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Financial Recession and Congestion Pricing: Has acceptability been affected?

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Abstract

This paper investigates the effects of economic recession on congestion pricing acceptability. We use data from two questionnaires; one before (2008) and one during (2013) the financial recession periods. The results show statistically significant differences in the responses to the two questionnaires regarding acceptability of the pricing system, use of private car for traveling, and opinions concerning traffic congestion. Public acceptability of the congestion pricing scheme has decreased significantly during the recession period. Among the important factors that were found to influence the probability of accepting a congestion pricing scheme are income, mode of travel, and frequently experiencing congestion. However, we note that there is a significant difference in the factors that affect acceptability in the periods before and during recession.

Keywords: financial recession; congestion pricing; acceptability; logistic regression

1. Introduction

Congestion pricing was first established in Singapore in 1975; Oslo, London, Stockholm and many other cities suffering from congestion problems followed. Congestion pricing is largely regarded as an effective traffic management measure in terms of reducing delays and emissions, raising funds for new transport system development, and promoting public transportation (Ieromonachou et al., 2006; TfL, 2005; Yang and Zhang, 2002). In addition, it has for long been considered as a tool for establishing equity among users (Hamer et al., 2012; Franklin, 2012), and even for addressing the externalities produced by the private car usage (Weisbrod and Williams,

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2011). For congestion pricing to be successful, equity effects should be efficiently communicated to the public, with perceived fairness being a key factor for road pricing acceptability (Chen and Wen, 2013; Sun and Jian, 2013). In fact, gaining public acceptability remains a major barrier in implementing congestion pricing in urban areas (Schade, 2003; Ison and Rye, 2005). Although congestion pricing improves mobility, the public is frequently hesitant in accepting this scheme as there is significant opposition to paying for a good or service - road infrastructure in this case - that used to be free of charge (Rentziou et al., 2011).

Willingness to pay for goods or services is linked to consumer purchasing power which has recently been affected by financial recession in many western countries. In 2009, the European Union's (EU) real GDP growth rate was negative for the first time at -4.4%; private final consumption is shrinking and unemployment reached 11% in 2013 (Eurostat, 2013). Greece has been severely affected by the on-going crisis with a real GDP growth rate of -7.1% in 2011 and of -6.4% in 2012. In this changing financial 'landscape', new points of transport market equilibrium are being established with consumer tastes changing. It is evident that previous transportation planning schemes must be revisited as travel time values are decreasing, mobility is shrinking, utilities are changing, and willingness to pay is adjusted accordingly. In light of the above, it is reasonable to assume that congestion pricing acceptability cannot remain constant.

The objective of this paper is to explore potential changes in congestion pricing acceptability due to financial recession through a case study in the city of Athens, Greece. First, we measure acceptability using a suitably adapted questionnaire which includes information on trip characteristics and socioeconomic attributes for respondents. The related survey was undertaken in 2013. Second, we statistically compare results to pre-crisis survey evidence based on an identical 2008 questionnaire. Third, we develop logistic regression models to assess public acceptability over a sample of 1,897 questionnaires while accounting for a number of external factors such as income levels, trip duration, car ownership, and so on. This paper builds on a line of previous works on both congestion pricing (Milioti et al., 2008; Rentziou et al., 2011) and the impact of the financial crisis upon transportation demand (Christoforou et al., 2012 ;Christoforou and Karlaftis, 2011). The added value of the present research is threefold: (i) we measure current acceptability of congestion pricing in a financially constrained era, (ii) we identify significant differences before and during recession, and (iii) we provide insight on the factors shifting public opinion against road pricing.

