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Financial Implications of Car Ownership and Use: a distributional analysis based on observed spatial variance considering income and domestic energy costs

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ABSTRACT

This paper presents a new perspective on assessing the financial impacts of private car usage in England and Wales using novel datasets to explore implications of motoring costs (principally Vehicle Excise Duty and road fuel costs) for households as part of the overall costs of their energy budget. Using data from an enhanced version of the Department for Transport 'MOT' vehicle test record database, combined with data on domestic gas and electricity consumption from the Department for Business, Energy and Industrial Strategy (formerly the Department of Energy and Climate Change), patterns of car usage and consequent energy consumption are investigated, and the costs of Vehicle Excise Duty and road fuel examined as a proportion of total expenditure on household direct energy consumption. Through the use of these new datasets it is possible to analyse how these vary spatially and in relation to levels of median income. The findings indicate that motoring costs are strongly regressive, with lower income areas, especially in rural locations, spending around twice as much of their income on motoring costs as the highest income areas.

1. Introduction

With increasing digitisation of vehicle records, new opportunities are being afforded to researchers interested in exploring car usage at the level of individual vehicles. In particular, periodic vehicle safety and emissions inspections are providing a fruitful source of new data. Globally, these tests are becoming increasingly common, taking place in all 27 EU Member States, 32 States in the US, and at least 17 countries in Asia (Cairns et al., 2014; Chatterton et al., 2015). Data from these tests are being put to a range of uses, including understanding spatial patterns and elasticities of car ownership and usage (Moyce and Lloyd, 2013; Reardon et al., 2016; Yeboah et al., 2016), understanding geographical patterns of vehicle emissions (Chatterton et al., 2015), relationships between vehicle usage and urban form (Diao and Ferreira, 2014), implications of future city growth on travel and associated greenhouse gas emissions (Ferreira et al., 2013), issues of environmental and energy justice (Chatterton et al., 2016a) and the potential positive and negative impacts of pay-*per*-mile vehicle insurance (Ferreira and Minikel, 2013).

In this paper, we explore the financial implications of car use by combining annual data from around 30 million vehicles from the UK vehicle inspection ('MOT' Ministry of Transport) test with accompanying registration data on the location of the registered keeper of the vehicle. We use this to calculate costs of Vehicle Excise Duty (VED) (an annual vehicle tax in the UK) and fuel costs at both a per vehicle and an aggregated area level (around 700 households). We then place these costs in the context of domestic expenditure on electricity and gas use by using energy consumption data from 24.5 million electricity meters and 21 million gas meters (DECC, 2014). While much previous work has looked at motoring costs longitudinally, particularly with respect to price elasticities of road fuel (e.g. Dargay, 2007, Goodwin et al., 2004), in this paper we look instead at how expenditure on motoring varies spatially and in relation to levels of median income. This places the work more in line with previous work on household expenditure (for example, Dresner and Ekins, 2006; Brand and Boardman, 2008; Druckman and Jackson, 2008; Thumin and White, 2008; Gough et al., 2011; Buchs and Schnepf, 2013a, 2013b; Hargreaves et al., 2013). However, this existing body of work generally has no, or very limited, spatial detail as it tends to be based on limited sample survey data, predominantly the UK Living Costs and Food Survey (formerly

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the Family Expenditure Survey and National Food Survey) which has an annual sample size of 6000 households in the UK per year. We present the work here as an important complementary perspective to these survey based approaches. Whilst our datasets present (near) universal information on vehicle and energy usage, we are cognisant of a number of limitations of this approach. First, due to both the size and security considerations of the datasets used, it is necessary to undertake analysis predominantly on the basis of data that is spatially aggregated (albeit over relatively small and socially homogenous areas – see below). Second, the motoring costs that we are able to base our assessment on are those that are dependent specifically on vehicle characteristics and usage, rather than costs such as insurance which are dependent heavily on the characteristics of the driver. Due to this second point, in this paper, our examination of expenditure has focused predominantly on VED and fuel costs. These are important as they are relatively inflexible and are the motoring costs most directly influenced by national taxation policy, therefore reflecting political decisions. Additional work has been carried out that has provided estimations of vehicle depreciation costs as well as the proportion of motoring costs used through travel to work. These have been presented elsewhere (Chatterton et al., 2016b).

Initially, this paper sets out the general costs of motoring from survey based work, before establishing the political history of both VED and fuel duty. This context is important for understanding the long-standing tension between viewing automobility as either a luxury or a necessity, and the impacts this has on what are considered to be appropriate taxation structures. The overall methodology is then described before setting out a number of different analyses. These are: relationships between VED and fuel costs, first at the level of individual vehicles and then as household averages at an areal level (including by level of urbanisation); relationships of VED and fuel costs to income and between road fuel costs and domestic energy costs; and finally looking at the proportion of income spent on these costs. There is then a discussion and conclusion section which explores the implications of the findings within the context of current and future mobility and energy policy.

