Financial implications of car use and the drive to work: a social and spatial distributional analysis using income data and area classifications.

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Abstract

Using new datasets from the UK Department of Transport that permit the calculation of annual fuel costs and Vehicle Excise Duty for all private motor vehicles under 3.5 tonnes in Great Britain, this paper presents an analysis on variations in household expenditure on motoring (particularly fuel costs) across England and Wales. Building on earlier work that focussed on variations in financial impacts of motoring based on median income for areas, this analysis extends the research in two main ways. Firstly through the use of UK Office for National Statistics' "area classifications" which allow variation in expenditure (and expenditure as a proportion of income) to be analysed in terms of eight different social profiles. Secondly, using UK Census Travel to Work data, we calculated an indicator that reflects the proportion of annual mileage driven by households in an area that is comprised of travel to and from work by car. The results indicate that use of the car and the financial implications vary between different social areas, but there tends to be a negative relationship between the proportion of income spent on motoring and the proportion of mileage used for commuting (i.e. those areas that use their cars *most* for driving to work, actually spend *less* of their income on fuel costs).

Introduction

Within the field of energy policy, financial issues, particularly at a household level, are becoming increasingly high profile in the UK. Whilst 15 years of government by New Labour saw a great deal of focus on household carbon footprints (for example the Act On CO_2 campaign targeting both driving and domestic energy usage – Reginez and Custead, 2011), despite David Cameron's pledge on day two of the coalition administration in 2010 to be the "Greenest Government Ever", the last six years have seen far more focus on efforts to make energy cheap, rather than to reduce the need for it. One of the characteristic phrases associated with this change in policy aspiration has been that of "hard-working families". The claim to supporting "hard-working families" seems to have become something of a political battleground. In 2005 it was claimed that it was the most over-used phrase of the general election that year, being seen as a move away from the individualism of the Thatcher era (Wheeler, 2005) and recently, it has been claimed that "*as a rhetorical label used by Labour politicians, it [hard-working families] is not winning votes*" (Todd, 2014). However, it has become something of a mantra for the Conservative government, not least with regard to the Department of Energy and Climate Change (DECC) where it has become a feature of almost every departmental statement (see Box 1 for some examples).

This can be seen as one aspect of a general reframing about energy debates under the Conservative government, and to some extent the Coalition government before it. This reframing has pushed issues of environment aside in favour of messages about (personal) financial security and (national) energy security.

In this paper we take the opportunity to reflect on this framing by presenting work on a project that 'traditionally' would have focussed on environmental impacts of energy consumption from private car use (Barnes and Chatterton, 2014; Chatterton et al., 2015), and instead examine the data to see what it can say about the financial impacts of car use on the households that drive them. To do this, we use new datasets made available by the UK government in order to undertake a spatial and social analysis of costs associated with private car use in the UK. We focus primarily on energy use from privately owned motor vehicles, but set this within the context of overall household direct energy usage.

The spatial analysis is undertaken at the level of Lower-layer Super Output Areas (LSOAs). These are UK Census geographies with an average size of ~700 households and ~1,600 people.

Box 1: Quotes from DECC on 'hard-working families'

A long-term plan to "*Keep bills as low as possible for hardworking families and businesses*" DECC update – Autumn 2015 (18th November 2015) https://www.gov.uk/government/collections/decc-update-autumn-2015

"*Our number one priority is to ensure that hardworking families and businesses have access to secure, affordable energy supplies they can rely on*." Andrea Leadsom – Energy Minister (DECC Press Release 11th December 2015)

"*I look forward to hearing the ideas from industry so we can ensure an innovative energy sector that works for hardworking families and businesses.*" Lord Bourne (DECC Press Release on 15th Jan 2016) https://www.gov.uk/government/news/consultation-to-encourage-innovation

"*This is a step forward in the Hinkley Point C project, which will play a crucial part in our plan to provide clean, affordable and secure energy for hardworking families and businesses.*" Lord Bourne (DECC Press Release on connections of Hinckley Point to the National Grid,15th Jan 2016) https://www.gov.uk/government/news/consent-approved-for-the-hinkley-point-c-connection-project

"*This Government is…working to keep bills as low as possible and making sure that the people that foot the bill, the hardworking families and businesses of Britain, get a good deal*" Amber Rudd – Energy and Climate Change Secretary (DECC Press Release in response to letter in The Times, 26th Jan 2016) https://www.gov.uk/government/news/what-the-government-is-doing-to-secure-investment-in-clean-secure-and-affordable-energy

And fuel duty is included……

"*British households will benefit from proposals that will be worth £50 on average, thanks to Government plans to reduce the impact of energy company bill rises. This builds on the help given to hard-working families through income tax cuts, the council tax freeze and the fuel duty freeze.*" Ed Davey Energy and Climate Change Secretary (DECC Press Release 2nd December 2013) https://www.gov.uk/government/news/govt-action-to-help-hardworking-people-with-energy-bills

Methodology

In 2010, the UK Department for Transport began publishing the records from the annual vehicle roadworthiness inspections (known in the UK as 'MOT' tests). These tests are required for every vehicle over three years old. This data provides details of the make and model of each vehicle, engine size, fuel type, date of first registration and colour, along with the recorded mileage at each test. Using the latter, it is possible to estimate the annual mileage of each vehicle (see Wilson *et al*., 2013, Chatterton et al., 2015).

Through analysis of vehicle characteristics (year of registration, engine size, and fuel type) and the annual distance driven, it has been possible to estimate annual costs arising from Vehicle Excise Duty (VED), fuel and depreciation for every private vehicle in Great Britain, including cars, minibuses, vans (<3.5t) and two and three wheeled vehicles[1]. This information is then analysed in association with income data and other socio-demographic and geographic data. Due to limitations of a number of these other data sources, we have only performed the analysis for England and Wales. This analysis has focussed on 2011 in order to utilise UK Census data from that year (since the UK Census only occurs every ten years).

Full details of this methodology are available in Chatterton et al. (2016). In brief, the MOT data allows fuel consumption energy use and tax bands to be calculated for individual vehicles based on vehicle age, engine size, fuel type and CO_2 emissions (where available from the manufacturer's rated value, or elsewhere from our own calculations, see Chatterton et al., 2105). Then, using the odometer readings from the vehicle tests, an estimate is calculated for annual mileage (see Wilson et al., 2013 for more details). Based on vehicle age, an estimate is also made of the difference in average cost of a vehicle between 2010 and 2011 to represent depreciation. Details of the costs calculations used for these three elements (VED, fuel and depreciation) are given below.

Average costs for households, and, separately, households with cars, were calculated using 2011 local area Census data. Income data has been taken from Experian estimates of median income (Experian, 2011).

Vehicle Excise Duty Costs

Taxation of motor vehicles has been in force since 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 purpose of the tax (whether it should be hypothecated for highway building/maintenance through a specific 'Road Fund' or whether it should go into the general tax pool to pay for some of the externalities associated with road transport e.g. health and environmental impacts). The current values of VED, with a complex structure of 36 different vehicle groups, are shown in Table 1. These have been in place since 2010 and have been used for the

[1] In the MOT dataset, vehicles are categorised as being in private or commercial ownership. Although some commercial vehicles would undoubtedly be available for private use too, there is no easy way to identify them and comparison with Census estimates of car availability indicate that using the private vehicle dataset should be a reasonable way of dealing with this issue (whilst inclusion of commercial vehicles would lead to meaningless results in some areas).

calculations in this paper. For a longer discussion on the history of, and future plans for, VED please see Chatterton et al. (2016).