2. Background

Public acceptability is widely recognized as a major barrier to widespread adoption of road pricing (16) (Schaller, 2010). As such, public acceptability has attracted considerable research attention in Europe (PRIMA, 1994; 2000; Di Ciommo et al., 2010), the US (Schaller, 2010) and internationally (Sun and Jian, 2013). Researchers report that acceptability is associated with three major issues; perceptions, individual characteristics, opinions and beliefs. First, public perception of the pricing scheme to be employed and its corresponding benefits are critical to gain acceptance (Odioso and Smith, 2009; Falzarano, 2009). Previous results have shown that the magnitude of the effect of perceived effectiveness and efficiency is greater for short-distance travelling (Chen and Wen, 2013). It is worth noting that many car users initially opposing pricing

schemes switch opinion when realizing the positive mobility effects of the scheme (Zmud and Arce, 2008; Gaunt et al., 2007; Schaller, 2006; Ross et al., 2009). The perception of the transportation system itself (PRIMA, 1994; 2000; Zmud and Arce, 2008; Gaunt et al., 2007; Schaller, 2006) and its level of user-friendliness (Zmud and Arce, 2008; Gaunt et al., 2007; Schaller, 2006; Jones, 2002; Harsman, 2001) are of importance as well. Acceptability also depends on the perceived availability of alternative transportation modes (PRIMA, 1994; 2000; Schaller, 2006;Odioso and Smith, 2009; Harsman, 2001).

Second, with regard to individual characteristics affecting acceptability, car ownership seems to be most critical with car owners opposing urban tolls and public transport users favoring road pricing (Zmud and Arce, 2008; Gaunt et al., 2007; Kottenhoff, and Brundell-Freij, 2009; Winslott-Hiselius et al., 2009). However, despite higher acceptability, the absence of strong support from transit users contributes to low levels of overall acceptability (Gaunt et al., 2007; Schaller, 2006). Moreover, the region of residence has been shown to influence public acceptability (Zmud and Arce, 2008), but the magnitude of the influence depends on the region examined. For example, Florida non-residents accept congestion pricing more than Florida residents, while in New York and Stockholm the result is in the opposite direction, with residents of inner city (pricing area) being in favor of congestion pricing (Zmud and Arce, 2008; Winslott-Hiselius et al., 2009). In Stockholm, having ones home and workplace on the same side of the pricing cordon works in favor of congestion pricing (Franklin, 2012). Residents of smaller towns tend to accept pricing systems easier (Vrtic et al., 2007), people over 55 are more averse to charging schemes (Fichtner and Riggleman, 2007), while gender may also come into play under specific contextual circumstances (Franklin, 2012).

Third, in terms of opinions and psychological mechanisms, the belief that objective truths, true justice, and an authentic beauty in this world exist, may impact acceptability in some cases (Schmocker et al., 2010). Previous experience with pricing schemes also increases overall acceptability (PRIMA, 1994; 2000;Zmud and Arce, 2008). In addition, it appears that acceptability is related to individual concerns regarding equity and privacy issues(PRIMA, 1994; 2000; Zmud and Arce, 2008;Falzarano, 2009; Ross et al., 2009; Jones, 2002; Harsman, 2001; DeCorla-Souza, 2008; Johnston et al., 1995). People who view air pollution as a significant problem are more likely to favor a pricing system (Jaensirisak et al., 2005), while people who oppose congestion pricing consider it as an additional tax measure rather than a measure for traffic management (Zmud and Arce, 2008; Schaller, 2006). And, although many of these respondents believe that congestion is a growing problem, they do not view pricing as a viable solution (Gaunt et al., 2007).Finally, people tend to accept congestion pricing when revenues are invested in public transport and for improving conditions for pedestrians and cyclists (Schuitema andSteg, 2008; CFIT, 2006; Schade and Schlag, 2003; Jones, 2002).

Previous research has identified many of the factors that affect public acceptability of congestion pricing worldwide. To the best of our knowledge, the impact of recession has not been addressed so far, despite empirical evidence showing a reduction in traffic and toll collection revenues worldwide. We believe that the Greek economic context and the Athens empirical settings are very well suited to explore the impact of recession on congestion pricing acceptability regarding the transferability of lessons learnt to other cities and Countries.

3. Data Description

Our questionnaire targeted respondents with no experience in the operation of a congestion charging scheme. Quantifying congestion pricing acceptability before implementing such a scheme is a necessary pre-condition for its successful implementation. It is well known that stated preference methods based on questionnaires usually produce results which suffer from hypothetical bias compared to revealed preference methods, but are particularly useful whenever specialized data are required in order to examine hypothetical situations that do not exist in real life.

