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# Economic crisis and promotion of sustainable transportation: A case survey in the city of Volos, Greece

Athanasios Galanis [a*], George Botzoris [b], Anastasios Siapos [a], Nikolaos Eliou [a], Vassilios Profillidis [b]

[a]*University of Thessaly, Department of Civil Engineering, Pedion Areos, 38334 Volos, Greece*
[b]*Democritus University of Thrace, Department of Civil Engineering, Vas. Sofias 12, 67100 Xanthi, Greece*

**Abstract**

The paper presents the results of a survey that examines the effects of the current economic crisis to the promotion of sustainable transportation in the city of Volos (a medium-sized Greek city, 130,000 inhabitants). The survey was based on a questionnaire conducted on a random sample of 605 participants through personal interviews in the year 2013. The questionnaire comprised 24 questions divided into two parts. In the first part, the participants provided their demographic data, purchase power, possession of bicycle, private vehicle and driving licence. In the second part, participants stated their choice to change transport mode for utilitarian or recreational trips comparing the years 2008 (before the crisis) and 2012 (crisis in process). They also answered questions about road safety and personal safety issues when they walk or bike during the day and night time in the city of Volos. The analysis supports that citizens have changed their transportation habits during the years of economic crisis in Greece in favor of sustainable transport modes. Due to the increased unemployment and the decreased personal income, commuters preferred the use of public transportation, bicycle or walk instead of private vehicles. Thus, the crisis has a positive impact towards sustainable mobility by changing the way commuters travel in urban areas favoring more economic, environmental friendly and socially alternative transport modes.


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* Corresponding author. Tel.: +30-24210-74174; fax: +30-24210-74119. E-mail address: atgalanis@uth.gr

## 1. Introduction

The transportation system is a dynamic one aiming to adopt every change in economical, societal and environmental issues in order to serve its purpose which is to transport passengers and freight efficiently and safely. The world economy is changing so fast, that it is necessary to decide in time every change by using the appropriate technological tools and use well trained human resources, in order to find the best financial opportunities and business proposals in favor of the society. Global production and trade has gradually moved towards the developing economic countries in the last decades. The economy today is in the era of globalization, meaning that people and capital can freely travel

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worldwide in order to find the best value for money and business opportunity. This fact impacts on the global financial system, because no country or enterprise is considered to be protected against unexpected situations or counted risks.

The term "economic crisis" is widely used in Greece not only for its economic point of view but also for its political and social ones. The Greek economic crisis starting in 2008 affected seriously the economy of the country. Between the years 2008÷2014, the Global Domestic Product (GDP) of Greece was reduced by 35.55% (Figure 1), compared to -6.85% in Spain, -7.99% in Portugal, -1.14 in Eurozone countries and -0.67% in the EU-28 countries (Profillidis and Botzoris, 2015). Unemployment increased in Greece from 7.8% in 2008 to 26.5% in 2014 (Figure 1), in Spain from 11.4% in 2008 to 24.5% in 2014, in Portugal from 8.8% in 2008 to 14.1% in 2014, in Eurozone countries from 7.6% in 2008 to 11.6% in 2014 and in the EU-28 countries from 7.0% in 2008 to 10.2% in 2014 (Profillidis and Botzoris, 2015).Unemployment of the youth was significantly affected in Greece after the year 2011 reaching up to 50% (52.4% in 2014), (Karafolas and Alexandrakis, 2015).

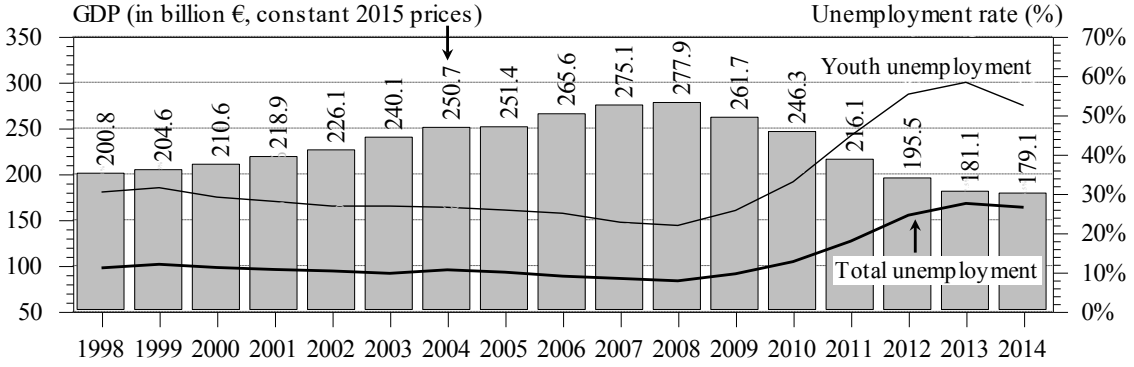


Figure 1. Evolution of GDP and (total and youth) unemployment rate in Greece (Profillidis and Botzoris, 2015).

