

# Transport Choice and the Long-Term Effects of the Financial Crisis in a Large Metropolis: Survey Evidence from Athens, Greece

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## Abstract

Financial crises present a threat and an opportunity for transport policymakers. Their potential to alter transport behaviour and choices can lead to mutual benefits for the commuter, society, and the environment. In our study, we explore how demographic, socio-economic and other transport-related determinants create shifts in transport mode change and choice, in the presence of a long-lasting economic recession. To do so, we analyse survey data collected from the Athens metropolitan area in 2016 with use of discrete choice logit models. The results show that public transport coverage plays the most important role when it comes to changing mode of transport, while the choice of transport is mainly affected by car ownership, gender, age and income of individuals.

## Keywords

Discrete Choice Models, Financial Crisis, Sustainable Transport, Transport Policy, Urban Transportation

## 1. Introduction

Transport is inextricably linked to economic conditions, whether in terms of transferring goods or population mobility. The causality between economic and transport growth is bidirectional, with periods of economic recession resulting in reduced transportation (Saidi and Hammami, 2017). Individual transport choice is affected by a multitude of factors including social, economic, demographic, cultural, and psychological characteristics (Buehler, 2011).

In the event of a financial crisis, several of these factors such as income, employment status, and transport frequency are expected to change (Cordera et al.,

2015). It is often the case, that during these times, transport demand shifts towards public transport (PT) or other environmentally friendly travel modes since transportation costs are lower (Kamruzzaman et al., 2014). On the other hand, economic growth is responsible for increased urban sprawl. This dispersion of inhabitants towards areas with less population density leads inevitably to less PT use due to limited coverage and efficiency (Alonso et al., 2018).

Greece entered the economic crisis in 2009 with significant impact on all aspects of life. Unlike other economies, Greece did not overcome the recession in the following years, but instead went into a borrowing and austerity measures spiral which peaked the crisis in 2013. The shrinking economic activity inevitably dragged along transportation with large reductions in passenger and freight transport (Moschovou and Tyrinopoulos, 2018). Moreover, there was a noticeable drop in car sales (Nanaki, 2018), which was in part caused by a rise in fuel prices (Konstantakis et al., 2017).

Moreover, the decline in production as well as the rise in unemployment reversed the general upward trend in traffic growth of the previous decades (Vogiatzis and Mandalozis, 2013). Before the financial crisis, the prevalent trend in the capital, Athens, was an average annual increase in traffic load by 3% and an annual reduction of the average speed by 2% (Sermpis et al., 2013). The metropolitan area of the capital extends to an area of approximately 723,524 acres which are home to approximately 3,753,783 inhabitants (ELSTAT, 2011). It is served by four main PT organisations, namely, bus, metro, tram, suburban railway, and in some areas also operate municipal buses. The number of trips, measured by the validations of tickets by the central urban transport authority (OASA), declined from 265,387,297 to 131,864,707 (OASA, 2015). Nevertheless, these figures though, are probably an overestimation since the recession made individuals more prone to lawbreaking behaviour regarding free PT ridership.

This paper uses survey data collected in 2016 from the metropolitan area of Athens expanding on authors' previous work (Nimorakiotaki and Sambracos, 2020). Although not in the heart of the economic recession, our aim is to capture the long-term effects with respect to factors that led to a change in transport mode, as a potential consequence of the financial crisis, and additionally, to further explore the determinants of transport choice during this economically stagnant period. To the best of our knowledge, there have not been studies that model the long-term effects of a long-lasting economic recession on the aforementioned issues. With the use of discrete choice logistic regressions we find that transport mode change and choice are influenced by different factors. Our study contributes to the effort transport policymakers make to identify and predict the changes and choices in PT use in a time when future financial crises are impending.

The rest of the paper is organized as follows: Section 2 entails a review of the literature while Section 3 comprises of survey information, the data used in our analysis and our methodological approach. Section 4 presents and discusses the results of our empirical analysis, while the final section concludes the paper.