In the first part of the questionnaire, a brief description of the proposed pricing scheme was given. The congestion pricing scheme proposed concerns the central zone of Athens currently bounded by a cordon area where number plate restrictions apply following an 'odd and even' system since 1982 (see Figure 1). Respondents were thus familiar to both the perimeter and the eventual alternate routes. The pricing scheme considered, seen as an alternative for limiting congestion, applies to private cars during weekdays from 07:00-21:00. Special cases of users such as residents of the pricing area, public transport, and motorcycles will be exempt, or will enjoy a considerable reduction in the fee.

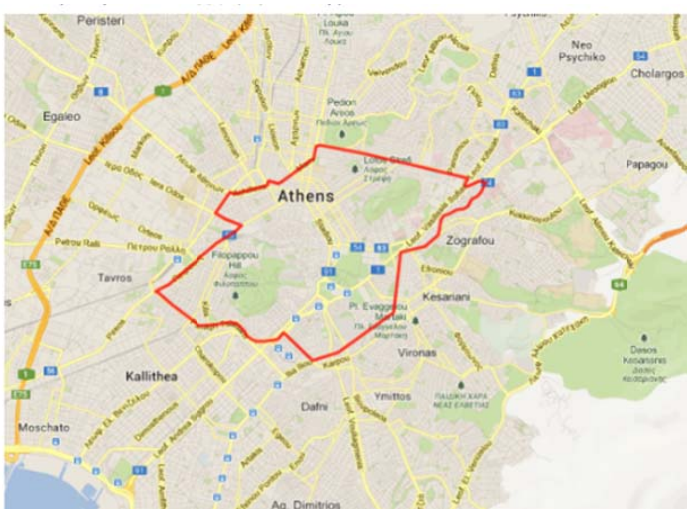

Figure 1: Cordon area of the proposed pricing scheme.

In the first part of the questionnaire respondents provided information on their trip characteristics such as purpose, duration and transport mode for a typical journey to/from the center of Athens. In addition, opinions regarding traffic congestion problems on the particular route most frequently followed were recorded. In the second part, responses regarding the acceptability of the congestion pricing scheme proposed, the factors that might affect traveler acceptance and the potential use of revenues raised through congestion pricing scheme in the center of Athens, were collected. Further, respondents were asked to choose the travel mode they would use in case such congestion pricing was implemented, as well as the classes of users that should be exempt from charges. The third part of the questionnaire included questions regarding socioeconomic and demographic characteristics for the travelers. Based on this questionnaire, two surveys were conducted; the first in 2008 recorded attitudes towards

congestion pricing acceptability before the recession period, while the second survey in 2013 the same information during economic recession.

In both surveys the questionnaire was completed via the internet as well as via personal interviews within the study area. The field survey was conducted on working days, during different hours of the day (08:00-20:00), and respondents were chosen at random in order to capture different population and trip characteristics. Table 1 presents summary statistics for selected variables for each section of the questionnaire (statistics are presented separately for the 2008 and 2013 questionnaires and for the consolidated database).

Table 1 allows for some interesting observations. First, respondents who travel to the pricing area (center of the City) have been reduced by half between 2008 and 2013. A modal shift towards public transportation can be inferred (see also Christoforou and Karlaftis, 2011). Second, business trips have decreased by 33% as unemployment is reaching an all-time peak (Eurostat, 2013). Third, trip durations become longer despite the recent traffic reduction in the Athens city center; only 27% of the respondents think of congestion as a serious problem. It can be thus assumed that travelers who are still using cars travel over longer distances while public transportation has become more attractive for short-trip travelling. Fourth, the distribution of income levels seems to have dramatically changed since 2008. Fifth, the number of respondents who believe that the funds raised by a congestion pricing scheme should be used either for relieving taxation or for improving the public health sector has increased. This is explained by the fact that high public debt has resulted to increased taxation and to severe cuts in vital public sector services.

