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Online shopping habits and the potential for reductions in carbon dioxide emissions from passenger transport

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ABSTRACT

Opportunities for online shopping are transforming travel behaviour related to shopping, and they have the potential to reduce overall travel demands. This paper analyses the potential for reductions in carbon dioxide (CO_2) emissions from passenger transport due to an increased use of online shopping in Sweden and adds to the broader picture of what potential growing online shopping might have on transport sustainability. This paper shows that there is a sustainability potential related to more sustainable travel habits by those who shop online more frequently. Calculations indicate that the predicted increase in online shopping behaviour together with the predicted increase of the Swedish population in 2030 would give a 22% decrease in CO_2 emissions related to shopping trips compared to 2012. Furthermore, if all travel is taken into account this would result in a 2% reduction in 2030 compared to total CO_2 emissions 2012. The paper furthermore discusses how these results might influence transport sustainability ambitions and policies. The discussion suggests that online shopping might facilitate reductions in CO_2 emissions but above all, it could act as a facilitator for implementing other policies promoting a less car dependent planning regime including shopping localisation.

1. Introduction

Increasing transport as a means for economic growth is often taken for granted (Essebo, 2013), and "curbing mobility is not an option" according to the 2011 EU Transport White Paper (European Commission, 2011). Transport is, however, the source of many environmental problems, and there is largely a consensus among transport researchers on the need for levels of transport to be reduced in order for the sector to contribute to more sustainable development (Johansson, 2009; Åkerman, 2011; Gudmundsson, 2008). It is important to note that it is not only the technical aspects of the transport infrastructure that need to change, but also transport behaviour (Nilsson and Khan, 2013; Moriarty and Honnery, 2013; Nissinen et al., 2015). Transport is responsible for almost 25% of global energy-related greenhouse gas emissions (IPCC, 2007). In Sweden, this share is even higher (33%) primarily due to the fact that electricity generation and heating in Sweden is less dependent on fossil fuels (The Swedish Environmental Protection Agency, 2015). Both in Sweden and globally, transport is increasing its share of emissions (The Swedish Environmental Protection Agency, 2015; the European Environment Agency, 2015).

Much effort has been put into finding solutions and measures to reduce the environmental impact of the transport sector (European Commission, 2013). The Swedish Commission on Fossil-Free Road Transport was recently tasked with identifying possible courses of action to reduce the emissions and the fossil fuel dependence of the transport sector in line with the national vision of Sweden to achieve zero net emissions of greenhouse gases by 2050 (Swedish Government Official Reports, 2013). Examples of the measures published by this commission for the Swedish context are presented in Table 1. This table includes the estimated impacts of the measures on the number of vehicle kilometres driven by car.

In Sweden, the CO_2 emissions from passenger transport are considerably greater than CO_2 emissions from freight transport (Swedish Transport Administration, 2013). Shopping trips account for approximately 20% of all trips and for approximately 10% of the total passenger mileage according to data from Sweden and other European countries (Trivector, 2011). More than one third of shopping trips are made by car (Winslott Hiselius et al., 2015). If the number and/or length of shopping trips made by car can be reduced, this would provide an interesting potential for increasing sustainability in the transport sector. Studies focusing on the

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Table 1
Estimated reduction in number of car kilometres in Sweden by 2030 and 2050 compared to a reference scenario (Swedish Government Official Reports, 2013).

	2030	2050
Planning	7–10%	15–20%
Fees and taxes	5%	6%
ITS	>0.3%	>0.3%
Car sharing	5%	7%
Travel free meetings	4%	6%

location of retailers and shopping centres in Sweden indicate a potential reduction of CO_2 emissions. The location of retailers (e.g. consumer electronics, pet shops, key cutting) can reduce CO_2 emissions from customer travel by 22% (Carling et al., 2013) while the location of shopping centres can lead to a reduction of 8–9% (Jia et al., 2013). A recent example of a study for the mid-European context is Seebauer et al. (2015) in which the impact on CO_2 emissions of restricting shopping and supporting neighbourhood stores and online shopping is analysed in Austria, indicating similar reduction levels.