Due to the economic crisis in Greece and other countries, citizens are trying to reduce their transportation cost not only for utilitarian but also for recreational purposes. Citizens favor the use of more sustainable transport modes (walking, bicycling, public transportation, car sharing) or they increase teleworking in order to balance the expenses (Botzoris et al., 2016). Due to this fact, a new balance in transport demand has been achieved and the necessity for investment in high cost transport infrastructure is reduced which benefits also the environment (Profillidis et al., 2014; Botzoris et al., 2015). The economic crisis should not be an excuse but an opportunity for public authorities in order to promote sustainable transportation in urban areas and improve their citizens' quality of life (Galanis and Botzoris, 2014).

This paper presents the results of a survey that examines the effects of the current economic crisis in Greece in sustainable transportation in the city of Volos (a medium-sized Greek city). The survey was based on a questionnaire conducted on a random sample of 605 participants of different age, education, profession and purchase power, through personal interviews in the year 2013. The aim of the survey was to reveal the participants' willingness to change transport mode for utilitarian or recreational trips comparing the years 2008 and 2012 and also evaluate road safety and personal safety issues when they walk or bike during the day and the night in the city of Volos.

## 2. Literature review

### *2.1 Sustainable transportation: Walking*

Walking is a sustainable transport mode available to all at no cost. The safer and more convenient the walking environment is, more citizens will prefer walking than other transport modes mainly for short distance urban trips. Cities that are suitable for walking have many benefits for their citizens such as an increased level of road and personal safety, better accessibility to destinations and selection of multiple transport modes.

There are major benefits from the promotion of walking both in urban and regional 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 propose two groups of factors that influence walking: ability and motivation (Shay et al., 2003). The "motivation" factors relate to personal or social characteristics. Only with the presence of the "ability" factors can the motivation factors be operational in order to promote walking among citizens.

The travel distance and time that is necessary for a commuter to reach his destination are major factors in order to travel on foot (Mackett, 2001). Pedestrians travel slowly, resulting to a limited distance they can reach: 1÷2 km. Issues more than road safety and mobility, like personal image and the value of time are usually the critical factors for a citizen's choice to walk. Especially, professionals with high salaries cannot afford to lose working time selecting to travel on foot or to use public transport modes. Personal safety is also a major issue for many citizens who they opt for walking (Easton and Smith, 2003). Especially women avoid walking during night time selecting another transport mode or choosing not to travel. Many parents consider that their children face not only road safety problems (as passengers) but also personal safety problems when they walk (Bradshaw and Jones, 2000).

The relationship between walking and built environment can be examined using specific audit tools (Galanis and Eliou, 2012). Furthermore, the features of the pedestrian built environment can be graded, resulting to a walkability index (Galanis and Eliou, 2011a). Finally, the pedestrian urban infrastructure can be examined using walkability indicators (Galanis and Eliou, 2011b). This type of indicators can help engineers and stakeholders to find where the pedestrians suffer from mobility issues across their desire route.

### *2.2 Sustainable transportation: Bicycling*

Bicycling is a sustainable transport mode, but bicyclists are considered vulnerable road users due to their higher risk in terms of road safety. The safer and more convenient the bicycling environment is, more citizens will prefer bicycling than other transport modes, especially for short and medium distance urban trips. The bicycling built environment is not the same either for cities in the same country or for districts of an urban agglomeration. There are many differences related with economic, cultural and geographical factors. The road environment differs between the central business district and neighborhoods of an urban area. A commuter should be able to ride his bike in order to reach the desirable destination with safety and convenience in the entire urban area. Municipality officials should improve the bikeability level of their city if they want to promote bicycle use and sustainable transportation.

