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Acceptability of a tradable driving credit scheme in the Netherlands and Beijing

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ABSTRACT

There is increasing interest in the concept of tradable driving credits (TDC) as an alternative road pricing measure. To a considerable extent, this interest is inspired by the belief that TDC will address some major equity-related concerns, which are often raised in the case of traditional road pricing, because the measure is revenue-neutral, offers an opportunity for individuals to gain, and guarantees a minimum amount of 'free' travel through the allocation of personal credit allowances. This study investigates the acceptability of a proposed kilometre-based TDC scheme for personal car use. By analysing data from the Netherlands and China (Beijing), opinions towards TDC and its determinants are studied in two different cultural, societal and institutional contexts. Acceptability was much higher in Beijing: 67% compared to 22% in the Netherlands. We relate this difference to higher congestion levels in Beijing and the city's current license plate-based driving restriction policy, compared to which TDC is evaluated to be more effective and fair by a majority of the participants. Having a higher income was positively related with acceptability in both countries, as were expected effectiveness and fairness. The effect of perceived fairness was particularly strong in Beijing.

1. Introduction

Considering the high external costs of congestion and pollution posed by the ongoing growth of car mobility, academics studying transport have long been convinced of the power of pricing solutions to internalise these costs and deliver a more efficient use of scarce road space (Pigou, 1920; Vickrey, 1963; Small and Verhoef, 2007). However, the small number of successful implementations following a multitude of road pricing proposals from all over the world to date demonstrates the massive unpopularity of charging for car use from societal and political sides. This trend has led to a recent growth in research that recognises the lack of public acceptance associated with road pricing measures and investigates its causes and variations (Harrington et al., 2005); Schade and Schlag, 2003; Jaensirisak et al., 2005; Ubbels and Verhoef, 2006; Gärling and Schuitema, 2007; Gaunt et al., 2007; Schuitema and Steg, 2008). These studies highlight that major contributors to people's opposition of pricing initiatives are the disbelief that road pricing will solve their problems, fear that the measure will treat them or others unfairly, and scepticism regarding the way revenues will benefit them or the transport domain as a whole.

Based on these observations, transport researchers have increasingly shown interest in the concept of tradable driving credits (TDC) as an alternative pricing measure that can potentially address these obstacles (Verhoef et al., 1997a; Viegas, 2001; Raux and Marlot, 2005; for reviews, see Fan and Jiang, 2013; Grant-Muller and Xu, 2014; Dogterom et al., 2017). As is commonly understood, a TDC scheme would allocate individual proportions of car use to drivers based on an aggregate target (formulated in, for example, units of distance or fuel consumption) that can be used and traded according to personal aspirations and prevailing market prices. Theoretically, TDC is effective in reaching a predefined car use reduction goal through cap setting, whereas in the case of conventional road pricing, a priori knowledge is needed regarding the precise elasticity to arrive at the desired reduction levels. Additionally, the goal can be reached in a cost-efficient way through the market. Furthermore, TDC could address issues of equity related to conventional road pricing by the distribution of free credit allowances to participants, by offering the opportunity to get financial gains out of the scheme, and by providing regulators with a tool to pursue certain distributional outcomes by configuring the initial credit allocation. Finally, TDC is revenue-neutral, leading to money circulating between

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participants rather than flowing to government funds.

Although TDC can be an appealing concept in theory, its feasibility is ultimately a matter of public opinion. At present, however, despite a rapidly increasing volume of theoretical explorations of TDC, very little attention has been devoted to public attitudes and perceptions of acceptability to potential TDC schemes in an empirical context (but see Kockelman and Kalmanje (2005) and Harwatt et al. (2011) for initial explorations on this theme). Public opinions have been more widely researched in the context of personal carbon trading (PCT), a comparable tradable credit scheme that covers other personal carbon producing sources in addition to car use (Bird et al., 2009; Bristow et al., 2010; Wallace et al., 2010; Andersson et al., 2011). These studies find a common preference for the trading scheme when compared to an equivalent carbon tax. However, these studies are largely UK-based and rely on qualitative interviews or questionnaires that are very general in design and do not present respondents with experiments in which their present behaviour is confronted with hypothetical scenarios, which could influence attitude formation. Moreover, although studies on acceptability in the context of PCT may yield valuable insights into the level and determinants of public acceptability of tradable schemes in general, they are of limited value when it comes to a more direct evaluation of TDC's acceptability relative to other travel demand management measures, which is important from a policy perspective. Finally, current studies are largely confined to the Western context, although interest in the concept of TDC is also coming from other contexts, especially from Asian countries, that might differ in cultural values when it comes to car use and public opinions towards travel demand management measures.

The aim of this paper is to address these shortcomings in the literature regarding public attitudes towards TDC by reporting the results of two studies, one conducted in the Netherlands and one conducted in China (Beijing). These studies employed an experiment in which behavioural responses towards a hypothetical TDC measure, as well as personal attitudes towards the measure were investigated. In an earlier paper (Dogterom et al., in press), behavioural responses were discussed; in this paper we look into the perceptions of the TDC measure under investigation. An important contribution of this paper is that, because of the nature and scale of the experiments, it is the first study that is able to quantify and analyse TDC's acceptability in relation to a wide variety of relevant mediating factors, such as socio-demographic characteristics, car use dependency, problem perception and expected outcome. A second contribution of this paper is that, by presenting results from a Dutch and Chinese context, it aims to identify whether there are differences in the acceptability of TDC and the factors contributing to it between settings in Europe and Asia. Not only is empirical research in the field of road pricing in China scarce, also the major cultural and institutional differences between both contexts make a comparison highly valuable.

This paper starts with a review of the current literature on the acceptability of road pricing in general and on TDC in particular. The third section discusses the data collection procedure. The fourth section presents a descriptive analysis of the attitudes, opinions and TDC acceptability at first and then investigates the effects of attitudes, opinions and socio-demographic characteristics on TDC acceptability by using multivariate regression analysis. The paper ends with a conclusion and a discussion.

2. Literature review

This section first summarises the literature on the acceptability of road pricing in general, followed by a review of studies that have addressed the acceptability of tradable credit schemes, both in the domain of personal travel and in the more general domain of personal energy consumption.

2.1. Acceptability of road pricing

An investigation into the acceptability of urban road pricing in eight European cities found an average acceptability of less than 30% (PRIMA, 2000). Based on a review of several road pricing studies, Jaensirisak et al. (2005) reported an average acceptability of 35% in cases without explicit mentioning of revenue use and of 55% in cases where revenue hypothecation was specified. The acceptability of road pricing[1] is found to vary with a range of factors.

Regarding the design of pricing schemes, the use of revenues is an important factor. Generally, schemes that lead to revenues flowing to general public funds are least acceptable. Re-allocation of revenues within the transport system, for example by investing it in public transport or lowering taxation on fuel consumption and car ownership, could lead to increased acceptability (Schade and Schlag, 2003; Ubbels and Verhoef, 2006; Schuitema and Steg, 2008; Verhoef et al., 1997b).