Table 1: Summary Statistics for Selected Variables

Variables	*2008*	*2013*	*2008-2013*
1st section of the questionnaire			
Residents of the pricing area	20.9	15.1	18.8
Respondents who travel to the pricing area by car (1 car; 0 other)	40.2	21.3	33.3
Business (1 if the purpose of trip is business, 0 otherwise)	61.6	40.6	53.9
Shopping (1 if the purpose of trip is leisure or shopping, 0 otherwise)	20.9	21.0	20.9
Studies (1 if the purpose of trip is studies, 0 otherwise)	10.6	24.6	15.8
Duration 1 (1 if duration of the trip is between 10 to 30 min; 0 otherwise)	55.6	38.9	49.5
Duration 2 (1 if duration of the trip is between 30 to 45 min; 0 otherwise)	26.7	31.7	28.5
Duration 3 (1 if duration of the trip is between 45 to 60 min; 0 otherwise)	12.1	18.0	14.3
Duration 4 (1 if duration of the trip is over 60 min; 0 otherwise)	5.6	11.4	7.7
High Flexibility of time of trip (1 yes; 0 otherwise)	30.6	28.5	29.8
Low Flexibility of time of trip (1 yes; 0 otherwise)	38.7	55.8	45.0
No Flexibility of time of trip(1 yes; 0 otherwise)	30.7	15.7	25.2
Traffic congestion problem on trip (1 if it is a serious problem; 0 otherwise)	82.1	47.8	69.6
Traffic congestion problem in the city of Athens (1 if it is a serious problem; 0 otherwise)	62.3	27.4	49.6
2 nd section of the questionnaire			
Acceptability of congestion pricing (1 if respondents accept; 0 otherwise)	33.9	7.8	24.4
Respondents who are going to travel to the pricing area by car after the implementation of the congestion pricing scheme	24.4	11.4	19.6

Respondents who believe that residents of pricing area should be exempt from paying the tariff	77.7	79.3	77.9
Respondents who believe that workers of pricing area should be exempt from paying the tariff	56.6	67.3	60.5
Respondents who believe that hybrid vehicles should be exempt from paying the tariff	39.7	34.3	37.7
Respondents who believe that motorcycles should be exempt from paying the tariff	39.6	34.6	37.7
Allocation of congestion pricing revenues for protecting the environment	50.2	28.7	42.3
Allocation of congestion pricing revenues for improving PT services	64.3	69.0	66.1
Allocation of congestion pricing revenues for improving health services	23.3	40.5	29.6
Allocation of congestion pricing revenues for improving the road network	37.6	44.2	40.0
Allocation of congestion pricing revenues for reducing car taxes	16.8	36.0	23.8
3rd section of the questionnaire			
Gender (1 if women; 0 if men)	39.3	47.7	42.4
Age 18- 34(1 yes; 0 otherwise)	43.3	52.7	46.7
Age 35-54 (1 yes; 0 otherwise)	41.5	31.6	37.9
Age>55 (1 yes; 0 otherwise)	15.2	15.7	15.4
Level of education 1 (1 if middle school; 0 otherwise)	4.4.	5.4	4.8
Level of education 2 (1 if high school; 0 otherwise)	34.2	22.9	30.1
Level of education 3 (1 if college; 0 otherwise)	61.4	71.7	65.1
Availability of car in residence (1 yes; 0 otherwise)	80.9	64.8	75.0
Income low (1 if income is low; 0 otherwise)	6.5	24.2	13.0
Income low to median (1 if income is low to median; 0 otherwise	16.9	33.3	22.9
Income median (1 if income is median; 0 otherwise)	48.2	33.1	42.7
Income median to high (1 if the income is low to median; 0 otherwise	19.5	6.8	14.8
Income high (1 if income is high; 0 otherwise)	8.9	2.6	6.6
Number of observations	1203	694	1897

4. **Methodology**

Logistic regression has been widely used to analyze variables of discrete nature (0, 1) (Washington et al., 2011). In this paper, logistic regression is used for estimating public acceptability of congestion pricing. The dependent variable represents positive (yes or 1) or negative (no or 0) responses to the question regarding acceptability of congestion pricing. The literature reports that perceptions, individual characteristics, opinions and beliefs explain acceptability; those responses were used as independent variables.