1.1. Costs of car ownership

The costs of running a car are made up of fixed annual costs (VED, MOT test fee, insurance etc.), sporadic costs (repair and maintenance), fuel costs and, greatest of all, depreciation. The overwhelming impact of the balance of these costs is that *"annual average cost per mile decreases as the annual mileage increases and is frequently perceived as merely the cost of fuel"* (RCEP, 1994: Box 7 C). Fig. 1 shows the average annual household costs of car ownership by income decile calculated from the UK Living Costs and Food Survey (LCFS) (ONS, 2012). These vary in total from £660 for the lowest income decile, to £7649 for the highest. The proportion of this that is spent on fuel varies between 32.3% for the highest decile and 42.6% for the second highest decile (36.6% overall), given that purchase costs are included. The living costs survey accounts for VED (and motoring fines) as a subsection of 'Licences, Fines and Transfers' alongside Stamp Duty for house purchases. Although the overall section is split by income decile, no such split is available for VED and motoring fines separately, so in Fig. 1 these have been allocated proportionally according to the whole section. The overall average VED paid is £156 per household. The LCFS accounts for the cost of a vehicle in terms of purchase price, which is calculated as an average over all the households (although not every household purchases a vehicle each year). Another common way of reflecting this cost is in terms of depreciation (the annual reduction between the purchase price and the resale value). This has been estimated at around 15% per year (CarsDirect, 2013), and was estimated, in 1994, to represent 42% of average annual vehicle costs (RCEP, 1994). This compares with between 21% and 35% (average 29.4%) for purchase costs in the LCFS for 2011, as shown in Fig. 1.

To illustrate the difficulties in calculating the *full* costs of car ownership, which extend beyond the costs outlined above into a range of non-direct and non-monetary costs, it is worth considering Lynn Sloman's analysis from her book Car Sick:

> *"The typical car owning, Briton today devotes nearly 1,300 hours a year to his or her car. It takes him over 500 hours to earn the money first to buy the car and then to pay for petrol, insurance, repairs and parking. He spends another 400 hours every year sitting in his car while it goes and while it waits in traffic jams. More than 250 hours are devoted to a myriad of small tasks associated with a car: washing it, taking it to the garage for repair, filling it with petrol, looking for the car keys and walking to the car, de-icing the windscreen in winter, and finding a parking space at the end of every trip. Finally, he has to work about 100 hours every year to earn the money to pay the extra building society interest because he has chosen a house with a garage rather than one without. All in all, the typical British car driver in 2005 devoted three and a half of his sixteen waking hours to his car. For this time, he travels a little less than 10,000 miles per year. His average speed is less than 8 miles an hour roughly the same as the speed at which he could travel on a bicycle."* (Sloman, 2006, p1-2).

A highly detailed spatial analysis might also consider the impact of local policies on motoring costs, such as residential parking, workplace parking levies, low emissions zones, congestion charging and so forth. However, as already stated, this paper does not attempt to consider the full costs of car ownership and use, but focuses specifically on VED and fuel cost, representing around 40% of total car costs (according to LCFS figures) and constituting the proportion of costs that national level policy has direct control over. We describe these briefly below.

1.2. Vehicle Excise Duty

Taxation of motor vehicles was first introduced in the UK in the 19th Century under the Customs and Inland Revenue Act 1888 which extended the definition of 'Carriage' from "*any vehicle drawn by a 'horse or mule, or horses or mules', to 'embrace any vehicle drawn or propelled' upon a road or, tramway, or elsewhere than upon a railway, by steam or electricity, or any other mechanical power*". Key issues that have surrounded VED from the start have involved issues of fairness and equity as well as questions over the appropriate

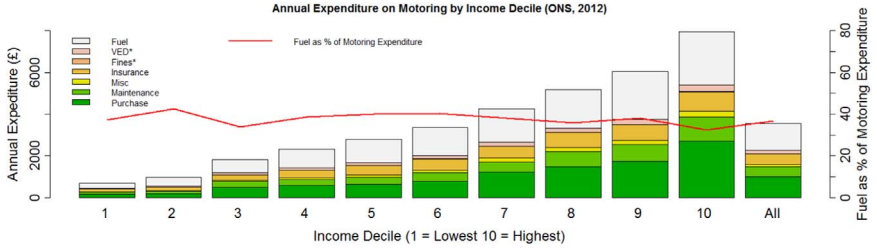

Fig. 1. Annual expenditure on running a car by income decile (ONS, 2012 - *indicates no split across deciles available – see text)).