Studies have also identified the effects of socio-demographic characteristics on the acceptability of road pricing. Income is typically regarded as an important determinant, with acceptability assumed to be higher for higher-income groups because road pricing, in the absence of revenue redistribution, would favour those with a lower marginal utility of money and a higher value of time (Arnott et al., 1994; Evans, 1992). However, whereas Verhoef et al. (1997b) and Golob (2001) could confirm a positive relationship between income and acceptability, Odeck and Bråthen (1997), Rienstra et al., (1999) and Jaensirisak et al. (2005) did not find a significant relationship, and, surprisingly, Harrington et al. (2005) even reported a negative association. Regarding age, Odeck and Bråthen (1997) and Jaensirisak et al. (2005) found that younger people accepted road pricing more readily, whereas Rienstra et al. (1999) found more support among older people. Of the studies that have identified a significant effect for education, Ubbels and Verhoef (2006), Odeck and Bråthen (1997) and Rienstra et al. (1999) reported more support among higher educated people, whereas Harrington et al. (2005) found a negative relationship between education and support. Another relevant factor is intensity of car use, which Gaunt et al. (2007) and Odeck and Bråthen (1997) found to negatively affect acceptability. The location of residence has not often been analysed as a distinctive factor. Rienstra et al. (1999) found lower acceptability levels for people living in villages compared to those living in larger cities and Gaunt et al. (2007), analysing the voting outcome of the Edinburgh road pricing referendum, found greater opposition among people living in the suburbs. Arguably, the effect of place of residence could be related to car use intensity, as those living in less populated areas often experience a higher car dependency.

In summary, studies have demonstrated mixed results regarding the effect of important socio-demographic factors. At the same time, studies that have also incorporated attitudinal factors and subjective perceptions in their analyses widely agree that attitudes have a much greater predictive power than socio-demographic factors in determining acceptability (Schade and Schlag, 2003; Jaensirisak et al., 2005; Gärling et al., 2008). Problem perception, fairness, infringement on freedom, expected effectiveness and expected personal outcome have been identified as important dimensions in the evaluation of road pricing's acceptability. Rienstra et al. (1999), Verhoef et al. (1997b) and Harrington et al. (2005) found that problem awareness has a positive effect on acceptability, although Bartley (1995) concluded that problem awareness is only very loosely related to acceptability and Schade and Schlag (2003) even reported the absence of a significant effect. Rather, it is expected effectiveness, i.e., the conviction that a measure can solve the problem, that seems to have a stronger impact on acceptability (Bamberg and Rölle, 2003; Schade and Schlag, 2003; Rienstra et al., 1999).

[1] Here, road pricing refers to different types of charging for the use of public roads, including congestion-based, cordon-based and distance-based pricing.

Another well-established finding is that the evaluation of a pricing measure as limiting a person's freedom and as being unfair leads to reduced acceptability levels (Bamberg and Rölle, 2003; Jakobsson et al., 2000; Eriksson et al., 2006; Golob, 2001). Bamberg and Rölle (2003) showed that these two concepts are related: the more the measure is perceived as an infringement on freedom, the less fair the measure is assessed. Fairness is not only a concept that is confined to the individual outcome, but evidently also relates to evaluations of equity, which refers to the distribution of costs and benefits of the measure on the aggregate level, which links to the concept of justice (Ittner et al., 2003).

Of course, socio-demographic characteristics might exert an effect through attitudes. Jakobsson et al. (2000) found that income had an indirect negative effect on the acceptability of road pricing through perceived fairness and infringement on freedom. In addition, Schade and Schlag (2003) concluded that higher-income groups were more likely to expect benefits from road pricing and therefore might support the measure through perceived outcome.

2.2. Acceptability of tradable credit schemes

Kockelman and Kalmanje (2005) proposed a credit-based congestion pricing scheme, in which drivers would receive a monthly free allowance of travel credits and would pay only when they exceeded their allowance, and investigated its potential compared to a regular congestion pricing scheme. They asked respondents in Austin (TX, US) for their responses to and support for the measure. The authors found that 24.9% of the respondents clearly supported the measure, which was considered a substantial share given the respondents' unfamiliarity with the measure, and concluded the measure to be a viable and competitive alternative. Harwatt et al. (2011) interviewed 60 persons in the UK about their reactions to and opinions of a personal car use-oriented tradable carbon permit scheme and an equivalent fuel price increase. They found that the trading scheme scored significantly higher than road pricing on personal and social acceptability as well as on fairness, expected effectiveness and the evaluated balance of costs and benefits. The interviews highlighted that the respondents believed that the trading scheme was fairer than road pricing, which led to the more positive attitude towards the trading scheme. Also, they believed that only the trading scheme was able to lower aggregate car use because of the limited availability of credits, which was an important contributing factor in their evaluation.

Other studies on the acceptability of personal trading schemes have been carried out in the context of schemes that cover all other personal/household energy usage and not only personal car use. Wallace et al. (2010), Bristow et al. (2010) and von Knobelsdorff (2008) found remarkably similar support levels, with 42%, 43% and 44% of the respondents, respectively, supporting a personal carbon trading scheme in the UK, and also reported an overall preference for the trading scheme in comparison with a carbon tax. In contrast, in a Swedish context, Andersson et al. (2011) found that 36% of the respondents supported a personal carbon trading scheme, significantly lower than the support for increasing carbon taxes, although it should be noted that a carbon tax had already been introduced in Sweden and could have had a negative effect on the support for an additional, different type of scheme. Their study showed perceived fairness to be a main determinant of support. However, they also controlled for the perceived complexity of the trading scheme and found this variable to have a larger impact on the scheme's acceptability, with lower support for higher perceived complexity. In contrast to the above-mentioned studies that evaluated attitudes to a fixed tradable scheme design, Bristow et al. (2010) investigated the impact of design aspects on the acceptability of both a personal carbon trading scheme and a carbon tax. Although no unique preference could be attributed to the trading scheme over the tax, their results indicate that the actual design has a critical influence on acceptability, with higher support ratings for the trading scheme based on credit allocation strategies that were regarded as being fairer.

Because TDC essentially is a pricing measure, that despite its unique distributional characteristics, still might be perceived as a measure meant to ration and price the otherwise (to some extent) free road access, we assume the factors and their effects identified in the road pricing literature as important determinants of acceptability to be largely the same in a TDC context. At the same time, we expect TDC to be evaluated more positively relative to conventional road pricing on expected effectiveness and fairness. Because of the strict cap on aggregate car use as a distinctive feature, and supported by the initial conclusions of the qualitative study of Harwatt et al. (2011), we expect people to have a stronger believe in TDC's ability to reduce car use relative to alternative measures. We also hypothesise that TDC will be evaluated more positively on fairness, because of the free distribution of free credit allowances, the ability to make money out of the scheme, and the placing of additional costs solely on above-allowance drivers. At the same time, there could still be a positive association between income and TDC acceptability because a TDC scheme, using an equal per-capita credit allocation, can still be expected to be regressive beyond the allowance, because it is not necessarily lower-income drivers that have the lowest car use intensities, and because higher-income drivers may have a higher willingness to pay for additional credits. Also, several studies found lower-income groups to be less able to change their car use in response to pricing measures (Washbrook et al., 2006; Clay and Mokhtarian, 2004), which can potentially reinforce a possible resistance to accepting TDC. Finally, we expect TDC to be more acceptable in Beijing than in the Netherlands given the higher levels of congestion and car-based pollution and the relative unpopularity of the present license plate-based driving restrictions in Beijing.

