Journal of Transport & Health 3 (2016) 326–335

Contents lists available at ScienceDirect

Journal of Transport & Health

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

The demand for ‘active travel’: An unobserved components approach

David C. Broadstock [a,*], Alan Collins [b]

[a] School of Accounting and Finance, The Hong Kong Polytechnic University, Kowloon, Hong Kong
[b] Department of Economics, University of Portsmouth, Portsmouth, United Kingdom

ARTICLE INFO

Article history:
Received 3 April 2015
Received in revised form
8 June 2016
Accepted 10 June 2016
Available online 29 July 2016

Keywords:
Unobservable components
Active travel
Seasonal substitution
Seasonally adaptive policy

ABSTRACT

This study informs the interface of travel demand analysis and health policy. There is a demand for cycling, walking or taking non-motorized modes together – a demand for ‘active travel’ – a term describing modes of transport which incur significant cardiovascular effort or metabolic costs. It is possible to establish a meaningful and policy relevant view of active travel demand by controlling for partially *unobservable* (not simply unobserved) generalized cost effects – where generalized cost can be considered the sum of all individual cost-components. Using monthly aggregated data from the UK National Travel Survey it is found that income effects are greater for lower income households and diminish with wealth and that some ‘seasonal substitution’, due to ‘generalized’ cost effects, can be identified. One consequence of this is that policy for active travel needs to be seasonally adaptive to reflect these substitution effects.

1. Introduction

There is a significant existing literature pointing to the desirability and dimensions of non-motorized transport in the context of climate change and sustainable development (see for example Woodcock et al., 2009). Additionally, however, walking and cycling offer considerable health benefits (Sallis et al., 2004; Ogilvie et al.; 2007, Pont et al., 2009), even though there are some limitations to the trip characteristics which they imbue, e.g., slower speed, shorter distance, nature of the built environment, limited carrying capacity, increased weather exposure, etc. (see for example Nankervis, 1999; Saelens et al., 2003; Frank, 2004; Gatersleben and Appleton, 2007). The interface of transport and health policy uses the trope of ‘active travel’ to denote use of various travel modes requiring cardiovascular effort or substantial metabolic costs to be incurred.[1] For many trip purpose and journey length combinations it is possible to identify inverse ‘U’ shaped relationships between health outcome and cardiovascular effort (metabolic cost), insomuch as ‘more’ walking and cycling generally offers positive marginal health benefits when compared to no walking or cycling (see for example Hamilton et al., 2008), but as with any form of exercise excessive amounts of walking and cycling can inadvertently create health problems ((see for example Lavie et al., 2015) who discuss the negative effects of both too little and too much exercise on the heart).

Transport strategy has recognized these benefits and evolved to accommodate the operational requirements of active modes of travel. The focus of this has been in terms of provision of cycling facilities, as facilities for walking are generally well tended to already (with the UK having an extensive network of footpaths nationwide). This is indirectly reflected in the UK Department for Transport (2015) Policy paper named ‘Setting the First Cycling and Walking Investment Strategy: setting the scene’ in which two probable strategic objectives are set forth (within Section 3 of the document): (i) “To double cycling activity”; and (ii) “To invest over £200 million to make cycling safer…”, as yet no specific objective is tailored towards the unique needs of walkers – though admittedly there still remains a phase of government consultation before the objectives are finalised. Arguably the UK is one of the more progressive environments for the integration of active travel into formal transport strategy design,[2] as

* Corresponding author.
E-mail addresses: David.broadstock@polyu.edu.hk (D.C. Broadstock), Alan.collins@port.ac.uk (A. Collins).

[1] By ‘active travel’ we focus on cardiovascular effort (metabolic cost) proxied using travel distance expended in the service of getting from ‘A’ to ‘B’ – i.e., where the primary service is the journey itself. Thus running on a treadmill in a gym cannot be categorized as ‘active travel’. We acknowledge that a number of authors in this area of the literature further distinguish between walking/cycling used for the separate purposes of recreation or as a main mode of transport, including Giles-Corti et al. (2005), Saelens and Handy (2008), Krizek et al. (2009), Sugiyama et al. (2012), and Van Holle et al. (2012).

[2] We thank a referee for posing the question: how effective is the UK at implementing active travel policies? We simply do not have the evidence within the scope of the data considered for this study to provide an answer with a great deal of accuracy, but anecdotally if one were to consider the provision and use of cycling facilities in 2015 compared for instance against 2000, it would be fair to say that there are clear differences. Growth in the provision of cycle routes and city-wide cycle hire schemes also support this. To this end the UK may be considered effective, but whether it is as effective as it could be remains a reasonable separate question.

http://dx.doi.org/10.1016/j.jth.2016.06.003
2214-1405/

can be seen for instance in the joint UK Department of Health and Department for Transport (2010), though other nations are implementing active travel related policy. In another example the Greek government (Ministry of Infrastructure, Transport and Networks, 2010) recently proposed a number of strategies to shift commuters from using private cars to public transport and bicycles including the provision of large scale bicycle routes – one within Athens (13 km) and a second connecting Athens' city centre with the coast (8 km).