## 2. Literature Review

The effects of the financial crisis on urban transport have been studied in several European cities. [Nielsen \(2015\)](#) explored the stability of urban form and location effects before and after the financial crisis for the Danish island of Zealand, which includes Copenhagen. He found significant changes in socio-economic characteristics as well as the urban form which highlight the importance of location for households in an effort to reduce travel time and costs during this adaptive period. [Ulfarsson et al. \(2015\)](#) examined how the transport frequency and importance of bus transit were affected by the financial crisis for the capital of Iceland, Reykjavik. Using survey data from 2009, his results show a 30% reduction in transport frequency, influenced mainly by the suburban residents. Additionally, bus transit was now considered more important by 20% of the participants with teleworking and decreased income being the main drivers behind both changes. Similarly, [Caldima et al. \(2020\)](#), using data from surveys before and after the crisis, examined the commuting patterns of university students from Oporto University in Portugal. Again, cost reduction and a turn for more sustainable means such as public transport was observed. This paper also raises some inequality concerns although the sample is based only on students.

There has been a plethora of studies in Spanish regions and cities. A study of ten Spanish metropolitan areas from 2008 to 2015 was conducted by [Romero and Monzon \(2018\)](#). The purpose was to assess the impact of the recession and recovery phase on fare revenues and operating costs of public transport systems. Interestingly, both appeared to increase gradually perhaps as a consequence of raises in ticket prices and increased PT supply. From a household expenditure point of view, [Cascajo et al. \(2018\)](#), using data from the Spanish Household Budget Survey found that the budget share of transportation had declined for most, except for the poorest households, reaching the lowest point in 2013. [Marquet and Miralles-Guasch \(2018\)](#), using survey data from the metropolitan area of Barcelona studied the changes in mobility habits between 2004-2012 capturing the effects of the financial crisis. They found a reduction in private modes of transport and an increase in short distance travel as well as non-motorized means depending on social factors and urban forms.

In Greece, [Efthymiou et al. \(2014\)](#) conducted a survey in Athens in order to examine the effect of the financial crisis on PT quality, demand, and user satisfaction. The data was collected during the worst phase of the recession (2013) and included information about metro and bus user satisfaction by measuring the importance of certain attributes as well as changes in demand. A mixture of methods were used in the analysis whose results were compared with a similar survey study by [Tyrinopoulos and Antoniou \(2008\)](#), which was conducted before the financial crisis. The studies revealed an increase in PT use for the ages 25 - 39. For metro users higher importance was given on information provision while bus users placed their emphasis on frequency and punctuality as they had before. [Efthymiou and Antoniou \(2017\)](#) augmented their analysis with the inclusion of all four PT

services operating in Athens in order to better understand the impact of the economic recession on PT user satisfaction and demand. They found that quality of service, environmental consciousness, the improvement of PT, and high car usage costs had a positive impact on PT demand. By contrast, PT use reduction was mainly attributed to alternative means of transport like bicycling and walking. Another survey study which was conducted in 2014 in Thessaloniki focusing on travel behaviour also found reduction in transport frequency (Papagiannakis et al., 2018). Moreover, it showed that the shift from car travel to PT was sensitive to household income. Finally, a survey study in the mid-sized city of Volos also confirms the positive effect of the financial crisis on sustainable transport (Galanis et al., 2017).

Although there have been plenty of studies dealing with the effects of the 2009 financial crisis on urban transportation, especially in the most affected countries, their focus was on the short-term effects. Greece's longstanding situation presents an opportunity to study also the long-term effects. By modelling the transport mode change (since before the crisis), and the present mode preferences, one can draw important conclusions on which factors led to a change in transport mode and which factors predict the mode of choice today.

### 3. Data & Methods

#### 3.1. Survey Data

A self-administered written questionnaire, consisting of 57 questions divided in four parts, was distributed to a non-probability sample of the metropolitan population of Athens. The first part included questions regarding demographic and socio-economic characteristics; the second part included questions concerning automobile ownership, frequency of use and characteristics; the third part focused on the effect of the financial crisis on transport mode choice and frequency of use; and the final part on the choice of transport today. A total of 308 questionnaires were collected in April, 2016. Despite the small size, our sample manages to represent the target population, that is, the adult population of urban Athens, in the key demographic and social characteristics, albeit older ages are somewhat underrepresented.

More recent data might have been less appropriate to study the long-term effects of the financial crisis since Greece's economy began recovering in 2018. But since the financial situation is more or less stable in the recent years our data might be able to capture the current transport mode choices to a fair extent. The full questionnaire is not presented here for brevity and is available upon request. Details on the questions from which data were extracted and used in the analysis can be found in **Table A1** of the **Appendix**.