3. Data collection

3.1. Experiments

Data on attitudes towards the TDC measure were collected through a questionnaire that was included in a larger experiment on behavioural responses towards the measure. The online experiments conducted in the Netherlands and Beijing varied in design, procedure, and participants to some extent (see Appendix 1). However, the same hypothetical TDC scheme was presented to the participants and the same questionnaire on TDC attitudes was used, apart from some minor modifications in the Chinese version, providing common ground necessary for comparison.

In both experiments, participants were first asked to report the car trips they made during the 7 previous days and to estimate the number of kilometres they drove during these days. Next, a distance-based TDC scheme, in which one credit was set to represent one kilometre of car driving, was introduced. Then, participants were presented with a series of scenarios in which they were given a certain number of free credits to use in the recorded week and in which they could state whether and how they would make changes to their trips in retrospect. In the Dutch experiment, the levels of credit availability and shortage were defined as a percentage of the reported car kilometres travelled. These levels and a value per credit (0.10, 0.15 or 0.20 Euro) were randomly assigned to the participants. Participants were asked to indicate the percentage of change in number of kilometres for the different activity categories if they wanted to change their car use in response to the scenario.

In Beijing, every participant was presented with the same scenarios, in which the credit surplus and shortage levels were set at a fixed amount for everyone, irrespective of the number of kilometres driven. One of three different credit values (0.5, 0.8 or 1.0 Yuan) were randomly assigned to the participants. Both experiments thus used multiple scenarios with different credit surplus and shortage levels. Consequently, participants could not easily detect from the experiment

how such a scheme would possibly affect their personal situation on the basis of their car use intensity relative to that of others.

3.2. Sample and context

In both contexts, car owners were recruited to participate in the experiment. Data collection took place in June (Netherlands) and July (Beijing) 2016. For details about the recruitment procedures and sample compositions the reader is referred to Dogterom et al. (in press).

There are important geographical, cultural, and institutional differences between the Netherlands and Beijing that must be considered when interpreting the findings. First, the sample in the Netherlands covers the nation as a whole, whereas the Chinese data collection is limited to the city of Beijing only. In a city context, exposure to travel-related problems might be more severe, while at the same time, car use alternatives are generally more abundantly available. Especially in Beijing, problems of congestion and pollution caused by car travel manifest themselves at a massive scale. Second, the socio-cultural position of the car is a context-specific factor, with car ownership and use having a much stronger appeal as a status symbol in China than in the Netherlands, especially among the rapidly growing wealthy and self-conscious Chinese urban middle class (Williams and Arkaraprasertkul, 2016; Yang et al., 2014; Belgiawan et al., 2014). Third, both contexts have their own unique historical trajectories with regard to car use management policy. Plans for a nationwide kilometre-based road pricing scheme were proposed and heavily debated in the Netherlands in the 90 s, but were rejected because of very limited social and political support (Ardıç et al., 2013; Smaal, 2012). In Beijing, citizens have faced some rigorous and very restricting measures in recent years that aimed to curb congestion, such as the lottery for the issuing of new license plates and the license plate-based one-day-a-week non-driving restriction (Xu et al., 2015; Yang et al., 2014; Wang et al., 2014). These settings form a relevant backdrop for interpreting TDC attitudes.

3.3. Questionnaire

Appendix 2 lists the items that measured participants' attitudes towards the TDC measure and participants' car use. All attitudes were measured at a 7-point scale. Following Schade and Schlag (2003), regarding problem perception, a distinction was made between perceived travel problems related to congestion and environmental impact. This was also relevant because we framed the TDC measure from the perspective of congestion in the introduction of the experiment. With regard to congestion, a further distinction was made between congestion as a personal and a social problem, because people might perceive congestion as a harmful phenomenon for society, without being personally affected by it (cf., Rienstra et al., 1999).

In contrast with most of the studies on the acceptability of road pricing, the questionnaire included the concept of car attachment, measured in three dimensions: instrumental, affective, and symbolic (Steg, 2005). We did so because positive car attitude is found to be negatively associated with the acceptance of road pricing (Steg, 2003), and because we expected meaningful differences between the two samples in the domain of car attachment. As already indicated, we expect important differences between symbolic car attachment between the Dutch and Chinese samples because of the car's strong role as a status symbol in a Chinese context (e.g., as a means to display wealth and financial reliability).

At the end of the questionnaire, two questions were formulated to inquire about participants' evaluation of the TDC measure compared to the recently debated per-kilometre fee (Netherlands) or the implemented license plate-based driving restrictions (Beijing) to address the relative attractiveness of TDC. The relative attractiveness was measured in terms of expected effectiveness and fairness, as the two issues have been identified as the most important objections to these respective policies.

Table 1
Means and standard deviations of the variables reflecting the attitudes towards car use and TDC.

	Netherlands		Beijing		t-test[a]
	M	S.D.	M	S.D.	
Problem perception congestion (societal)	4.98	1.27	6.00	1.24	−13.50**
Problem perception congestion (personal)	3.27	1.53	5.55	1.29	−27.12**
Problem perception environmental	4.17	1.43	4.55	1.44	−3.79**
Expected effectiveness congestion	3.38	1.52	5.59	1.76	−24.91**
Expected effectiveness environment	3.44	1.47	4.58	1.75	−11.56**
Personal outcome	3.60	1.45	3.51	1.76	0.89
Instrumental car attachment	4.22	1.85	3.69	1.73	4.91**
Symbolic car attachment	2.58	1.50	4.10	1.67	−15.72**
Affective car attachment	4.63	1.55	4.65	1.53	−0.21
Infringement freedom	4.64	1.70	4.44	1.78	1.86
Unfairness	4.26	1.64	3.17	1.62	11.08**
Relative effectiveness	3.75	1.41	4.64	1.80	n/a
Relative fairness	3.84	1.42	4.82	1.76	n/a
Acceptability	3.46	1.51	4.85	1.67	−14.44**

[a] Welch's test for unequal variances.
** Significant at the 0.05 alpha level.

Note that the translation process resulted in a somewhat different formulation of questions/statements between the Netherlands and Beijing. Whereas in the Netherlands most questions were formulated using the statement format, the Beijing questionnaire relied solely on the question format. Furthermore, note that for the items personal outcome, instrumental car attachment, and fairness opposite measurements were used. Although we acknowledge that this is not an ideal situation, we reversed the scores for Beijing on these items for the purposes of analysis.

4. Results

4.1. Descriptive results

Means and standard deviations for the measured items as well as the t-tests on the means are presented in Table 1. The Welch's *t*-test is used, which is more reliable than the Student's *t*-test when the sample sizes differ and the variances are unequal, as is the case with our data. The null hypothesis assumes that the means of both samples are equal. The results show that the null hypothesis should be rejected for most of the items (indicated by a p-value smaller than 0.05, which states that the chance of a false rejection is less than 5%), showing that there are major statistical differences between the two samples. First, car owners from Beijing report a considerable higher problem awareness, both in terms of congestion and car-related pollution, which is not surprising given the scale and intensity of these problems in Beijing. At the same time, likely influenced by problem awareness, they report a higher perceived ability for TDC to effectively curb congestion and car-related pollution than car owners in the Netherlands. Regarding the Dutch sample, one remarkable observation is that mean score for perceiving congestion as a societal problem is substantially higher than the mean score for viewing congestion as a personal problem, whereas this gap is smaller in Beijing.