In logistic regression, the dependent variable y_i represents the log of the ratio of the probability P_i to the probability$(1 - \mathrm{P_i})$, where P_i is the probability that the one alternative is chosen and $(1 - \mathrm{P_i})$ is the probability that the other alternative is chosen. This relationship can be described as follows (Washington et al., 2011):

$$log\,\frac{P_i}{1-P_i} = a + \beta_i x_i, \;\; i = 1, \ldots . n \qquad (1)$$

where a is the constant term; β_i represent the coefficients of the independent variables x_i.

Equation (1) also can be written as follows:

$$\frac{P_i}{1-P_i} = e^{(a+\beta_i x_i)} = e^{a} \cdot e^{\beta_i x_i} \qquad (2)$$

As the value of one of independent variables increases by one, with the other independent variables remain constant, equation (2) can be transformed as follows

$$\frac{P_i^{'}}{1-P_i^{'}} = e^{a} \cdot e^{\beta_i(x_i+1)} = e^{a} \cdot e^{\beta_i x_i} \cdot e^{\beta_i} = \frac{P_i}{1-P_i} \cdot e^{\beta_i} \quad (3)$$

Equation (3) shows that as the price of an independent variable increases by one, while the rest variables do not change, the ratio of probabilities Pi/(1-Pi) is multiplied by the term $e^{\beta i}$. The term $e^{\beta i}$, called odds ratio (OR), ranges from 0 to infinity. Considering that P_i is the probability of alternative (1) to be chosen and (1-Pi) is the probability of the alternative (0) being chosen, when the OR is greater than 1 alternative (1) is more likely to be chosen.

5. Results

5.1 Comparison of Responses to the two Questionnaires

The main goal of the paper is to examine the impact of financial recession on congestion pricing acceptability in the city of Athens, Greece. To this end, we tested whether there exist statistically significant differences between the responses to the 2008 and 2013 questionnaires regarding acceptability of the pricing system, use of private car for traveling, and opinions concerning traffic congestion.

This investigation was done using the Chi-Square test. Data used in chi-square tests are either counts or frequencies measured across categories or across any scale(Washington et al., 2011). This goodness-of-fit test compares the observed and expected frequencies in each category to test that all categories contain the same proportion of values. Assuming that sample sizes are sufficiently large and the two populations are randomly sampled (both conditions hold for the two questionnaires used in this paper), the null hypothesis is that there is no statistically significant difference between the two population proportions and the alternative hypothesis is that there is statistically significant difference between the two population proportions.

In Table 2, frequencies and percentages of the responses concerning congestion pricing acceptability for the two surveys are presented. Congestion pricing acceptability was rather high in the 2008 survey (33.9%). A large decrease is recorded in the 2013 survey, with acceptability being at 7.8%. Since the chi square critical value for one degree of freedom is 3.84, the null hypothesis of no difference between the two samples is rejected at the 5% critical level. We can thus conclude that congestion pricing acceptability between the two time periods (before and during the financial recession) is significantly different.

Table 2: Chi-Square Test for Congestion Pricing Acceptability

Acceptability						
	Values			*Percentages*		
Year	*No*	*Yes*	*Total*	*No*	*Yes*	*Total*
2008	795	408	1203	66.1%	33.9%	100%
2013	640	54	694	92.2%	7.8%	100%
2008+2013	1435	462	1897	75.6%	24.4%	100%
Chi-Square Test		Value		Asymp. Sig. (p-value)		
Pearson Chi-Square		163.162		0.000		

To investigate the impact of financial recession on traffic congestion as perceived by respondents, the questionnaire included a question whether traffic congestion is a serious problem in their trip. Comparison of the two samples (Table 3), clearly suggests that traffic congestion was perceived as a serious problem in 2008, while in 2013 the percentage of respondents who believe that traffic congestion is a serious problem is reduced. This result is verified by the chi square test, where the null hypothesis is rejected, indicating that there is a statistically significant difference between the two samples (the sample before and the sample during the economic recession).

