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Peak car? Drivers of the recent decline in Swedish car use

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ABSTRACT

It has long been well-known that economic variables such as GDP and fuel price as well as socio-demographic characteristics and spatial distribution are key factors explaining car use trends. However, due to the recently observed plateau of total car travel in many high income countries, it has been argued that other factors, such as changes in preferences, attitudes and life-styles, have become more important drivers of car use. This paper shows that the two variables, GDP per capita and fuel price, explain most of the aggregate trends in car distances driven per adult in Sweden: as much as 80% over the years 2002 to 2012. The estimated elasticities are well in line with previous literature and can reasonably well reproduce the trend in car distances driven per adult back to 1980. We find, however, a substantial variation in elasticities between municipalities depending on public transport supply, population density, share of foreign-born inhabitants and the average income level.

1. Introduction

Since 2008, car travel per adult has declined in Sweden, as in many other high income countries (Goodwin, 2013a, 2013b; Goodwin and Van Dender, 2013; Millard-Ball and Schipper, 2011). Although it is well-known that economic and demographic factors are important drivers of car use trends, this recent development has led some to argue that other factors, such as changes in preferences, attitudes and life-styles, have become more important drivers of car travel. The OECD (2013) report on trends in car use, applying data aggregated to the country level, concludes that economic downturn and rising fuel prices explain some of the trends in car distances driven in the past decade, but not all. To reach this conclusion, however, the authors make the strong assumption that fuel price elasticity is constant across and within countries, despite strong indication that the elasticities differ substantially between rural and urban residents and between low- and high-income households (Blow and Crawford, 1997; Santos and Catchesides, 2005; Wadud, et al., 2009; 2010).

The purpose of this study is to explore the extent to which economic variables can explain the trends in car travel in Sweden from 2002 to 2012. We estimate the elasticity of VKT (vehicle kilometers traveled) per adult with respect to fuel price and GDP per capita on aggregate time-series data. The analysis reveals the extent to which the temporal changes in VKT per adult can be explained by trends in fuel price and GDP per capita. We allow for different elasticities in urban areas and other regions. The data include actual distance meter readings of more than two-thirds of the cars in Sweden, and the distances for the remaining one third of cars are predicted. This large data set ensures robustness with respect to random variation. The estimated elasticities are also validated on time-series data from 1980.

The observed trend break in VKT has been seen as a challenge for travel demand forecasting, the accuracy of which has been questioned (Millard-Ball and Schipper, 2011). The Swedish state-of-practice forecasting model predicts a total VKT growth of 1.2% annually 2010–2030 (Swedish Transport Administration, 2012). The previous forecast, 2006–2020, predicted an annual growth of 0.8%. The average yearly increase in total VKT from 1999 to 2012 of 1.1% is in-between these forecasts. Still, this trend has by no means been constant. During the years 2008–2012, the total VKT declined by 0.3% per year. The latter period is also characterized by low GDP growth and increasing fuel prices.

The main question tackled in this paper, the extent to which the economic factors can explain the recent trends in VKT, is a key issue in transport forecasting. Transport forecasting models rely on the assumption that the parameters explaining past travel behavior remain constant over time (Fox and Hess, 2010). These parameters typically capture responses to changes in economic and demographic variables, such as GDP, fuel price, geographical distribution of firms and population by socio-economic status. Hence, to the extent that VKT trends are driven by such variables, a good transport model could predict future travel demand as long as the development of the input variables is reasonably well predicted (which is a challenge in itself). To the extent, however, that the trends in VKT are driven by changes in preferences, attitudes and

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life-styles, transport models would not be able to predict them.

Although there is substantial variation in the literature, estimated elasticities of fuel price on VKT are usually close to −0.2 in the short run, and −0.7 in the long run (Brons et al., 2014; Dahl, 2012; Dahl and Sterner, 1991; Espey, 1998; Goodwin et al., 2004; Graham and Glaister, 2004; Sterner and Dahl, 1992). The distinctions between short-term or long-term elasticities are by no means clear cut, but Goodwin et al. (2004) refer to short-term responses as taking place within a year whereas long adjustments refer to the asymptotic end state, usually taking place within 3–10 years. Based on a literature survey, Hanly et al. (2002) report an average elasticity of real GDP on VKT of 0.30 in the short term and 0.73 in the long run.

The elasticities reported above are average values but vary substantially depending on trip type, individual characteristics (e.g. income), transport options and land-use. Wadud et al. (2010), Blow and Crawford (1997) and Santos and Catchesides (2005) (the former using US data and the latter two using UK data) find that elasticities are higher among urban residents than among rural residents. Here and throughout this paper we are referring to the absolute values of elasticities on VKT. Higher elasticities among urban residents are plausible, given better access to public transport and a larger variety of destination alternatives in urban areas. Santos and Catchesides (2005) find that the elasticity of fuel price on VKT ranges from −0.63 for low income urban households to −0.07 for the richest rural residents. Headicar (2013) also finds a stronger recent trend decline in car use in London than in the rest of the UK.