Table 1: Current rates of Vehicle Excise Duty (2016 and in place since 2010)

Cars Registered on/after 1st March 2001													
Band	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
CO_2 (g/km)	<= 100	101-110	111-120	121-130	131-140	141-150	151-165	166-175	176-185	186-200	201-225	226-255	Over 255
Petrol/ Diesel Cars	£0	£20	£30	£110	£130	£145	£180	£205	£225	£265	£290	£490	£505
Alt. Fuel Cars	£0	£10	£20	£100	£120	£135	£170	£195	£215	£255	£280	£480	£495

Cars Registered before March 2001	
<= 1549cc	£145
>1549 cc	£230

Light Goods Vehicles	
Pre-2001	£225
Euro 4/5	£140

Motor bikes			
<= 150cc	**151-400cc**	**401-600cc**	**Over 600cc**
£17	£38	£59	£81

Tricycles	
<= 150cc	**> 150cc**
£17	£81

Fuel Costs

Fuel costs are comprised of two main elements: basic costs of fuel and taxation. In the UK, fuel duty for petrol and diesel (and biofuel equivalents) is one of the highest in the world at £0.5795 per litre, with standard rate VAT added on top (OECD, 2013). Between January 1990 and October 2015, this resulted in the total tax being paid on a litre of petrol comprising between 53% and 86% of the total pump price. When adjusted for inflation, petrol prices have increased by only 18% between October 1990 and October 2015 (from £0.85/litre to £1.08/litre), however there have been significant price spikes, with a maximum in April 2012 when petrol costs reached a 2015 equivalent of £1.47/litre (see Figure 1). Currently (March 2016) fuel duty has been frozen for over five years as part of government policy to reduce overall tax burdens (Conservatives.com, 2015). This is despite very significant reductions in the underlying price of fuel over this time.

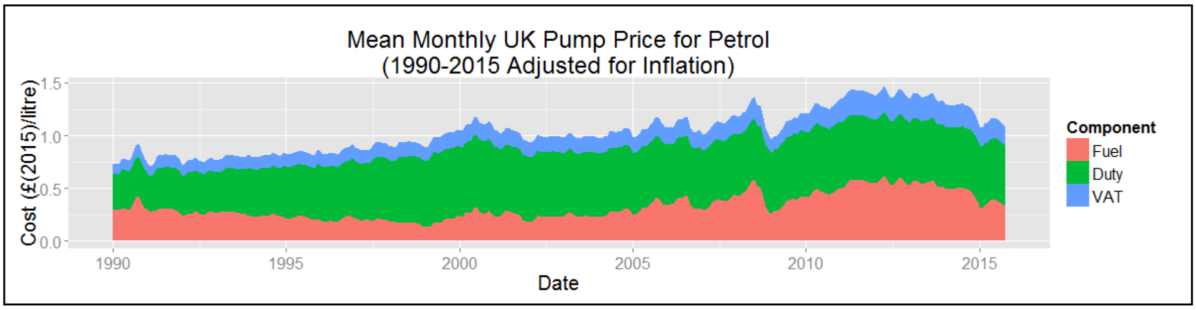

Figure 1: Relative composition of UK pump price for petrol (1990-2015) (DECC, 2015)

Costs of Depreciation

Recent work by the UK Department for Environment, Farming and Rural Affairs (Defra) in support of the UK Air Quality Plan has been used as the basis for an assessment of depreciation costs. Defra (2015) provides an assessment of average vehicle cost by Euro Standard banding for 2020, along with annual depreciation factors, based on detailed analysis of historic data for previous depreciation rates and vehicle values in 2014.

In this study, these have been used to estimate average original vehicle costs for cars and vans for every year since 1993 when the first Euro Standard was introduced (Table 2).

Table 2: Estimation of original price based on 2020 values and depreciation rates from Defra (2015)

Emission Standard	Years of First Registration	Cars		Light Goods Vehicles	
		2020 Value (Defra)	Estimated New Value	2020 Value (Defra)	Estimated New Value
Euro 1	1993-1996	£118	£13,500	£169	£35,000
Euro 2	1997-2000	£237	£13,500	£374	£35,000
Euro 3	2001-2005	£567	£14,500	£679	£25,000
Euro 4	2006-2010	£1,138	£12,500	£1,831	£25,000
Euro 5	2011-2015	£2,722	£12,500	£4,051	£20,500
Euro 6	2015-	£7,749	£13,000	£10,927	£19,000

Depreciation Rates		
Year	Cars	LGVs
1	0.37	0.35
2	0.18	0.18
3+	0.16	0.18

Then by tracking the price of vehicles on a year-by-year basis it has been possible to estimate the average value of depreciation in 2011 (e.g. the value in 2011 compared to the value in 2012). Depreciation rates have been estimated for 2 and 3-wheelers as being half that for cars, and vehicles registered prior to 1993 are assumed to have no significant depreciation due to their age (they are either almost valueless, or they will hold their value due to 'classic' status). Figure 2 shows the calculated 2011 depreciation rates for cars and vans by year of first registration.

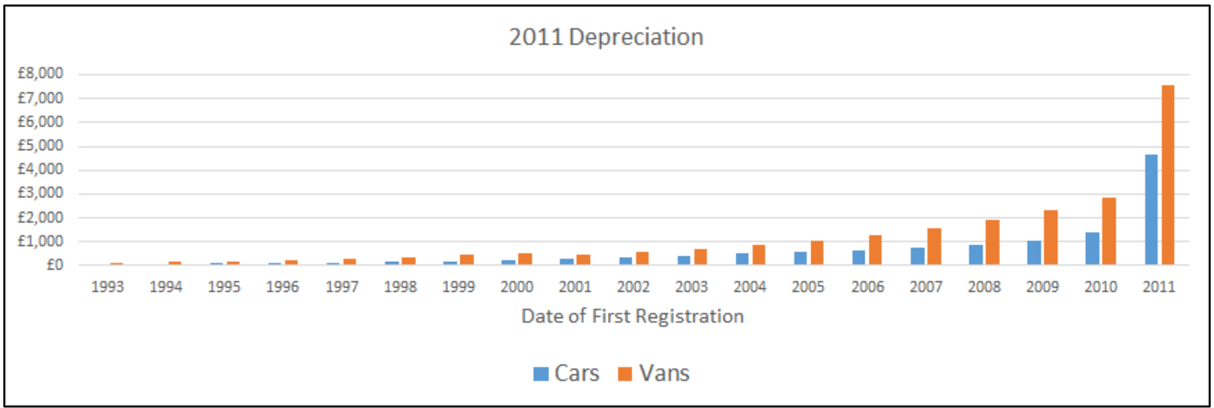

Figure 2: 2011 depreciation estimates for cars and vans by registration year

Relative Expenditure on Motoring

After establishing the per vehicle costs for VED, fuel and depreciation, these were then multiplied by the average number of cars per household (for those households that owned or had access to a car, hereafter defined as 'HH with cars') for each LSOA from the census to give an average figure for expenditure per HH with cars on motoring for each area. This was then aggregated by median income decile (Figure 3) to explore how expenditure varies by income. Aside from the highest income quantile for fuel, expenditure on all three elements increases as income increases. However, the percentage of these costs that is made up of fuel decreases from 64.7% to 60.5% from lowest income to highest income decile.