Table 3: Chi-Square Test for the Problem of Traffic Congestion

Traffic congestion problem on trip						
	Values			*Percentages*		
Year	*No*	*Yes*	*Total*	*No*	*Yes*	*Total*
2008	215	988	1203	17.9%	82.1%	100%
2013	362	332	694	52.2%	47.8%	100%
2008+2013	577	1320	1897	30,4%	69.6%	100%
Chi-Square Test		Value		Asymp. Sig. (p-value)		
Pearson Chi-Square		245.268		0.000		

The use of private cars has also been affected by recession. The chi square test confirms that there is a statistically significant difference between the two samples at the 5% significance level (Table 4). Moreover, the percentage of people intending to use their cars for entering the pricing area after implementation of the proposed scheme is statistically different between the two samples (Table 5).

Table 4: Chi-Square Test for Current Mode Use

Mode of transportation_CAR						
	Values			*Percentages*		
Year	*No*	*Yes*	*Total*	*No*	*Yes*	*Total*
2008	719	484	1203	59.8%	40.2%	100%
2013	546	148	694	78.7%	21.3%	100%
2008+2013	1256	632	1897	66.7%	33.3%	100%
Chi-Square Test		Value		Asymp. Sig. (p-value)		
Pearson Chi-Square		70.817		0.000		

Table 5: Chi-Square Test for Mode Use Following Congestion Pricing Implementation

Mode of transportation_CAR						
	Values			*Percentages*		
Year	*No*	*Yes*	*Total*	*No*	*Yes*	*Total*
2008	910	293	1203	75.6%	24.4%	100%
2013	615	79	694	88.6%	11.4%	100%
2008+2013	1525	372	1897	80.4%	19.6%	100%
Chi-Square Test		Value		Asymp. Sig. (p-value)		
Pearson Chi-Square		46.981		0.000		

Statistically significant differences exist between the responses to the two sample groups (before and during the economic recession) regarding acceptability of the pricing system, use of private car for traveling, and opinions concerning the degree of traffic congestion. Both the number of cars and the intensity of car use have been severely affected by economic recession, thus reducing the intensity of traffic congestion in the center of Athens. The reduction of traffic congestion in conjunction with the reduction in income may have contributed to a significant decrease in public acceptability of the toll system since 2008. In what follows, we explore the factors that affect pre-crisis, crisis, and overall acceptability and we quantify their impact.

5.2 Modeling Acceptability

The intertemporal comparison of public acceptability of congestion pricing schemes in the center of Athens is based on the questionnaire earlier discussed. Three binary logistic regression models were developed to model public acceptability of congestion pricing; one model (Table 6) using the 2008 database, one model (Table 7) using the 2013, and one model (Table 8) using both sets of data (pooled data). The dependent variable (public acceptability) takes the value of one when the respondent accepts the congestion scheme and zero when the respondent does not.

Tables 6 and 7 present the estimation results for public acceptability before and during the economic recession respectively. In both models, respondents with high income, respondents who consider traffic congestion to be a serious problem in their trip and respondents who state that they are going to travel by car after the implementation of the congestion pricing scheme are more likely to accept the congestion pricing scheme. Interestingly, while in the 2008 model people with both high and medium to high income are more likely to accept congestion pricing, in the 2013 model only the highest income class has an increased probability of accepting the urban congestion pricing system.

Table 6: Logistic Regression Estimation Results of Public Acceptability of Congestion Pricing (year 2008)

Variables	*Coefficient*	*t statistic*	*Odds Ratio*
Constant	-0.935	-4.174	0.393
Residents (1 if yes; 0 otherwise)	-0.295	-1.810	0.745
Respondents who travel to the pricing area by car (1 car; 0 other)	-0.442	-2.376	0.643
Flexibility of time of trip (1high; 0 otherwise)	0.485	3.489	1.624
Traffic congestion problem on trip (1 if it is a serious problem; 0 otherwise)	0.404	2.295	1.497
Respondents who are going to travel to the pricing area by car after the implementation of the congestion pricing scheme	0.336	1.623	1.399
Respondents who believe that hybrid vehicles should be exempt from paying the tariff	0.422	3.149	1.525
Respondents who believe that motorcycles should be exempt from paying the tariff	-0.509	-3.743	0.601
Allocation of congestion pricing revenues for reducing car taxes	-0.471	-2.479	0.624
Availability of car in residence (1 yes; 0 otherwise)	-0.334	-1.920	0.716

