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# Acceptability of road pricing and revenue use in the Netherlands[1]

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## ABSTRACT

It is generally acknowledged that the implementation of more efficient road pricing measures meet public resistance and that acceptability is nowadays one of the major barriers to successful implementation. This paper presents the empirical results of a questionnaire among Dutch commuters regularly facing congestion asking for their opinion (in terms of acceptance) on road pricing measures and revenue use targets. We find that road pricing is in general not very acceptable and that revenue use is important for the explanation of the level of acceptance. Road pricing is more acceptable when revenues are used to replace existing car taxation or to lower fuel taxes. Moreover, personal characteristics of the respondent have an impact on support levels. Higher educated people, as well as respondents with a higher value of time and with higher perceived effectiveness of the measure, seem to find road pricing measures more acceptable than other people. The same holds for people that receive financial support for their commuting costs and for respondents driving many kilometers in a year. When we ask directly for the acceptability of different types of revenue use (not part of a road pricing measure), again abandoning of existing car (ownership) taxes receives most support whereas the general budget is not acceptable. It appears that lower income groups have a stronger preference for a reduction of existing income taxes when revenues from road pricing are allocated than higher income people.

KEYWORDS: road pricing, revenue use, acceptance

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# 1. Introduction

Road transport is known to generate considerable external costs, in particular in the form of congestion, accidents and noise. Governments may use different types of measures to deal with these problems, pricing being one of them. Most countries use a number of coarse pricing mechanisms, such as fuel duties, registration fees and parking charges. This current charging regime however, is not very efficient. Economists have advocated the use of more targeted pricing tools for a long time, and have demonstrated the welfare gains. Nevertheless, these more efficient road pricing measures have up till now only seldom been implemented in practice. The low level of implementation is nowadays not so much caused by technical or administrative problems. It is generally acknowledged that pricing measures meet public resistance and that acceptability is one of the major barriers to successful implementation of new and more efficient pricing measures (MC-ICAM, 2003).

Transport pricing schemes have the double consequence of discouraging transport use, at least at certain times on certain parts of the network, and of transferring cash from private persons to other (often public) funds. The fact that road pricing – at least before recycling of revenues – involves such a transfer of cash from private travelers to public institutions, is likely to be a major impediment to its public acceptability. Furthermore, the implementation of efficient road pricing policies typically affects equity in a way that policy makers and/or the general population are likely to disapprove of.

Therefore, to render pricing schemes politically and publicly acceptable, it seems desirable to 'recycle' the revenues generated in such a way that most population subgroups are at least equally well off. The destination and distribution of these revenues may be used to gain public and political acceptance. At the same time, acceptability objectives of revenue recycling may conflict with efficiency goals. Mayeres and Proost (2001) suggest for instance that using revenues for public transport investments may induce welfare losses that exceed the welfare benefits obtained from pricing itself.

The Netherlands has a long experience in developing new road pricing proposals to reduce the increasing levels of congestion. None of these plans has ever been implemented mainly due to low levels of public acceptance. It is therefore interesting to investigate the issue of acceptance of road pricing and use of revenues in this country. This paper reports on the acceptability of new road pricing measures among Dutch commuters facing congestion on a regular basis.

This paper is organised as follows. Section 2 discusses the previous literature on the acceptance of road pricing and the role of revenue use in this. Many public concerns can be identified which policy makers should take into account when thinking about implementation of road pricing. Acceptance is significantly affected by the way in which revenues are used; various possibilities exist, all with different consequences. Section 3 outlines the empirical survey conducted, and presents the results from our data analysis. We try to identify important explanatory variables for the level of acceptance for different types of road pricing measures, and identify the most acceptable destination of the revenues. Section 4 concludes.

# 2. Acceptability and Revenue Use in Literature

In modern societies private cars play a very important role in satisfying existing mobility demands. But current car traffic also causes serious problems like congestion, pollution, noise and accidents. Theory of transport economics detects the problem as one of negative externalities: since marginal social costs exceed the marginal private costs, demand is too high. The standard theoretical economic solution is to internalise these external costs by raising the price to marginal social costs. It is remarkable that such pricing instruments are applied so seldom, because efficiency improvements mean that everyone can potentially be made better off, because the winners are more than able to compensate the losers. Various explanations can be given why the measure is only rarely implemented in practice. The regulator may face different types of constraints ranging from practical (and technical) ones to institutional and acceptability constraints (see for an overview on barriers Ubbels and Verhoef, 2004). At present the major barriers to the successful implementation of transport pricing strategies relate largely to lack of stakeholder and political acceptability, rather than to technical or administrative problems. Since raising prices is generally disliked by the respective user group, the acceptance of pricing policies is often low. But pricing also generates revenues, which one can use for many purposes, including influencing the public acceptability of pricing. In this section we discuss literature results on revenue use and acceptance of road pricing.

### 2.1 Acceptability and the Implementation of Transport Pricing Measures

Many attempts have been undertaken to introduce urban road pricing around the world over the last 40 years, and many of them have failed. Examples of schemes that have never been implemented include Stockholm, Hong Kong and the Netherlands. In most cases extensive studies had demonstrated the technical feasibility and economic benefits of introducing the scheme, but the problem was public and political acceptability. This aspect has apparently received inadequate attention in the belief that a scheme which showed strong social and economic benefits would sell itself.

Despite the fact that politicians and the public regard traffic problems in cities as a very important and urgent issue, people may have several concerns about road pricing. Besides the views and intentions of the persons affected by the measure, also responsible political bodies, as another key group, have to be taken into account. The TransPrice project concluded that the lack of political willingness to implement charging measures stems from a perceived low acceptability of the electorate for such measures (TransPrice, 1999). This paper will not consider acceptability of politicians but instead focus on the public acceptability. The policy maker should consider this before implementing pricing measures of any kind. Public concerns often mentioned include (Jones, 1998):

- It is difficult for drivers to accept the notion that they should pay for congestion, it seems irrational and inappropriate;
- Car users feel that urban road pricing is not needed, roads are a publicly provided good that should be free at the point of use;
- Pricing will not lessen congestion, it is an ineffective measure because drivers will be inelastic to road charges;
- The measure will result in unacceptable privacy issues;
- Road pricing will face implementation problems such as unreliable technology and boundary issues;
- Road pricing is considered to be unfair.

Despite these concerns, there are some practical experiences where road pricing actually has been implemented. Singapore, Norway and ‘value’ pricing projects in the U.S. are examples where road tolls are levied. These projects have also met public opposition, but the political will was strong in most cases. The proposal of the Oslo toll ring for instance, was opposed by 70% of the population (PROSAM, 2000). Remarkable is that the proportion in favour of the toll system has steadily increased over time. Sullivan (2002) has found that successfully implemented value pricing projects (projects with variable tolls) often share several key attributes including effective advertising, communication of benefits in simple and tangible terms and the fact that use of the tolled road was optional (people had a choice). However, there are also some projects that failed. Characteristics of unsuccessful efforts include the presence of influential project adversaries and the perception of the public that the schemes are developed just to raise extra money.

The level of acceptance may also be explained by other factors. Verhoef (1996) asked morning peak road users about their opinion on road pricing. An overwhelming majority (83%) stated that his or her opinion depends on the allocation of revenues. The opinion of businesses on the other hand seem to depend very much on the perceived effectiveness with regard to time savings. An analysis of the economic effects of road pricing in Utrecht (the Netherlands) indicates that companies are positive as long as time savings are expected to compensate for road pricing costs (see PATS, 1999). However, these businesses do have their doubts whether road pricing would be really effective and decrease the level of congestion. Results from four case study cities in the EU study AFFORD (2001) show that factors determining business acceptability may depend on local circumstances.

The previous suggest that there are some guidelines to policy makers that increase the probability of a successful implementation of road pricing (in terms of obtaining some level of acceptability (see also CUPID, 2000)). Pricing strategies should be perceived as very effective solutions, and communication of objectives and revenue spending is of crucial importance. Moreover, fairness issues have to be addressed, the system must be perceived as fair in terms of personal benefits and costs. The use of revenues together with the charging structure is important in influencing the distributional impacts in the desired direction.

### 2.2 Acceptability and the Use of Revenues

The previous indicated that the use of the revenues from pricing instruments may strongly influence its acceptability. There are various options how to use the revenues. Literature suggest that the revenues may for instance be used for highway capacity enlargement, highway maintenance, investment in public transport, reduction in road taxes or other taxes (e.g. Small, 1992 and Higgins, 1997). Empirical questionnaire results reported in several studies confirm the finding that acceptability differs depending on the type of measure and the way revenues are used. Bartley (1995) for instance finds that road and congestion pricing are generally not regarded as acceptable. Improvement of public transport is the most acceptable policy to limit road use according to his findings, more than by measures which restrict driving possibilities. In another study Jones (1998) finds that road pricing is not publicly acceptable unless the money raised is hypothecated for local transport and environmental projects.

Verhoef (1996) asked for the public opinion among Dutch commuters on a number of possible allocations of revenue spending on a five point scale, varying from a very bad allocation of revenues to a very good allocation. The allocation objectives that are in the direct interest of the road users received most support, as may be expected. Road investments, together with lower fuel and vehicle taxes ('variabilisation') received the highest average score. General purposes, such as general tax reductions and the government budget in general, obtained least support from morning peak road users. In between were transport purposes other than road, notably public transport.

