the second part, the respondents were asked about the frequency of use of various transport modes (private car, public transport, walking) for utilitarian or recreational trips, by comparing their choices to those made in the years 2008 and 2017. The questions were closed-ended, so the respondents were limited to choose one of the pre-coded responses given to the questionnaire.

#### 3.2. Results of the Survey

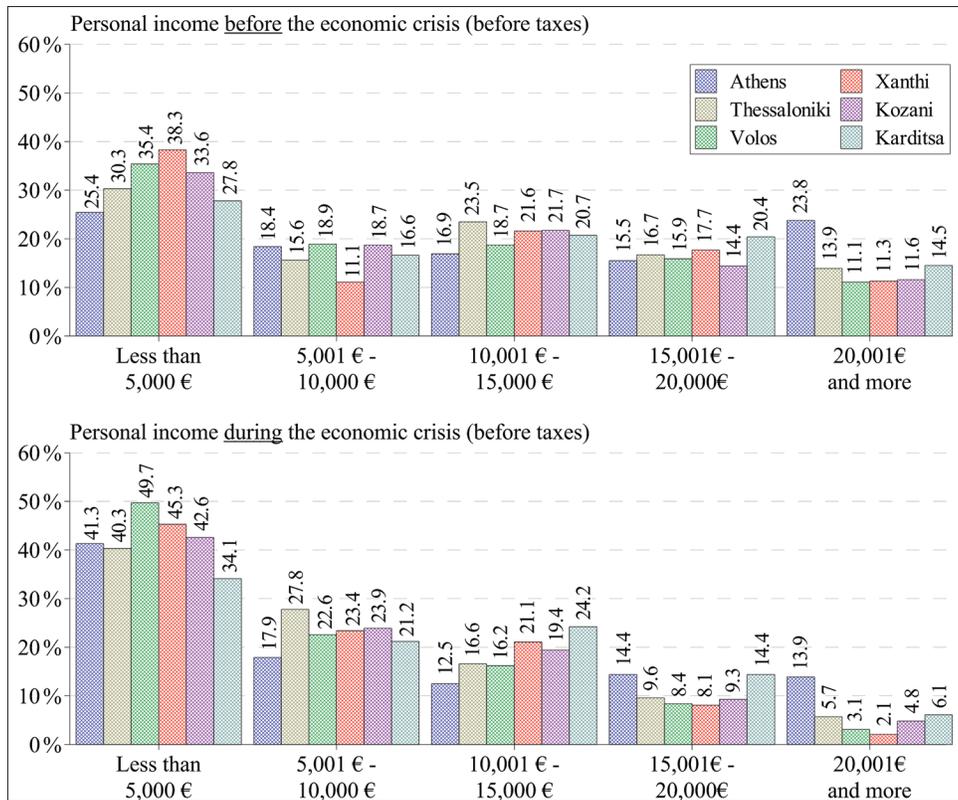
Figure 2 gives the results of the survey regarding the level of personal income by comparing the years 2008 (before the economic crisis) and 2017 (economic crisis continued). It is evident that the respondents' average personal income has been significantly reduced:  $-26.1\%$  in Athens,  $-30.9\%$  in Thessaloniki,  $-34.7\%$  in Volos,  $-34.4\%$  in Xanthi,  $-26.3\%$  in Kozani, and  $-23.6\%$  in Karditsa. The reduction of the personal income of the respondents of the questionnaire survey is very close to the official reduction of per capita GDP given in Figure 1, and this could be a confirmation that the sample selection was unbiased and representative of the whole population.

The change in frequency of use of private car and of public transport and walking, for both utilitarian and recreational purposes, is illustrated in Figure 3. For all the cities under study, the respondents revealed a trend to reduce the use of private car and to substitute it with public transport and/or walking.

#### 3.3. Evaluation of the Results

By giving numerical values in each one of the five possible linguistic choices (Almost never, Rarely, Sometimes, Often, Almost always) of respondents concerning the frequency of use of various transport modes, we can quantify the shift between 2008 (the year before the economic crisis) and 2017 (economic crisis continued) of the preference from the private car to more sustainable transport alternatives (public transport or walking). The

**Figure 2:** Personal income of respondents before (2008) and during the economic crisis (2017)



following numerical crossings were used: the numerical value 0 for the linguistic choice “Almost never,” the value 1 for the choice “Rarely,” the value 2 for the choice “Sometimes,” the value 3 for the choice “Often,” and the value 4 for the choice “Almost always.”