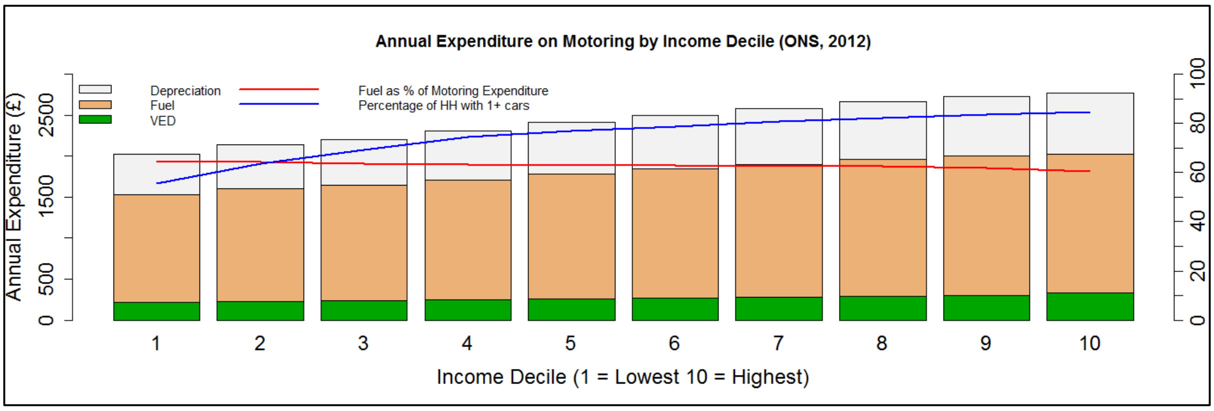

Figure 3: Average Household (with cars) Motoring Costs (VED, Fuel and Depreciation) by LSOA Income Decile

Income has generally been found to have a strong relationship to levels of car ownership along with population density (Dargay and Gately, 1999; Romilly et al., 2001; Holtzclaw et al., 2002; Clark, 2007; Yeboah et al. 2015a, Yeboah et al. 2016). However, this does not necessarily translate from ownership to use, or from use to costs. Income may well *permit* higher levels of expenditure on motoring but does not dictate that this will occur. Income may well be a proxy for a wide range of other factors that lead to increased ownership or usage. These may well be either structural (such as the ability to own a house with more parking provision) or they might be social, pertaining to a range of socio-demographic factors including chosen/adopted 'lifestyle'.

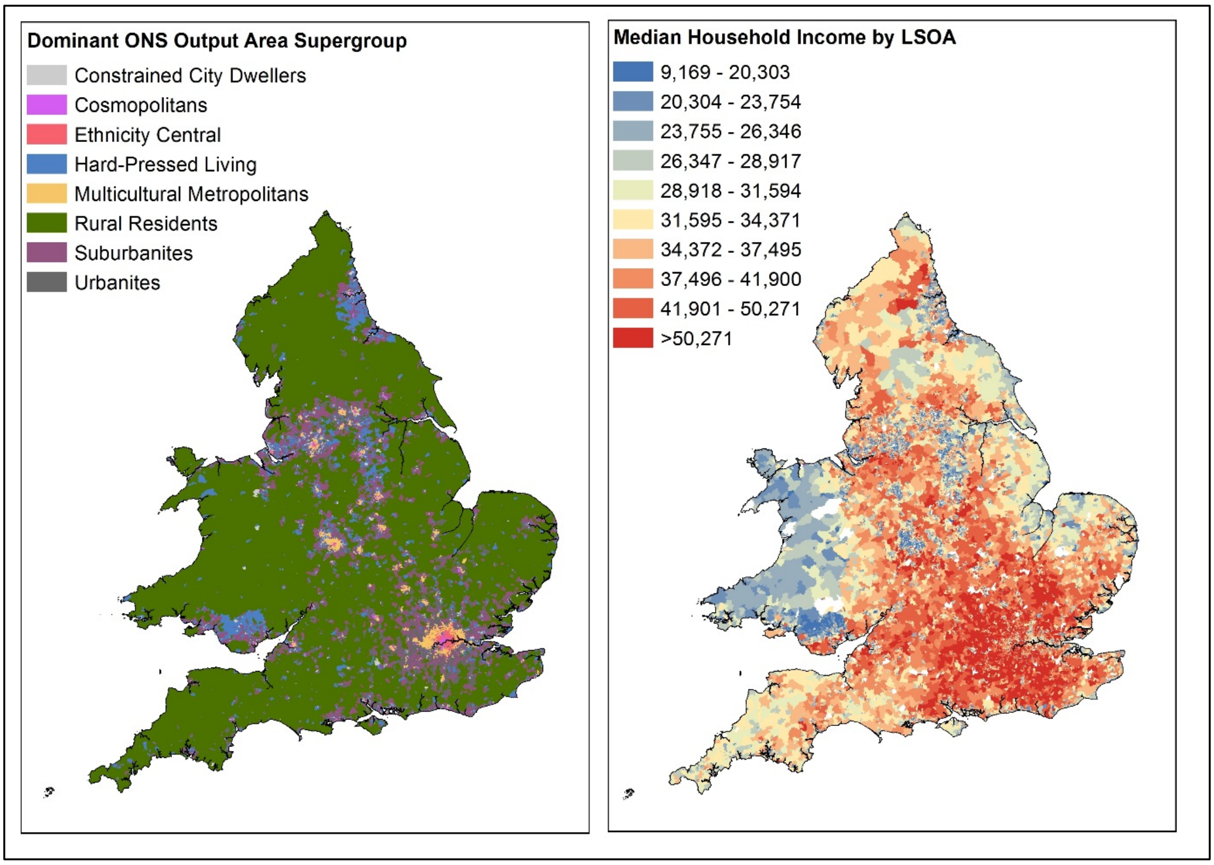

Figure 4: Maps of dominant ONS area classification supergroups, and Experian LSOA median household income

In order to further explore the latter, LSOA were categorised using the Office for National Statistics Output Area Classifications (ONS, 2012). These classifications, comprising eight supergroups, 26 groups and 76 subgroups are illustrative of the characteristics of the demographic structure, household composition, housing, socio-economic characteristics and employment patterns in each of the 181,408 Census Output Areas (OAs) in England and Wales. For the purposes of this analysis, LSOAs have been classified on the basis of the dominant OA supergroup within each area (by number of OAs in each classification – there being an average of around five output areas in each LSOA). The eight supergroups are: Rural residents, Cosmopolitians, Ethnicity central, Multicultural metropolitans, Urbanites, Suburbanites, Constrained city dwellers. For convenience, the pen portraits for these supergroups have been included in the annex to this paper. Figure 4 shows maps of the dominant ONS supergroup for each LSOA as well as median household income (split into deciles).

Figure 5 and Figure 6 show relationships between expenditure on road fuel, median household income and area classification. Figure 5 shows that, as with Figure 3, fuel cost increases with income, and that the highest incomes tend to be in areas dominated by Cosmopolitans (mean HH income = £46k), Suburbanites (£40k), and Urbanites(£38k). The lowest incomes, as one might expect, are associated with areas where Constrained City Dwellers (£24k) and Hard Pressed Living (£21k) dominate.