The importance of the use of the funds in gaining or losing public acceptance for a pricing measure has also been shown by a survey in the UK (Jones, 1998). The attitudes of people to a series of measures that would reduce urban traffic problems were asked. When asked independently (road pricing as a stand alone measure), only 30% responded in support of charging road users to enter highly congested urban areas (Jones, 1998). The respondents were then offered a package that includes a charge on entering a zone that was then used to fund better public transport, traffic calming and better facilities for walking and cycling. This resulted in a support of 57% for the package. A similar result was found in particular for London. A single measure was supported by 43% of the public, whereas 63% accepted the scheme when revenues were used for purposes approved by respondents. Hypothecating revenues thus increases public support.

The AFFORD study conducted an empirical survey on public acceptability of different pricing strategies in the four European cities of Athens, Como, Dresden and Oslo (see also Schade and Schlag, 2000). They also investigated the attitudes of the respondents regarding how to use the revenues arising from road pricing. It was again found that transport purposes of money use, such as public transport improvements, are favoured by a vast majority of respondents. Lowering vehicle taxes is also supported by the people, whereas lower income taxes is not a popular revenue spending target[2]. This study has also analysed factors influencing the degree of acceptability of pricing measures. Variables such as 'social norm', 'perceived effectiveness' and 'approval of societal important aims' were found to be positively connected with the acceptability of pricing strategies.

An interesting study by Small (1992) suggests that public and political support can be reached for road pricing, even without using all revenues to compensate travelers since higher user charges are accompanied by reduced travel times. He searched for a strategy that funds programs with such a variety of distributions of impacts that nearly everyone affected will find at least some offsetting benefits, and a majority will perceive the entire package as an improvement. Seven interest groups were distinguished ranging from traveling public and public transport users to low tax advocates. It was suggested to keep money in the transportation sector. Funds should be allocated about equally between monetary subsidies to travelers, substitutions of general taxes now used to pay for transportation services, and new transportation services. Small illustrates this by designing a politically feasible (in terms of support from the earlier identified interest groups) congestion pricing package for Southern California. His equity analysis indicates that this program makes every class of traveler better off (combination of travel time saved, financial improvements and transportation improvement), with the greatest gains for higher income drivers and public transport users.

There is a downside to using revenues solely to improve acceptability. From a broader perspective, it becomes important also to consider explicitly the interaction (or trade off) between public acceptability and efficiency. Clearly, when too easily a scheme were adopted so as to meet public acceptability requirements, its efficient properties may be undermined – even by so much that the efficiency considerations motivating the scheme in the first place would then call for its cancellation. For economic efficiency reasons, revenues should be used in such a way that does not distort the transport sector and brings the maximum benefit to society. Economic theory argues that optimal congestion toll revenues are exactly sufficient to fund optimal road capacity (the so-called Mohring-Harwitz result). This is a straightforward use of toll revenues, but only applies as a strict equality under certain theoretical conditions. Hypothecation of the revenues to public transport, often advocated from an acceptability perspective ("funding the substitute"), need not be very efficient. Mayeres and Proost (2001) demonstrate (by using a general equilibrium model) that the net welfare effect of an increase in the congestion tax depends among others on the efficiency effects of the tax revenue recycling. A higher tax on peak car transport increases welfare when its revenue is used to cut

[2] This is how the public *prefers* revenues to be used. Their expectations are rather different, however. Around 70% of the respondents expect that the money will be used for state or municipal purposes, which is not appreciated (Schade and Schlag, 2000).

taxes on most other commodities used in the model or to expand road capacity (the highest welfare gain). Using the revenues to increase the subsidy of public transport is not attractive, because the welfare impact of the lower congestion level is offset by the negative impact of stimulating the consumption of already strongly subsidized public transport. Parry and Bento (2001) explored the interactions between taxes on work-related traffic congestion and pre-existing distortionary taxes in the labor market. They use a general equilibrium model to show that when congestion pricing revenues are used to reduce distortive labor taxes, this can raise the overall welfare gain from that pricing measure (it may even double this welfare benefit via a net positive impact on the labor supply). Lump-sum transfers to households, which discourage labour supply in their model, appear not to be very efficient; the welfare losses can easily offset the welfare gain from internalizing the congestion externality. Recycling the revenues in public transport fare subsidies appears to be less efficient than tax cuts of labour supply according to their analysis, because the former leads to a suboptimal allocation of commuting among modes and smaller welfare gains on the distorted labour market. This source of inefficiency may be even larger at more substantial amounts of traffic reductions (welfare losses increase due to the inability of inducing an optimal allocation).

### 2.3 This survey

This paper analyses the acceptance of road pricing measures (including the use of revenues) by Dutch commuters that face congestion. It is important to know which factors influence acceptability of road pricing. Literature provides useful insights on relevant determinants explaining the level of support; these will briefly be discussed before we explain our objectives.

The previous sections indicated that public acceptability of transport pricing measures is generally low when compared with other type of transport measures such as an improvement of public transport (e.g. Bartley, 1995; Jones, 1998). Least accepted are generally all kinds of road user fees (Schade, 2003). As part of the measure, it is also important to explain what happens with the revenues. The allocation of revenues raised with road pricing can be an important means of increasing its social feasibility. Furthermore, Steg (2003) identifies several other factors that are not directly linked to the measure itself but do affect the acceptability of transport pricing. People’s problem awareness, the attitude towards car driving, mobility related social norms and the perceived effectiveness of the measure are identified as important in explaining the level of support. For example, Rienstra and others (1999) find that the acceptance of policy measures increases if people are more convinced about the effectiveness of this measure.

Acceptability of road pricing also depends on personal features such as age and income. Following economic theory, it is to be expected that high income earners may be less opposed to price measures in order to reduce congestion than people with lower incomes, because their value of time is higher. Verhoef and others (1997) indeed find that income as well as the willingness to pay for time gains has a significant and positive impact on the opinion on road pricing. Other factors, such as the expectation to be compensated, the perception of congestion as a problem and trip length, are also important in explaining the public’s opinion. Rienstra and others (1999) have analysed the support (together with perceived effectiveness and problem perception) for transport policy measures in general (not in particular for road pricing). They find that several personal features and the perceived effectiveness have a significant impact on the respondent’s support for policy measures in transport. While gender and type of household do not seem to have impact on support levels for transport measures, these tend to be higher when the educational level and age becomes higher. Car and driving

license owners support transport measures significantly less. Of all measures, car drivers have the least support for price measures. The authors find no significant impact of the level of income on the support for price measures.
Our analysis probably comes closest to that of Rienstra (1999) and Verhoef (1997). We also identify factors explaining the level of acceptance of road pricing and revenue use and include the perceived effectiveness and the value of time of respondents into the analysis. This study extends on the work of Verhoef by considering multiple variants of pricing measures, systematically varied over dimensions such as price levels, differentiation and revenue use. Moreover, the individual value of time estimates are now based on a choice experiment, while in Verhoef's questionnaire these were based on open-ended WTP questions. Moreover, we also include the value of schedule delay and uncertainty into the analysis. The work of Rienstra analysed the support for transport measures in general, we focus specifically on road pricing measures. For that reason, our sample consists only of car drivers facing congestion on a regular basis.

## 3. Acceptance and Revenue Use

### 3.1 Data collection

The data used in this paper have been obtained by conducting an (interactive) internet survey among Dutch commuters. The full questionnaire can roughly be divided into three parts. First, we asked for some socio-economic characteristics of the respondent (such as education and income). In order to analyse the behavioural responses to road pricing we developed a stated choice experiment, which is the second part of the survey. And finally we asked for the opinion of the respondents on several carefully explained road pricing measures. The first and the second part was answered by 1115 respondents, whereas the latter sample (opinion questions) consisted of 564 respondents. This paper will present outcomes of the analysis of this latter part of the survey.
The data collection was executed by a specialised firm (NIPO), which has a panel of over 50.000 respondents. Since the survey was aimed at respondents that use a car for their home to work journey and also face congestion on a regular basis, we selected working respondents, who drive to work by car two or more times per week, and who face congestion of 10 or more minutes for at least two times a week. This resulted in a total of about 6800 possible respondents. An initial analysis revealed that a random sample would result in a relatively low number of women and lower income groups. Because income differences are important to analyse, it was decided to 'over sample' the lower income groups and create an equal number of respondents over the various income classes. The data were collected during three weeks in June 2004 (before summer holidays).

### 3.2 Survey

As previously explained, the survey started with some general questions asking for important explanatory variables of the respondent. These variables may help explain the differences in acceptance levels. Most variables are explained in Appendix 1. Additional variables included in our analysis are not socio-economic in nature. We have information on the perceived effectiveness of the measures, and have an estimate of the value of time (VOT) of the respondent. It is worthwhile to analyse the effects of these variables on acceptance[3].

[3] We do not only have an estimate of the VOT of the respondent, also the value of schedule delay (early and late) and the value of uncertainty are available. We refer to appendix 3 for more information on the derivation of these values.

Appendix 1 shows the profile of our sample. Apparently Dutch commuters facing congestion are in most cases men and relatively high educated. A majority of the respondents is between 26 and 45 years old and do not have children. These characteristics of our data base have been compared with the general profile of the Dutch car driver facing congestion, in order to check representativeness. Research by Goudappel Coffeng (1997) suggests that about 75% of all drivers in congestion is men (equal to our sample). Our sample includes more respondents between the age of 26 and 35 (about 10% more), whereas the share of persons older than 45 years is lower than the 1997 profile. Moreover, drivers in congestion tend to be higher educated (our sample consists of 44.1% bachelors and masters whereas the general profile has 36%) and have a higher income. The effect of the "over sampling" of lower income is clearly present. About 25% of the drivers in this sample has an income below €28.500 (modal income), whereas the 1997 profile predicts only 8% drivers to fall in this category.
The respondent was confronted with three different types of road pricing measures. After a concise description of each measure, the respondents' opinion on various issues was asked. People could indicate the acceptability of a specific measure on a 7-point scale, ranging from 'very unacceptable' to 'very acceptable'. We have also asked how effective they think that the measure would be, both individually (i.e. would you drive less?) and in general terms (will there be less congestion and will there be smaller environmental problems?). The answers to these latter questions (also on a 7-point scale) have been included into the analysis as explanatory variables for the level of acceptance.