By using the numerical values which were set in each one of the five linguistic choices (Almost never, Rarely, Sometimes, Often, Almost always), Figure 4 illustrates the average value of frequency of use of each transport mode (private car, public transport, walking) for all six cities, for both utilitarian and recreational trip purposes, for the years 2008 and 2017. For example and as far as the city of Athens is concerned, the statistical processing of the survey revealed that before the economic crisis the average frequency of use of private car was 2.28 for utilitarian and 2.42 for recreational purposes; however, during the economic crisis, the frequency of use of private car decreased to 1.77 for utilitarian and 1.66 for recreational purposes (Figure 4). Meanwhile, in the city of Athens the frequency of walking for utilitarian purposes increased from 1.52 before the economic crisis to 2.16 during the crisis, while the frequency of walking for recreational purposes increased from 1.71 before the crisis to 2.20 during the crisis.

The marginal increase of the frequency of public transport use for the cities of Xanthi, Kozani and Karditsa during the economic crisis is due to the limited bus network and the low frequency of services (5-8 bus lines, half-hourly, hourly and in some cases bihourly bus services).

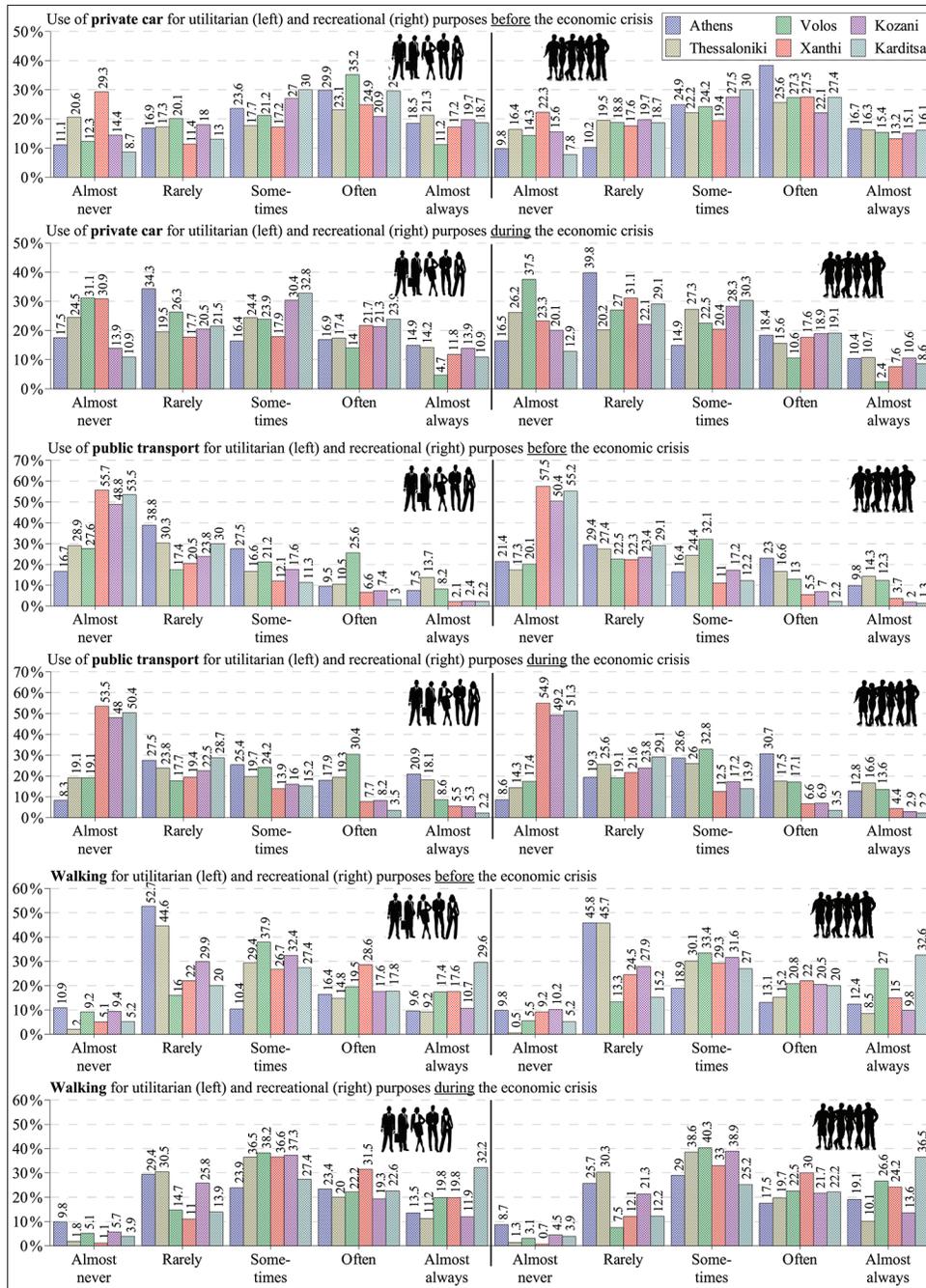
Walking proved to be an excellent option to substitute private car use; however, the spatial extent and the population size of the city seems to affect the frequency of walking (i.e., the case of

Athens and Thessaloniki). The smaller the city is, the better for a commuter to walk. The frequency of walking is also affected by the climate and the type of terrain. The city of Kozani is such a case of a mountain city with colder climate, in comparison with the other 5 cities. For the city of Kozani, the walking presents the lower frequency as an option instead of private car use. The combination of mountain terrain, the climate and the limited bus network is the answer for the reduced, in comparison with the other five cities under study, willingness of the commuters of the city of Kozani to reduce car use and start walking.