TRAN Schoice and TRAN Schange are our dependent variables. They are indicator variables which represent the answers to the questions "For your daily commutes (employment, education, household chore, entertainment) you use more frequently?" and "Before the financial crisis (2009) did you use the same

mean of transport as today during a typical workday?”, respectively. FEMALE, AGE, INCOME, EDU, CAR, COVERAGE, FREQUENCY are the covariates. FEMALE, AGE are predictors for the demographic characteristics; INCOME, EDU, control for the socio-economic characteristics; COVERAGE is a Likert scale variable that controls for PT coverage of the home area—and to a certain degree user satisfaction since it is self-perceived—and CAR, FREQUENCY control for the car ownership and frequency of car use, respectively. All covariates are categorical, except for CAR which is a non-negative integer.

For the model specification, other variables such as the cc of car, parking space, household size, residence type, and job transportation were also considered for the model but were not selected due to either multiple missing values, collinearity issues, or complete lack of significance in any of the models. Unemployment was another variable that was omitted due to very low variability since only 5.52% of the sample stated unemployed. In any case, INCOME can be also viewed as a proxy for unemployment. For our analysis we use the variables described in **Table 1**.

**Table 1.** Descriptive statistics.

Variables	Category	Freq.	%	Cum. %
TRANSchoice	0 = Car/Motorbike	154	50.49	50.49
	1 = Public Transport	151	49.51	100.00
TRANSchange	0 = No	237	77.20	77.20
	1 = Yes	70	22.80	100.00
FEMALE	0 = male	155	50.32	50.32
	1 = female	153	49.68	100.00
AGE (in years)	16 - 25	64	20.78	20.78
	26 - 40	120	38.96	59.74
	41 - 60	105	34.09	93.83
	61+	19	6.17	100.00
INCOME (net monthly personal income in €)	0 - 800	65	15.26	15.26
	801 - 2000	272	63.85	79.11
	2001+	89	29.98	100.00
EDU (education level)	Secondary	85	27.60	27.60
	Bachelor	155	50.32	77.92
	Masters'/Ph.D.	68	22.08	100.00
COVERAGE (PT coverage of home area)	Not at all/Low	21	6.82	6.82
	Medium	81	26.30	33.12
	Well	92	29.87	62.99
	Very well	114	37.01	100.00

**Continued**

	Never to 2 times a month	96	31.17	31.17
FREQUENCY (of car use)	1 to 4 times a week	98	31.82	62.99
	Everyday	114	37.01	100.00
	Mean	S.D.	Min.	Max.
CAR (in natural units)	1.35	0.76	0	4.00

Notes: Freq. = Frequency; % = Percentage; Cum. % = Cumulative Percentage.

**3.2. Methods**

For our empirical analysis we estimate two binary multivariable logit models with heteroskedasticity robust standard errors. Logistic regression was chosen over linear probability models due to the discrete nature of our dependent variables, i.e., TRAN Schoice and TRAN Schange. Following [Cameron and Trivedi \(2005: pp. 469-470\)](#), the estimated model(s) is:

$$P(y_i = 1|x_i) = \Lambda(x_i\beta), \quad (1)$$

where  $i$  denotes the individual,  $\Lambda(\cdot)$  is the cumulative distribution function of the logistic distribution,  $y_i$  is a binary variable taking the values of 1 and 0 for each of the dependent variables as described in [Table 1](#) and  $x_i$  is the set of the covariates.

We also calculate the average marginal effects (AME), that is, the average change on the conditional

mean of the dependent variable,  $E(y|x)$ , when a regressor  $x_i$  changes by an infinitesimal amount, while other regressors remain at their observed values. In the case of an indicator variable, say  $z$ , they represent the discrete change in  $E(y|x)$  when  $z$  changes from zero to one. AME provides more useful information in non-linear models where the marginal effect is not constant but varies depending on the values of other regressors. The estimation for continuous variables was performed with the following formula:

$$\frac{\partial \Pr[y_i = 1]}{\partial x_i} = \Lambda(x'\beta)\{1 - \Lambda(x'\beta)\}\beta_j. \quad (2)$$

The covariates of our models were tested for pairwise correlation using Spearman's rank in order to detect potential collinearity issues. Moderate linear correlation (0.55) was detected only between AGE and INCOME. Our models converged fast in 5 and 4 iterations ruling out a serious multicollinearity problem ([Cameron and Trivedi, 2009](#)).