*Table 1: Short description of the transport pricing measures presented to the respondents*

| Measure | Alternative |
|---|---|
| 1: Bottleneck passage | A: flat toll throughout the week |
| | B: coarse toll (flat within peak hours on working days) |
| | C: multistep toll during peak hours only |
| | D: toll depends on actual traffic conditions |
| 2: Kilometer charge differentiated by vehicle type | A: Revenues to general budget |
| | B: Revenues to traffic system |
| | C: Lower car taxation and new roads |
| | D: Revenues to public transport |
| | E: Abolishment of car ownership taxes |
| | F: Lower fuel taxes |
| | G: Revenues to improve and construct new roads |
| 3: Kilometer charge with different charge levels and different revenue use | A: 2.5 €cent, unclear revenue use |
| | B: 5 €cent, unclear revenue use |
| | C: 7.5 €cent, unclear revenue use |
| | D: 2.5 €cent, improvement of road network |
| | E: 5 €cent, improvement of road network |
| | F: 7.5 €cent, improvement of road network |
| | G: 2.5 €cent, abolish existing car taxation |
| | H: 5 €cent, abolish existing car taxation |
| | I: 7.5 €cent, abolish existing car taxation |

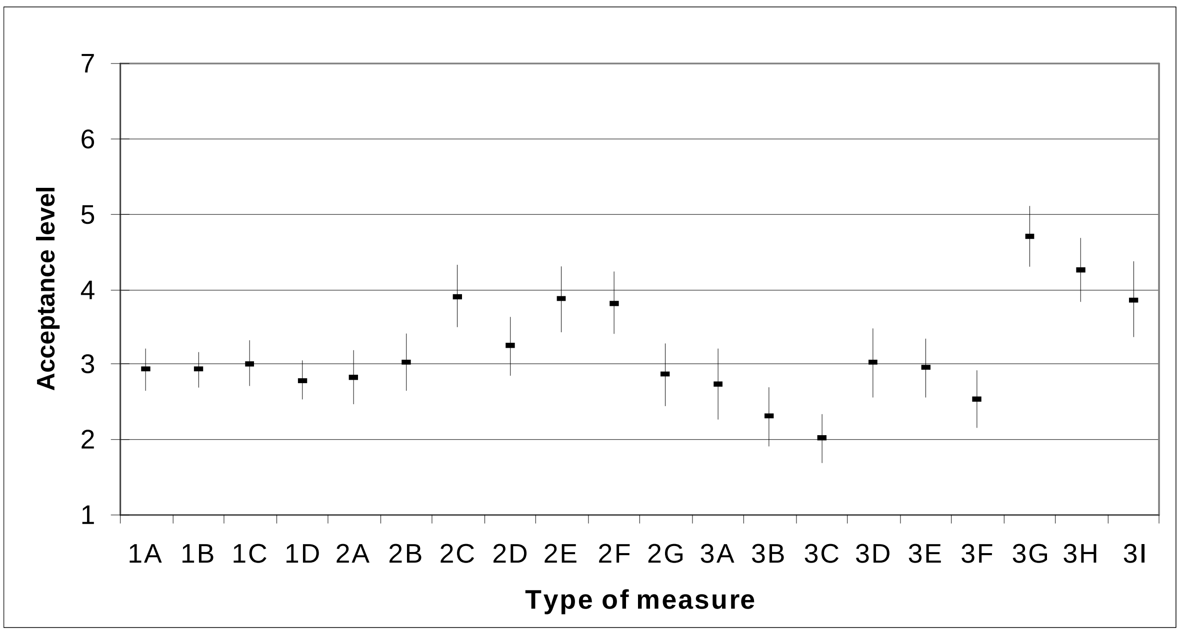
Not each respondent had to evaluate the same type of measure. Within each type of measure, we have developed various alternatives differing on type of charge (measure 1), type of revenue use (measure 2) and level of charge plus revenue use (measure 3) (see Table 1). This resulted in 4 different alternatives for measure 1, 7 different alternatives for measure 2, and 9 different descriptions of type 3 measure (a detailed description can be found in Appendix 2).
All alternatives have been randomly divided over the respondents. This means that we obtained about 140 observations for each alternative of measure 1, 80 for each alternative of measure 2, and 60 for each alternative of measure 3. A short introduction preceded the explanation of the measures. This was to explain that one should imagine the implementation

of the measures in the Netherlands. It was also to be assumed that the privacy of car users is guaranteed, electronic equipment registers the toll and the driver can choose freely the payment method (e.g. credit card, bank transfer etc.).
In addition, we have asked the respondents to evaluate the acceptance of different revenue uses separately (without specifying the road pricing measure). Six different revenue use options were presented to the respondent: the treasury of the government (and hence be used for other purposes than transport), new roads, improvement of public transport (e.g. increase of frequencies), a removal of existing car ownership taxes, a decrease in fuel taxation and a decrease of income taxes. Again, for each option, a 7-point acceptability scale was used.

### 3.3 Methodology and results

Before investigating the distribution of the levels of acceptance we start with an overview of the average acceptance levels for each single measure. Figure 1 shows the mean acceptance outcomes and its confidence intervals[4].

*Figure 1: Mean and 95% confidence intervals of acceptance scores on each single measure (level 1 = very unacceptable; level 7 = very acceptable)*




The mean level of acceptance differs considerably between the various types of measures. Where all types of measure 1 (bottleneck passage tolls) can be classified as somewhat unacceptable, this is not always the case for the other measures. In particular measures 2C (revenue use: new roads and less car taxation), 2E (abandoning of road taxation) and 2F (lower fuel taxes) have higher acceptance levels. But, a score of 4 still means that the respondents are neutral. The patterns of outcomes for measure 3 can be easily explained by the structure of the measure (a combination of 3 different charge levels with 3 different revenue use options). Apparently the respondents prefer revenues to be used for abolishment

[4] We present ‘unweighted’ results. When we correct the outcomes for representativeness (on age, education and income) to obtain a good match with the profile of Goudappel Coffeng and create a ‘weighted’ sample, we find comparable results.

of car taxation over that of new road and an unclear destination. A charge of 2,5 €cent is more acceptable than higher charges of 5 and 7,5 €cent, as may be expected. Measure 3G has the highest mean (4,71) which comes close to an average score of 5 (‘somewhat acceptable’).

These findings suggest the following interesting issues. First, given the results for measure 1 it seems that the level of acceptability does not depend on the complexity of the measure. Hence, acceptability is not necessarily a reason for starting simple. Second, measure 3 suggests that revenue use has more effect on the level of acceptance than the charge level (for the chosen range). People prefer a charge of 7,5 €cent with abolishment of car taxation over a charge of 2,5 €cent with revenues hypothecated to the general treasury. This underlines the importance of the allocation of the revenues.

Appendix 4A shows the percentages of respondents that find the various measures ‘unaccaptable’ or ‘very unacceptable’. These outcomes confirm the previous described ‘mean’ pattern. For instance, measure 3C is least acceptable, not only on average but also in terms of number of respondents.

*Methodology for assessing differences between groups*

Various econometric techniques are of course available that can be used to investigate the relation between various variables. The methodology to be applied depends to a large extent on the structure of the data. Here, the aim is first to explain the level of acceptance for the various measures, where the dependent variable consists of a choice out of an ordered set of acceptance alternatives. Given this framework, the ordered probit (OP) technique seems to be most appropriate (see for discussion of OP Maddala (1983)). Ordinary Least Squares (OLS), which assumes an unbounded continuous dependent variable, is less appropriate, although it would have had the advantage of more easily interpretable coefficients.

The underlying response model for an OP estimation is of the following form (see Davidson and MacKinnon, 1993):

$$ACC^* = \beta' X_i + \varepsilon.$$

The underlying continuous response variable ACC* is unobserved, X is the vector of explanatory variables, β gives the vector of coefficients, and ε is the residual. The observed discrete response variable ACC is related to ACC* as follows:

$$\begin{aligned}
ACC &= 1 && \text{if } ACC^* \le \mu_1, \\
ACC &= 2 && \text{if } \mu_1 \le ACC^* < \mu_2, \\
ACC &= 3 && \text{if } \mu_2 \le ACC^* < \mu_3, \\
&\vdots \\
ACC &= 7 && \text{if } \mu_6 \le ACC^*.
\end{aligned}$$

The μ’s (threshold values in the model output) are unknown parameters to be estimated jointly with β, and the model assumes that ε is normally distributed across observations. The constants μ therefore divide the domain of ACC* into 7 segments, which corresponds with observations of the discrete response variable. The model estimates probability intervals for the seven possible answers:

$$\text{Prob}\,(Z_{ij} = J) = \Phi(\mu_j - \beta' X_i) - \Phi(\mu_{j-1} - \beta' X_i)$$

where Φ is the cumulative standard normal, and $Z_{ij}$=J represents each acceptability score. The interpretation of the estimated coefficients is not straightforward. The estimated coefficients for the included explanatory variables can be interpreted as indications of shifting the distribution to the left or the right depending on the sign of the β’s. Assuming that β is positive, this means that that the probability of the leftmost category (in this case ACC=1) must decline. At the same time we are shifting some probability into the rightmost cell (ACC=7). But what happens to the middle cells is ambiguous and is dependent on the local densities. Hence, we must be very careful in interpreting the coefficients in this model (see Greene, 1993). The values of the coefficients can more easily be interpreted in a relative sense: a larger value denotes a larger marginal impact.