Beijing car owners report a lower instrumental dependence on car use but a higher symbolic value of car use than car owners in the Netherlands. This is in line with our expectations based on the reasons outlined in the previous section: better access to alternative modes of transport and the framing of the car as status symbol in Beijing. There are no statistical differences between the samples on infringement on mobility freedom. However, there is a difference with regard to unfairness, with the Beijing participants believing the measure is fairer on average than those in the Netherlands. As the literature on road pricing

indicates that infringement on freedom is usually closely related to perceptions of fairness, the differences between the mean values of both items for Beijing are rather remarkable. However, in contrast to infringement on freedom, an evaluation of perceived unfairness could transcend the personal domain and include equity aspects related to the larger community. Therefore, Beijing car owners, although perceiving the measure as restricting their own mobility, could still believe the measure is just considering the wider distribution of costs and benefits for the city and the entire group of car drivers, to which the more collectivistic-oriented culture of China might contribute (Zhao et al., 2015; Sun et al., 2004). Also, Beijing participants' experiences with existing travel demand management measures, that are widely viewed as unfair, could contribute to a lower score on perceived unfairness, which a related item considers in in more detail.

Beijing car owners indicate a higher expected effectiveness and fairness of TDC relative to the alternative measure taken as a reference. However, a comparison between the Netherlands and Beijing is less meaningful here because of the very different, context-specific alternative measures that TDC is compared with. Still, the evaluation of expected effectiveness and fairness of TDC relative to the kilometre-based road pricing and the license plate-based driving restriction as proposed/implemented in the Netherlands and Beijing, respectively is highly relevant in their own case. Therefore, Table 2 provides additional details on these items. Approximately 25% of the Dutch car owners believe TDC is more effective and fairer than kilometre pricing and more than 40% of the respondents have a neutral stance. In Beijing, 62% of the respondents think TDC is more effective than the license plate-based driving restriction, and more than two-thirds believe the measure to be fairer. This indicates a high level of dissatisfaction with the current car travel policy in Beijing and suggests that TDC can possibly be a viable alternative when it comes to public support. This is further supported by a similar acceptance rate (67%) for TDC for Beijing. In the Netherlands, the acceptance level of TDC is much lower, with only 21.6% of the participants believing the measure is acceptable, while about twice as many think the measure is unacceptable. This might be caused by a lower perception of congestion as an urgent problem and a lower level of acceptance of government intervention in their personal car use in a culture where the influence of the government in people's daily life is limited compared to the Chinese context. However, again, a relatively large proportion, 36% of the respondents, take a neutral stance, suggesting there might be room for acceptance levels to increase with scheme adjustments or by providing more information

4.2. Statistical analysis of TDC acceptability

4.2.1. Approach

In the following section, regression models will be presented to investigate the factors contributing to the acceptance of TDC. These factors include the attitude items as discussed above as well as the socio-demographic characteristics of the participants.

It should be noted that in our aim to identify factors that contribute to the acceptance of TDC we present our results as two different case studies rather than as a direct comparison of the Dutch and Beijing cases. This is not only because some attitudes have not been measured equally in both contexts, but also because of the presence of some dissimilarities regarding data on the socio-demographic characteristics of the two samples. For example, while the Dutch dataset includes information about participants' relational status and the presence of children in the household, in the Beijing dataset only information about the number of people in the household is available. Furthermore, relevant information on the age and residential context of the participants is only available in the Dutch dataset. Additionally, one should bear in mind that the income categories are not fully comparable. First, an appropriate reference income level, such as average income, is difficult to define in the Beijing context where car owners have categorically higher incomes than the average income for all Beijing inhabitants. Secondly, the income categories used in both experiments (number of categories and number of participants in the respective categories) differed considerably. Therefore, the three income categories in the respective models have been defined based on the availability of the data and are not directly comparable between the samples.

Ordinary least squares (OLS) regression models were estimated with the level of acceptability as the dependent variable. For both samples, two models were estimated: one to test the effects of socio-demographic characteristics only, and one to test the combined effects of socio-demographic characteristics and attitudes. In each of the models, the maximum variance inflation factor did not have a value higher than 5, indicating the absence of multi-collinearity among the variables and suggesting OLS was an acceptable approach to estimate the coefficients. The regression on the Beijing data failed the Breusch-Pagan test, implying the presence of heteroscedasticity. Therefore, a regression with robust standard errors was performed for the Beijing case.

5. Results

Tables 3 and 4 present the estimation results for the Dutch and Beijing case, respectively. Consistent with previous research (Schade and Schlag, 2003; Jaensirisak et al., 2005; Gärling et al., 2008), the impact of socio-demographic characteristics on the level of acceptability is very limited, as demonstrated by the low fit of the models with the socio-demographic characteristics only.

For both the Dutch and Beijing sample, the results of Model 1 reveal an income effect. In the Netherlands, those in the highest income category view TDC more acceptable than those in the lowest income category. In Beijing, both the middle and higher income groups consider TDC more acceptable, with the strongest effect for the middle-income group, as shown by its larger coefficient. This income effect casts doubt

Table 2
Distribution of rating reflecting the attitudes 'relative effectiveness', 'relative fairness', and 'acceptability'.

Value	Rating	Netherlands			Beijing		
		Relative effectiveness	Relative fairness	Acceptability	Relative effectiveness	Relative fairness	Acceptability
Low	1	10.4	10.2	15.7	10.5	9.9	6.8
	2	8.7	6.4	11.7	5.0	3.3	5.5
	3	12.7	13.1	15.0	8.0	6.5	5.6
	4	42.6	43.2	36.0	14.6	13.2	15.2
	5	17.4	17.0	15.0	22.9	23.5	26.2
	6	5.5	7.2	3.8	26.8	29.9	26.2
High	7	2.8	3.0	2.8	12.3	13.8	14.6
Low	1–3	31.8	29.7	42.4	23.5	19.7	17.9
	4	42.6	43.2	36.0	14.6	13.2	15.2
High	5–7	25.6	27.1	21.6	62.0	67.1	67.0

Table 3
Estimation results based on TDC acceptability for the Netherlands (OLS regression).