**4. Results & Discussion**

In this section we present and discuss the findings of our research with respect to both research questions raised in the Introduction of the paper.

**4.1. A Summary of Survey Responses**

To summarise some of the questionnaire findings, men and women had equal

participation (155 to 153) while age was distributed normally with the age group 31 - 40 having the higher relative frequency (21.75%). The education level in our sample was mainly made from people with bachelor's degree (50.32%) since tertiary education in Greece is free. The aforementioned population structure is very similar to the 2011 census with respect to the Attica (NUTS 2 region which includes Athens) as well as the national population. With respect to PT, a staggering 39% of the sample stated that they would never use PT regardless of the fare. On the other hand, 78% stated that they would use PT if it was less crowded and an 80% if route times decreased.

In regard to economically oriented data, income, measured by net monthly earnings, of 801 - 1200 € was the most prevalent (30.49%). Half the sample possessed only one car in their family while only 59% had parking space. 43.9% were driving cars of 1201 - 1500 € and only a small fraction (7.72%) had surrendered their licence plates due to high operational cost. The monthly average spending for PT was 18.24 € compared to the 83.03 € for car. In addition, 57.98% had reduced the frequency of their daily commutes after the financial crisis (2009) while 22.80% had changed means of transport. Most people who changed means of transport due to the financial crisis were then using car (43.24%). Today (the day the questionnaire was answered), PT was the primary choice of transport (46.25%) with car second (38.11%). Interestingly, the average commute frequencies do not appear to differ significantly between 2009 and 2016 in our data.

## 4.2. Change in Transport Mode

Our empirical findings for the model that examines factors that might have led to a change in transport mode since the beginning of the financial crisis (2009) show that only COVERAGE is statistically significant. Individuals with medium public transport coverage have a 21% reduced probability to have changed mode of transport compared to those who reported no or low coverage. This effect is even more profound for individuals who reported being covered very well by PT in their home area. For this category the probability reduces by 34% compared to the referent group. In relative terms, those who reported the highest PT coverage were 7.4 times less likely to change mode of transport. From the rest of the covariates, INCOME is the single variable that appears to only decrease the odds of transport change. This is confirmed by a statistically significant AME between low and high income individuals. In this comparison, high income individuals (2001+ €) had 18% reduced possibility on average to change mode compared to the low income group (0 - 800 €). Car ownership, although not statistically significant, was the sole factor that influenced only positively change.

The absence of statistically significant variables, led to the hypothesis that, for younger individuals other factors such as, acquiring a drivers' license and getting employment, probably influenced their change in transport mode more than any effects of the economic recession due to their young age pre-crisis. To test this hypothesis, we restricted our sample to individuals over the age of 30<sup>1</sup> The estimated

<sup>1</sup>For a more parsimonious model, since our sample was significantly reduced, AGE was introduced as an integer variable per 10-year increments.

age-truncated model severely outperformed the full sample model in diagnostics, indicating again that the frequency of car use plays a significant role for individuals over 30. While the marginal probabilities of COVERAGE remained in similar levels with the previous model, the marginal probability of transport change reduced by a significant 17% and 26% for those who use car 1 to 4 times a week and everyday users, respectively, compared to those who never use or use up to 2 times per month. The remaining predictors were similar to the full sample model. The results of both models are presented in **Table 2**.