In order to promote bicycling, researchers worldwide have focused on route quality issues, such as traffic conditions, signalization, bicycle and vehicle lane design, curb and surface conditions, slope, weather, lighting, safety, accessibility to specific land uses, and also environmental factors associated with bicycling (Landis et al., 2001; Moritz, 1998).

A number of instruments have been developed to identify the bikeability level of the urban road environment. Many of them provide measures of levels of service or similar indices, assessing the bicyclists' safety level based on route-related variables. Some methodologies examined the bicycling level of service on road segments in order to provide an index of how well urban and rural roads accommodate bicycle travel (Jensen, 2008). The validity and reliability of these instruments is not completely examined (Moudon, 2003). A limited number of studies examined environmental characteristics that are related with bikeability, like levels of stress, comfort and satisfaction (Landis et al., 1997). The most important barriers to bicycling include the insufficient or unsafe bicycling infrastructure, shortage of bicycling amenities, motorists' traffic flow and speed, and undesirable land use conditions (Goldsmith, 1993; Litman, 2000; Galanis and Eliou, 2014; Galanis et al., 2014).

## 3. Methodology

The survey took place in the city of Volos which is a medium-sized Greek city in the year 2013. It was based on a questionnaire survey conducted on a random sample of 605 individuals of different sex, age, profession and purchase power through personal interviews. Despite the fact that the sample was random, there was an effort to select the participants as representatively as possible based on their demographic data. The answers in the survey were

anonymous so the participants could answer more freely especially in relation to questions of personal income. The participants were also able to ask questions and clarifications regarding the survey.

The questionnaire consisted of 24 questions and was divided into two parts. The first part (questions 1 to 10) focused on demographic data, personal income,possession of bicycle, private vehicle and driving license,comparing the years 2008 and 2012. In the second part (questions 11 to 24) commuters'stated their willingness to change transport mode for utilitarian or recreation trips comparing the years 2008 and 2012 and furthermore evaluated road safety and personal safety issues when they walk or bike during the day and night in the city of Volos. Statistical analysis of results of the survey was conducted with the use of Microsoft Office Excel software.

## 4. Results

Table 1 presents the results of the questions 1 to 4 regarding the demographic data of the participants. More men (56.69%) than women (43.31%) participated in the survey. The majority of the participants were less than 25 years old (39.21%) and 26÷35 years old (23.77%) and most of them were high school graduates (44.46%) or had a university diploma (34.05%). An index very useful concerning the current economic crisis in Greece is the unemployment rate (23.09%) of participants.

The results of question 5 (5a and 5b) regarding the level of personal income before taxes comparing the years 2008 and 2012 are listed in Table 2. It is obvious that the participants' income has been reduced and furthermore we can conclude that in the year 2012 almost half of the participants (49.59%) live below poverty line.

Table 1. Demographic data (questions 1÷4).

| Question 1: Age | | Question 3: Profession | | Question 4: Education | |
|---|---|---|---|---|---|
| | | | | Primary school | 12.40% |
| <25 | 39.21% | Public servant | 11.55% | Secondary school | 9.09% |
| 26÷35 | 23.77% | Private employee | 20.21% | High school | 44.46% |
| 36÷45 | 13.83% | Self-occupant | 11.33% | University | 34.05% |
| 46÷55 | 11.16% | Student | 23.04% | Question 2: Sex | |
| >55 | 12.03% | Unemployed | 23.09% | Man | 56.69% |
| Sample | 605 | Retired | 10.78% | Woman | 43.31% |

Table 2. Level of personal income (before taxes) comparing the years 2008 and 2012 (questions 5a, 5b).

| Question 5a: Personal income in the year 2008 (before taxes) | | | | |
|---|---|---|---|---|
| <5,000€ | 5,001€ ÷ 10,000€ | 10,001€ ÷ 15,000€ | 15,001€ ÷ 20,000€ | >20,001€ |
| 45.12% | 16.86% | 16.86% | 15.87% | 5.29% |
| Question 5b: Personal income in the year 2012 (before taxes) | | | | |
| <5,000€ | 5,001€ ÷ 10,000€ | 10,001€ ÷ 15,000€ | 15,001€ ÷ 20,000€ | >20,001€ |
| 49.59% | 23.14% | 13.06% | 11.40% | 2.81% |