Various specifications of the model for all measures (by including variables that may be expected to have some explanatory power) have been tried. The following tables present our preferred specifications. The estimations for each type of measure have been done with the same explanatory variables, to maximize comparability between the models.

*Measure 1: Electronic toll on daily bottlenecks with fixed revenue use (new roads)*

Table 2 presents the estimation results for measure 1. The first row presents the estimates for the thresholds values $\mu$'s explained above. The second row presents all explanatory variables that have been included in the estimation. It appears that the individual's value of time (VOT), level of education, and compensation of costs by the employer have a significant and positive impact on acceptance. Most signs of the coefficients are as expected, for example, respondents with higher value of time tend to have higher acceptance levels of an electronic toll on daily bottlenecks. Interestingly, inclusion of the individual's value of schedule delay (early and late) and the value of uncertainty did not lead to significant results. This suggests that people find it hard to predict whether or not uncertainty will reduce under congestion pricing, and whether or not advantages in terms of schedule delay costs can be realized. Alternatively, people may have ignored these matters.

As expected, commuters that have to pay the toll themselves (no compensation) and drive many kilometers tend to find the measure less acceptable than drivers receiving full compensation and are using the car less often. Income is not significant; one explanation may be that VOT and education (both correlated with income) take up the expected effect. Income indeed becomes significant (at 5% level) when VOT and education are not included in the estimation. On the other hand, the type of measure, living in one of the three larger cities (loc1, included to compare the opinion of people located in densely urbanised areas with the rest of the Netherlands) and the weight of the car do not seem to have an important impact.

As already visible in Figure 1, the different types of bottleneck charging measures have no significant effect on acceptance of the respondent. It makes no difference whether it is a charge at all times (1A), a peak time charge (1B), a differentiated peak charge (1C) or a charge based on actual traffic conditions (D), although the latter seems somewhat less acceptable than the other three (although not significantly). The perceived level of 'general effectiveness' in terms of (less) congestion (effectiveness (less congestion) in Table 2) has an important impact on acceptance[5]. The results suggest that respondents who think that the measure will be effective also tend to find it more acceptable. The effectiveness in terms of less environmental problems is not included in the model as this variable was highly correlated with 'effectiveness (less congestion)'. The 'personal effectiveness' (indicating whether people tend to use their car less when the measure is implemented) shows a somewhat irregular pattern. Compared to people indicating not to change their behaviour (peff=1), respondents that find a personal change more likely have a higher level of acceptance. This may be explained by so-called protest voters in group 1: "the measure is not acceptable because I will not change behaviour" or "I say I will not change behaviour because I don't want this measure implemented". An explanation of the low score of peff=7 may be

[5] The type of measure that has been proposed has no significant impact on the level of general effectiveness (in terms of less congestion).

that these respondents (indicating that they will most likely drive less) find the measure not that acceptable because they perceive the consequences of changing behaviour as (very) negative.

*Table 2: Results of ordered probit analysis with the acceptance of measure 1 as dependent variable*

| **Variable** | **Probit ACC measure 1** | **Sign.** |
|---|---|---|
| Threshold (μ's) | | |
| $\mu_1$ | 1.073 (.450) | ** |
| $\mu_2$ | 2.309 (.456) | *** |
| $\mu_3$ | 2.781 (.458) | *** |
| $\mu_4$ | 3.136 (.461) | *** |
| $\mu_5$ | 4.036 (.469) | *** |
| $\mu_6$ | 5.564 (.538) | *** |
| Gross yearly income | 8.58 E-03 (.019) | |
| VOT | 4.26 E-02 (.010) | *** |
| Gender (female) | -.166 (.121) | |
| Education | | |
| Edu2 (junior general sec.) | .245 (.232) | |
| Edu3 (intermediate vocational) | .168 (.156) | |
| Edu4 (senior general sec.) | .414 (.198) | ** |
| Edu5 (bachelor) | .413 (.152) | *** |
| Edu6 (master) | .739 (.191) | *** |
| Loc1 (3 large cities) | -.197 (.121) | |
| Childyes | 9.92E-02 (.112) | |
| Age | | |
| Age1 (18-25) | -.257 (.250) | |
| Age2 (26-35) | -9.48E-02 (.199) | |
| Age3 (36-45) | -4.91E-02 (.208) | |
| Age4 (46-55) | -.184 (.209) | |
| Travel time in congestion/free flow tt | 6.25E-02 (.075) | |
| Type of measure | | |
| M1A (charge of € 1) | .168 (.136) | |
| M1B (charge of € 2during peak) | .167 (.128) | |
| M1C (peak time charge) | .134 (.133) | |
| Yearly driven number of kilometers | -2.92E-06 (.000) | * |
| Comp1 (no transport costs paid by employer) | -.310 (.163) | * |
| Comp2 (transport costs partly compensated) | -9.93E-02 (.108) | |
| Weight1 (low weight) | .167 (.189) | |
| Weight2 (middle weight) | .221 (.159) | |
| General effectiveness (less congestion) | | |
| Geff2 | .774 (.149) | *** |
| Geff3 | 1.107 (.185) | *** |
| Geff4 | 1.554 (.236) | *** |
| Geff5 | 1.765 (.185) | *** |
| Geff6 | 2.145 (.262) | *** |
| Geff7 | 1.859 (.497) | *** |
| Personal effectiveness (drive less yourself) | | |
| Peff2 | 354 (.128) | *** |
| Peff3 | .539 (.199) | *** |
| Peff4 | .212 (.196) | |
| Peff5 | .360 (.185) | * |
| Peff6 | .447 (.230) | * |
| Peff7 | 2.92E-02 (.433) | |
| N | 564 | |
| Log-likelihood | -815.555 | *** |
| Pseudo R-square | Cox and Snell | .379 |
| | Nagelkerke | .393 |
| | McFadden | .142 |

Notes: The standard errors are shown in brackets. *, ** and *** denote significance at the 10, 5 and 1% level, respectively, (two-sided *t*-test).

*Measure 2: Kilometer charge dependent on vehicle weight with different revenue use*

Table 3 shows the estimation results for the second measure. Again we see the importance of the VOT and compensation of costs by the employer. Education is not as important as for measure 1. One explanation may be that measure 2 (like 3) is more easily accepted on the basis of equity arguments, which require less intellectual effort than effectiveness or efficiency. A striking difference with the previous estimation is the difference between the (sub-) types of measure. Measure C, E and F obtain significantly more support than measure G, but also than the other 3 alternatives of this measure. This suggests that when revenues from the charge will be used to lower or abandon existing car taxation (2B and 2E) or fuel taxes (2F), more public support is obtained. The weight of the car (and also the yearly driven number of kilometers) does not have a significant impact, despite the fact that this measure differentiates on this characteristic. Again, perceived general effectiveness in terms of congestion and personal effectiveness have significant impact on the level of acceptance. We have included the effectiveness in terms of less congestion into the estimation and not the effectiveness on the environment despite its possible relevance here. These two variables are again strongly correlated and have equal results in terms of significance. The mean score on environmental effectiveness is only slightly higher than the perceived effectiveness on congestion (it is not very probable that congestion will decrease or the environment will benefit from this measure). Given the nature of this measure, one may have expected a greater difference. Personal effectiveness shows almost an equal (irregular) pattern to what we have found for measure 1, again the same hypothesis applies here.

*Measure 3: Kilometer charge with different toll levels and revenue uses*

The third measure that we have analysed consists of 9 sub-measures that combine one out of three types of revenue use with one out of three levels of a charge. Two sets of dummy variables thus define the type of measure: one for the type of revenue use and one for the level of the charge. Table 4 shows the results for this estimation. It is interesting to see that the level of acceptance very much depends on the way revenues are redistributed, and (but less so, for the values considered) the level of the charge (as may be expected). Higher charges are relatively less acceptable, and abolishment of existing car taxes is far more acceptable than an unclear revenue use (note the high coefficient) and somewhat more than the construction of new roads. This is consistent with finding that measure 3G (combination of low charge and abandoning of existing car taxes) is relatively most acceptable (confirmed by the results shown in Figure 1). It is remarkable that the weight of the vehicle does have an explanatory impact here. This may have something to do with the fact that the previous measure was differentiated according to weight. In answering acceptance respondents may have compared it with that measure, therefore people with smaller cars find this measure less acceptable. Expected effectiveness has again a very significant impact on the level of acceptance. Commuters indicating that the measure will be effective are less opposed to this measure. The respondents' value of time and education seem to loose importance compared with the other measures. In contrast to the previous measures, personal effectiveness is now not significant. It is not clear what causes these differences with the previous cases.