	Model 1		Model 2	
	Beta	Sig.	Beta	Sig.
Constant	3.497	0.000	0.900	0.006
Male	−0.096	0.502	0.040	0.632
Age 30–45	−0.207	0.344	−0.050	0.700
Age > 45	−0.302	0.141	−0.110	0.377
Single	0.108	0.550	0.009	0.929
Children in household	0.122	0.460	0.024	0.809
Higher education (university and higher professional)	−0.126	0.420	−0.052	0.575
Disposable monthly household income €2000-3500	0.226	0.240	0.054	0.638
Disposable monthly household income > €3500	0.616	0.011	0.279	0.054
No income stated	−0.015	0.946	0.145	0.262
More than 1 car in household	−0.088	0.590	−0.022	0.822
Residence in non-urban municipality	−0.001	0.996	0.113	0.206
Problem perception congestion (general)			−0.019	0.615
Problem perception congestion (personal)			0.017	0.582
Problem perception environmental			0.014	0.707
Expected effectiveness congestion			0.086	0.056
Expected effectiveness environment			0.015	0.743
Personal outcome			0.171	0.000
Instrumental car attachment			0.005	0.843
Symbolic car attachment			0.052	0.109
Affective car attachment			0.019	0.520
Infringement freedom			−0.059	0.108
Unfairness			−0.176	0.000
Relative effectiveness			0.224	0.000
Relative fairness			0.375	0.000
R^2		0.023		0.680

Table 4
Estimation results based on TDC acceptability for Beijing (OLS regression).

	Model 1		Model 2	
	Beta	Sig.	Beta	Sig.
Constant	4.103	0.000	5.201	0.000
Male	−0.089	0.495	−0.013	0.863
Disposable monthly household income ¥4000–6000	0.693	0.009	−0.112	0.478
Disposable monthly household income > ¥6000	0.545	0.039	−0.057	0.708
University degree	−0.048	0.741	−0.111	0.193
More than 2 persons in household	0.378	0.026	0.058	0.547
More than 1 car in household	−0.379	0.174	−0.093	0.541
Problem perception congestion (general)			0.011	0.791
Problem perception congestion (personal)			0.033	0.497
Problem perception environmental			−0.030	0.483
Expected effectiveness congestion			0.120	0.014
Expected effectiveness environment			0.031	0.512
Personal outcome			0.006	0.887
Instrumental car attachment			−0.007	0.750
Symbolic car attachment			0.031	0.393
Affective car attachment			0.001	0.973
Infringement freedom			−0.057	0.209
Unfairness			−0.586	0.000
Relative effectiveness			0.117	0.025
Relative fairness			0.093	0.094
R^2		0.023		0.691

on the assertion that TDC could lead to more equal rates of support among different income groups because elements of the scheme would be more beneficial to lower-income groups than conventional road pricing. This assertion is often linked to the distribution of free credits and the belief that lower-income groups generally drive fewer kilometres and thus would be better able to sell excess credits.

Whereas the income effect is the only socio-demographic effect in the Dutch model, in Beijing, acceptability is also influenced by household size, as those living in household with more than two persons find TDC significantly more acceptable. It is possible that these households are more car-reliant and are more severely affected by congestion and the license plate-based driving restriction measure, especially if younger children are present, may make them more prone to evaluate TDC positively.

Clearly, the attitudes are better predictors of acceptability, as the total explained variance by the model increases to 68% and 69.1% in the full models for the Dutch and Beijing samples, respectively. Most of the socio-demographic effects disappear, only a marginally significant income effect remains in the Dutch full model, showing that socio-demographic effects are largely mediated through the attitudes. Our results show that for both samples, problem perception has no significant effect on acceptability, but that expected effectiveness does have an effect, although there is only a marginally significant effect for the Dutch sample. The effects in this study are not different from what has been found in the literature on conventional road pricing, It is rather the belief that the measure could help solve the problem rather than the perception of the problem itself that explains acceptability of the measure (Schade and Schlag, 2003; Bamberg and Rölle, 2003). Further, as expected, perceived unfairness, another important predictor of acceptability found in the literature (Jakobsson et al., 2000; Fujii et al., 2004; Eriksson et al., 2006), impacts acceptability. The effect of perceived unfairness is particularly strong for the Beijing sample, as revealed by the size of the coefficients, which might be explained by concerns that TDC will favour richer car drivers in the city, which faces extreme competition for road access and has large income differences. In the Beijing experiment, participants were given the opportunity to leave a personal remark and a considerable share of them expressed concerns about wealthier drivers simply buying all the credits needed to satisfy their car travel aspirations under TDC, hence driving up credit prices.

The importance of expected effectiveness and fairness as predictors of acceptability is further evidenced by the significant effects of these items when they are measured as a relative evaluation of TDC compared to kilometre-pricing/license plate-based driving restriction. Here, however, the effect of relative effectiveness and fairness on acceptability is larger in the Netherlands than in Beijing, as indicated by the larger coefficients. The effect of relative fairness in Beijing is only significant at the 0.1 alpha level. This might be due to the higher correlation between perceived unfairness and perceived relative fairness in Beijing as compared to the Netherlands (−0.59 and −0.29, respectively). The large effect size for perceived unfairness implies that in Beijing, TDC acceptability is largely affected by the more fundamental evaluation of how fair the expected distribution of benefits and costs under TDC is for participants themselves and others, rather than by a relative evaluation of the measure compared to the existing license plate-based driving restriction, which is subject of a common disapproval, as shown in the previous subsection. In contrast, in the Netherlands, where participants had a more neutral stance towards the expected performance of TDC compared to a hypothetical per-kilometre road pricing measure, the expected relative effectiveness and fairness appeared to be more important as determinants of TDC acceptability.

Infringement on freedom does not influence acceptability for either sample. As found in the literature, this could be because infringement on freedom is closely related to fairness and personal outcome. A striking difference between the Dutch and Beijing case is the presence of an effect of personal outcome in the Netherlands, whereas such effect is absent in Beijing. Potentially, Dutch participants view personal outcome more as an evaluation of expected personal financial benefit or loss, making the item a clearly distinct category relative to the other items, whereas Beijingers might evaluate personal outcome more in relation to other items such as fairness and freedom of mobility. Contextual factors can also play a role here, with Beijingers, living in a very congested and economically unequal city and in a country with a

more collectivistic orientation, possibly attaching more importance to evaluations of TDC in relation to broader themes of congestion and equity than to evaluations based on a purely individually-oriented monetary cost-benefit analysis when it comes to accepting TDC.

6. Conclusion and discussion

Road pricing is a theoretically attractive mechanism to solve urgent congestion problems. However, the widespread lack of public acceptability is a major obstacle for its implementation. The tradable driving credits (TDC) measure presents an innovative concept that seeks to address some key aspects of this lack of social support: it would guarantee a certain minimum level of car use without additional credit costs to drivers, offer the opportunity to financially gain from the system by selling credits, ensure effectiveness through a fixed cap on total car travel, and present a revenue-neutral pricing system. In this paper, we investigated the levels of TDC acceptability and its evaluation in reference to alternative travel demand management (TDM) measures, and analysed the factors that affect TDC acceptability. By analysing data from the Netherlands and from Beijing, we presented two case studies that illuminate opinions concerning TDC and its determinants from both a European and an Asian context.

In the Netherlands, 21.6% of the car owners view TDC as acceptable to various degrees, and slightly more than 25% of the respondents think that TDC is more effective in reducing congestion and is fairer than a conventional road pricing scenario with a per-kilometre price. This level of acceptability is lower than the acceptability rates of about 30–35% that other (urban) road pricing proposals have gained according to the literature. Also, it is lower than other studies on tradable credit-based policies have found in other Western European countries, but as these studies discuss (carbon-trading) policies with a rather different scope and scale, a comparison with these acceptability rates can only be made with caution. However, the acceptability rate is comparable with the support level that Kockelman and Kalmanje (2005) found in the US in the context of a more similar credit-based congestion pricing policy (24.9%). They concluded that the measure is a promising alternative to conventional road pricing given the little knowledge their respondents had about the measure. They argued that making people more familiar with the measure through information and experience might lead to increased support levels. The same might apply in interpreting our results. Additionally, as 35% of the Dutch participants have a neutral opinion, and thus are not clearly opposed to the measure, it can be concluded that there is certainly potential for TDC, especially since in the Netherlands congestion is steadily rising again in a period of renewed economic growth, which is accompanied by an increasing recognition that price-based TDM measures seems to be unavoidable in the future.