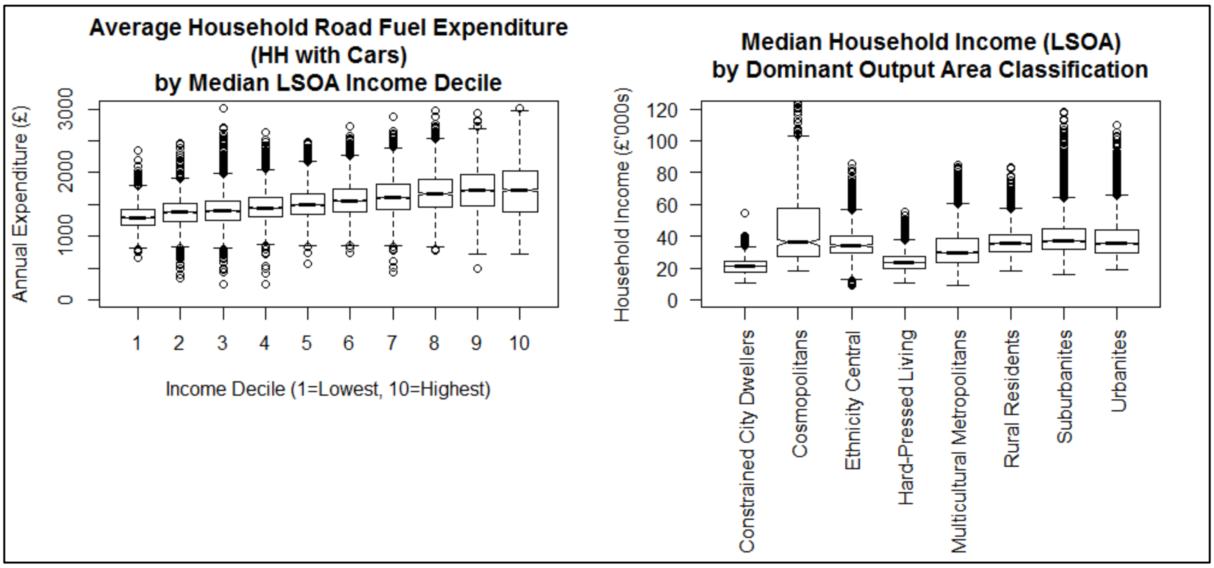

Figure 5: Expenditure on road fuel by income decile, and median household income by ONS output area supergroup.

Figure 6 clearly shows the value of undertaking the analysis in this way. Despite the higher incomes shown for Cosmopolitans in Figure 5, these areas have the lowest average annual household expenditure on car costs (mean = £1,046 on fuel; £662 on VED and depreciation). The next lowest are Ethnicity Central (£1150; £684) and Constrained City Dwellers (£1278; £721). The highest groups are Rural Residents (£2041; £1119), Suburbanites (£1693; £1069) and then Urbanites (£1511; £908). It is interesting to note that spending on fuel is always greater than spending on VED/depreciation.

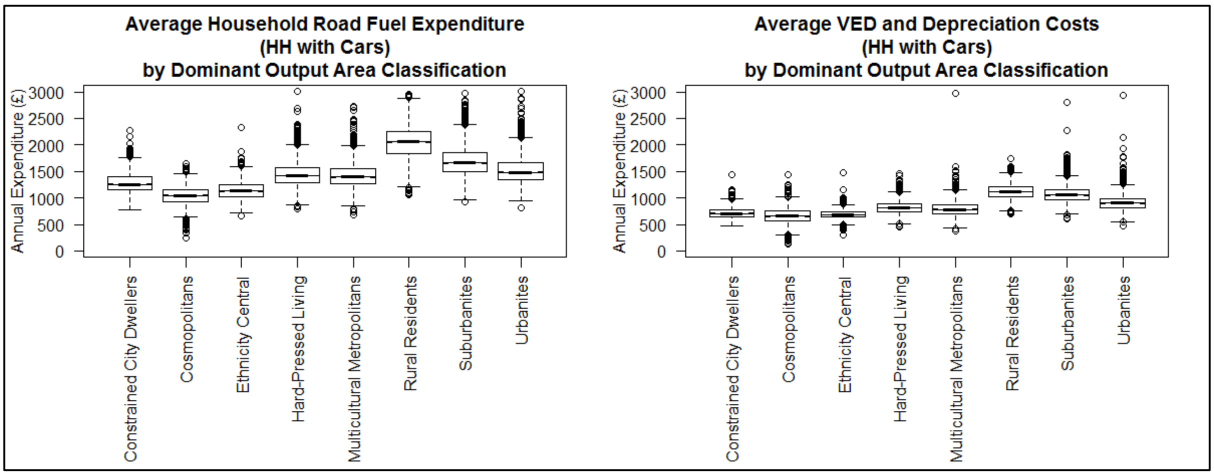

Figure 6: Expenditure on road fuel and other motoring costs (VED and Depreciation) by dominant ONS output area supergroup

Levels of Car Ownership

We acknowledge that the way the data is analysed and presented for average households, multiplying the properties of an average vehicle by the average number of cars owned by a household with cars, has a tendency to mask over variations in levels of car ownership between the areas or groupings we are looking at. The average number of cars per HH (with cars) will, in particular, have a significant impact on the calculated financial costs. Therefore, Figure 7 and Figure 8 present information on the variation in levels of car ownership (percentage of households with access to a car and average number of cars per household (for those households with cars)) by both income decile and ONS supergroup. As might be expected, for income, both measures of car ownership increase steadily with income. In Figure 8, showing ownership by ONS supergroup, we again see the same pattern for both indicators. Here, Rural Residents, Suburbanites and Urbanites have the highest levels of vehicle ownership whilst Ethnicity Central has the lowest. In the middle, Hard-Pressed Living and Multicultural Metropolitans have higher ownership (by both measures) that Constrained City Dwellers and Cosmopolitans.

