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Use of a novel dataset to explore spatial and social variations in car type, size, usage and emissions

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ABSTRACT

The 'MOT' vehicle inspection test record dataset recently released by the UK Department for Transport (DfT) provides the ability to estimate annual mileage figures for every individual light duty vehicle greater than 3 years old within Great Britain. Vehicle age, engine size and fuel type are also provided in the dataset and these allow further estimates to be made of fuel consumption, energy use, and per vehicle emissions of both air pollutants and greenhouse gases. The use of this data permits the adoption of a new vehicle-centred approach to assessing emissions and energy use in comparison to previous road-flow and national fuel consumption based approaches. The dataset also allows a spatial attribution of each vehicle to a postcode area, through the reported location of relevant vehicle testing stations. Consequently, this new vehicle data can be linked with socio-demographic data in order to determine the potential characteristics of vehicle owners.

This paper provides a broad overview of the types of analyses that are made possible by these data, with a particular focus on distance driven and pollutant emissions. The intention is to demonstrate the very broad potential for this data, and to highlight where more focused analysis could be useful. The findings from the work have important implications for understanding the distributional impacts of transport related policies and targeting messaging and interventions for the reduction of car use.

Introduction

Efforts to reduce greenhouse gases in the UK are regularly framed in terms of the overall 'legally binding' commitment for an 80% reduction in greenhouse gas emissions relative to 1990 levels that is set out in the 2008 Climate Change Act. 24% of current domestic UK GHG emissions are from transport (DECC, 2013). Car travel contributes 58% of this, whilst light vans contribute 12.5% and motorbikes/mopeds contribute 0.5% (DfT, 2011). Due to the inability of some source sectors to make an 80% reduction, such as agriculture, waste and domestic aviation, it will be necessary for other sectors, particularly domestic surface transport, to decarbonise almost entirely (Committee on Climate Change, 2010; DECC, 2011). In addition to the problem of greenhouse gases and climate change, road transport is responsible for over 95% of the Air Quality Management

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Areas declared under the UK's Air Quality Strategy and Local Air Quality Management (LAQM) framework (Longhurst et al., 2011).

This paper sets out how new data released by the UK Department for Transport (DfT) can offer a radically new perspective on these emissions, and on energy use, through calculations at the level of the individual vehicle. The data is acquired from the UK annual road worthiness vehicle inspection data (known as the 'MOT (Ministry of Transport) test')[1] which provides information on vehicle characteristics, annual mileage and the (presumed) location of the vehicle owner (via the location of the Vehicle Test Station – see below). By attributing energy and emissions across the country to a relatively local level, based upon actual vehicle mileages, the methodology set out in this paper offers completely novel calculations that have been impossible to date. Although there is existing work that links energy use and emissions to household location (see for example Hatzopoulou et al., 2007, 2011), the methodologies used in these studies employ modelled trip data and have only been undertaken at the level of individual cities. The point of the methodology set out in this paper is not to presume that vehicles are driven at the point of registration or VTS, but instead to link fuel use and emissions to vehicle ownership.

In addition, by linking the MOT data spatially with socio-demographic data, it is possible to work towards an assessment of *who* is responsible for energy and emissions (in terms of area of residence and general demographic characteristics), rather than *why* they are emitted (e.g. journey purpose – see, for example, DfT (2008), Chapter 3) or source calculations of *where* they are emitted (e.g. emissions calculations based on flows for road links, as used in the UK National Atmospheric Emissions Inventory – see Waygood et al. (2013) for a short description of the NAEI and similar methodologies). Whilst the spatial location of greenhouse gas emissions, unlike 'conventional' air pollutants, is largely immaterial in terms of ambient concentrations due to the global nature of climate change (see Tiwary et al., 2013), it is relevant to climate mitigation policy in order to identify emitters and appropriately target reduction measures. Spatial location of vehicle owners is also relevant with regard to energy use where, in a future when Plug-In Vehicles may have become established, the majority of energy required by the Light Duty Vehicle (LDV) fleet may need to come from the local electricity distribution grids of the owners rather than in liquid/gas form from filling stations.

The use of local data, linking emissions to location of vehicle owners, allows links to be made between responsibility for emissions and exposure to local-scale public health and environmental problems. This need not be limited just to the consideration of conventional air pollutants as done here (particulate matter (PM) and nitrogen oxides (NOx)) but could be extended to other public health issues associated with car use such as noise, road safety, and use of public space for which distances driven can be seen as a proxy variable. The approach also affords a new method for assessing environmental and social justice issues around air pollution, building on work such as Mitchell and Dorling (2003). In particular, this work highlights the difference between a *potentially* dirty car (i.e. one with high emissions or fuel consumption per km) and an *actually* dirty car (i.e. based on total emissions from the vehicle in any given per year).

This paper demonstrates the potential value and diversity of analyses afforded by the MOT dataset, including estimations of commonly used statistics (e.g. vehicle km/year for private vehicles) but from a novel data source. A review of vehicle inspection and maintenance programmes (Cairns et al., 2014) has indicated the extent to which these tests are carried out globally, and therefore the potential for the work presented here to be carried out elsewhere. Since 31st December 2011, all 27 European Member states (under European Directive 2010/48/EU) are required to undertake vehicle inspection tests at least every two years (once vehicles are four years old or over). In the US, 17 states have compulsory periodic (annual or biennial) safety inspection programmes, whilst 32 states have either partial or full emissions inspection programmes (Wikipedia, 2015). In Asia at least 17 countries were testing for roadworthiness and/or emissions (UNEP, 2011a). Although vehicle inspection data have been used for certain types of analysis previously, to date, we are not aware of any similar work of the scale and nature described here, although, given the widespread nature of such testing, there is considerable potential for such work.

Data description and methodology

The MOT dataset

In 2010, DfT began publishing results from the annual MOT tests. Around 38 million test records (including test passes and test failures) relating to some 27 million vehicles are stored in the database each year (DfT, 2013a). With the application of some mathematics (see, for example, Cairns et al., 2013; Wilson et al., 2013a, 2013b), it is possible to estimate the annual distance driven for the majority of LDVs in the UK.[2] DfT have undertaken some analysis of this dataset focussing primarily on vehicle age and mileage (DfT, 2013a). In addition to the odometer reading of the vehicle at each test, the dataset includes details of the make and model of the vehicle, engine size, fuel type, date of first registration and colour. The primary unit in the current public release of the data is the vehicle test (rather than the vehicle). Each test (and therefore the vehicle undergoing the test) is spatially attributed to the Postcode Area (PCA – see below) of the relevant Vehicle Testing Station (VTS) where the vehicle

[1] http://data.gov.uk/dataset/anonymised_mot_test.

[2] In practice, this 'annual' value is a proxy value based on a two-year weighted average of mileage readings from the annual vehicle test records – from a year before to a year after the date when the average is taken (see Wilson et al., 2013a).