Income median to high (1 if income is median to high; 0 otherwise)	0.784	4.810	2.190
Income high (1 if income is high; 0 otherwise)	1.281	6.354	3.599
Number of observations		1203	
ρ^2 (Nagelkerke R square)		0.124	

Table 7: Logistic Regression Estimation Results of Public Acceptability of Congestion Pricing (year 2013)

Variables	*Coefficient*	*t statistic*	*Odds Ratio*
Constant	-1.992	-6.845	0.136
Traffic congestion problem on trip (1 if it is a serious problem; 0 otherwise)	0.807	2.595	0.242
Respondents who are going to travel to the pricing area by car after the implementation of the congestion pricing scheme	0.758	1.895	2.133
Respondents who believe that workers should be exempt from paying the tariff	-1.179	-3.791	0.308
Respondents who believe that motorcycles should be exempt from paying the tariff	-1.149	-2.542	0.317
Allocation of congestion pricing revenues for reducing car taxes	-0.917	-2.413	0.400
Income high (1 if income is high; 0 otherwise)	1.601	2.463	4.959
Number of observations		694	
ρ^2 (Nagelkerke R square)		0.194	

Table 8 shows the factors that were found to be statistically significant at the 90% level in explaining congestion pricing acceptability (with combining the data for the two periods). We note that 'Year' is a dummy variable that takes the value of 0 for the 2008 and the value of 1 for the 2013 questionnaires. The negative coefficient indicates that acceptability is reduced 2013 compared to 2008.

Both the variables that reflect respondent perceptions regarding traffic congestion in the particular trip and the variable that reflects respondent perceptions regarding traffic congestion in the whole city of Athens, are found to positively affect the probability of acceptance. Further, respondents who already use private cars to enter the center are less likely to accept congestion pricing, while people who are going to use private cars following implementation of the congestion pricing scheme in the central area of Athens are more likely to accept. Car availability also decreases acceptability.

Table 8: Logistic Regression Estimation Results of Public Acceptability of Congestion Pricing (year 2008 and 2013)

Variables	*Coefficient*	*t statistic*	*Odds Ratio*
Constant	0.111	0.389	1.117
YEAR (0 if 2008, 1 if 2013)	-1.403	-7.794	0.246
Respondents who travel to the pricing area by car (1 car; 0 other)	-0.371	-2.108	0.690
Purpose (1 if the purpose of trip is leisure or shopping, 0 otherwise)	-0.39	-2.281	0.677

Duration (1 if the duration of the trip is between 45 to 60 min; 0 otherwise)	0.329	1.788	1.389
Flexibility of time of trip (1high; 0 otherwise)	0.598	4.041	1.819
Traffic congestion problem on trip (1 if it is a serious problem; 0 otherwise)	0.435	2.806	1.545
Traffic congestion problem in the city of Athens (1 if it is a serious problem; 0 otherwise)	0.402	3.141	1.495
Respondents who are going to travel to the pricing area by car after the implementation of the congestion pricing scheme	0.465	2.360	1.592
Respondents who believe that residents of pricing area should be exempt from paying the tariff	-0.293	-2.078	0.746
Respondents who believe that workers of pricing area should be exempt from paying the tariff	-0.606	-4.887	0.546
Respondents who believe that Hybrid vehicles should be exempt from paying the tariff	0.258	2.048	1.295
Respondents who believe that motorcycles should be exempt from paying the tariff	-0.596	-4.585	0.551
Allocation of congestion pricing revenues for reducing car taxes	-0.604	-3.512	0.547
Availability of car in residence (1 yes; 0 otherwise)	-0.342	-2.165	0.710
Income low (1 if income is low; 0 otherwise)	-0.995	-3.783	0.320
Income low to median (1 if income is low to median; 0 otherwise	-0.638	-3.222	0.529
Income median (1 if income is median; 0 otherwise)	-0.758	-4.594	0.468
Income high (1 if income is high; 0 otherwise)	0.497	2.062	1.644
Number of observations	1897		
ρ^2 (Nagelkerke R square)	0.265		