This study presents a means of analyzing active travel and the principal economic relationships that underlie its demand. In particular, the study indirectly measures the unobserved generalized cost of combined recreational and non-recreational cycling and walking thus treating them as a unified mode of transport referred to as ‘active travel’.[3] This is consistent with already widely applied operational planning principles. Hitherto, planning principles and academic literature treat policy and interventions for active-travel in a fairly linear way – prescribing broad policy instruments such as: provision of cycle parking; maintenance of active travel infrastructure; creation of cycle loan schemes; promotion of tourism, leisure and sport; integration with local public transport operators; reduced speed limits on surrounding road networks etc., see for example Sustrans and Transport Scotland (2014) for a representative example of policy guidance. This study, however, presents evidence of the need for seasonally adaptive policy instruments.

The scientific and societal value of this work derive from the following aspects: first is that it provides an initial inquiry into within-year trends in the consumption of walking and cycling, which among other things pays dividends in terms of revealing consistent seasonal substitution effects. It is subsequently argued that this finding creates room for devising seasonally adaptive policy instruments – something which has not featured strongly in existing policy discourse. Further it is highlighted (through the results reported in Section 3) that the nature of active travel as a good may vary with income, with implications of it being considered an inferior good at lower-mid levels of income; though for cycling specifically, there seems partial evidence of an additional status effect at higher income levels. Indirectly the research raises to the fore the fact that in certain cases, such as with the demand for active travel, existing national survey data makes it less than straightforward to providing robust and meaningful analysis that is capable of directly informing and evaluating existing policy objectives and the instruments used to achieve them.

2. Methodology and data

This section presents and describes the data and methodology used in the analysis. There is no natural measure of cost/price for either walking or cycling (e.g., for car travel fuel cost would be one natural measure of price), however, it is nonetheless implicit that consumers respond to some notion of cost. This is consistent with the familiar notion of generalized cost in transport which suggests that consumers respond to all measures that reflect the ‘value’ of a journey. For example, the cost of walking would increase with bad weather, unsafe streets or hilly environments requiring increased metabolic exertion. Moreover, policy design often hinges on the availability of cost information with tax policy being an obvious example, where taxes (or subsidies) are used to discourage (encourage) demand. With this in mind, the desire is to quantify the structure of a demand function for active travel and reveal some concept of net costs for active travel. The notion of cost that will be revealed is fully general, and in essence the *net* ‘generalized cost’ of travel. Unlike in some cross-sectional or panel based studies, the purpose of this study is not to identify individual cost components, rather to use statistics to reveal a net cost and more importantly the dynamics of this net cost. There is an obvious tradeoff in this approach where clarity of individual effects is sacrificed in favor of greater certainty of the net effect.

Specifically, the underlying net generalized cost information will be estimated as an unobserved component within a broadly defined demand function (defined at the national level) conditioned on observable income effects, e.g.,

$$Q_d = f(\underbrace{g(C_1, C_2, \ldots, C_k)}_{\text{unobserved}}, Y) \tag{1}$$

where Q_d is the quantity of active travel demanded, Y is some measure of income/wealth and $g(C_1, C_2, ..., C_k)$ is the net cost component which is acknowledged to be some aggregate reflection of a function $g(\cdot)$ of individual cost contributors $C_1, C_2, ..., C_k$. Admittedly some components of the generalized cost $g(C_1, C_2, ..., C_k)$ can be controlled for within the data, but certainly not all. Thus the problem becomes one of understanding demand patterns when some or all of the cost components are latent. The econometric approach to handle this issue will be formulated after outlining the more readily defined demand and income measures.

The data are taken from the UK National Travel Survey (NTS) for the years 2002–2014. The NTS is an extensive quasi-panel survey reported on an annual basis with data that is collected on a rolling basis throughout the year. The NTS data for `demand' are aggregated for each month (thus leading to a final dataset with 156 consecutive monthly observations running from 2002:1 to 2014:12) by summing up across all individuals and are summarized in Fig. 1, along with their general characteristics described in Table 1. Demand in this instance is measured as total distance travelled (NTS variable ‘SD’ or stage distance) for either walking or cycling or active travel (the sum of walking and cycling). Survey weights (NTS weight variable ‘W2’) are used as recommended within the ‘NTS User Guidance’ to control for non-response bias in the travel survey diary sample.

In terms of a representative measure of income, the NTS does not provide for a well-defined and continuous measure of income making it necessary to use a proxy variable. Instead the NTS in recent years simply classifies a household as being either low, medium or high income. Income effects are therefore identified from the NTS survey data in terms of three individual series, the number of high income households $Y_{t,high}$, the number of medium income households $Y_{t,med}$ and the number of low income households $Y_{t,low}$ (each indexed to a base of 2002:1 = 100). This classification is not arbitrary as high income households have a much higher probability of being composed of individuals with high income, and low income households cannot contain high income individuals by definition. Hence, the collinearity between household wealth and individual wealth is considered to be sufficiently high to make it a reasonable proxy. The two panels of Fig. 1 provide plots for the individual series, and it can be seen that the number of high income households in the country is growing faster relative to the number of low income households, but that the general number of medium income households remains largely stable. This figure also plots the demand index for active travel, which includes both walking and cycling. It should be recognized that the generated data, which might otherwise be referred to as pseudo-time series data, is reflective of the weighted *achieved* sample. An alternative might

[3] Distinguishing it from the previous work of Broadstock and Collins (2010) for example, which focused on non-recreational cycling only.

Please cite this article as: Broadstock, D.C., Collins, A., The demand for ‘active travel’: An unobserved components approach. Journal of Transport & Health (2016), http://dx.doi.org/10.1016/j.jth.2016.06.003