**Table 2.** Empirical results for change in transport mode.

Variables	Categories	TRANS change			TRANS change (Sample restricted to age 30+)		
		Logit coef.	Odds Ratio	AME	Logit coef.	Odds Ratio	AME
FEMALE	male (reference)	-0.07	0.93	-0.01	-0.54	0.58	-0.07
	female	0.30	0.28	0.05	0.44	0.26	0.05
AGE <sup>†</sup>	16 - 25 (reference)				-0.39 (0.25)	0.67 (0.17)	-0.05 (0.03)
	26 - 40	0.46 (0.43)	1.59 (0.69)	0.08 (0.07)			
	41 - 60	-0.52 (0.56)	0.59 (0.33)	-0.07 (0.08)			
	61+	-0.03 (0.71)	0.97 (0.69)	-0.00 (0.11)			
INCOME	0 - 800 (reference)						
	801 - 2000	-0.36 (0.35)	0.70 (0.25)	-0.06 (0.06)	-0.46 (0.50)	0.63 (0.31)	-0.06 (0.07)
	2001+	-1.54 (1.23)	0.21 (0.26)	-0.18 (0.09)**	-1.29 (1.33)	0.28 (0.37)	-0.14 (0.11)
EDU	Secondary (reference)						
	Bachelor	0.32 (0.41)	1.37 (0.56)	0.05 (0.07)	0.55 (0.51)	1.73 (0.88)	0.07 (0.06)
	Masters'/Ph.D.	-0.52 (0.49)	0.59 (0.29)	-0.07 (0.07)	-0.75 (0.87)	0.47 (0.41)	-0.07 (0.07)
COVERAGE	Not at all/Low (reference)						
	Medium	-1.02 (0.55)*	0.36 (0.20)*	-0.21 (0.12)*	-0.89 (0.62)	0.41 (0.26)	-0.16 (0.11)
	Well	-0.69 (0.53)	0.50 (0.26)	-0.15 (0.12)	-0.88 (0.60)	0.41 (0.25)	-0.16 (0.11)
	Very Well	-2.00 (0.56)***	0.13 (0.08)***	-0.34 (0.11)***	-2.44 (0.72)***	0.09 (0.06)***	-0.33 (0.10)***
FREQUENCY	Never to 2 times a month (reference)						
	1 to 4 times a week	0.12 (0.43)	1.13 (0.49)	0.02 (0.07)	-1.04 (0.64)*	0.35 (0.23)*	-0.17 (0.10)*
	Everyday	-0.36 (0.44)	0.70 (0.31)	-0.05 (0.07)	-2.01 (0.65)***	0.13 (0.09)***	-0.26 (0.09)***
CAR		0.09 (0.22)	1.09 (0.23)	0.01 (0.03)	0.06 (0.32)	1.06 (0.33)	0.01 (0.04)

**Continued**

Observations	304	189
Log-pseudolikelihood	-146.4	-73.6
McFadden's R <sup>2</sup>	0.11	0.2
AIC (BIC)	322.7 (378.5)	173.2 (215.4)
Correct classification (%)	78.62	84.66

Notes: Heteroskedasticity robust standard errors in parentheses. \*, \*\*, \*\*\* denote the significance level at 0.1, 0.05 and 0.01, respectively. AME are the average marginal effects. Classified with Pr = 0.50 as cut-off value. The constant terms were estimated but were omitted from the presentation. †In the restricted sample model, age was added as a continuous variable per 10-year increments.

A limitation of this variable is that it fails to capture the direction of the change (i.e., from PT to car or the opposite). This fact is another possible explanation for the lack of statistical significance since a potential reverse relationship of a predictor variable in the two cases might be cancelling the effect. Nevertheless, public transport coverage of the home area remains a constant, influencing negatively change in both models. The increased PT options might have led individuals to an optimal commute routine so that the effect of the financial crisis would be minimal on their everyday travel behaviour. It appears that PT coverage should become the focal point when predicting the change in transport mode due to the long-term effects of financial shocks for urban populations. Evidence that high income individuals are somewhat immune to the long-term effects of the crisis transportation-wise comes as no surprise. What is perhaps surprising, is the fact that frequent car users over the age of 30 were less likely to change mode of transport, but there are several explanations. Habit formation before the crisis, unreliable PT, and personal preferences are only some of them. Short-term effects might have spurred a temporary change but that is something our data cannot answer. In any case, this matter requires further investigation.

### 4.3. Choice of Transport

We now proceed to the next research question, that is, what determines the choice of transport. In this model, we identify a lot more statistically significant covariates such as FEMALE, AGE, INCOME and CAR. All variables, except for FEMALE have a negative effect on the probability of choosing PT.

Beginning with FEMALE, women were 2.5 times more likely to use PT for their daily commutes than men, a 18% increase in probability on average. Individuals aged 26 - 40 and 41 - 60 were 5 and 7.6 times less likely to use PT, respectively, compared to participants aged 16 - 25. Furthermore, middle income (801 - 2000 €) individuals had a decreased probability of 17% compared to low income participants of using PT more frequently. Finally, the probability of using PT reduced by 19% for each additional car owned. Education level and PT coverage were the only non significant variables in the model whose results are presented in **Table 3**.