Table 3 demonstrates the results of the possession of driving licence (question 6), possession of private vehicle per family (question 7), number of private vehicles per family (question 8), cc ($cm^3$of the displacement volume of the engine) of the new vehicle versus the old one in the case of change (question 9) and the possession of bicycle (question 10) comparing the years 2008 and 2012. We can conclude that more participants have a driving licence comparing the years 2012 (72.07%) and 2008 (62.48%). It is also quite interesting the fact that more families possess no private vehicle comparing the years2012 (23.64%) and 2008 (11.90%). In the case of changing the old private vehicle with a new one during the years 2008÷2012, participants favored vehicles with engines of smaller size in cubic centimeters (1000cc÷1400cc), (44.15%) which present a lower purchase and maintenance cost. A very interesting index is the possession of bicycle (question 10) which has significantly increased comparing the years 2012 (62.81%) and 2008 (48.43%).

Table 3. Possession of driving licence, private vehicle and bicycle comparing the years 2008÷2012 (questions 6 to 10).

| | | | | |
|---|---|---|---|---|
| Question 6: Driving licence of private vehicle | | | | |
| Year 2008 | 62.48% | Year 2012 | 72.07% | |
| Question 7: Possession of private vehicle per family | | | | |
| Year 2008 | 88.09% | Year 2012 | 76.37% | |
| Question 8: Number of private vehicle per family | | | | |
| Number | 0 | 1 | 2 | >2 |
| Year 2008 | 11.90% | 53.88% | 26.94% | 7.27% |
| Year 2012 | 23.64% | 50.25% | 21.82% | 4.30% |
| Question 9: Change of private vehicle – new versus old during the years 2008÷2012 (cc) | | | | |
| | 1000cc÷1400cc | 1400cc÷1600cc | 1600cc÷1800cc | >1800cc |
| | 44.15% | 22.22% | 2.05% | 31.58% |
| Question 10: Possession of bicycle | | | | |
| Year 2008 | 48.43% | Year 2012 | 62.81% | |

Figure 2 illustrates the results of the use of transport modes for utilitarian and recreational trips comparing the years 2008 and 2012. We conclude that there is an obvious reduction in the use of private vehicles for both utilitarian and recreational trips (question 11a, 11b). On the contrary, there is an increase in the use of public transportation (bus) for both utilitarian and recreational trips (questions 12a, 12b). The participants also stated that they have increased bicycling (questions 13a, 13b) and walking (questions 14a, 14b) during the years mentioned.

Table 4 presents the results of the participants' opinion regarding the personal (question 15) and public reduction (question 16) of private vehicles use for both utilitarian and recreational trips during the years 2008 and 2012, and also their willingness to proceed with further reduction (question 17). The results reveal a major reduction of private vehicle use mainly for recreational trips (>80%) and a strong willingness (75.54%) to further reduce them.

Table 4. Change of private vehicle use comparing the years 2008÷2012 (questions 15÷17).

| | | | |
|---|---|---|---|
| Question 15: Personal reduction of private vehicle use | | | |
| Utilitarian trips | 47.27% | Recreational trips | 82.15% |
| Question 16: Opinion for public reduction of private vehicle use | | | |
| Utilitarian trips | 74.71% | Recreational trips | 80.99% |
| Question 17: Willingness to further reduce the use of private vehicle | | | 75.54% |

The results of the participants' opinion regarding the change of transportation behavior during the years 2008 and 2012 are presented in Table 5. The results reveal their willingness to walk, bike and use public transport modes (in the city of Volos, the bus was the only available public transport mode) for both utilitarian and recreational trips (question 18). Participants revealed that the main reasons to walk in the year 2008 were the low level of convenience (32.56%) and increased travel duration (24.96%), (question 19a). Additionally, the main reasons not to use a bicycle it the year 2008 were the low level of convenience (22.98%) and perceived level of road safety (18.51%) in combination with the lack of proper infrastructure for bicyclists (17.52%). The reasons to increase walking (question 20a) and bicycling (question 20b) during the years 2008 and 2012 were mainly economic referring to the reduction of personal income (~50%) and the rise of oil/gas price (~30%).