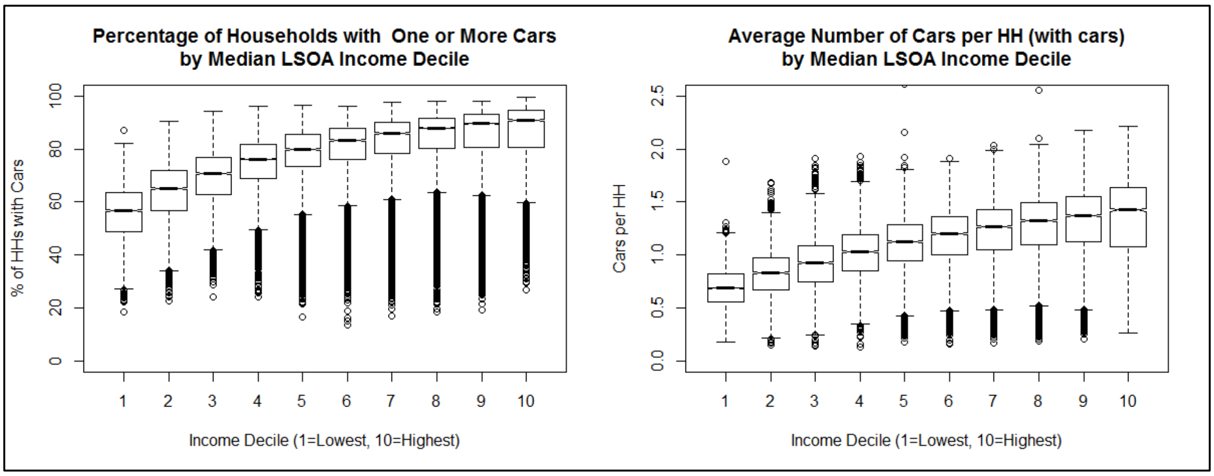

Figure 7: Levels of car ownership by income decile

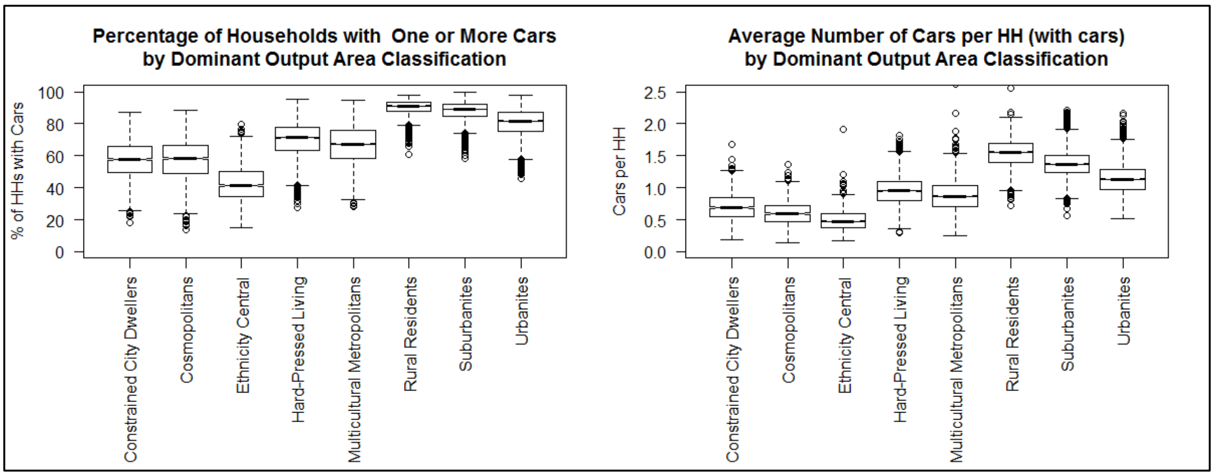

Figure 8: Levels of car ownership by dominant ONS output area supergroup

Travel to work by car

Whilst the MOT dataset provides extensive information on vehicles and overall distances driven, it provides no information on the types of journeys on which the calculated mileages are accumulated. Whilst sources of information such as the National Travel Survey can provide information on distances driven by journey purpose, the limited samples involved mean that it isn't suitable for matching to the MOT data for spatial analysis at a detailed level. The only information that is available with universal spatial coverage on journey purpose is from the Census Travel to Work flow data. This data provides origin and destination data for journeys to work at two spatial scales: output areas (OA = somewhat smaller than the LSOA resolution being used in this study) and middle-layer super output area (MSOA = somewhat larger than the LSOA resolution being used in this study). Information on the travel mode used to get to work is, however, only available at the MSOA resolution. The following method was used to create a figure at the LSOA level that is indicative of the proportion of mileage in each area that is used on travel to work.

Using data for output areas, the distance from OA population weighted centroid to population weighted centroid was calculated, and then the total distance travelled was calculated by multiplying this by the number of trips from each origin (home) OA to each destination (workplace) OA. This gives an estimate of the total straight line distance travelled to work between OAs. Although some journeys will be shorter than that distance, others will be longer.

The same approach was undertaken for the MSOA data, but calculating figures for both the total distance travelled between home and work MSOAs, and the distance travelled by car between these MSOAs. From these, a figure was then calculated for the proportion of travel to work distance that was driven by car for each of the 7,201 MSOAs.

Then, matching the origin and destination OAs to the proportion figures for the MSOAs in which they sit, this proportion was applied to the distance travelled in each from each origin OA to give an estimate of the travel to work distance by car for each OA. These distances were then aggregated to the LSOA level to create an indicator of distance travelled to work by car for each LSOA per working day.

In order to get an estimate of the total annual distance driven to work by car, these figures were then multiplied by two, to reflect the two-way nature of journeys, and multiplied by 220, as an estimate of the number of working days in a year (accounting for weekends, bank holidays, estimated sick days, leave days and working from home days); and by 1.42 as a multiplier to adjust Euclidean distances from centroid to centroid to network distances (Boscoe et al., 2012). An indicator was then created by dividing this figure by the total km driven by cars in each LSOA[2].