**Table 3.** Empirical results for choice in transport mode.

Variables	Categories	Logit coef.	Odds Ratio	AME
FEMALE	male (reference)			
	female	0.92 (0.29)***	2.52 (0.72)***	0.18 (0.05)***
AGE	16 - 25 (reference)			
	26 - 40	-1.60 (0.47)***	0.20 (0.09)***	-0.30 (0.08)***
	41 - 60	-2.03 (0.53)***	0.13 (0.07)***	-0.39 (0.09)***
	61+	-1.29 (0.85)	0.28 (0.23)	-0.24 (0.16)
INCOME	0 - 800 (reference)			
	801 - 2000	-0.89 (0.33)***	0.41 (0.14)***	-0.17 (0.07)***
	2001+	-1.10 (0.79)	0.33 (0.27)	-0.21 (0.15)
EDU	Secondary (reference)			
	Bachelor	-0.01 (0.36)	0.99 (0.36)	-0.00 (0.07)
	Masters'/Ph.D.	-0.29 (0.39)	0.74 (0.29)	-0.05 (0.07)
	Not at all/Low (reference)			
	Medium	-0.05 (0.53)	0.95 (0.50)	-0.01 (0.10)
	Well	-0.41 (0.52)	0.66 (0.34)	-0.08 (0.09)
CAR	Very Well	-0.43 (0.49)	0.65 (0.32)	-0.08 (0.09)
		-1.03 (0.22)***	0.36 (0.08)***	-0.19 (0.04)***
	Observations	302		
	Log-pseudolikelihood	-163.5		
	McFadden's R <sup>2</sup>	0.22		
	AIC (BIC)	353.1 (401.3)		
	Correct classification (%)	72.19		

Notes: Heteroskedasticity robust standard errors in parentheses. \*, \*\*, \*\*\* denote the significance level at 0.1, 0.05 and 0.01, respectively. AME are the average marginal effects. Classified with Pr = 0.50 as cut off value. The constant terms were estimated but omitted from the presentation.

Females being more frequent PT users is a finding in accordance with previous research (Ng and Acker, 2018). The attitude men have towards PT and their attachment to automobiles might play a role in this result (Simićević et al., 2016). In addition, a study by Jetter et al. (2020), indicates that men became more risk averse and impatient during the financial crisis. This fact might also explain why they choose to avoid the waiting times and uncertainty involved in Athens' PT. As for age, whether this negative effect is attributed to the age-income-car

ownership correlation, or is a matter of comfort and persistent behaviour cannot be said positively. What can be said positively is that young people are less likely to have a driver's license or access to the family car, thus creating more demand for PT.

Income and car ownership are not independent factors since one needs the former to buy the latter. Income level is also correlated with the ability to cope with the costs surrounding car usage (i.e. gasoline, traffic taxes, car taxes), therefore higher PT use from low income individuals in troubled economic times is an expected result. The number of cars owned has a pretty dramatic effect on the choice of transport mode in our sample. Our results are in line with the findings of [Paulley et al. \(2006\)](#) in regard to income and car ownership.

EDU and COVERAGE do not appear statistically significant. Regarding the former, a case can be made for the absence of ecological emphasis in the Greek educational system irrespective of the level ([Paraskevopoulos et al., 1998](#)). This lack of environmental consciousness might in turn result in less PT usage ([Saleem et al., 2018](#); [Shen et al., 2008](#)). The fact that PT coverage is not significant is somewhat surprising. One could argue that individuals are indifferent to the level of PT coverage with regards to choosing transport but given that 67% stated COVERAGE above medium and only 6.8% below medium we can assume that it is not indifference but rather accustomation to a high level of coverage. Another possible factor is the PT user satisfaction which has the potential to influence negatively the use of PT ([Tyrinopoulos and Antoniou, 2008](#)).

An effort to change men attitudes towards PT is easier said than done since men appear to have more inelastic travel behaviour patterns than women ([Simićević et al., 2016](#)). However, cultivating an environmental consciousness through the educational system is more realistic and imperative for the reduction in car usage. Increased taxation on additional cars might also aid in the effort for more PT use since car ownership appears to have the heaviest contribution to the choice of transport.

