



Inclusion of latent constructs in utilitarian resource allocation model for analyzing revenue spending options in congestion charging policy



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ABSTRACT

With the government planning a congestion charging (CC) scheme for Jakarta, public support is regarded as a prerequisite for its implementation. Politicians typically see CC reform as a controversial policy if there is no public support. Yet a CC plan is currently under active development and remains under consideration as a way to mitigate the acute traffic congestion in Jakarta. The CC theme has been recognized as a powerful instrument in both delivering efficient road use and raising revenues. Studies indicate that revenue redistribution is one of the most important determinants of public support for such scheme. Given the absence of studies from the Asian megacity context, this paper presents a systematic study of how public perceptions relate to revenue spending choice behavior. A stated preference (SP) questionnaire is developed to investigate citizen's perceptions of CC reform, their preferences for revenue redistribution and their current travel behavior. Using data collected using this SP questionnaire in 2013, a hybrid revenue allocation (HRA) model is formulated that captures the impact of tangible factors (i.e. charges, socio-demographic characteristics, travel behavior) and intangible factors (perceptions) during process of deciding among revenue spending alternatives. The proposed model is drawn from traditional utilitarian resource (time) allocation theory, with an extension consisting of latent constructs representing subjective individual psychological perceptions. We find that there is a strong correlation between revenue allocation preferences and an individual's subjective psychological perceptions. The most preferred revenue allocations are for public transport improvements and traffic safety improvements, with 54% and 29% agreement, respectively. We find there is little support for spending revenues on other issues such as for stimulating local business (13%) and for parks/green spaces, driving education/enforcement and improving the parking system (4% in total). The findings of sensitivity analysis further disclose that the choice of spending on public transport improvements among respondents who frequently visit the central business district (CBD) is sensitive to the level of the CC charge, while for respondents who frequently enter the CBD by car and have a medium-high income the traffic safety allocation is sensitive to charge.

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1. Introduction

Car ownership and car usage have continued rapid growth into the current decade in Jakarta, the capital of Indonesia. Consequently, most urban areas are suffering from unmaintained externalities such as excessive travel times, air pollution, unnecessary energy consumption, and even serious economic loss due to the extraordinary traffic congestion. One promising policy measure aimed at mitigating the negative effects of traffic is congestion charging (CC). This is regarded as a potentially powerful strategy aimed at changing road users' travel behavior (Cools et al., 2011; Olszewski and Xie, 2006). The ultimate goals of such schemes include achieving efficient infrastructure use, efficient infrastructure provision and improved financial viability (Link and Stewart-Ladewig, 2005) as well as raising revenues and managing congestion (Litman, 2002; De Palma et al., 2007). The revenues generating from such a reform could be used for public transport improvement, constructing new infrastructure and maintaining existing road networks (Manville and King, 2013).

Examples of CC implementations in Singapore, London, and Stockholm that have effectively mitigated traffic congestion have been reported by Eliasson and Mattsson (2006), Loukopulos et al. (2006), Olszewski and Xie (2006) and Phang and Toh (1997). Since then, following success in Singapore, London and Stockholm, there has been an increase in the number of cities evaluating the potential of CC reform, among them Sydney (see Zeng et al., 2014; Hensher, 2013), Las Palmas de Gran Canaria (see Grisolia et al., 2015), Nagoya (see Miwa et al., 2009; Ando et al., 2010; Sato et al., 2014), Jakarta (see Sugiarto et al., 2014b, 2015a, 2015b, 2016, 2017), Mashhad (see Azari et al., 2013a, 2013b), Athens (see Rentziou et al., 2011), Taichung (see Joe et al., 2007, 2012) and so forth. Thus it is well established that a CC strategy is able to mitigate car dependence. For instance, the implementation in London was able to reduce car traffic by up to 15–20% (TfL, 2004). However, at the same time, implementing this powerful strategy is not easy. The public is generally skeptical about such a policy, so significant opposition arises particularly among car users. Several proposals have been dropped for lack of public support, such as a proposal in Edinburgh (see Gaunt et al., 2007) and one in New York City (see Schaller, 2010). In the case of Edinburgh and Manchester, the public glare surrounding referenda led to rejection of charging proposals by majorities of 70–80% (see Saunders, 2005; May et al., 2010). Additionally, the extension of CC in London has also been dropped due to local opposition. These examples demonstrate that there are serious barriers to the pursuit of CC reform, and that governments need clear guidance as to making better use of this powerful policy.

The acceptability of a CC reform reflects people's attitudes towards the scheme. Schuitema et al. (2010) defined acceptability as the tendency to evaluate a road pricing scheme with some degree of favor or disfavor before it is implemented. Previous studies have made intensive attempts to understand public behavior regarding the acceptability of implementing such a policy. A study by Schade and Schlag (2003) revealed that the acceptability of a scheme is well explained by determinants such as personal outcome expectations and the expected effects of implementing the policy. Further investigation by Eriksson et al. (2008) demonstrated that psychological determinants such as problem awareness, policy fairness and perceived effectiveness are important factors affecting acceptability. These results align with those of Sugiarto et al. (2015a, 2015b, 2016, 2017), who found that intangible determinants include inhibition of freedom of movement, recognition of the scheme's effectiveness and trust in government policy might enhance acceptability. Furthermore, an exploration by Gehlert et al. (2008) indicated that behavioral adaptation to a CC scheme, manifested in ways such as a preference for a particular revenue allocation, appears to have an influence. This in similar vein to the findings of Small (1992) and Schuitema et al. (2010), who revealed that the allocation of revenues is one of the most important determinant for the acceptability of CC reform. Further study by Eliasson and Mattsson (2006) concluded that the revenue redistribution strongly correlates with the perceived of fairness of a CC scheme.

Following the rationale that a CC strategy will reduce car traffic, there are several beneficial impacts of such a policy including improving safety (see Green et al., 2014) and enhancing public transport ridership (see TfL, 2004; Leape, 2006). The revenues raised from a scheme could be used to fund new infrastructure and public transport facilities. An investigation in the UK by Jones (1991) and Ison (2000) revealed that revenue redistribution to public transport is the most acceptable allocation, particularly when that public transport investment is made within the charging area. This in a similar vein to the results by Thorpe et al. (2000) and Farrell and Saleh (2005), based on a survey in the UK carried out in Cambridge, Newcastle upon Tyne and Edinburgh, where respondents were asked to indicate their level of agreement with a number of revenue spending options. Their findings shown that the most popular allocation was on public transport improvement. They further found that there was a little support for spending in other areas, such as for reducing general taxation or funding new roads. However, a study by Langmyhr and Sager (1997) in Trondheim was for a scheme that would raise revenues to improve the transport system, including 82% on road building and 18% on public transport, safety and environmental improvements.

While this research on CC revenue allocations has mainly been related to how revenue should be allocated and has treated it as a determinant of acceptability, this determinant has not been examined systematically, particularly from the perspective of an Asian megacity. Further, these existing studies have used a traditional utilitarian framework to model revenue spending allocations. That is, their models have considered only objective or measurable attributes from the alternatives and socio-demographic characteristics of individuals as explanatory variables. This despite that fact that it has been well recognized in recent years that attitudes and perceptions also influence individual choice behavior (see for example Bolduc et al., 2008; Yanez et al., 2010; Bierlaire et al., 2010; Raveau et al., 2010; Sugiarto et al., 2015a, 2015b). Therefore, this paper presents a study of public perceptions into revenues spending options choice behavior. A stated preference (SP) questionnaire was developed to investigate citizen's perceptions about the introduction of CC reform, preferences regarding revenues

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