*Table 3: Results of ordered probit analysis with the acceptance of measure 2 as dependent variable*

| Variable | Probit ACC measure 2 | Sign. |
|---|---|---|
| Threshold (μ's) | | |
| $\mu_1$ | -.263 (.443) | |
| $\mu_2$ | .609 (.444) | |
| $\mu_3$ | .943 (.445) | ** |
| $\mu_4$ | 1.267 (.445) | *** |
| $\mu_5$ | 1.898 (.448) | *** |
| $\mu_6$ | 3.073 (.461) | *** |
| Gross yearly income | -2.51E-02 (.019) | |
| Gender (female) | -7.49E-02 (.119) | |
| Education | | |
| Edu2 (junior general sec.) | -.115 (.223) | |
| Edu3 (intermediate vocational) | 8.12E-02 (.151) | |
| Edu4 (senior general sec.) | .213 (.193) | |
| Edu5 (bachelor) | .260 (.149) | * |
| Edu6 (master) | .424 (.184) | ** |
| Loc1 (3 large cities) | -7.00E-02 (.119) | |
| Childyes | 1.23E-02 (.110) | |
| Age | | |
| Age1 (18-25) | -8.21E-02 (.245) | |
| Age2 (26-35) | -.289 (.199) | |
| Age3 (36-45) | -.204 (.206) | |
| Age4 (46-55) | -.255 (.207) | |
| Travel time in congestion/free flow tt | 2.05E-02 (.073) | |
| Type of measure | | |
| M2A (revenues to general budget) | -.139 (.173) | |
| M2B (traffic system in general) | -2.69E-02 (.178) | |
| M2C (lower car taxes and new roads) | .469 (.176) | *** |
| M2D (public transport) | .138 (.172) | |
| M2E (abandon existing ownership tax) | .471 (.177) | *** |
| M2F (lower existing fuel taxes) | .524 (.176) | *** |
| Yearly driven number of kilometers | -2.55E-06 (.000) | |
| Comp1 (no transport costs paid by employer) | -.372 (.160) | ** |
| Comp2 (transport costs partly compensated) | -.246 (.106) | ** |
| Weight1 (low weight) | .187 (.187) | |
| Weight2 (middle weight) | .131 (.156) | |
| VOT | 2.37E-02 (.010) | ** |
| General effectiveness (less congestion) | | |
| Geff2 | .637 (.139) | *** |
| Geff3 | .887 (.168) | *** |
| Geff4 | .846 (.193) | *** |
| Geff5 | 1.216 (.184) | *** |
| Geff6 | 1.258 (.275) | *** |
| Geff7 | 2.287 (.790) | *** |
| Personal effectiveness (drive less yourself) | | |
| Peff2 | .275 (.138) | ** |
| Peff3 | .400 (.180) | ** |
| Peff4 | .187 (.189) | |
| Peff5 | .420 (.187) | ** |
| Peff6 | .242 (.244) | |
| Peff7 | -.204 (.316) | |
| N | 564 | |
| Log-likelihood | -935.406 | *** |
| Pseudo R-square | Cox and Snell | .272 |
| | Nagelkerke | .280 |
| | McFadden | .087 |

Notes: The standard errors are shown in brackets. *, ** and *** denote significance at the 10, 5 and 1% level, respectively, (two-sided *t*-test).

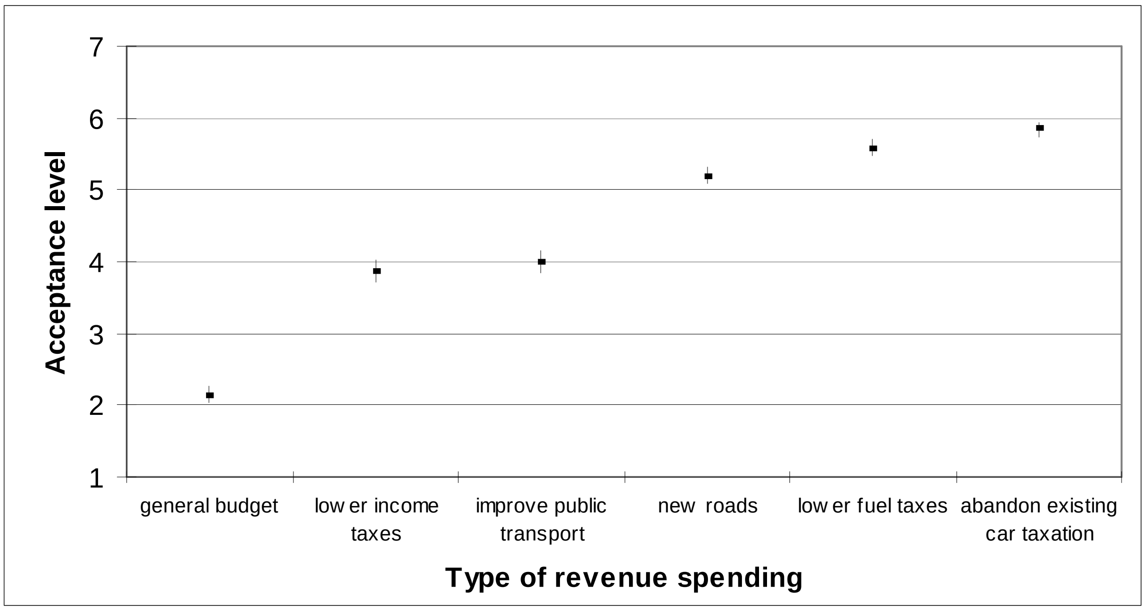
*Table 4: Results of ordered probit analysis with the acceptance of measure 3 as dependent variable*

| Variable | Probit ACC measure 3 | Sign. |
|---|---|---|
| Threshold (μ's) | | |
| $\mu_1$ | -2.43E-02 (.440) | |
| $\mu_2$ | .960 (.441) | ** |
| $\mu_3$ | 1.331 (.442) | *** |
| $\mu_4$ | 1.728 (.444) | *** |
| $\mu_5$ | 2.325 (.447) | *** |
| $\mu_6$ | 3.405 (.459) | *** |
| Gross yearly income | 1.06E-02 (.019) | |
| Gender (female) | -.3.05E-02 (.120) | |
| Education | | |
| Edu2 (junior general sec.) | -.156 (.233) | |
| Edu3 (intermediate vocational) | 8.14E-02 (.154) | |
| Edu4 (senior general sec.) | 8.38E-02 (.196) | |
| Edu5 (bachelor) | .280 (.151) | * |
| Edu6 (master) | .194 (.187) | |
| Loc1 | -5.31E-02 (.122) | |
| Childyes | -7.00E-02 (.111) | |
| Age | | |
| Age1 (18-25) | -.102 (.251) | |
| Age2 (26-35) | -.129 (.201) | |
| Age3 (36-45) | -9.25E-02 (.208) | |
| Age4 (46-55) | -.218 (.210) | |
| Travel time in congestion/free flow tt | 4.58E-03 (.074) | |
| Charge=5 €cent (dummy) | -.273 (.114) | ** |
| Charge=7,5 €cent (dummy) | -.536 (.115) | *** |
| Revenue use is new roads (dummy) | .270 (.118) | ** |
| Revenue use is abandon car taxes (dummy) | 1.235 (.123) | *** |
| Yearly driven number of kilometers | -2.15E-06 (.000) | |
| Comp1 (no transport costs paid by employer) | -.358 (.163) | ** |
| Comp2 (transport costs partly compensated) | -.180 (.106) | * |
| Weight1 (low weight) | -.520 (.189) | *** |
| Weight2 (middle weight) | -.335 (.157) | ** |
| VOT | 1.84E-02 (.010) | * |
| General effectiveness (less congestion) | | |
| Geff2 | 1.050 (.159) | |
| Geff3 | 1.230 (.185) | *** |
| Geff4 | 1.090 (.218) | *** |
| Geff5 | 1.605 (.205) | *** |
| Geff6 | 1.779 (.284) | *** |
| Geff7 | .650 (.652) | *** |
| Personal effectiveness (drive less yourself) | | |
| Peff2 | 4.23E-02 (.149) | |
| Peff3 | -2.56E-02 (.202) | |
| Peff4 | .150 (.198) | |
| Peff5 | 8.76E-02 (.204) | |
| Peff6 | 9.21E-02 (.247) | |
| Peff7 | -.276 (.351) | |
| N | 564 | |
| Log-likelihood | -873.327 | *** |
| Pseudo R-square | Cox and Snell | .408 |
| | Nagelkerke | .419 |
| | McFadden | .145 |

Notes: The standard errors are shown in brackets. *, ** and *** denote significance at the 10, 5 and 1% level, respectively, (two-sided *t*-test).

*Revenue use only*
Finally, we have asked the respondents for their opinion on allocation categories of the revenues per se, so without defining the road pricing measure. Six different possibilities have been evaluated on acceptance by the respondents (general budget, new roads, improve public transport, abandon existing car taxation, lower fuel taxes and lower income taxes). The findings presented in Figure 2 are largely in line with the previous findings of revenue use as part of a road pricing measure. An abolishment of existing car taxes is most preferred (a mean score of 5.85, a 6 is 'acceptable'), whereas the general budget is 'unacceptable'. The construction of new roads is valued rather positive here, while the acceptability of measure 2G (kilometer charge with the same type of revenue use) is considerably lower (see Figure 1). More than 74% of the respondents indicated that the general budget is 'unacceptable' or 'very unacceptable' (see Appendix 4A). The confidence intervals are smaller than those of the road pricing measures (see Figure 1), indicating less variance in the answers.