As for Beijing, a much higher share of 67% of the participants view the TDC measure as acceptable. Reasons for this high level of support are likely to be found in the city's massive problems of congestion and car-related pollution, and widespread dissatisfaction with the current driving restrictions. More than 60% of the respondents believe that TDC is more effective and fairer than the current license plate-based driving restriction, which was taken as a reference TDM measure. Academic studies have criticised these license plate-based driving restriction measures in Chinese cities repeatedly by empirically demonstrating its evident negative side effects and by theoretically showing its inability to deliver an efficient and sustainable solution in the long term, and have suggested a tradable credit approach to deal with the urgent car traffic problem as a better alternative (e.g., Wang et al., 2014; Nie, 2016, 2017). In addition to these studies, this present research shows that from a social acceptability perspective, TDC is certainly worth considering further in the context of cities such as Beijing.

Regression analysis revealed that in both the Netherlands and Beijing, people with higher incomes find TDC more acceptable, and that people living in larger households do so in Beijing only. These effects correlate with attitudes because the socio-demographic effects largely disappear when other attitudes towards TDC are included. Attitudes of expected effectiveness to reduce congestion and perceived fairness, which have been identified in the literature as the most important factors in explaining acceptability of road pricing, also dominate as predictors of TDC acceptability. In the Netherlands, people who report that they expect a better personal outcome under TDC and have a higher symbolic car attachment, which seems to correlate with income, rate TDC as more acceptable.

The income effect that has been found is interesting because in the wider road pricing literature some studies find a similar income effect whereas others do not. It is also interesting because TDC is often framed as an alternative that is potentially less harmful to lower-income households compared to conventional road pricing, which is often regressive in nature. Yet, the alternative concept of TDC does not lead to lower-income groups viewing the measure equally as acceptable as higher-income groups. Lower-income groups might be more worried about the 'marketisation' of road access and might expect that higher-income groups' higher willingness to pay to maintain their travel will drive up credit prices to levels that make buying additional credits less affordable to them. This might especially be the case in a highly competitive context like Beijing. A considerable share of the Beijing participants' personal remarks hinted at the presence of such worries. Also, perceived fairness appeared a stronger determinant of TDC acceptability in Beijing than in the Netherlands.

Due to the lack of space – the questionnaire on attitudes was part of a larger experiment – some determinants of TDC acceptability need more detailed investigation to come to a better understanding of their precise role in TDC acceptability and meaning in their own unique socio-cultural context. For example, personal outcome could be defined in terms of accessibility improvement or merely by financial gain/loss, and fairness could be approached more specifically from a consumer and a citizen perspective (Eliasson, 2016; see also Levinson (2010) for different dimensions of equity). Psychological factors such as social norms and trust in government, that have not been covered in this research, have also been identified as important influencing factors of road pricing acceptability (Schade and Schlag, 2003; Eriksson et al., 2006; Kim et al., 2013), and should be addressed in future (cross-cultural) TDC research.

Further, as Bristow et al. (2010) showed in the context of personal carbon trading, acceptability of tradable credit-based policies greatly depends on the features of the scheme. Much differentiation is possible in terms of credit allocation (e.g., definition of eligible credit receivers, differentiation according to needs), credit price and trading (e.g., introduction of maximum price, setup of the market), and credit usage (e.g., only during congestion, attached to fuel instead of distance). It is likely that TDC acceptability levels will vary substantially under different TDC designs and can potentially increase after some design fine-tuning. Future research is needed to determine possible design effects: qualitative research that is able to identify critical design features and to clarify the particular social strengths and weaknesses of TDC in relation to other TDM measures, as well as quantitative research that is able to systematically test design effects and to assess what would constitute an optimal TDC scheme when it comes to social support.

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Appendix 1

Description of the TDC used in the experiment.

Netherlands

Welcome to the website of the study on 'Tradable Driving Credits' of Utrecht University.

Imagine that the government provides each Dutch individual with a kilometre credit budget to combat congestion. You would receive a budget that contains a certain number of kilometres that you can drive without paying an additional fee. You are required to buy additional kilometres to drive more. When you drive less, you could sell your unused kilometres and earn money that way.

This Tradable Driving Credits measure has not been implemented anywhere in the world yet and there are no plans to do so at the moment. However, in order to be able to answer future questions regarding the measure on the basis of scientific research, we would like to investigate the possible effects of the measure. Because of this, Utrecht University makes a start with this research through this website.

First you will be asked to provide information about some recent car trips. Based on these trips, we will present you a series of scenarios. In these scenarios, you will be asked whether or not you would like to have changed your car use under the presented conditions. This research is based on hypothetical scenarios. That means that you cannot earn or lose real money. However, we ask you to consider the scenarios and the outcomes for your own personal situation as realistically as possible.

[Collection of travel data]

Example of a given TDC scenario:

Imagine the following situation:

In the upcoming week, you planned to conduct the same activities as you reported for the last 7 days. You would drive 300 km (*reported by the participant in the first part of the experiment*). In this scenario, the following situation would apply to you:

Amount of kilometre credits needed in the upcoming week:	300
Availability/shortage of kilometre credits:	45 credits **shortage** (in this scenario the participant has 15% less credits than needed for the reported car use; one of 4 options (30% less, 15% less; 15% more, 30% more) is randomly selected here)
Value of one kilometre credit:	€0.10 (one of 3 options (€0.10; €0.15; €0.20) is randomly selected here)
Amount of money that you would receive/pay if you would carry out all planned activities by car:	Pay €4.50

Based on this information, would you adjust the number of kilometres that you planned to drive if a situation with Tradable Driving Credits were applicable? Yes/No.

[If 'Yes', the following appeared] Please specify the activity categories for which you want to make changes. You could change the number of kilometres in the box.

	Old situation	Change	New situation	Difference
Work and education	30 km	−40%	18 km	−12 km
Services	60 km	− 0%	30 km	− 0 km
Social	150 km	No change	150 km	0 km
Sports, culture and recreation	60 km	No change	60 km	0 km
Other	0 km	No change	0 km	0 km

[In the 'Change' boxes, participants could select a percentage of change (rounded to tens) or select 'No change', In the situation above, the participant reduced 42 km and, consequently, had to buy 3 additional credits].

Questions about attitudes:

Now we ask you to answer some questions and statements about the traffic situation in the Netherlands, your own car use and the Tradable Driving Credits measure.

[Questionnaire on attitudes, see Appendix 2]

Beijing

First, we would like to express our gratitude to you for your participation in our survey. This survey is meant to investigate a traffic policy that can alleviate traffic congestion, and it is anonymous and without commercial value.