Table 6 presents the results of perceived road and personal safety level of pedestrians and bicyclists comparing the years 2008 and 2012. It is obvious that the level of both personal and road safety is lower during the nighttime than the daytime and furthermore there is a general reduction during the years mentioned. Most revealing is the reduction level of pedestrians' personal safety comparing the years 2012 (68.26%) and 2008 (91.74%) during the daytime. The level of personal safety during the daytime (>90%) that enjoyed a citizen of a medium-sized Greek city before the inception of economic crisis was a very important index for quality of life and social justice.

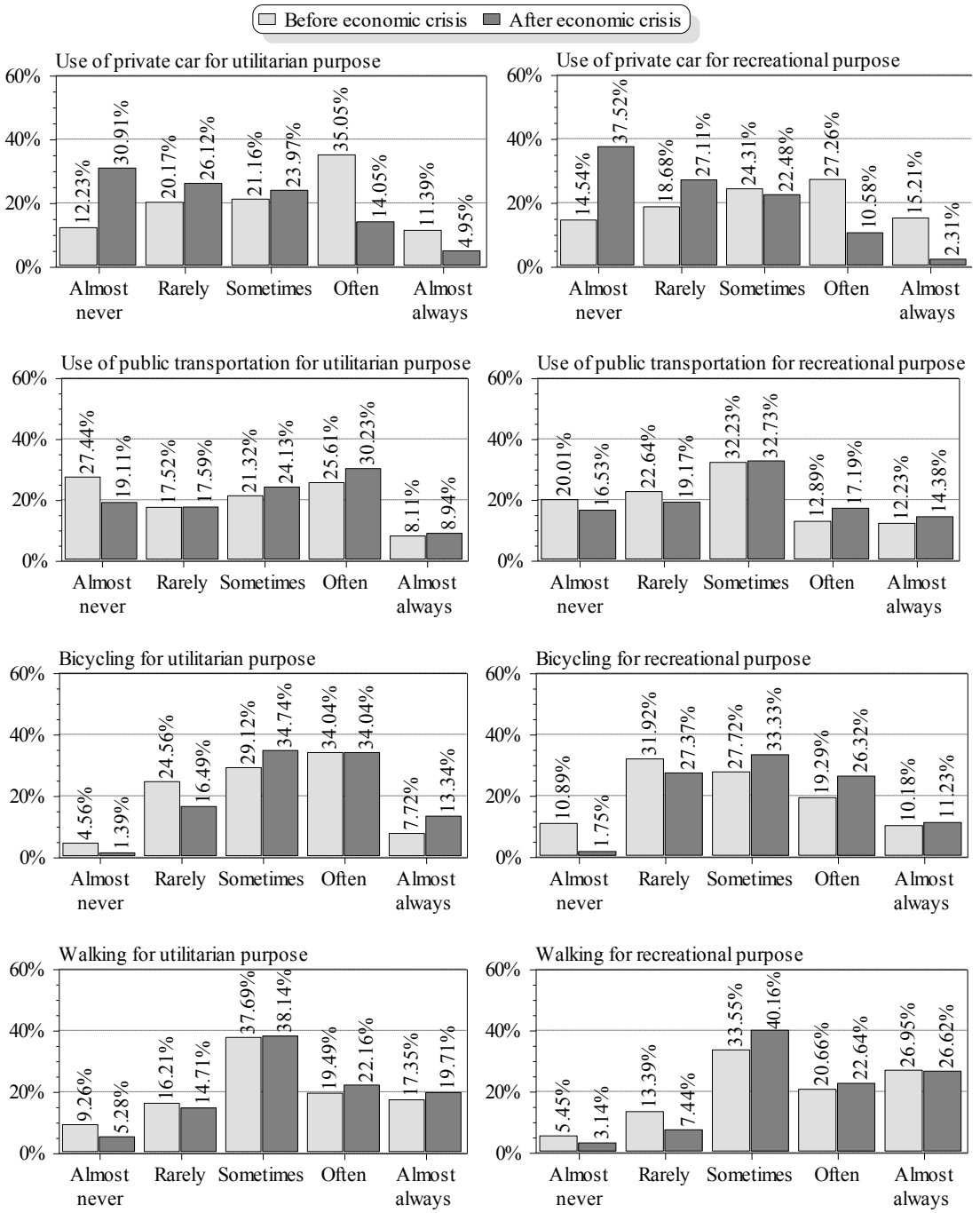


Figure 2. Use of various transport modes for utilitarian and recreational purposes the year 2008 (before economic crisis) and the year 2012 (economic crisis in process).