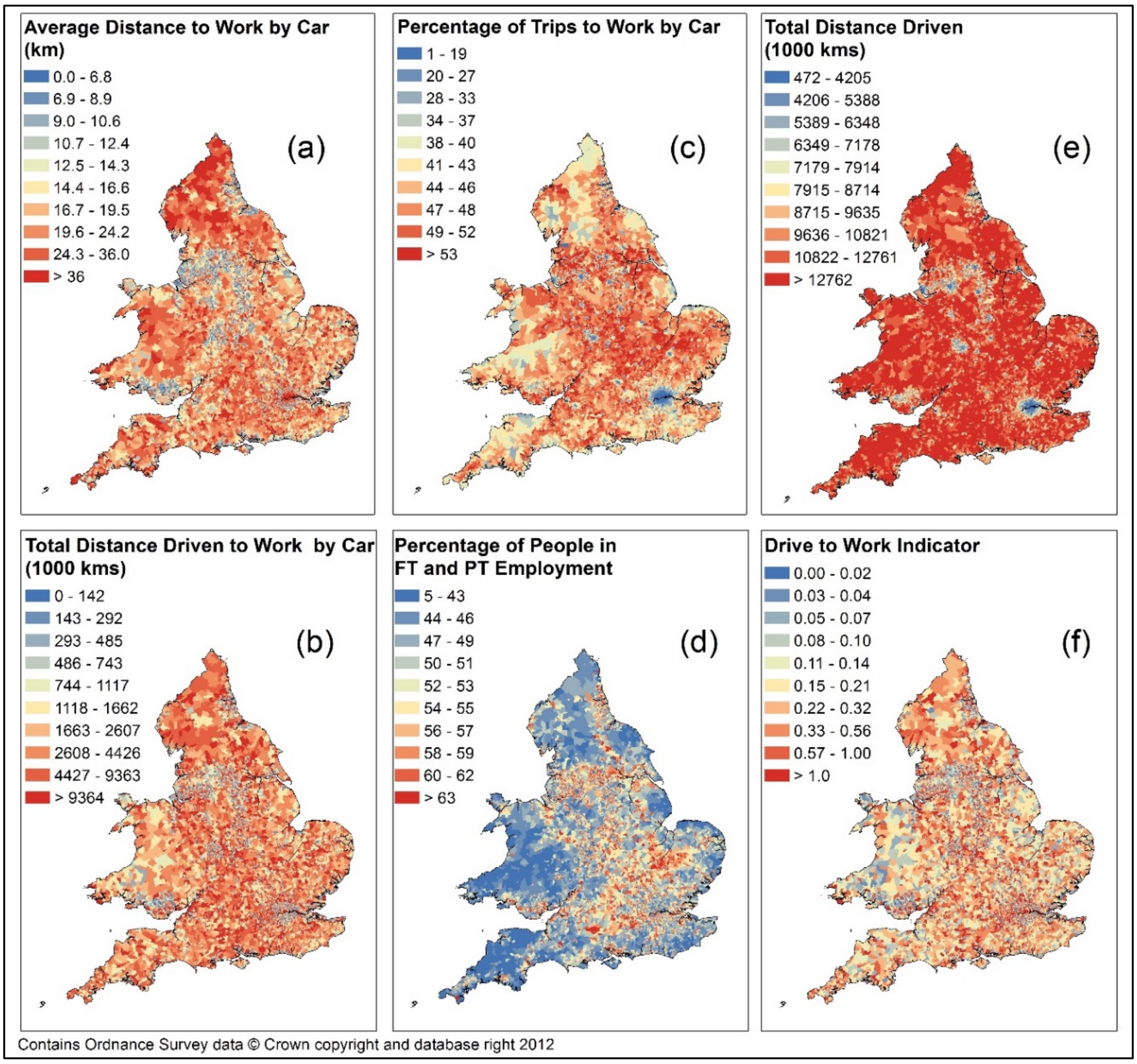

Figure 9: Maps showing information on aspects of journey to work mileage

[2] Using this method, approximately 12% of areas end up with an index of > 1.0. These have been grouped on the maps as the highest band, but removed from the later boxplot analyses. It is likely that the exclusion of the commercial vehicle mileages from the MOT dataset is responsible for some of this discrepancy. Also, the calculation of the drive to work distance is still at an exploratory stage and the current method potentially overestimates distance, both in the conversion of MSOA modal data to OA and also through the application for the 220 days annual multiplier and 1.42 factor for converting straight line to network distances. For this reason we present the data as an indicator of the proportion of driving that is done to work, not as the proportion itself.

Figure 9 shows a set of maps showing both the “Drive to Work Indicator” as well as the components of the calculation: (a) Average daily distance driven *to* work by car for each LSOA, (b) Total annual distance driven to/from work per LSOA, (e) Total distance driven by all cars per LSOA and data from the Census on: (c) percentage of workers driving to work by car, and (d) the percentage of people in full-time or part-time employment. Some of the notable features of, and differences between, the maps are discussed below.

a) **Average daily distance to work by car**: This map shows the average origin to destination distance calculated across all car commutes in each area. Whilst this map tends to show, as might be expected, that distances driven to work in urban areas tend to be shorter than distances in urban areas, the pattern is not nearly as clear cut as for total mileage (map e). In particular, within many urban centres, especially London and Birmingham, because people working nearby tend to use non-car modes, those people who do use the car tend to drive much longer distances. Also many rural areas appear intermediate, suggesting that many rural parts of the country do manage to support relatively local employment opportunities, even if, as indicated in map c, these need to be accessed by car.
b) **Total annual distance driven to/from work by car**: This map shows the total annual distance driven to/from work, linking both the average distance (a) and the percentage of people who drive to work (c), with the number of people in employment (d). Even though low proportions of people who live in urban centres drive to work (c), many of these areas show high overall levels car travel resulting from those who do drive. Rural areas are a mix of medium and high car travel. Perhaps surprisingly, the lowest levels of total work-related car driving tend to be on the fringes of towns and cities.
c) **Percentage of trips to work by car**: This map shows, for those people working, (d) what proportion drive to work by car. As might be expected, urban centres stand out clearly as low car commute areas, presumably because employment opportunities are readily accessible and public transport is good. The impact of radial train lines from London are also apparent. However, somewhat more surprising are the number of rural areas which have low proportions of car commutes, such as mid-Wales, Dartmoor, Exmoor, the north Norfolk coast and the east Lincolnshire coast. One possible explanation is the importance of immediately local employment such as farming and tourism.
d) **Percentage of people in FT/PT employment**: Levels of employment tend to be lowest in rural areas, particularly around the peripheries of the country. Interestingly, London doesn’t stand out clearly on the map, and there is a clear difference between low levels of employment in north London and high levels in south London. Employment also tends to be low in many urban centres, especially in the Midlands and north of England.
e) **Total distance driven**: This is data from the MOT dataset showing the total distance driven by all privately-owned vehicles registered within each LSOA. This clearly shows that urban areas have the lowest overall levels of driving, followed by suburban areas, and then rural areas. However, the ‘Valleys’ area in South Wales stands out as a rural area with low levels of driving.
f) **Drive to Work Indicator**: This is the figure that loosely represents the proportion of all mileage per area that is likely to arise from car journeys to and from work (b). The overall pattern is very varied, representing a complex outcome from the factors shown in the other five maps. Again, some very interesting contrasts come out, for example a very high index

for some urban centres (e.g. London and Birmingham) as well as for some peripheral areas (e.g. south west Wales). There is no clear discernible pattern though.

As there is no clear spatial pattern to the proportion of car use for work journeys, this was explored further using income data and the ONS area classifications. Analysis by income band (Figure 10) shows very little variation in the proportion of car use for driving to work, with no systematic pattern except for a slight increase in deciles two, three and four (means = 0.21,0.2,0.20 respectively compared to an overall mean of 0.195). When considering the ONS supergroups (Figure 11) a much greater variation is perceptible, with Cosmopolitans (mean indicator = 0.34) using their cars most for commuting, then Ethnicity Central (0.30) and then Rural Residents (0.26). Surburbanites use their cars least for commuting (0.13) followed by Hard Pressed Living (0.17) and (Multicultural Metropolitans (0.20).