Imagine that the government would allocate driving credits to combat congestion. You would receive a budget that contains a certain number of kilometres. You can drive these kilometres without paying an additional fee and buy additional ones in a market. Please answer the following questions based on your own personal situation as realistically as possible.

[Collection of travel data]

You will now receive a budget that contains a certain number of kilometre credits that you can drive without paying an additional fee. You are required to buy additional credits when you drive more. When you drive less, you can sell unused credits to earn money. How will you arrange your car trips in the following scenarios (by adding/cancelling car trips or change transport modes/routes/destinations)?

Example of a given TDC scenario:

In the upcoming week, you planned to conduct the same activities by car as last week. The number of kilometre credits that are available is 50 credits less than you would need for these activities. The price of one kilometre credit is ¥0.50. Would you make changes in your planned car trips?

1. Drive more

2. Drive less
3. No change

[If option 1 or 2 is selected] Please state the percentage by which you want to increase/decrease (*depending on previous answer*) your car kilometres for the following activity categories: Work and study/Daily living/Social and recreation *(any number could be chosen)*.

[For each activity category] How would you realise your indicated change? (less/more trips; other routes; other destinations; other transport modes (only in case of a decrease in car use)).

Questions about your personal situation:

[Questionnaire on attitudes (see Appendix 2) and personal characteristics].

Appendix 2

Questionnaire on attitudes used in this paper

1. Problem perception congestion (societal)

   'To what extent do you think congestion in general is a problem in [the Netherlands/Beijing]?'[a]

2. Problem perception congestion (personal)

   'To what extent do you experience congestion as a problem in your personal car use?'[a]

3. Problem perception environment

   'To what extent do you think that car use in general is a problem for the environment?'[a]

4. Expected effectiveness in reducing congestion

   'Do you think that the implementation of Tradable Driving Credits would reduce congestion?'[b]

5. Expected effectiveness in reducing environmental impact

   'Do you think that the implementation of Tradable Driving Credits would reduce the impact of car use on the environment?'[b]

6. Personal outcome

   Netherlands – 'Do you think that in general you would be better or worse off if a Tradable Driving Credits scheme were implemented?'[c]
   Beijing – 'Do you think in general you will be worse off if a Tradable Driving Credits scheme were implemented?[b]

7. Instrumental car attachment

   Netherlands – 'I do not have any alternatives for my car use'[d]
   Beijing – 'How easy could you in general choose other transport modes than the car?'[e]

8. Symbolic car attachment

   Netherlands – 'My car gives me status and prestige'[d]
   Beijing – 'Does the car provides you status and prestige?'[f]

9. Affective car attachment

   Netherlands – 'Driving gives me pleasure'[d]
   Beijing – 'Does driving gives you pleasure?'[f]

10. Infringement on freedom

    Netherlands – 'I view the Tradable Driving Credits measure as an infringement on my personal mobility freedom'[d]
    Beijing – 'Do you perceive Tradable Driving Credits as an infringement on your personal mobility freedom?'[f]

11. Unfairness

    Netherlands – 'I view the Tradable Driving Credits measure as unfair'[d]
    Beijing – 'Do you think Tradable Driving Credits is fair?'[f]

12. Relative effectiveness

Netherlands – Netherlands – 'Compared to a "per-kilometre charge", i.e. a scheme in which everybody pays a fee for each kilometre, I think Tradable Driving Credits is a better way to deal with congestion'[d]

Beijing – 'Do you think Tradable Driving Credits can perform better in reducing congestion than the license plate-based driving restriction policy?'[f]

13. Relative fairness

Netherlands – 'Compared to a "per kilometre charge", I think Tradable Driving Credits is fairer'[d]

Beijing – 'Do you think Tradable Driving Credits is fairer than the license plate-based driving restriction policy?'[f]

14. Acceptability

Netherlands – 'How acceptable is the Tradable Driving Credits measure to you in an overall sense?'[g]

Beijing – 'In general, do you think Tradable Driving Credits is acceptable to you?'[f]

[a]1 = not a problem at all; 7 = very severe problem

[b]1 = very unlikely; 7 = very likely

[c]1 = much worse; 7 = much better

[d]1 = fully disagree; 7 = fully agree

[e]1 = very hard; 7 = very easy

[f]1 = not at all; 7 = absolutely

[g]1 = highly unacceptable; 7 = highly acceptable

References

Andersson, D., Löfgren, Å., Widerberg, A., 2011. Attitudes to Personal Carbon Allowances. School of Business, Economics and Law at University of Gothenburg Working papers in economics.

Ardıç, Ö., Annema, J.A., Van Wee, B., 2013. Has the Dutch news media acted as a policy actor in the road pricing debate? Transp. Res. Part A 57, 47–63.

Arnott, R., de Palma, A., Lindsey, R., 1994. The welfare effects of congestion tolls with heterogeneous commuters. J. Transp. Econ. Policy 28, 139–161.

Belgiawan, P.F., Schmöcker, J.D., Abou-Zeid, M., Walker, J., Lee, T.C., Ettema, D.F., Fujii, S., 2014. Car ownership motivations among undergraduate students in China, Indonesia, Japan, Lebanon, Netherlands, Taiwan, and USA. Transportation 41, 1227–1244.

Bamberg, S., Rölle, D., 2003. Determinants of people's acceptability of pricing measures. Replication and extension of a causal model. In: Schade, J., Schlag, B. (Eds.), Acceptability of transport pricing strategies. Elsevier, Oxford, pp. 235–248.

Bartley, B., 1995. Traffic demand management options in Europe: the MIRO project. Traffic Eng. Control 95, 596–603.

Bird, J., Jones, N., Lockwood, M., 2009. Political Acceptability of Personal Carbon Trading: Findings From Primary Research. Institute for Public Policy Research, London.

Bristow, A.L., Wardman, M., Zanni, A.M., Chintakayala, P.K., 2010. Public acceptability of personal carbon trading and carbon tax. Ecol. Econ. 69, 1824–1837.

Clay, M.J., Mokhtarian, P.L., 2004. Personal travel management: the adaption and consideration of travel-related strategies. Transp. Plann. Technol. 27, 181–209.

Dogterom, N.J., Bao, Y., Xu, M., Ettema, D.F. et al., in press. Willingness to change car use under a tradable driving credits scheme: a comparison between Beijing and the Netherlands. J. Transp. Land Use.

Dogterom, N.J., Ettema, D.F., Dijst, M.J., 2017. Tradable credits for managing car travel: a review of empirical research and relevant behavioural approaches. Transp. Rev. 37, 322–343.

Eliasson, J., 2016. Is congestion pricing fair? Consumer and citizen perspectives on equity effects. Transp. Policy 52, 1–15.

Eriksson, L., Garvill, J., Nordlund, A., 2006. Acceptability of travel demand management measures: the importance of problem awareness, personal norm, freedom, and fairness. J. Environ. Psychol. 26, 15–26.

Evans, A.W., 1992. Road congestion pricing: when is it a good policy? J. Transp. Econ. Policy 26, 213–243.

Fan, W., Jiang, J., 2013. Tradable mobility permits in roadway capacity allocation: Review and appraisal. Transp. Policy 30, 132–142.