The calculation of the average value concerning the frequency of use of each transport mode for the year before (2008) and during (2017) the economic crisis permits the introduction of the proxy income elasticity which is defined as the ratio of the change in the frequency, as the respondents revealed in their answer to the questionnaire survey, of use of each transport mode (private car, public transport, walking) to the change in income of the respondents. Since the proxy elasticity refers to a period more than 1 year (the survey records the changes in frequency of transport mode use and of per capita income between the years 2008 and 2017), it can be considered as long run proxy income elasticity.

Table 2 illustrates for each city the average percentage reduction of the personal income of the respondents of the survey and the change, on average for utilitarian and recreational purposes, of the frequency of use of private car, public transport and walking. By dividing the change of the transport mode use with the personal income reduction, the proxy long run income elasticity of the specific transport mode use is calculated.

**Figure 3:** Frequency of use of private car, of public transport and of walking for utilitarian and recreational purposes before (2008) and during the economic crisis (2017)



The average proxy income elasticity for public transport is calculated to be  $-0.59$  (Table 2), and this value is almost equal to Holmgren (2007) estimation for the US public transport ( $-0.60$ ) and close to Bresson et al. (2003) who calculated income elasticity for English cities and found it to be between  $-0.62$  and  $-0.97$ . Concerning the private car use, the average proxy income elasticity is calculated to be  $0.74$  (Table 2). This value refers to the falling Greek economy of the period 2008-2017, so it must be compared with the results found by Dargay (2007) who estimated the long run elasticity when the personal income decreases equal to  $0.86$ .

In the absence of detailed studies referred to the walking elasticities with respect to income, the proxy elasticities of Table 2 cannot

be compared with another study. From Table 2 it results that 1% reduction of personal income increases  $0.46\%$  the demand for walking. The elasticities are lower for the cities of Volos and Karditsa, probably because they are the most bike-friendly cities with modern bicycle infrastructure and a well-organized rent-a-bike network, something that does not exist in the cities of Athens, Thessaloniki, Xanthi and Kozani.

#### 4. CONCLUDING REMARKS

This paper presented the results of a questionnaire survey conducted in six Greek cities (Athens, Thessaloniki, Volos, Xanthi, Kozani, and Karditsa), which represent almost half (49.5%) of

Figure 4: Change of the frequency of use of private car, of public transport and of walking before (2008) and during the economic crisis (2017)

