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Peak car and increasing rebound: A closer look at car travel trends in Great Britain

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ABSTRACT

This paper uses econometric analysis of aggregate time-series data to explore how different factors have influenced the demand for car travel in Great Britain since 1970 and how the rebound effect has changed over that time. Our results suggest that changes in income, the fuel cost of driving and the level of urbanisation largely explain travel trends over this period – with recent reductions in car travel (peak car) being driven by a combination of the rising fuel cost of driving, increased urbanisation and the economic difficulties created by the 2008 financial crisis. We find some evidence that the proportion of licensed drivers has influenced aggregate travel trends, but no evidence that growing income inequality and the diffusion of ICT technology have played a role. Our results also suggest that the rebound effect from improved fuel efficiency has averaged 26% over this period and that the magnitude of this effect has *increased* over time. However, methodological and data limitations constrain the level of confidence that we can have in these results.

1. Introduction

Per capita car travel reached a plateau or began to decline in several OECD countries after the millennium, following more than half a century of continuous growth (Schipper, 2011; Van Dender and Clever, 2013). In Great Britain (GB), per capita car travel reached a peak in 2002 and fell by 9% over the subsequent decade. Although the 2008 financial crisis accelerated this trend, it was clearly established several years before.

There has been much debate about the causes of this so-called ‘peak car’ phenomenon and the extent to which it represents a permanent or merely a temporary break with historic trends (Goodwin, 2012; Goodwin and Van Dender, 2013; Millard-Ball and Schipper, 2011; Newman and Kenworthy, 2011; Puentes and Tomer, 2008). Some authors, such as Bastian et al. (2016), argue that simple economic models based solely on changes in income and fuel prices “… are able to predict the plateau and decrease of car travel with quite remarkable accuracy…” (Bastian et al., 2016). Others consider these economic factors to be insufficient and focus instead on changes in demographics, spatial patterns, social norms and other variables (Garikapati et al., 2016; Metz, 2013; Wee, 2015). For example, Goodwin and Van Dender (2013) argue that: “…an aggregate model focusing on GDP effects and fuel prices is too crude to catch the diversity and dynamics underlying aggregate car travel demand and how it changes…”.

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Bastian et al. (2016) emphasise that their conclusions do not rule out the existence of alternative explanations, or imply that there been no changes in other variables such as lifestyle and attitudes, or demonstrate that those variables have no effect on travel patterns. Instead, they simply argue that there is no "…compelling evidence that one needs to assume something else than fuel price and GDP to explain the aggregate VKT development after 2003…". Wadud and Baierl (2017) question Bastian *et al*'s findings, arguing that their use of 'out of sample' forecasts is invalid. But in response, Bastian et al. (2017) argue that a longer time series is preferred for estimation and that a model estimated with a shorter time period nevertheless gives consistent results.

Over the last few years a remarkably wide range of factors have been cited as contributing towards 'peak car', although some have received more attention than others (DfT, 2015e; Goodwin, 2012; Newman and Kenworthy, 2011; Van Dender and Clever, 2013). They include, for example: increasing income inequality and the worsening economic situation of young people (Klein and Smart, 2017); the increased take-up of higher education opportunities amongst young people, thereby delaying their access to cars (DfT, 2015e); the changing age structure of the population, with a growing proportion of older people who tend to drive less (Goodwin, 2012); relative increases in the non-fuel costs of car ownership and use (e.g. insurance and parking) (DfT, 2015e; Le Vine and Jones, 2012; Rohr and Fox, 2015); the approach towards saturation levels of both car and driving license ownership (Delbosc, 2016; Goodwin, 2012; Le Vine and Jones, 2012); changes in company car taxation leading to reductions in the amount of subsidised car travel (Le Vine et al., 2013); the substitution of car transport by electronic communication, together with the growth of e-commerce, home-working and online shopping (McDonald, 2015; Metz, 2013; Wee, 2015); changing preferences regarding the ownership and use of cars relative to other goods and services (McDonald, 2015); the growing trend towards urbanisation, reversing the historic 'flight to the suburbs' (Headicar, 2013); increased congestion, especially on urban roads (DfT, 2015a); modal shifts encouraged by improvements in public transport, cycling and walking infrastructure (DfT, 2015e; Goodwin, 2012); the declining marginal utility of increasing average trip length (Metz, 2013); the levelling off of door-to-door car speeds coupled with relatively stable travel time-budgets (Metz, 2013); and the high rate of net immigration in the first decade of the 21st century, coupled with a lower propensity to drive amongst immigrant communities (Headicar, 2013).