Table 5. Change of transportation behavior comparing the years 2008 and 2012 (questions 18÷20).

| Question 18: Willingness to change private vehicle use with another transport mode | | | | | | | |
|---|---|---|---|---|---|---|---|
| Utilitarian trips | | | | Recreational trips | | | |
| Walking | Bicycle | Bus | | Walking | Bicycle | Bus | |
| 31.40% | 43.64% | 37.85% | | 36.86% | 36.53% | 46.61% | |
| Question 19a: Reasons not to walk in the year 2008 | | | | | | | |
| Cost | Time | Convenience | Road safety | Personal safety | Image | Weather | Infrastructure |
| 0.00% | 24.96% | 32.56% | 8.60% | 3.97% | 8.76% | 12.07% | 9.09% |
| Question 19b: Reasons not to bike in the year 2008 | | | | | | | |
| Cost | Time | Convenience | Road safety | Personal safety | Image | Weather | Infrastructure |
| 0.66% | 7.93% | 22.98% | 18.51% | 10.25% | 9.59% | 12.56% | 17.52% |
| Question 20a: Reasons to increase walking during the years 2008÷2012 | | | | | | | |
| Infrastructure improvement | Road safety | Personal safety | Income reduction | Raise of oil / gas price | Raise of private vehicles taxes | | |
| 1.32% | 2.64% | 0.99% | 52.07% | 29.42% | 13.55% | | |
| Question 20b: Reasons to increase bicycling during the years 2008÷2012 | | | | | | | |
| Infrastructure improvement | Road safety | Personal safety | Income reduction | Raise of oil / gas price | Raise of private vehicles taxes | | |
| 3.31% | 5.29% | 0.66% | 51.57% | 32.23% | 6.94% | | |

Table 6. Perceived level of road safety and personal safety of pedestrians and bicyclists comparing the years 2008 and 2012 (questions 21÷24).

| Question 21: Pedestrians personal safety | | | | |
|---|---|---|---|---|
| Year 2008 | Day | 91.74% | Night | 65.62% |
| Year 2012 | | 68.26% | | 52.40% |
| Question 22: Bicyclists personal safety | | | | |
| Year 2008 | Day | 96.36% | Night | 80.33% |
| Year 2012 | | 80.33% | | 64.30% |
| Question 23: Pedestrians road safety | | | | |
| Year 2008 | Day | 52.07% | Night | 41.98% |
| Year 2012 | | 47.77% | | 40.83% |
| Question 24: Bicyclists road safety | | | | |
| Year 2008 | Day | 68.10% | Night | 47.44% |
| Year 2012 | | 56.36% | | 35.54% |

## 5. Conclusions

The goals of the present paper were two-fold: first to assess the impact of the Greek economic crisis on trends of public transport use and second to assess whether the reduction of income leads to an increase of use of modes like bicycles, walking and public transport. A questionnaire survey on the impact of economic crisis on sustainable transportation in the medium-sized Greek city of Volos was conducted, comparing the years 2008 (before the economic crisis) and 2012 (crisis in process). A sample of 605 individuals participated in the survey and they answered a questionnaire of 24 questions through personal interviews. The main conclusions drawn from that survey are as follows:

- Personal income was severely reduced due to economic crisis. As a result, more people live in economic conditions far lower, compared to the period before the economic crisis and the unemployment level continues to rise, affecting their transport habits.
- A distinctive decrease of intensive use of private vehicles for both utilitarian and recreational trips and an increase of walking, bicycling and use of public transport, mainly for economic reasons, is monitored. We anticipate that this trend will continue to rise in order to reduce transport cost.

- The perceived level of personal and road safety for pedestrians and bicyclists during the mentioned years is reduced. However, citizens continue to use their private vehicles because they are afraid for their personal safety mainly during the nighttime, thus preventing the use of sustainable transport modes.

A thorough quantification and causal correlation between the economic crisis (expressed as per capita GDP) and the variables that measures the citizens' transportation habits and preferences requires the estimation of income elasticities for the various urban transport modes, accordingly quantitative data before and during economic crisis (i.e. traffic volume at selected road cross-sections, passengers of busses, bicyclists, unemployment rate, and others). In most medium-sized Greek cities such data are unavailable; consequently the questionnaire survey was the only possible method to monitor the above parameters.