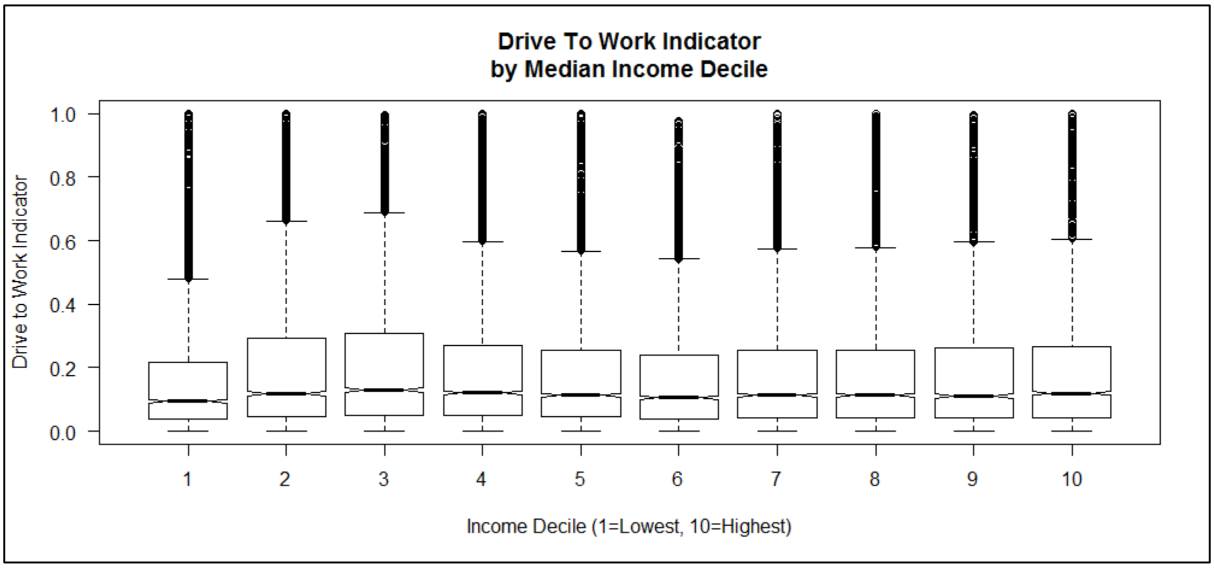

Figure 10: Drive to work indicator by income decile

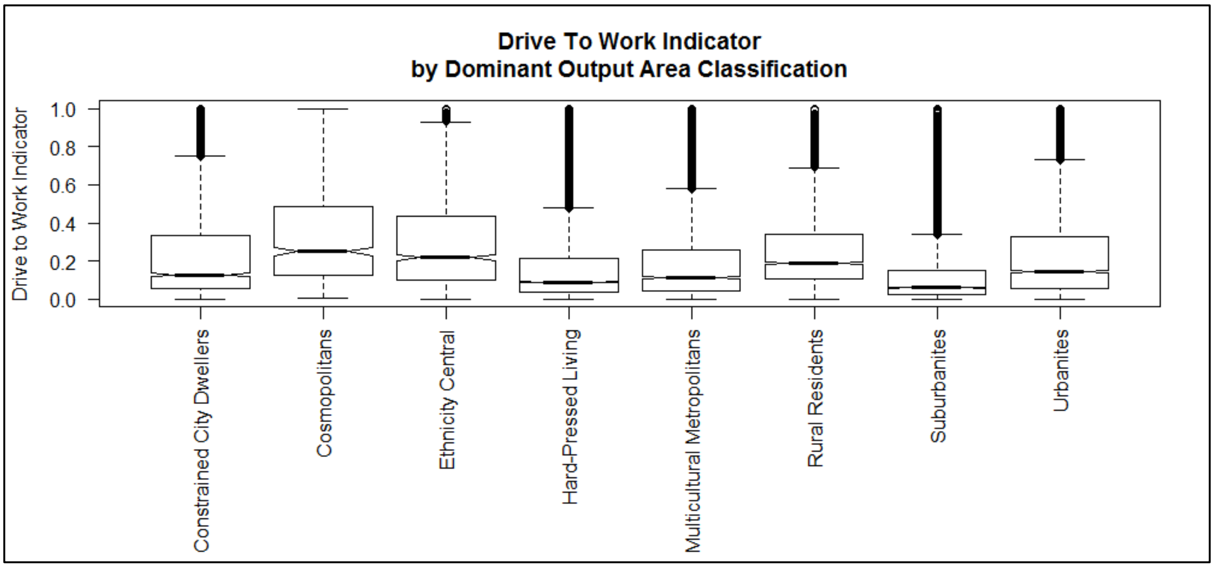

Figure 11: Drive to work indicator by ONS area classification supergroup

Discussion

Previous work has explored the relevance of income and urban-rural classifications on motoring expenditure (Chatterton et al., 2016). This paper takes that analysis further through the use of the ONS area classification, which incorporates a mix of geographic, structural and cultural factors.

Figure 12 shows how for each supergroup there is a different relationship between absolute fuel expenditure and the use of cars for work versus other uses. In the top left-hand corner of the plot, Cosmopolitan areas have a tendency to spend less on fuel whilst using a greater proportion of their mileage on getting to and from work. In contrast, at the other ends of the spectrum, Surburbanite areas spend more on fuel but use their cars less for work, and Rural Residents spend more on fuel but lie somewhere in the middle in terms of their usage of cars for commuting.

These may reflect both structural accessibility issues and social/cultural preferences, with Rural Residents facing longer (and more car dependent) distances to both employment opportunities and other services than Cosmopolitans, whilst Surburbanites may have either shorter car journeys or non-car options for work journeys, but choose, say, to visit a diverse range of locations for shopping and leisure.

If, instead of looking at actual expenditure on fuel, we examine average household expenditure (for households with cars) as a proportion of median income for each LSOA (Figure 13), we can see a change in the pattern emerging. Here we see that the financial implications of motoring are greater for Constrained City Dwellers and Hard Pressed Living areas than they are for Rural Resident areas.

The results shown in Figure 13 indicate that at the area classification level, there tends to be a negative relationship between the proportion of income spent on motoring and the proportion of mileage used for commuting (i.e. those areas that use their cars *most* for driving to work, actually spend *less* of their income on fuel costs).

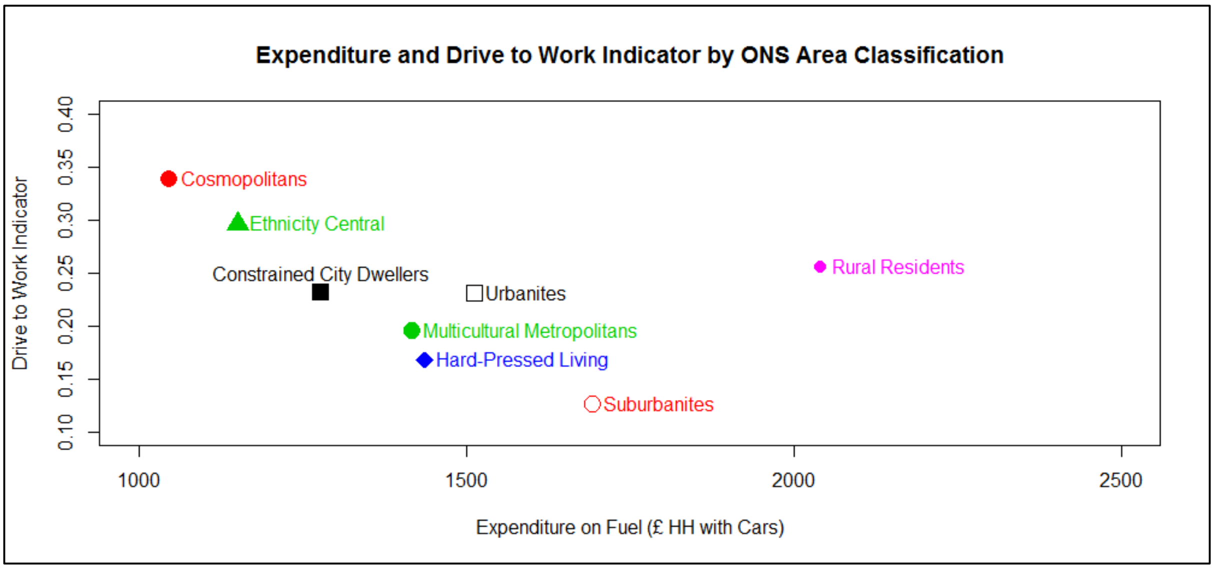

Figure 12: Average household expenditure (HH with cars) and Drive to Work indicator by ONS supergroup