National travel surveys (NTS) have been conducted in several years in Sweden, from 1978 to 2011. Due to limited sample size of these, inducing substantial random variation between the annual samples, especially for longer car trips, and declining response rates, however, the NTS data cannot be used for analyzing inter-temporal trends in aggregate car travel. Bastian and Börjesson (2015), however use the NTS data 1978–2011 to describe how more general car use patterns have evolved within different segments of the population.

Our econometric model results show that the two variables GDP per capita and fuel price explain most of the VKT trends, as much as 80%, over the years 2002 to 2012. Moreover, the elasticities estimated in this model are well in line with previous literature and can reasonably well reproduce the VKT trend per adult in Sweden back to 1980. Hence, based on the decline in VKT per adult observed 2002–2012, it is at least too early to draw the conclusion that we are seeing any substantial trend break in the preferences for driving on the aggregate level. The large explanatory power of the two variables, GDP per capita and the fuel price, is reassuring and lends some credibility to transport forecasting.

A caveat of our analysis that it is aggregate. In a more disaggregate analysis we find a substantial variation in the GDP per capita elasticities and fuel price elasticities between municipalities. The VKT per adult trends appear to be more sensitive to GDP per capita in municipalities where the average income is low, and where the public transport supply and population density are high. Lower GDP per capita elasticities in high income and dense municipalities indicate saturation in car travel, in consistency with the analysis of French data by Grimal et al. (2013). Hence, although GDP and fuel price explain most of the VKT trends on the aggregate level, which provides some credibility for transport models in general, the observed variation provides a warning for very aggregate analyses of car use trends and a call for more in-depth analyses.

2. Data

To measure VKT between the years 2002 and 2012 we use distance meter readings from passenger car inspections, which are mandatory in Sweden. The data is aggregated per municipality and calendar year and spans from 2002 to 2012. Actual driving distances are recorded for approximately two-thirds of all cars registered in Sweden, both privately owned and company cars. These observations are used to estimate distances driven for the remaining one-third of cars in Sweden, based on car age, model and ownership type. Among the cars without recorded distances, 60% are less than three years old, because cars less than three years old are not inspected. The estimated yearly distance of the new cars equals the yearly average distance of the three-year-old cars (within the same class) inspected for the first time. This implies a risk that a fraction of the inter-temporal changes in driving distances lags behind in the data. However, since our aim is to study the peak car issue we need to consider the national trends in car travel. We therefore include the estimates of the travel distances of the cars that are not observed in our analysis. Moreover, if excluding the vehicles that are not inspected from the analysis we would not to be able to compare our results with longer term national historical or other studies concerning aggregate elasticities.

The distance of each car is assigned to the municipality where the car is registered. Roughly one-fourth of cars are company cars, which on average are driven 20% farther than cars registered to a person (Statistics Sweden, 2014b). Comparisons across municipalities within the same year may be biased because company cars are sometimes registered in a municipality different from the residence of the user. Comparisons across time are more reliable where the share of company cars per municipality remains relatively stable over time. The municipalities of Solna, Malmö and Lund are excluded altogether from the municipality level analysis because of their higher concentration of company car registrations.

In this paper, we define urban areas as the 25 municipalities within Stockholm County (excluding Solna municipality) and the municipalities of Gothenburg and Mölndal. The latter two municipalities constitute the Gothenburg urban area. We apply this relatively narrow definition of urban areas, because the extensive public transit networks, labor market size and population density make the Stockholm and Gothenburg urban areas distinct from other parts of Sweden.

Stockholm County (excluding Solna municipality) has 2.1 million inhabitants (Statistics Sweden, 2014a). It has a well-developed public transport network including metro, commuter trains, trams and buses. The share of public transit trips to and from the inner city reaches 75% during peak hours (Börjesson et al., 2014). The inner city of Stockholm is spread across several islands, connected by bridges. This implies relatively high road congestion for a city of comparable size, especially before the introduction of inner city congestion charges in 2006 (Börjesson et al., 2014). Gothenburg is Sweden's second largest city. The most central municipalities in this region, Gothenburg and Mölndal, have 590,000 inhabitants in total (Statistics Sweden, 2014a). The public transport system comprises trams, commuter trains and buses and the road congestion is fairly limited. According to the National Travel Survey 2013 the average mode share for car driving and car passenger combined is 44% in Stockholm County, 52% in Gothenburg and 61% in the rest of Sweden.

In the present analysis, we focus on the drivers of VKT per adult. Adults are defined as registered residents of Sweden, aged 18–84. Population, GDP, average income and license holding statistics are taken from Statistics Sweden. A measure of public transport supply by municipality (defined as vehicle km per square kilometer in 2012) is calculated from a database covering