Identifying the relative importance of these factors is very challenging, partly because the required data is often lacking but also because the different factors are highly interdependent. For example, substitution of car transport by ICT is more likely amongst young people, but these also face some of the biggest economic difficulties and are more likely to live in urban areas. Hence, while there is increasing amount of research on 'peak car', a consensus on the explanations of the phenomenon remains elusive. Moreover, the most recent data from the US and the UK suggests that car travel may be on the rise again – perhaps encouraged by an improving economic situation and falling oil prices (DfT, 2015d, 2016). If this trend continues, it would reinforce the argument that economic factors remain dominant.

1.1. Dynamic rebound

A second area of debate is the extent to which improvements in vehicle fuel efficiency (ε) have encouraged more car travel (S) – the so-called rebound effect. Fuel efficiency improvements make car travel cheaper which in turn may encourage both more car ownership and more car use. This phenomenon is commonly investigated through econometric analyses of aggregate data on fuel use and travel patterns, which allow the rebound effect to be estimated from the elasticity of distance travelled with respect to fuel efficiency ($\eta_{\varepsilon}(S) = \partial \ln(S)/\partial \ln \varepsilon$) (Sorrell and Dimitropoulos, 2007a).[1] A finding that this elasticity exceeds zero implies that some of the potential fuel savings from the efficiency improvements have been 'taken back' by increased driving. In practice, reliable data on vehicle fuel efficiency is frequently unavailable, or does not vary enough to permit robust estimates. But since the source of the rebound is *cheaper* driving, an alternative (and more common) approach is to estimate the direct rebound effect from one of three *price* elasticities, namely: the elasticity of vehicle kilometres with respect to the fuel cost per kilometre ($\eta_{p_S}(S)$); the elasticity of vehicle kilometres with respect to the price of fuel ($\eta_{p_E}(S)$); and/or the elasticity of fuel consumption with respect to the price of fuel ($\eta_{p_E}(E)$). These elasticities are only equivalent under certain assumptions (Sorrell and Dimitropoulos, 2007a; Stapleton et al., 2016), suggesting the need for caution when interpreting and comparing the results from different studies. Also, technical improvements in fuel economy (e.g. better aerodynamics) may have encouraged a shift towards larger and more powerful cars, but most studies overlook this owing in part to lack of data (Ajanovic et al., 2012; Knittel, 2009).

Dimitropoulos et al. (2016) conducted a meta-analysis of the results from 76 primary studies in this area and found a mean long-run rebound effect of 32%. However, most of these estimates were from the US, with only Stapleton et al. (2016) providing estimates for GB. Also, most of the studies use a double log functional form that constrains the elasticities to be constant. In practice, the rebound effect may change over time or with increasing incomes, but few studies have investigated this. Fouquet (2012) provides a very long-run perspective and estimates that the own price elasticity of UK passenger transport demand fell from −1.5 in 1850 to −0.6 in 2010, while Small and Van Dender (2007) estimate that long-run rebound effect in the US was around 22% over the period 1960–2001, but fell to only 10.7% over the period 1997–2001. Greene (2012) confirmed Small and van Dender's estimate using aggregate time-series data, but a study by Hymel and

[1] The elasticity of fuel consumption with respect to fuel efficiency ($\eta_{\varepsilon}(E)$) is then given by: $\eta_{\varepsilon}(E) = \eta_{\varepsilon}(S) - 1$.