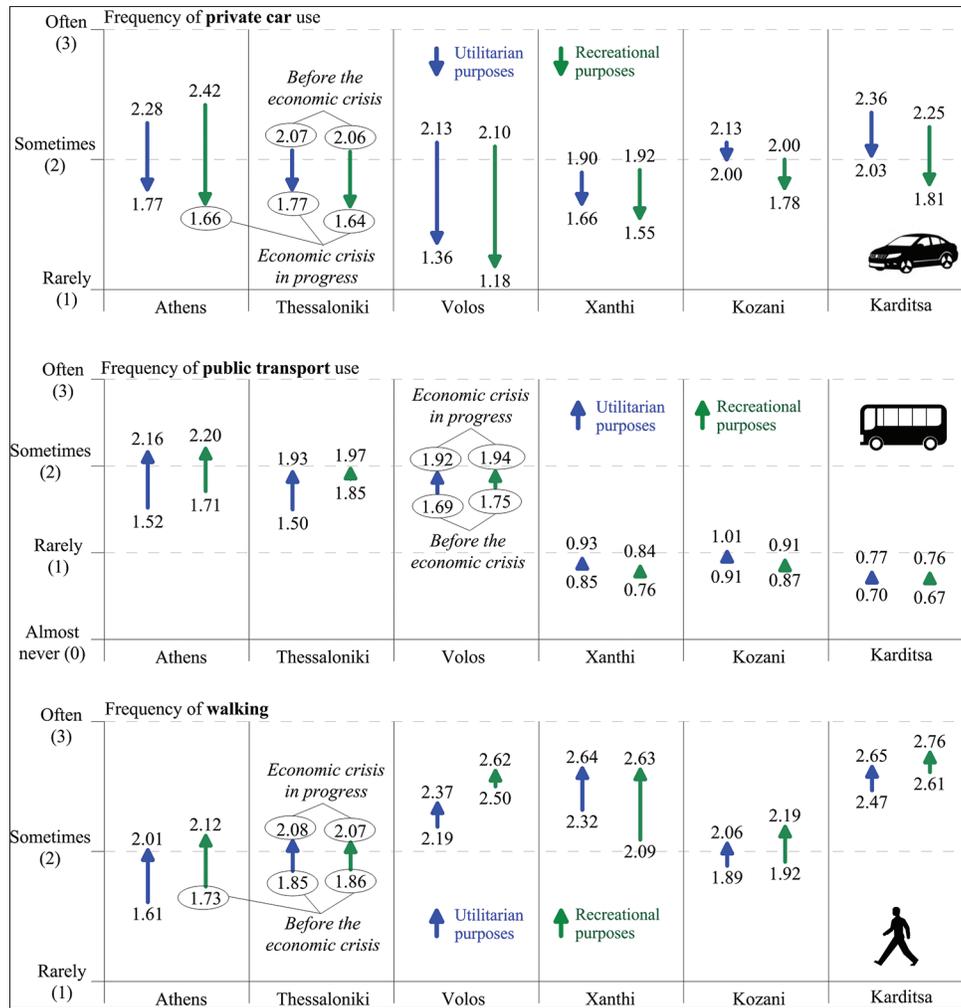


Table 2: Revealed effects of economic crisis: percentage personal income reduction, change of the frequency of use of various transport modes and proxy income elasticities for the city under study

City	Reduction of personal income (%)	Change (%) during economic crisis of the frequency of the specific transport mode use			Proxy long run income elasticity on the frequency of the specific transport mode use		
		Private car	Public transport	Walking	Private car	Public transport	Walking
Athens	-26.1	-26.7	35.3	24.1	0.78	-1.03	-0.70
Thessaloniki	-30.9	-17.3	18.2	12.2	0.50	-0.53	-0.35
Volos	-34.7	-41.4	11.0	6.2	1.59	-0.42	-0.24
Xanthi	-34.4	-15.8	18.9	20.5	0.67	-0.80	-0.87
Kozani	-26.3	-8.8	7.4	11.1	0.29	-0.24	-0.36
Karditsa	-23.6	-17.0	14.0	6.8	0.65	-0.53	-0.26
Average	-29.3	-21.2	17.5	13.5	0.74	-0.59	-0.46

the urban population of the country, with the conduct of personal interviews carried out during the year 2017. The aim of the survey was to examine the change of commuters' behavior for utilitarian and recreational urban trips towards sustainable transport modes such as public transport, and walking, by comparing the year 2008 (before the economic crisis) and the year 2017 (economic crisis continued, but it was in recession). The main conclusions of this survey were the following:

- Personal income of respondents was severely reduced during the years of economic crisis (-26.1% in Athens, -30.9% in Thessaloniki, -34.7% in Volos, -34.4% in Xanthi, -26.3% in Kozani, and -23.6% in Karditsa). The 42.1% of the

individuals that participated in the sample were living below the poverty line (<5000 €). As a result, people live in economic conditions far lower compared to the period before the crisis, a new fact that affects the use of private cars and commuters' habits.

- A significant decrease (about 21.2% on average) of frequency of use of private cars (especially in cities that ensures alternative transport modes, like Athens and Volos) and an increased use of public transport (about 17.5% on average) and walking (about 13.5% on average) for both utilitarian and recreational urban trips for all cities was noticed. We anticipate that this trend will continue in the following years

in order to further reduce transport cost in combination with a better organization of public transport and the improvement of sidewalks in urban streets.

An analytic calculation of income elasticities of the various transport modes requires the thorough causal correlation between the personal income and the variables that measure the commuters' habits and preferences. Thus, quantitative data are required, such as road traffic volume at selected cross-sections, number of passenger of various public transport modes (busses, metro, tram, etc.), number of pedestrians, etc. In most cases (and for almost all Greek cities) such data are either unavailable or the collection is time-consuming and costly; consequently the questionnaire survey is the only possible or economically affordable method to estimate elasticities.

To this end, the term proxy elasticity is introduced and described in this paper, as a useful tool for the mining of elasticities drawn from questionnaire surveys. Obviously, the values of these proxy elasticities should be checked carefully in order to be within the range found in the relevant bibliography. These proxy income elasticities are calculated for the six Greek cities and their values are compared with income elasticities of other studies.

The paper does not seek to analyze whether the economic crisis was the driving force for the shift from private cars to more sustainable transport choices in Greek urban areas. Undoubtedly it was the case to some extent. It describes a transition and shift to sustainable and environmental friendly transport modes. Thus the economic crisis in Greece has created a new reality in urban mobility and gives city planners new opportunities towards sustainable transport. It is mainly a political challenge to preserve and defend the observed situation by motivating the environmentally friendly and economically efficient urban mobility.

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