Transportation Research Part D 35 (2015) 23–39

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Measuring the equity effects of a carbon charge on car commuters: A case study of Manchester Airport

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ARTICLE INFO

Keywords:
Airport commuters
Damage cost of carbon dioxide emissions
Equity effects
Nested logit model
Consumer welfare

ABSTRACT

This papers attempts to quantify the equity effect of a hypothesized economic instrument, a carbon charge on car commuters, for reducing carbon dioxide emissions produced by commuters on airport surface access. Manchester Airport is taken as a case study using staff Survey data from 2008 and 2010. Consumer welfare change is analysed for measuring the equity effects of carbon charge by user group, which considers the changes of travel mode choice, the carbon dioxide emissions reduction, the revenue from a carbon charge and how it is distributed. First, the individual carbon footprint in terms of gram passenger kilometre, and the damage cost of carbon by commuters on airport surface access are estimated. Next, the impact of carbon charge on travel behaviour is investigated by the nested logit model. Finally, the net effect of carbon charges is assessed by travel mode user, gender, job type, and age group. The results show some impacts of the carbon charge on car users and carbon reduction, and the positive effects on lower income group and less carbon commuters. The quantified results provide the evidences for the mitigation policies to combine monetary incentives with disincentives for travel behaviour change, and demonstrate the different equity effects among commuter groups.

Introduction

This study aims to assess and quantify the equity effects of a hypothesised economic instrument, a carbon charge on car commuters, as an abatement method to reduce the carbon dioxide (CO_2) emissions produced by commuters in airport surface access by using a case study of Manchester Airport.

Policy drivers encourage airports to reduce emissions not only directly from airports but also from surface access, including passengers and commuters (ACI, 2008; Department for Transport, 2004, 2007). The emissions from surface transport used by passengers and airport employees are airports' second largest emission source, after aircraft emissions. For instance, they accounted for more than 38% of total emissions, after aircraft-related emissions (56%), at London Gatwick Airport in 2008 (BAA London Gatwick Airport, 2009). This demonstrates the importance of the management of surface access transport emissions at the airport. The airport has an important role in reducing emissions, although this is not straightforward (ACI, 2009). In particular, it is complicated for commuting employees. Since the airport companies themselves have not been seen to be addressing the problem, it is difficulty to persuade staff of third-party companies to change their own travel behaviour, (Budd et al., 2011; Humphreys and Ison, 2003).

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http://dx.doi.org/10.1016/j.trd.2014.11.016
1361-9209/

The number of individuals travelling to the airport increases along with airport development. Among others, airport workers generally commute along the same routes every day. The influence of commuters' behavioural changes on environmental benefits can be large in the long term. Therefore, an effective cost–benefit analysis of airport commuters' surface access is required for the airport's master plan, together with the local community. The assessment should take account of externalities including climate change-related gases, such as CO_2 emissions.

A UK Government White Paper (Department for Transport, 2004) encourages the greater use of public transport for airport surface access, including that of passengers and commuters. Under Airport surface access strategies (ASASs; Department for Transport, 1999), which feed into Local Transport Plans, airport operators are responsible for implementing strategies to encourage individuals' use of public transport for airport surface access. These plans require long-term, large investment for implementation, since many stakeholders, such as local governments, train operators, local residences, are involved.

Humphreys et al. (2005) discussed policy instruments for dealing with employee surface access policies, including incentives for public transport users and disincentives to car users by means of car parking space restrictions and road pricing. The allocation-of-parking theme has a key role in employees' commuting policies not only for the airport, but also for all working environments (Russo et al., 2012). Indeed, Manchester Airport has taken several actions to improve public transport, such as large investment in rail and coach stations and cycling facilities and restricting parking allocation (Manchester Airport, 2007). However, no specific economic incentive or disincentive measures have yet been introduced, according to the interviews with Manchester Airport.

The private sector, including airports, is reluctant to internalise external costs (e.g. the cost of CO_2), particularly in the current economic downturn. However, internalising external costs improves economic efficiency while at the same time redistributing welfare between different groups (Maddison et al., 1997; Van Wee, 2011), such as high- and low-income groups. There exists the issue of equity among employees, and perhaps airports (e.g. large airports and small airports). Indeed, car ownership costs have increased in the past decade due to higher fuel prices, and could increase further if additional environmental taxes are imposed. While high-income groups can afford car travel for their commute, relatively low-income groups will be more inclined to change to public transport or cycling if car ownership costs continue to increase (Taylor et al., 2009).

The transport sector is the third largest source of greenhouse gas (GHG) emissions in the UK (Tight et al., 2005). Short-term behavioural change is crucial if the benefits of new technology are to be fully realised (Chapman, 2007). Disincentive policies such as fuel taxes, road pricing and car parking restrictions have been employed and have worked effectively in order to fill the difference between private and social costs and thus improve efficiency (Gallo, 2011; Santos et al., 2010). In addition, the positive impacts of revenue from congestion charges may result in an overall reduction of social exclusion (Raje, 2003).

In the case of the airport, entry pricing for taxis or drop-off charges can work to restrict entry and thus change travel mode behaviour. At the same time, monetary incentives to reduce the number of car users at work, such as parking charges or carbon charges, can be implemented. Indeed, economic instruments such as congestion charges and parking fees are often expressed as an efficient method to reduce the demand or to change the travellers' behaviour (Eliasson and Mattsson, 2006; Nakakura and Kockelman, 2002; Rotaris and Danielis, 2014). Another possibility is the introduction of car-sharing schemes to reduce emissions and congestion by providing commuters with incentives to share their car travel with others (see, for example, Department for Transport, 2004 for experiences at London Heathrow Airport). These various measures have differentiated effectiveness and equity effects.

An important difference between financial instruments and non-financial instruments is that in the first case, revenues are generated that can be distributed to address equity effects.

This study attempts to assess a hypothesised carbon abatement scheme, which is a carbon charge on car commuters working at airports. This is an entry charge for car commuters; however, it does not depend on the duration of parking. The rationale behind a carbon charge on car users is based on the 'polluter pays' concept, with a combination of incentives and disincentives for car users to discourage lone car use and encourage a travel mode shift to other modes, such as public transport. It also generates revenue to be able to offer monetary incentives to green commuters.

Eliasson and Mattsson (2006) develop a method for detailed and quantitative assessment of equity effects of road pricing by taking into account changes in travel behaviour and how revenue from road pricing is used. Our study is inspired by their study and fundamentally follows their methods. It also aims to assess the application to commuters' airport surface access strategy to change commuters' travel behaviour in order to reduce carbon emissions produced during their commuting. The quantified results provide sufficient evidence to merit exploring the mitigation measures by focusing on the equity effects of the carbon abatement instrument on different groups.

Manchester Airport is chosen because it is a relatively large airport with good direct rail and motorway links in the UK. However, the share of public transport use among employees (5% in 2005) is small compared with other large UK airports, such as London Gatwick (11.3%) and Heathrow (6%). The public transport usage by commuters has decreased even after the implementation of the ASASs proposed by Manchester Airport. The ASAS of Manchester Airport targeted 20% of the public transport share of commuters in 2005 and 30% in 2015, which requires drastic action if the target is to be achieved. Therefore, it can act as a good example for exploring opportunities to encourage changes in commuters' travel behaviours, shifting from car travel to other modes such as public transport, walking and cycling.

The remainder of this paper is structured as follows. Section 'Methodology and data used' explains the methodology, models and data used. The current travel mode share and amount of carbon emitted by commuters are examined by using Manchester Airport as a case study in Section 'Empirical analysis: Manchester Airport'. The quantified equity effects of a