*Figure 2: Mean and 95% confidence intervals of acceptance scores on each type of revenue use (level 1 = very unacceptable; level 7 = very acceptable)*




We have carried out a similar type of (ordered probit) analysis as we did for the road pricing measures, to explain the acceptance levels for these types of revenue use. When policy makers want to compensate certain groups, it is useful for them to know the preferences of these groups. The estimations of the preferred results can be found in Appendix 5. Again, for each type of revenue use the same explanatory variables have been included after having tried various specifications of the model (by including variables that may be expected to have some explanatory power).
The results differ greatly over the various types of revenue use. Income is only significant when revenues are used to lower income taxes or to construct new roads. Lower income groups dislike revenues to be used for new roads more than people with a higher income, whereas the opposite holds when revenues are used to lower income taxes. The explanation for the first finding could be that lower income people drive less. For the second finding, the higher marginal utility could be an explanation. Hence, when policy makers propose to compensate the lowest income groups by lowering income taxes they obtain most support

from this category (although overall support levels for this type are rather modest, see Appendix 4B where we present the mean scores for the different income categories). Another interesting variable is the compensation of costs by the employer. As may be expected, respondents who are not or only partly compensated have in general more support for an abandoning of existing car taxation than people who do not have to pay these taxes. This may also explain the disapproval of revenues being used for the general budget by people without a full compensation, a personal compensation is a better objective for this group. The weight of the vehicle seems important for two targets: lower fuel taxes and improvement of public transport. Owners of smaller vehicles (with lower weights) find lower fuel taxes less acceptable than others, this may be explained by the fact that this group drives relatively more fuel efficient and consequently benefits less than people with large (and heavy) cars. The importance of the VOT for certain allocation categories (i.e. general budget and improvement of public transport) seems somewhat strange and inexplicable.

*Summary and comparison*

Literature indicates that people have several concerns about road pricing, which explain the rather low levels of acceptance. Our findings confirm the low acceptability, the mean outcome for most measures that have been evaluated is 'not very acceptable'. However, average acceptability of quite a few measures considered is only one point (out of 7) below neutral, which is less dramatic than an outright disapproval. Moreover, considerable differences exist between various measures.

A first interesting finding from the analysis of measure 1 is that the type of measure may not always have a large impact on the level of acceptance. It does not matter whether a flat bottleneck toll is introduced or a time dependent charge (that is likely to be more difficult to understand).

The analysis of the other two measures indicates that (as expected) revenue use is an important explanatory variable for the acceptance level. This confirms the findings of other studies such as Verhoef (1996). It is also found that individual features are important. Education, the VOT of the respondents, and financial compensation (partly or full) by the employer are important explanatory variables. In accordance with Rienstra and others (1999), education has an increasing effect on support levels (only found for measure 1), whereas income seems to have no significant impact after correcting for education and value of time (all measures). We have also included the value of schedule delay (early and late) and the value of uncertainty of respondents into the analysis. Our study does not confirm that these individual indicators are important in explaining acceptance. The perceived effectiveness of the measure does indeed have an important (positive) impact on the support levels, as indicated also by Steg (2003). In addition, we found a weaker relationship between personal effectiveness and support levels. We have looked at the effectiveness in environmental terms, but it appeared that answers were almost equal to effectiveness in terms of less congestion (and hence were too strongly correlated to allow use of both).

The findings on acceptance for revenue use targets are similar to earlier reported results in literature. The allocation objectives that are in the direct interest of the road users receive most support. Improvement of public transport is less acceptable in comparison with findings of Schade and Schlag (2000). Revenues may theoretically ideally be used to reduce distortive income taxes (which is beneficial from a welfare perspective), but support for this option from Dutch commuters is low.

## 4. Concluding Remarks

Economists have advocated the use of more appropriate pricing tools for a long time by demonstrating the welfare gains. Nevertheless, road pricing measures have up till now only seldom been implemented in practice. The low level of implementation is nowadays not so much caused by technical or administrative problems. It is generally acknowledged that pricing measures meet public resistance and that acceptability is currently one of the major barriers to successful implementation of new and more efficient pricing measures.

Despite the fact that politicians and the public regard transport problems as very urgent and important, people do have concerns about road pricing, resulting in low acceptance levels. Previous studies suggest that this is mainly related to the perceived (low level of) effectiveness of the measure, the feeling that roads are free to use and the fact that it is an unfair measure. An intelligent communication strategy can help to reach some level of acceptance, but literature also suggests that there is an important role for the destination of revenues of the pricing measure. Spending targets that are in the direct interest of the road users seem to receive most support.

The outcomes from a survey among Dutch commuters analysed in this paper confirm these findings. The first measure that has been evaluated by the respondents (electronic toll differing according to place and/or time without changing revenue use) is in general (for all alternatives) perceived as somewhat unacceptable, irrespective of the type (or alternative) of measure. The acceptance of second measure (a kilometer charge depending on vehicle weight combined with different allocation of revenues) does depend on the type of measure. This indicates that the respondents' opinions on road pricing are very sensitive to the way tax revenues are allocated. The measure is more acceptable when revenues are used for a decrease in fuel taxes, an abolishment of existing car taxation or to lower existing car ownership taxes together with the construction of new roads; indeed those targets that are in the direct interest of the respondent (car driver). These findings correspond with results from the third measure. It is also found that higher charges are less acceptable.

Most of our findings are in line with results of previous literature. For the first two measures (and to a lesser extent also for measure 3) it was found that education, the VOT of the respondents and financial compensation (partly or full) by the employer are important explanatory variables. Higher educated people, as well as respondents with a higher VOT, seem to find road pricing measures more acceptable than others. The same holds for people that receive financial support for their commuting costs. The perceived effectiveness of the measure (in terms of less congestion) does have an important (positive) impact on the support levels. Finally, we found a weaker relationship, an inverted U, between personal effectiveness and support levels.

The analysis of measure 1 showed that the complexity of a measure does not affect the levels of acceptance. The structure of this measure was varied (with different toll structures when passing a bottleneck), while revenue allocation was kept constant. This may suggest that policy makers can consider more efficient differentiated pricing schemes instead of a rather simple flat fee in dealing with bottleneck congestion, without loosing acceptance. We have also included the value of schedule delay (early and late) and the value of uncertainty of respondents into the analysis of these measures. The results do not confirm that these individual indicators are important in explaining acceptance. Despite the hypothesized impact of variables such as income, the driven number of kilometers and weight of the car (with measure 2), we haven't found evidence on this. The effect of income seems to be fully captured by education and the value of time.

The above findings on revenue use targets are largely confirmed when we do not present the type of measure, and ask directly for the acceptance of various ways to redistribute the revenues. Dutch car commuters find it almost acceptable when policy makers decide to use the revenues to compensate the car drivers by abandoning current car taxation. This option outperforms all other destinations in terms of acceptance. Lower fuel taxes and new roads are slightly less acceptable. By far the least attractive option is the public treasury. The analysis towards explaining variables of these revenue use targets showed a very diverse pattern. For some allocation categories (lower income taxes and new roads) income was important, whereas for other spending targets compensation of costs by the employer (e.g. abandoning existing car taxation) and the weight of the vehicle (e.g. lower fuel taxes) appeared to have impact on acceptance. Income seems the most relevant variable in this case because equity is often an issue when it comes to implementation of pricing measures and policy makers may want to compensate the lower income groups. It appears that lower income groups have a stronger preference to lower existing income taxes with revenues from road pricing compared with higher income people. The opposite holds when revenues are used to construct new roads.

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***Appendix 1: Explanation and population share of explanatory (dummy) variables of data set (N=564)***

| **Variable** | **Type** | **Levels** |
|---|---|---|
| Gender | Dummy | Male (75,2%); Female (24,8%) |
| Age | Dummies | Age1: 18-25 (7,3%), Age2: 26-35 (39,7%), Age3: 36-45 (28,2%), Age4: 46-55 (18,1%), Age5: 56+ (6,7%) |
| Education | Dummies | Edu1: primary (15,6%), Edu2: junior general secondary (MAVO) (6,0%), edu3: intermediate vocational (MBO) (24,8%), edu4: senior general secondary (HAVO/VWO) (9,4%), edu5: Bachelor (31,9%), edu6: Master (12,2%) |
| Income (gross yearly) | Continuous | |
| Place of residence (region) | Dummies | Loc1: 3 large cities* (17,9%), loc2: rest west (33,9), loc3: north (3,7%), loc4: east (23,9), loc5: south (20,6%) |
| Family size | Dummies | Fam1: 1 person (23%), fam2: 2 (31,6%), fam3: 3 (18,3%), fam4: 4 (18,3%), fam5: 5 (7,6%), fam6: 6 (1,2%) |
| Number of children younger than 11 | Dummies | Childno: 0 (72,5%), childyes: 1 or more (27,5%) |
| Type of measure | Dummies | Measure 1A to 1D, 2A to 2G (see app. 2) |
| Measure 3: charge level | Dummies | Charge=2.5 €cent, charge=5 €cent, charge=7.5 €cent |
| Measure 3: revenue use | Dummies | Revenue use is unclear, revenue use is new roads, revenue use is abandon car taxes |
| VOT | Continuous | |
| Weight of the car | Dummies | Weight1: low weight (22,7%), weight2: middle class (67,2%), weight3: heavy (10,1%) |
| Yearly number of kilometers driven | Continuous | |
| Compensation of costs by employer | Dummies | Comp1: none (11,9%), comp2: partly (43,8%), comp3: completely (44,3) |
| Travel time with congestion/free flow travel time | Continuous | |
| General effectiveness (will this measure lead to less congestion) | Dummies | Geff1: very unlikely (20.4%), geff2: unlikely (37.4%), geff3: a little unlikely (14.4%), geff4: not likely, not unlikely (6.0%), geff5: a little likely (16.3%), geff6: likely (4.4%), geff7: very likely (1.1%) |
| Personal effectiveness (will this measure make you drive less kilometers) | Dummies | Peff1: very unlikely (31.7%), peff2: unlikely (34.9%), peff3: a little unlikely (8.2%), peff4: not likely, not unlikely (8.3%), peff5: a little likely (10.1%), peff6: likely (5.3%), peff7: very likely (1.4%) |

