Estimating direct rebound effects for personal automotive travel in Great Britain

Centre on Innovation and Energy Demand

Research Councils UK Energy For a Low Carbon Future

Impacts

Using econometric and other techniques to estimate the historical energy savings from low energy innovations, to explore future energy savings and to identify how they may be increased

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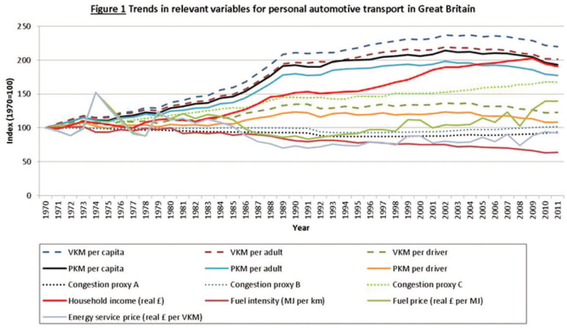
There is considerable potential to improve the energy efficiency of road transport, but the economy-wide energy savings may be less than anticipated owing to various 'rebound effects'.

For example, lower running costs may encourage increased ownership and use of private cars, while improvements in engine efficiency and aerodynamics may encourage the development of larger and more powerful cars, rather than more efficient cars. Similar processes are at work within freight transport, where efficiency improvements may lead to more goods being moved over greater distances, as well as encouraging increased consumption of different types of goods, all of which will have consequences for economy-wide energy consumption.

Research aims

This project will estimate the historical impact of energy efficiency improvements in GB road passenger transport (followed by freight transport in a later, similar project) together with the magnitude of these different types of rebound effect. These results will be compared with others from different regions and time periods and used to draw implications for future national policy.

Figure 1 Trends in relevant variables for personal automotive transport in Great Britain

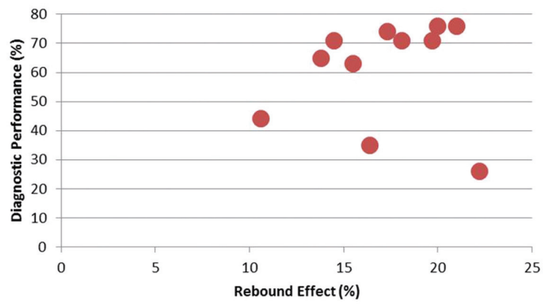


Methodology

The primary method is the econometric analysis of aggregate time-series data on GB transport activity, fuel consumption and other relevant variables, combined with parallel analysis of GB household expenditure and vehicle performance data.

The first stage of the project employs data on personal automotive vehicles over the period 1970-2011 (Figure 1) and estimates the increase in distance travelled as a result of improved fuel efficiency. The 'energy service' is measured in terms of both vehicle kilometres (VKM) and passenger kilometres (PKM) and the direct rebound effect is estimated as the elasticity of these with respect to fuel efficiency (MJ/km), fuel prices (£/MJ) and energy service prices (£/km). Estimates are produced and compared from a number of econometric models that take static, dynamic and co-integrating forms. The performance of these models is then compared using an unusually comprehensive array of diagnostic tests.

Figure 2 VKM-fuel price rebound effect versus model diagnostic performance



Expected outputs

In the first stage, two journal articles are planned to be submitted this year; potential outlets include Ecological Economics, Energy Economics. Energy Policy or Transportation Research Part A: Policy and Practice. We also intend to present this work at the Eleventh International Conference on Environmental, Cultural, Economic & Social Sustainability (Copenhagen, January 2015).

Early findings

Isolating the direct rebound effect in GB personal automotive transport is challenging owing to data limitations and the relatively limited variation in key independent variables. Improvements in fuel efficiency have been offset by relatively small increases in road fuel prices, leading to limited variation in price per kilometre. This compares to regions such as the US, where the data is better and the relevant changes have been larger. To address this, we estimate a range of models and test them extensively. To date, we have estimated 27 models for VKM and conducted a total of 300 diagnostic tests. These have yielded 11 statistically significant estimates of the rebound effect with respect to fuel prices, but none with respect to fuel efficiency. Our results suggest that rebound effects may have offset 11-22% of the potential fuel savings, but these figures are likely to provide an upper bound. We have also explored the relationship between the size of estimates and model diagnostic performance (Figure 2).

CIED is a collaboration between researchers from the Sussex Energy Group (SEG) at SPRU, University of Sussex; the Transport Studies Unit (TSU) at the University of Oxford; and the Sustainable Consumption Institute (SCI) at the University of Manchester and is one of six Research Centres on End Use Energy Demand funded by the RCUK Energy Programme.

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