The results and conclusions of this survey can help state officials to promote sustainable transport modes (walking, bicycling and public transportation) due to their social, environmental and economic advantages. Economic crisis with its impacts on citizens' reduction of personal income and increase of unemployment can change their travel behavior for both utilitarian and recreational trips in favor of sustainable transportation. This survey could be a useful case study for further research in order to estimate the change of citizens travel behavior in urban areas in relation to the changing values of parameters of the internal and external environment.

## References

Botzoris, G.N., Galanis, A.T., Profillidis, V.A., Eliou, N.E., 2015. Coupling and decoupling relationships between energy consumption and air pollution from the transport sector and the economic activity. International Journal of Energy Economics and Policy 5, 949-954.

Botzoris, G., Profillidis, V., Galanis, A., 2016. Teleworking and sustainable transportation in the era of economic crisis. 5th International Virtual Conference on Information and Telecommunication Technologies (ICTIC 2016), Žilina, Slovakia.

Bradshaw, R., Jones, P., 2000. The family and the school run: What would make a real difference? University of Westminster.

Easton, H., Smith, F., 2003. Getting there: Reducing crime on public transport. Nacro-Crime and Social Policy Sector, London.

Galanis, A., Eliou, N., 2011a. Grading methodology of the pedestrian urban road environment. WSEAS Transactions on Environment and Development 7, 157-166.

Galanis, A., Eliou, N., 2011b.Evaluation of the pedestrian infrastructure using walkability indicators. WSEAS Transactions on Environment and Development 7, 385-394.

Galanis, A., Eliou, N., 2012. Development and implementation of an audit tool for the pedestrian built environment. Transport Research Arena-Europe 2012, Procedia-Social and Behavioral Sciences 48, 3143-3152.

Galanis,A.T., Botzoris, G.N., 2014. Sustainable mobility and traffic management in urban built environment, 2nd International Virtual Scientific Conference 2014 (SCIECONF), 515-519.

Galanis, A., Eliou, N., 2014. Development and implementation of an audit tool for urban bikeway road network. Transport Research Arena (TRA) 5th Conference: Transport Solutions from Research to Deployment, Paris, France.

Galanis, A., Papanikolaou, A., Eliou, N., 2014. Bikeability audit in urban road environment: Case study in the city of Volos, Greece. International Journal of Operations Research and Information Systems 5, 21-39.

Goldsmith, S.A., 1993. Reasons why bicycling and walking are not being used more extensively as travel modes, U.S. Department of Transportation, Federal Highway Administration, Washington D.C.

Jensen, S.U., 2008. Bicycle tracks and lanes: A before-after study. Proceedings of Transportation Research Board 87th Annual Meeting, Washington, D.C.

Karafolas, S., Alexandrakis, A., 2015. Unemployment effects of the Greek crisis: A regional examination.Procedia Economics and Finance 19, 82-90.

Landis, B.W., Vattikuti, V.R., Brannick, M.T., 1997. Real-time human perceptions: Towards a bicycle level of service. Transportation Research Record 1578, 119-126.

Landis, B., Vattikuti, V., Ottenberg, R, McLeon, D., Guttenplan, M., 2001. Modeling the roadside walking environment: Pedestrian level of service. Transportation Research Record 1773, 81-88.

Litman, T., 2000.Pedestrian and bicycle planning: A guide to best practices. Victoria Transport Policy Institute.

Mackett, R.L., 2001. Policies to attract drivers out of their cars for short trips. Transport Policy 8, 295-306.

Moritz, W., 1998.Adult bicyclists in the United States: Characteristics and riding experience in 1996. Transportation Research Record 1636, 1-8.

Moudon A.V., Lee, C., 2003. Walking and bicycling: an evaluation of environmental audit instruments. American Journal of Health Promotion, 18, 21-37.

Profillidis,V., Botzoris, G., 2015. Greek economic crisis and the impact on transport activities, 3rd Panhellenic Conference on Environmental and Natural Resource Economics. Volos, Greece.

Profillidis, V.A., Botzoris, G.N., Galanis, A.T., 2014. Environmental effects and externalities from the transport sector and sustainable transportation planning – A review. International Journal of Energy Economics and Policy 4, 621-635.

Shay, E., Spoon, S.C., Khattak, A.J., 2003. Walkable environments and walking activity. Report to the Southern Transportation Center, University of Tennessee.