* Amsterdam, Rotterdam and The Hague

*Appendix 2: Description of measures*

| Measure | Alternatives |
|---|---|
| 1. Electronic toll on daily bottlenecks (independent of bad weather); revenues hypothecated to construct new roads and improve existing roads | A) charge of € 1,00 at all times<br>B) charge of € 2,00 on working days, during peak hours: 7.00-9.00 and 17.00-19.00, no charge on other times<br>C) peak time charge: 6:00- 7:00 € 0,50, 7:00-7:30 € 1,00, 7:30-8:00 € 1,75, 8:00-8:30 € 2,50, 8:30-9:00 € 1,75, 9:00-9:30 € 1,00, 9:30-10:00 € 0,50. The same structure for the evening peak (16.00-20.00)<br>D) charge depends on traffic density, more congestion means a higher charge with a maximum of € 5,00 |
| 2. Kilometer charge depending on weight of the car (heavy cars are less environmental friendly). Light cars pay 4 €cent per kilometer; middle weight cars pay 5 €cent per kilometer; heavy cars pay 6 €cent per kilometer. Monthly (extra) costs for the various types of cars based on average kilometrage were presented to respondent. | A) Revenues hypothecated to general budget of the government<br>B) Revenues hypothecated to the traffic system in general, this may include new roads or improvement of public transport<br>C) Revenues used to lower existing car taxes and improve or construct new roads<br>D) Revenues hypothecated to public transport<br>E) Revenues used to abolish existing car ownership taxes<br>F) Revenues used to lower existing fuel taxes<br>G) Revenues used to improve roads and construct new road infrastructure |
| 3. Kilometer charge | A) charge of 2,5 €cent per kilometer; revenue use unclear<br>B) charge of 5 €cent per kilometer; revenue use unclear<br>C) charge of 7,5 €cent per kilometer; revenue use unclear<br>D) charge of 2,5 €cent per kilometer; revenues used for new and better roads<br>E) charge of 5 €cent per kilometer; revenues used for new and better roads<br>F) charge of 7,5 €cent per kilometer; revenues used for new and better roads<br>G) charge of 2,5 €cent per kilometer; revenues used to abolish existing car taxes (ownership and purchase)<br>H) charge of 5 €cent per kilometer; revenues used to abolish existing car taxes (ownership and purchase)<br>I) charge of 7,5 €cent per kilometer; revenues used to abolish existing car taxes (ownership and purchase) |

***Appendix 3: Calculation of VOT, VSDL, VSDE and VUNC point estimates***

The value of time (VOT), value of schedule delay late (VSDL) and early (VSDE) and value of uncertainty (VUNC) were derived from questions posed in the stated choice experiment, aimed at establishing estimates at the individual level. Four different screens were designed fo this purpose (one for each variable), each offering four alternatives that differ in tolls, travel time, departure time and uncertainty (only in the screen for VUNC). The respondents were then asked to allocate ten (commuting) trips over these four different alternatives. The design of the alternatives for VOT, VSDE, VSDL and VUNC respectively has been created as follows.

The average VOT according to previous (Dutch) studies is about € 7.5 per hour (see Gunn, 2001 and AVV, 1998). Given this value, we have identified the following four intervals:

1. € 0 – 4
2. € 4 – 8
3. € 8 – 12
4. > € 12

In order to allocate responses to one of the above categories, the following choice was offered (presented to the respondent in this format):

| | A (group 4) | B (group 3) | C (group 2) | D (group 1) |
|---|---|---|---|---|
| Departure time | $T_D$ | $T_D$ – 15 min. | $T_D$ – 30 min. | $T_D$ – 45 min. |
| Travel time | $T_f$ | $T_f$ + 15 min. | $T_f$ + 30 min. | $T_f$ + 45 min. |
| Arrival time | $T_A$ | $T_A$ | $T_A$ | $T_A$ |
| Toll | € 6 | € 3 | € 1 | € 0 |

The respondent was then asked to allocate ten trips over these four alternatives. If the respondent chooses alternative C over D, we can infer that he is willing to pay € 1 to save 15 minutes of travel time (implying a VOT of at least € 4 per hour). In order to calculate a point estimate for an individual we do need a mean interval value. It is not plausible to assume that the exact values are the middle points of its interval (and this is not possible for the fourth interval). Therefore we hypothesize that there is an underlying statistical distribution that can be fitted to the actual aggregated trip allocation of the point estimate questions and approximate the mean interval values based on this presumed distribution. We have chosen to use the Gamma distribution. In order to find the parameters of the best fitting Gamma distribution, we have applied the least square method (minimum difference between actual and simulated distribution). When the parameters have been estimated, it is possible to determine the mean interval values. Furthermore, it appeared that the distributions were (slightly) different for income; the mean interval value depends on the income of the respondent. The table below presents the mean average values for VOT, VSDE, VSDL and VUNC for the different income groups.

| Income (gross yearly) | VOT | | | | VSDE | | | | VSDL | | | | VUNC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0-4** | **4-8** | **8-12** | **>12** | **0-2** | **2-4** | **4-6** | **>6** | **0-8** | **8-16** | **16-24** | **>24** | **0-3** | **3-6** | **6-9** | **>9** |
| <28.500 € | 2.4 | 5.9 | 9.8 | 18.5 | 1.1 | 2.9 | 4.9 | 9.6 | 3.5 | 11.7 | 19.7 | 44.1 | 1.6 | 4.4 | 7.3 | 13.4 |
| 28.500-45.000 € | 2.4 | 5.9 | 9.8 | 18.1 | 1.1 | 2.9 | 4.9 | 9.5 | 3.4 | 11.6 | 19.6 | 40.2 | 1.6 | 4.4 | 7.3 | 13.1 |
| 45.000-68.000 € | 2.7 | 6.0 | 9.9 | 17.6 | 1.1 | 2.9 | 4.9 | 9.5 | 3.5 | 11.6 | 19.7 | 40.2 | 1.6 | 4.4 | 7.3 | 13.3 |
| >68.000 € | 2.7 | 6.0 | 9.9 | 17.9 | 1.1 | 2.9 | 4.9 | 9.5 | 3.2 | 11.6 | 19.6 | 38.9 | 1.6 | 4.4 | 7.3 | 12.9 |

It is now possible to calculate a point estimate for an individual's value of time as the weighted average of the intervals' expected values, where the weights are determined by the trips allocated to that interval by the respondent. For instance, when a respondent with an income of less than 28.500€ allocates 5 trips to B and 5 trips to C a VOT point estimate of 7.8 results ((5*5.9+5*9.8)/10).

Below we show the alternatives that have been presented to the respondents in order to derive VSDE, VSDL and VUNC.
Literature suggests that the **VSDE** is about half of the VOT. Therefore, we defined the following 4 intervals:

1. € 0 – 2
2. € 2 – 4
3. € 4 – 6
4. > € 6

| | A (group 4) | B (group 3) | C (group 2) | D (group 1) |
|---|---|---|---|---|
| Departure time | $T_D$ | $T_D$ – 15 min. | $T_D$ – 30 min. | $T_D$ – 45 min. |
| Travel time | $T_f$ | $T_f$ | $T_f$ | $T_f$ |
| Arrival time | $T_A$ | $T_A$ – 15 min. | $T_A$ – 30 min. | $T_A$ – 45 min. |
| Toll | € 3 | € 1.50 | € 0.50 | € 0 |

According to the literature **VSDL** is about twice the VOT. Therefore, we defined the following 4 intervals:

1. € 0 – 8
2. € 8 – 16
3. € 16 – 24
4. > € 24

| | A (group 4) | B (group 3) | C (group 2) | D (group 1) |
|---|---|---|---|---|
| Departure time | $T_D$ | $T_D$ + 10 min. | $T_D$ + 20 min. | $T_D$ + 30 min. |
| Travel time | $T_f$ | $T_f$ | $T_f$ | $T_f$ |
| Arrival time | $T_A$ | $T_A$ + 10 min. | $T_A$ + 20 min. | $T_A$ + 30 min. |
| Toll | € 8 | € 4 | € 1.33 | € 0 |

We have defined, rather arbitrarily, the following intervals for the **VUNC**:

1. € 0 – 3
2. € 3 – 6
3. € 6 – 9
4. > € 9

| | A (group 4) | B (group 3) | C (group 2) | D (group 1) |
|---|---|---|---|---|
| Departure time | $T_D$ – 30 min. | $T_D$ – 30 min. | $T_D$ – 30 min. | $T_D$ – 30 min. |
| Min. travel time | $T_f$ + 30 min. | $T_f$ + 5 min. | $T_f$ + 0 min. | $T_f$ |
| Max. travel time | $T_f$ + 30 min. | $T_f$ + 35 min. | $T_f$ + 40 min. | $T_f$ + 55 min. |
| Min. arrival time | $T_A$ | $T_A$ – 15 min. | $T_A$ – 30 min. | $T_A$ – 45 min. |
| Max. arrival time | $T_A$ | $T_A$ + 5 min. | $T_A$ + 10 min. | $T_A$ + 15 min. |
| Tol | € 6 | € 3 | € 1 | € 0 |