Fujii, S., Gärling, T., Jakobsson, C., Jou, R.-C., 2004. A cross-country study of fairness and infringement on freedom as determinants of car owners' acceptance of road pricing. Transportation 31, 285–295.

Gärling, T.C., Jakobsson, C., Loukopoulos, P., Fujii, S., 2008. Public acceptability of road pricing. In: Verhoef, E.T., Bliemer, M.C.J., Steg, L., Van Wee, B. (Eds.), Pricing in Road Transport: A Multi-Disciplinary Perspective. Cheltenham, UK? Edward Elgar, MA, USA.

Gärling, T., Schuitema, G., 2007. Travel demand management targeting reduced private car use: effectiveness, public acceptability and political feasibility. J. Social Issues 63, 139–153.

Gaunt, M., Rye, T., Allen, S., 2007. Public acceptability of road user charging: the case of Edinburgh and the 2005 referendum. Transp. Rev. 27, 85–102.

Golob, T.F., 2001. Joint models of attitudes and behaviour in evaluation of the San Diego I-15 congestion pricing project. Transp. Res. Part A 35, 495–514.

Grant-Muller, S., Xu, M., 2014. The role of tradable credit schemes in road traffic congestion management. Transp. Rev. 34, 128–149.

Harrington, W., Krupnick, A.J., Alberini, A., 2005. Overcoming public aversion to congestion pricing. Transp. Res. Part A 35, 87–105.

Harwatt, H., Tight, M., Bristow, A.L., Gühnemann, A., 2011. Personal Carbon Trading and fuel price increases in the transport sector: an exploratory study of public response in the UK. Eur. Transp. 47, 47–70.

Ittner, H., Bekcer, R., Kals, E., 2003. Willingness to support traffic policy measures: the role of justice. In: Schade, J., Schlag, B. (Eds.), Acceptability of Transport Pricing Strategies. Elsevier, Oxford, pp. 249–265.

Jaensirisak, S., Wardman, M., May, A.D., 2005. Explaining variations in public acceptability of road pricing schemes. J. Transp. Econ. Policy 39, 127–153.

Jakobsson, C., Fujii, S., Gärling, T., 2000. Determinants of private car users' acceptance of road pricing. Transp. Policy 7, 153–158.

Kim, J., Schmöcker, J.D., Noland, R.B., 2013. Attitudes towards road pricing and environmental taxation among US and UK students. Transp. Res. Part A 48, 50–62.

Kockelman, K., Kalmanje, S., 2005. Credit-based congestion pricing: a policy proposal and the public's response. Transp. Res. Part A 39, 671–690.

Levinson, D., 2010. Equity effects of road pricing: a review. Transp. Revi. 30, 33–57.

Nie, Y., 2017. On the potential remedies for license plate rationing. Economics of Transportation. in press.

Nie, Y., 2016. Why is license-plate rationing not a good transport policy? Transportmetrica A 13, 1–23.

Odeck, J., Bråthen, S., 1997. On public attitudes toward implementation of toll roads – the case of Oslo toll ring. Transp. Policy 4, 73–83.

Pigou, A.C., 1920. The Economics of Welfare. Macmillan, London.

PRIMA, 2000. Deliverable D4. Ways and means to improve the acceptance of urban road pricing. Pricing measures Acceptance Project. Inregia, Stockholm.

Raux, C., Marlot, G., 2005. A system of tradable CO2 permits applied to fuel consumption by motorists. Transp. Policy 12, 255–265.

Rienstra, S.A., Rietveld, P., Verhoef, E.T., 1999. The social support for policy measures in passenger transport. A statistical analysis for the Netherlands. Transp. Res. Part D 4, 181–200.

Schade, J., Schlag, B., 2003. Acceptability of urban transport pricing strategies. Transp. Res. Part F 6, 45–61.

Schuitema, G., Steg, L., 2008. The role of revenue use in the acceptability of transport pricing policies. Transp. Res. Part F 11, 221–231.

Smaal, M.L., 2012. Politieke strijd om de prijs van automobiliteit. De geschiedenis van een langdurend discours: 1895–2010 [Political fight about the price of car mobility. The history of a lengthy debate: 1895–2010]. (PhD thesis). Tilburg University, Delft, Eburon.

Small, K.A., Verhoef, E.T., 2007. The Economics of Urban Transportation. Routledge, London.

Steg, L., 2005. Car use: lust and must. Instrumental, symbolic and affective motives for car use. Transp. Res. Part A 39, 147–162.

Steg, L., 2003. Factors influencing the acceptability and effectiveness of transport pricing. In: Schade, J., Schlag, B. (Eds.), Acceptability of Transport Pricing Strategies. Elsevier Sciences, Oxford, pp. 187–202.

Sun, T., Horn, M., Merritt, D., 2004. Values and lifestyles of individualists and collectivists: a study on Chinese, Japanese, British and US consumers. J. Consum. Marketing 21, 318–331.

Ubbels, B., Verhoef, E., 2006. Acceptability of road pricing and revenue use in the Netherlands. Eur. Transp. Transpori Europei 32, 69–94.

Verhoef, E., Nijkamp, P., Rietveld, P., 1997a. Tradeable permits: their potential in the regulation of road transport externalities. Environ. Plann. B 24, 527–548.

Verhoef, E., Nijkamp, P., Rietveld, P., 1997b. The social feasibility of road pricing: a case study for the Randstad area. J. Transp. Econ. Policy 31, 255–276.

Vickrey, W.S., 1963. Pricing in urban and suburban transport. Am. Econ. Rev. 53, 452–465.
Viegas, J.M., 2001. Making urban road pricing acceptable and effective: searching for quality and equity in urban mobility. Transp. Policy 8, 289–294.
Von Knobelsdorff, M., 2008. Public Acceptability of Personal Carbon Trading. University of Cambridge Master Thesis.
Wallace, A.A., Irvine, K.N., Wright, A.J., Fleming, P.D., 2010. Public attitudes to personal carbon allowances: findings from a mixed method study. Clim. Policy 10, 385–409.
Wang, L., Xu, J., Qin, P., 2014. Will a driving restriction policy reduce car trips? – the case study of Beijing, China. Transp. Res. Part A 67, 279–290.
Washbrook, K., Haider, W., Jaccard, M., 2006. Estimating commuter mode choice: a discrete choice analysis of the impact of road pricing and parking charges. Transportation 33, 621–639.
Williams, M., Arkaraprasertkul, N., 2016. Mobility in a global city: making sense of Shanghai's growing automobile-dominated transport culture. Urban Studies 1–16.
Xu, M., Grant-Muller, S., Huang, H.-J., Gao, Z., 2015. Transport management measures in the post-Olympic Games period: supporting sustainable urban mobility for Beijing? Int. J. Sustain. Dev. World Ecol. 22, 50–63.
Yang, J., Liu, Y., Qin, P., Liu, A.A., 2014. A review of Beijing's vehicle registration lottery: short-term effects on vehicle growth and fuel consumption. Energy Policy 75, 157–166.
Zhao, G., Dijst, M., Chai, Y., 2015. Between haven and heaven in cities: differences between China and the Netherlands in companionship and meeting place. Urban Studies 53, 2469–2487.