It has been suggested that the growing trend of online shopping might lead the transport sector to become more efficient with regard to energy use and CO_2 emissions. Rotem-Mindali and Weltevreden (2013) have published an extensive and interesting review of studies on how business-to-consumer online shopping affects mobility. There have been many conceptual studies presenting theories and assumptions on the possible impacts of online shopping (Salomon, 1985, 1986; Mokhtarian, 2004), and since the establishment and expansion of the online market, many empirical studies have also been undertaken. In many empirical studies, the results indicate that online shopping acts as a substitute for personal shopping travel (Corpuz and Peachman, 2003; Weltevreden and van Rietbergen, 2007). However, there are also empirical results which indicate that online shopping will have a limited or even no impact on the number of trips and total distance travelled for shopping (Keskinen et al., 2002; Visser and Lanzendorf, 2004; Weltevreden, 2007). With a focus on online searching, there are studies which claim that there can even be a positive effect between online shopping and mobility behaviour resulting in additional travel due to the online options and accessibility (Farag et al., 2006, 2007). Finally, there are studies reporting empirical evidence for both substitution and complementarity behaviour within different groups in the sample population. This is, for instance, shown in Tonn and Hemrick (2004) where the use of e-mail and/or the Internet resulted in some respondents substituting one or more trips to a bookstore while some made more trips to bookstores.

With regard to the total number of passenger trips, one must recognise that online shopping could very well result in no reduction at all or even an increase in trips in line with findings on the effects of telecommuting. In the mid-seventies, telecommuting was predicted to be substitute for traditional forms of transport for commuting (Niles and Gray, 1975). However, the empirical results from, e.g., Niles (2001), De Graaff (2004), and Choo and Mokhtarian (2007), among many other authors, suggest that telecommunications and travel are complementary and even increase total travel. Gould and Golob (1997) argue that, analogous to the finding that saved travel for work is converted into new trips, saved shopping travel might be converted into other types of travel. Thus, the combination of substitution and the complementary effects of travel lead to a very complicated picture of the overall effect of online shopping. Even if there is a substitution effect in the number of trips for shopping, there might be a rebound effect in trips for other purposes. This increase in other types of trips might, of course, occur even if the number of physical shopping trips is unaffected or increases.

To understand the complicated impact of online shopping requires study designs that look at total travel over a national level, e.g., Casas et al. (2001), Ferrell (2005), and Zhou and Wang (2014). Winslott Hiselius et al. (2015) presented a study designed to include all daily travel over a representative sample of the Swedish population. Analysis of the travel survey data indicated that there are some mobility pattern differences between frequent online shoppers and those with less frequent online shopping behaviour, although there were no simple and conclusive overall differences in total travel patterns. However, a significant overall difference in mode choice could be seen between frequent regular online shoppers and those who do not shop regularly online.

The latter result is interesting since if online shopping increases the use of more sustainable modes of transport, then online shopping might – even on a short-term basis – provide a sustainability potential for the transport sector. For instance, in Van Loon et al. (2015) and Seebauer et al. (2015) the authors argue that consumer behaviour regarding the number of trips and mode choice are critical factors for determining the sustainability effects of online shopping.

However since these studies mostly use cross-sectional datasets, conclusions regarding the causal effects of online shopping behaviour are difficult to draw, since the estimated effect may also be due to self-selection, which refers to individuals selecting themselves into preferred choices rather than being randomly distributed (Hong et al., 2014). The presence of self-selection might then lead to a bias in the estimated effect of online shopping on travel behaviour much in the same way as has been discussed for walkability in different residential areas, e.g. Bohte et al. (2009). The use of longitudinal data (rather than cross-sectional data) provides a better way to begin to understand underlying causalities.

The aim of this paper is to further discuss the potential for reductions in passenger transport CO_2 emissions as a result of an increased use of online shopping on the national level in Sweden. The discussion is based on estimates of CO_2 emissions for the typical travel behaviour of different categories of online shoppers in Sweden today as recorded by Winslott Hiselius et al. (2015). However, because online shopping is currently growing very rapidly, and estimates for the future present a continuous rise in online shopping (GSI, 2013), this investigation also estimates possible reductions in CO_2 emissions in 2030 based on the predicted growth in online shopping. The analysis also acknowledges, in line with Crocco et al. (2013), that an increasing share of online shopping will likely lead to changes not only in travel behaviour but also in the use of transport systems and how shopping locations are distributed. Consequently, this paper also analyses trip length and transport modes for various trip purposes as the basis for discussion of the total potential regarding passenger transport CO_2 efficiency. This is used as the basis for a discussion as to whether emissions reduction potentials can be realised solely by the expected growth in e-shopping, or whether other conditions for the transport system and supportive actions for a less car-dependent lifestyle are also required.

2. Method

2.1. Method overview

This paper aims to provide an overall picture of the potential for passenger transport CO_2 emission reductions due to increased use of online shopping in Sweden. This is done by presenting estimates of:

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