The resulting average values for the VOT, the VSDE, the VSDL, and the VUNC for the different income groups are shown in the following Table.

| | VOT | VSDE | VSDL | VUNC |
|---|---|---|---|---|
| <28.500 € | 9.9 | 4.6 | 18.6 | 5.8 |
| 28.500-45.000 € | 9.2 | 4.3 | 14.9 | 5.0 |
| 45.000-68.000 € | 9.8 | 4.7 | 13.6 | 5.3 |
| >68.000 € | 10.5 | 5.0 | 12.6 | 5.2 |

***Appendix 4A: Percentage of respondents ranking measures and revenue use as 'unacceptable' or 'very unacceptable'***

| Type of Measure | % of respondents | Type of revenue use | % of respondents |
|---|---|---|---|
| Measure 1A | 53,6 | General budget | 74,3 |
| Measure 1B | 51,5 | New roads | 8,6 |
| Measure 1C | 52,9 | Improve public transport | 31,0 |
| Measure 1D | 55,9 | Abandon existing car taxation | 3,2 |
| Measure 2A | 52,3 | Lower fuel taxes | 5,3 |
| Measure 2B | 50,0 | Lower income taxes | 33,5 |
| Measure 2C | 28,6 | | |
| Measure 2D | 48,3 | | |
| Measure 2E | 35,5 | | |
| Measure 2F | 37,2 | | |
| Measure 2G | 53,9 | | |
| Measure 3A | 59,3 | | |
| Measure 3B | 75,0 | | |
| Measure 3C | 81,5 | | |
| Measure 3D | 55,2 | | |
| Measure 3E | 48,6 | | |
| Measure 3F | 60,6 | | |
| Measure 3G | 13,6 | | |
| Measure 3H | 18,0 | | |
| Measure 3I | 32,3 | | |

***Appendix 4B: Mean of acceptance scores on each type of revenue use for four different income categories (level 1 = very unacceptable; level 7 = very acceptable)***

| Allocation type | <28.500 € (N=140) | 28.500-45.000 € (N=179) | 45.000-68.000 € (N=152) | >68.000 € (N=93) |
|---|---|---|---|---|
| General budget | 2.27 | 2.11 | 2.11 | 2.09 |
| New roads | 4.97 | 5.11 | 5.26 | 5.62 |
| Improve public transport | 4.08 | 3.88 | 4.11 | 3.86 |
| Abandon existing car taxation | 5.84 | 5.77 | 5.97 | 5.79 |
| Lower fuel taxes | 5.66 | 5.57 | 5.67 | 5.36 |
| Lower income taxes | 4.22 | 3.85 | 3.75 | 3.50 |

## *Appendix 5: Ordered probit analysis with revenue use only as a dependent variable*

| Variable | Revenue use: general budget | | Revenue use: new roads | | Revenue use: improve public transport | |
|---|---|---|---|---|---|---|
| Threshold (μ's) | | ***Significance*** | | ***Significance*** | | ***Significance*** |
| $\mu_1$ | -3.51E-02 (.288) | | -2.712 (.297) | *** | -.510 (.268) | *** |
| $\mu_2$ | .728 (.289) | ** | -2.186 (.283) | *** | .167 (.267) | *** |
| $\mu_3$ | .987 (.290) | *** | -1.784 (.278) | *** | .406 (.267) | *** |
| $\mu_4$ | 1.259 (.292) | *** | -1.345 (.275) | *** | .734 (.268) | *** |
| $\mu_5$ | 1.783 (.299) | *** | -.691 (.272) | ** | 1.332 (.270) | ** |
| $\mu_6$ | 2.674 (.351) | *** | .492 (.272) | * | 2.030 (.276) | * |
| Income (gross yearly) | | | | | | |
| Income 1 (less than €28.500) | 6.74E-02 (.151) | | -.451 (.145) | *** | 8.66E-02 (.142) | |
| Income 2 (€28.500-€45.000) | 4.31E-04 (.143) | | -.360 (.137) | *** | 1.163E-02 (.134) | |
| Income 3 (€45.000-€68.000) | -2.07E-02 (.147) | | -.265 (.140) | * | .129 (.137) | |
| Gender (female) | 7.94E-02 (.151) | | -.137 (.115) | | 3.342E-02 (.113) | |
| Loc1 | -.136 (.125) | | 7.236E-03 (.116) | | 6.312E-02 (.115) | |
| Age | | | | | | |
| Age1 (18-25) | 4.65E-02 (.249) | | -.490 (.240) | ** | -.257 (.236) | |
| Age2 (26-35) | -7.72E-02 (.195) | | -.275 (.195) | | -7.023E-02 (.184) | |
| Age3 (36-45) | -.151 (.200) | | -.324 (.192) | * | -.149 (.188) | |
| Age4 (46-55) | -4.49E-02 (.210) | | -.407 (.202) | ** | -.236 (.197) | |
| Yearly driven number of kilometers | -2.67E-02 (.000) | | -1.129E-06 (.000) | | 1.930E-06 (.000) | |
| Comp1 (no transport costs paid by employer) | -.447 (.166) | *** | -.128 (.152) | | -.104 (.151) | |
| Comp2 (transport costs partly compensated) | -.203 (.108) | * | -.179 (.102) | * | -.152 (.100) | |
| Weight1 (low weight) | .155 (.195) | | -1.984E-02 (.249) | | .544 (.180) | *** |
| Weight2 (middle weight) | .168 (.163) | | 9.005E-02 (.151) | | .354 (.180) | ** |
| VOT | 2.20E-02 (.010) | ** | 9.026E-02 (.009) | | 2.24E-02 (.009) | ** |
| N | 564 | | 564 | | 564 | |
| Log-likelihood | -795.618 | ** | -899.676 | ** | -1054.943 | ** |
| Pseudo R-square | Cox and Snell | .035 | Cox and Snell | .051 | Cox and Snell | .044 |
| | Nagelkerke | .037 | Nagelkerke | .053 | Nagelkerke | .045 |
| | McFadden | .012 | McFadden | .016 | McFadden | .012 |

| Variable | Revenue use: abandon existing car taxation | | Revenue use: lower fuel taxes | | Revenue use: lower income taxes | |
|---|---|---|---|---|---|---|
| Threshold (μ's) | | ***Significance*** | | ***Significance*** | | ***Significance*** |
| $\mu_1$ | -2.324 (.317) | | -2.233 (.299) | *** | -.715 (.270) | *** |
| $\mu_2$ | -1.854 (.295) | ** | -1.771 (.286) | *** | .169 (.267) | |
| $\mu_3$ | -1.660 (.290) | *** | -1.487 (.282) | *** | .468 (.268) | * |
| $\mu_4$ | -1.154 (.284) | *** | -1.107 (.279) | *** | .797 (.268) | *** |
| $\mu_5$ | -.586 (.281) | *** | -.598 (.277) | ** | 1.304 (.270) | *** |
| $\mu_6$ | .504 (.281) | *** | .622 (.277) | ** | 2.121 (.278) | *** |
| Income (gross yearly) | | | | | | |
| Income 1 (less than €28.500) | 1.21E-02 (.148) | | .174 (.146) | | .421 (.142) | *** |
| Income 2 (€28.500-€45.000) | -3.73E-02 (.139) | | .171 (.137) | | .225 (.134) | * |
| Income 3 (€45.000-€68.000) | .180 (.144) | | .297 (.141) | ** | .241 (.137) | * |
| Gender (female) | -2.86E-02 (.118) | | 3.323E-02 (.117) | | 6.70E-02 (.113) | |
| Loc1 | -7.317E-02 (.120) | | -.242 (.118) | ** | -.287 (.115) | ** |
| Age | | | | | | |
| Age1 (18-25) | -.430 (.246) | * | -5.82E-02 (.244) | | .456 (.236) | |
| Age2 (26-35) | -.221 (.194) | | -4.95E-02 (.191) | | .449 (.185) | * |
| Age3 (36-45) | -7.54E-02 (.199) | | -.129 (.195) | | .374 (.189) | ** |
| Age4 (46-55) | -6.23E-02 (.209) | | 2.18E-02 (.205) | | 7.03E-02 (.198) | ** |
| Yearly driven number of kilometers | 1.17E-06 (.000) | | -1.43E-06 (.000) | | -2.660E-06 (.000) | * |
| Comp1 (no transport costs paid by employer) | .411 (.159) | *** | .436 (.158) | *** | 9.84E-02 (.150) | |
| Comp2 (transport costs partly compensated) | .249 (.105) | ** | .120 (.103) | | -6.45E-02 (.100) | |
| Weight1 (low weight) | -.199 (.187) | | -.506 (.187) | *** | 2.80E-03 (.179) | |
| Weight2 (middle weight) | -3.52E-02 (.156) | | -.284 (.156) | * | 7.56E-02 (.179) | |
| VOT | 4.85E-03 (.010) | | 4.87E-03 (.010) | | 1.24E-02 (.009) | |
| N | 564 | | 564 | | 564 | |
| Log-likelihood | -777.800 | * | -830.182 | ** | -1041.136 | *** |
| Pseudo R-square | Cox and Snell | .040 | Cox and Snell | .045 | Cox and Snell | .062 |
| | Nagelkerke | .043 | Nagelkerke | .048 | Nagelkerke | .063 |
| | McFadden | .015 | McFadden | .015 | McFadden | .017 |

Notes: The standard errors are shown in brackets. *, ** and *** denote significance at the 10, 5 and 1% level, respectively, (two-sided *t*-test).