From the five levels of income considered, only the highest level increases the probability of accepting congestion pricing, while the lower income levels decrease the probability of accepting such a scheme. The purpose of the trip also affects public acceptability; people who travel to the pricing area for leisure or shopping are less likely to accept the implementation of a congestion pricing scheme. This is probably because the value of time for people who travel for shopping is lower compared to that of people traveling for business. Turning to respondent opinions regarding the users to be exempt from the congestion pricing scheme, exemption for hybrid vehicles increases proposed scheme's acceptability. Finally, allocation of revenues for reducing taxes, significantly reduces the probability of accepting congestion pricing; this is similar to findings of previous research (SchuitemaandSteg, 2008; Rentziou et al., 2011). A summary of the main factors that significantly increase (+) or decrease (-) the probability of accepting the congestion pricing scheme is presented in Table 9.

Table 9: Main Factors Influencing Congestion Pricing Acceptability

Variables	*2008*	*2013*	*Pooled*
Residents	-		
Respondents who travel to the pricing area by car (1 car; 0 other)	-		-
Purpose (1 if the purpose of trip is leisure or shopping, 0 otherwise)			-
Duration of the trip (between 45 to 60 min)			+
High flexibility of time of the trip	+		+

Traffic congestion problem on trip	+	+	+
Traffic congestion problem in the city of Athens			+
Respondents who are going to travel to the pricing area by car after the implementation of the congestion pricing scheme	+	+	+
Respondents who believe that residents of pricing area should be exempt from paying the tariff			-
Respondents who believe that workers of pricing area should be exempt from paying the tariff		-	-
Respondents who believe that hybrid vehicles should be exempt from paying the tariff	+		+
Respondents who believe that motorcycles should be exempt from paying the tariff	-	-	-
Allocation of congestion pricing revenues for reducing car taxes	-	-	-
Availability of car in residence	-		-
Income low			-
Income low to median			-
Income median			-
Income median to high	+		
Income high	+	+	+

6. Conclusions

Road pricing acceptability is widely viewed as an effective traffic management measure. Research and practice worldwide has shown that gaining public acceptance is a major barrier in implementing congestion pricing in urban areas. During financial recession, it is reasonable to assume that high acceptability rates are even more difficult to attain. In this paper, we statistically examine this hypothesis by measuring the decreased acceptability during recession. Moreover, we identify significant differences with the pre-crisis period and we provide insight on the factors shifting public opinion against road pricing. The quantitative results highlight key areas of acceptability and provide useful information to road concessionaires to define efficient pricing policies.

Three binary logit models were developed, that were specified over a sample of 1,897 questionnaires undertaken both before and during financial recession in Athens, Greece. From a methodological standpoint, the development of three distinct models (i.e. 2008, 2013, pooled) allows for important insights. The direction of the relationship between external factors and acceptability does not change across models. However, the factors found to significantly affect acceptability are rather different: 17 in the pooled model, 11 in the 2008 model, and only 6 in the 2013 model. Importantly, only five factors were significant in all models; this possibly suggests that the pooled model fails to adequately describe acceptability in both periods. Most importantly, the 2008 model cannot adequately describe acceptability during the recession period. The latter highlights the need to recalibrate many of the transportation planning models used and to explicitly account for the crisis effects.

From a policy perspective, this research provides insight on the factors affecting public opinion towards road pricing particularly during financial recession. Our findings show that the effects of several traveler and trip characteristics on acceptability change between 2008 and 2013. Model results suggest that being a resident of - or travelling to

- the cordon area, having high journey time flexibility or having increased car availability, are not important during the recession period. Also, people experiencing daily delays and people whose income is high are more likely to accept road pricing under any circumstances. It seems that, in both cases, the value of time is higher than the price of conventional toll fees; further research is needed to explore the latter. Finally, our findings suggest that communication campaigns during recession should primarily target lower income travelers and motorcycle users to alter transportation habits.

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