## 5. Conclusion

In this paper, we aimed at identifying demographic, socio-economic, and transport-related factors that might have made individuals change transport mode compared to what they were using before the financial crisis in an attempt to capture the long-term effects. We also examined which of these factors determines the choice of transport today (2016) for everyday commutes where potential changes in habits have been formed. Using survey data from a large metropolis and binary logit models we find that PT coverage of home area mainly determines whether an individual will change mode of transport. With respect to the choice of transport, car ownership, age, gender, and income level appear to be the main predictors.

Our study suffers from a series of limitations. The absence of pre-crisis data that would illuminate more the effects of the crisis is the study's main limitation. Moreover, the self-administered questionnaires are often accompanied by misclassifica-

tion bias and the subjective measures used in some questions can lead to similar issues. In addition, there is potential recall bias regarding the transport change question and the exposure of younger individuals to the crisis which we aimed to solve with our age-restricted model. With respect to transport choice, our analysis is limited to automobiles and PT which nevertheless represent the vast majority of commuters in Athens. The internal validity of the study is limited by the sampling methodology which led to unrepresentativeness of older adults, as well as the relatively small sample size.

The generalizability of the results is subject to the similarity with the adult population of Athens. Finally, a larger sample may have altered some of the findings.

The importance of PT coverage when it comes to changing the mode of transport of an urban population is the main takeaway message of the study. The social dimension of PT should not be neglected since a very well covered individual is much more protected, transportation-wise but also financially, from the short or long-term effects of an economic recession. The fact that PT coverage was not a significant predictor of transport mode choice is a clear indicator that PT quality adjustments are necessary. Changing economic conditions can be in favour of sustainable transport if policy makers act accordingly. A potential shift towards PT should be perceived as an opportunity and should be met with the proper incentives so that the change becomes permanent (Redman et al., 2013).

### Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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## Appendix

### Survey questions and answers

**Table A1.** Questionnaire.

Variable created <sup>†</sup>	Question	Responses	%	Cum. %
TRANS choice	For your daily commutes (employment, education, household chore, entertainment) you use more	0 = Car/Motorbike	50.49	50.49
		1 = Public Transport	49.51	100.00
TRANS change	Before the financial crisis (2009) did you use the same mean of transport as today during a typical workday?	0 = Yes	77.20	77.20
		1 = No	22.80	100.00
FEMALE	Sex	0 = Male	50.32	50.32
		1 = Female	49.68	100
AGE	Age	1 = 16 - 20	9.74	9.74
		2 = 21 - 25	11.04	20.78
		3 = 26 - 30	17.21	37.94
		4 = 31 - 40	21.75	59.74
		5 = 41 - 50	17.21	76.95
		6 = 51 - 60	16.88	93.83
		7 = 61 - 70	5.19	99.03
		8 = 71+	0.97	100
INCOME	Monthly net personal income	1 = No income	16.72	16.72
		2 = <400 €	8.2	24.92
		3 = 401 - 800 €	23.28	48.2
		4 = 801 - 1200 €	30.49	78.69
		5 = 1201 - 2000 €	17.05	95.74
		6 = 2001 - 3000 €	2.62	98.36
		7 = 3001 - 4000 €	0.66	99.02
		8 = 4001 - 5000 €	0.33	99.34
		9 = >5001 €	0.66	100
EDU	Education level	1 = Secondary	27.6	27.6
		2 = B.A./B.Sc.	50.32	77.99
		3 = M.A./M.Sc.	19.48	97.4
		4 = Ph.D.	2.6	100

**Continued**

		1 = None	10.39	10.39
		2 = 1	50	60.39
CAR	How many cars do you possess in your family?	3 = 2	34.09	94.48
		4 = 3	4.87	99.35
		5 = 4+	0.65	100
		1 = Not at all	0.32	0.32
		2 = Low	6.49	6.82
COVERAGE	The area you reside is covered by public transport	3 = Mediocre	26.6	33.12
		4 = Well	29.87	62.99
		5 = Very well	37.1	100
		1 = Never	20.78	20.78
		2 = Rarely	9.09	29.87
FREQUENCY	How often do you use your car?	3 = Twice a month	1.23	31.1
		4 = Once a week	12.01	43.11
		5 = 3-4 times a week	19.81	62.92
		6 = Every day	37.01	100

Notes: % = Percentage; Cum. % = Cumulative Percentage. †Categorical variables were created by collapsing categories, so as to multiple observations exist in all categories.