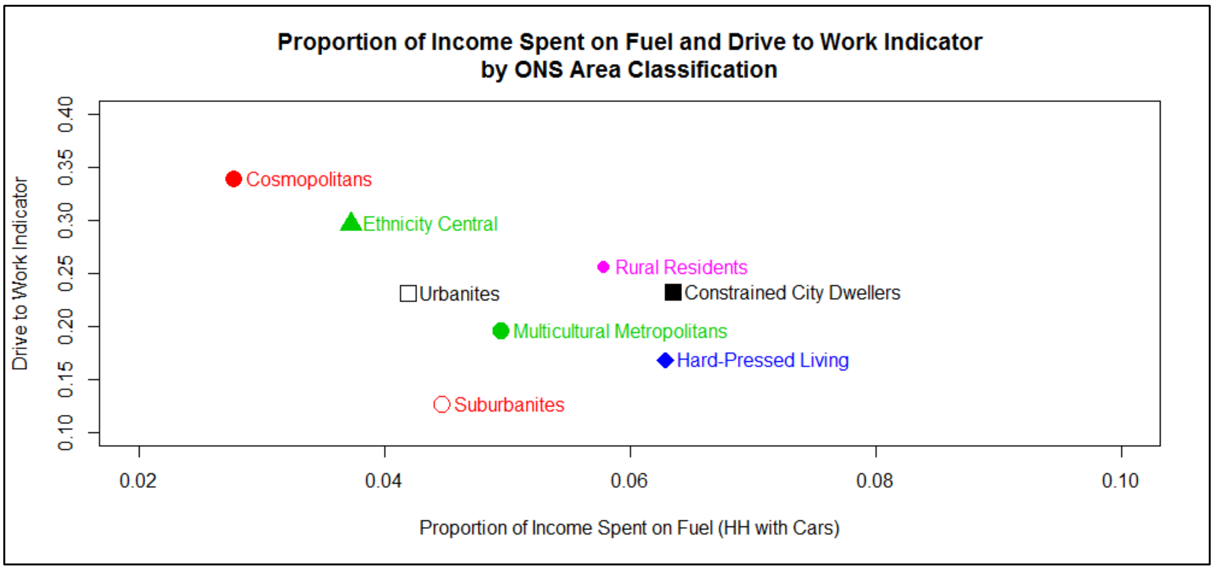

Figure 13: Proportion of income spent on road fuel (HH with cars) and Drive to Work indicator by ONS supergroup

Conclusions

The work presented in this paper represents a preliminary attempt to use the new MOT dataset to explore the financial impacts of motoring, not just in terms of impact on different income groups, or in urban vs rural locations (as discussed in Chatterton et al., 2016), but through using an area classification that describes more subtle patterns of location and socio-economic characteristics.

This paper has also involved the novel step of applying the Census travel to work data to calculate an indicator figure to represent drive to work car mileage as a proportion of the total mileage of cars registered in an area, rather than for other journey purposes. In doing this, we acknowledge that the notion of a single journey purpose may be less relevant now than it has been in the past, with increases in multi-destination journeys through trip-chaining.

In designing policy measures to address motoring costs, policy-makers concerned about 'hard working families' will therefore need a careful understanding of how different groups would be affected, since those who drive the most, or who drive the most for work, are not necessarily those who are most affected by motoring costs.

We acknowledge the limitations of any analysis that is undertaken on the basis of area level aggregations, particularly one that involves aggregation across such a range of parameters as vehicle ownership and use, fuel consumption, income and social profiling. However, the ability to undertake spatial analysis at relatively fine scale across the entire country provides an important complementary context for understanding the activities of individual households in relation to other currently available information from sources such as the National Travel Survey or Living Costs and Food Survey.

Future work will involve exploring the actual mileages travelled by different groups, along with a greater investigation of the impact of differential levels of car ownership between the groups. Variations in both VED and depreciation costs will also be explored along with other vehicle parameters in order to unpack whether there are any vehicle purchasing preferences that appear to be having an impact on the fuel costs in addition to the distances driven (although initial work

(Chatterton et al., 2015) has suggested that, in terms of exhaust emissions, mileage has a much greater impact than the efficiency or cleanliness of the engine).

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MOT Project website http://www.MOTproject.net

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Annex 1: Pen portraits for ONS Output Area Classification Supergroups
Reproduced from ONS (2015)

1 – Rural residents
The population of this supergroup live in rural areas that are far less densely populated compared with elsewhere in the country. They will tend to live in large detached properties which they own and work in the agriculture, forestry and fishing industries. The level of unemployment in these areas is below the national average. Each household is likely to have multiple motor vehicles, and these will be the preferred method of transport to their places of work. The population tends to be older, married and well educated. An above average proportion of the population in these areas provide unpaid care and an above average number of people live in communal establishments (most likely to be retirement homes). There is less ethnic integration in these areas and households tend to speak English or Welsh as their main language.

2 – Cosmopolitans
The majority of the population in this supergroup live in densely populated urban areas. They are more likely to live in flats and communal establishments, and private renting is more prevalent than nationally. The group has a high ethnic integration, with an above average number of residents from EU accession countries coinciding with a below average proportion of persons stating their country of birth as the UK or Ireland. A result of this is that households are less likely to speak English or Welsh as their main language. The population of the group is characterised by young adults, with a higher proportion of single adults and households without children than nationally. There are also higher proportions of full-time students. Workers are more likely to be employed in the accommodation, information and communication, and financial related industries, and using public transport, or walking or cycling to get to work.

3 – Ethnicity central
The population of this group is predominately located in the denser central areas of London, with other inner urban areas across the UK having smaller concentrations. All non-white ethnic groups have a higher representation than the UK average especially people of mixed ethnicity or who are Black, with an above average number of residents born in other EU countries. Residents are more likely to be young adults with slightly higher rates of divorce or separation than the national average, with a lower proportion of households having no children or non-dependent children. Residents are more likely to live in flats and more likely to rent. A higher proportion of people use public transport to get to work, with lower car ownership, and higher unemployment. Those in employment are more likely to work in the accommodation, information and communication, financial, and administrative related industries.

4 – Multicultural metropolitans
The population of this supergroup is concentrated in larger urban conurbations in the transitional areas between urban centres and suburbia. They are likely to live in terraced housing that is rented – both private and social. The group has a high ethnic mix, but a below average number of UK and Irish born residents. A result of this is that households are less likely to speak English or Welsh as their main language. Residents are likely to be below retirement age. There is likely to be an above average number of families with children who attend school or college, or who are currently too young to do so. The rates of marriage and divorce are broadly comparable with the national average. The level of qualifications is just under the national average with the rates of unemployment being

above the national average. Residents who are employed are more likely to work in the transport and administrative related industries. Public transport is the most likely method for individuals to get to and from work, since households are less likely to have multiple motor vehicles available to them.

5 – Urbanites
The population of this group are most likely to be located in urban areas in southern England and in less dense concentrations in large urban areas elsewhere in the UK. They are more likely to live in either flats or terraces, and to privately rent their home. The supergroup has an average ethnic mix, with an above average number of residents from other EU countries. A result of this is households are less likely to speak English or Welsh as their main language. Those in employment are more likely to be working in the information and communication, financial, public administration and education related sectors. Compared with the UK, unemployment is lower.

6 – Suburbanites
The population of this supergroup is most likely to be located on the outskirts of urban areas. They are more likely to own their own home and to live in semi-detached or detached properties. The population tends to be a mixture of those above retirement age and middle-aged parents with school age children. The number of residents who are married or in civil-partnerships is above the national average. Individuals are likely to have higher-level qualifications than the national average, with the levels of unemployment in these areas being below the national average. All non-White ethnic groups have a lower representation when compared with the UK and the proportion of people born in the UK or Ireland is slightly higher. People are more likely to work in the information and communication, financial, public administration, and education sectors, and use private transport to get to work.

7 – Constrained city dwellers
This supergroup has a lower proportion of people aged 5 to 14 and a higher level aged 65 and over than nationally. It is more densely populated than the UK average. People are more likely to be single or divorced. There is a lower representation of all the non-White ethnic groups and of people who were born in other EU countries. There is a lower proportion of households with no children. Households are more likely to live in flats and to live in social rented accommodation, and there is a higher prevalence of overcrowding. There is a higher proportion of people whose day-to-day activities are limited, and lower qualification levels than nationally. There is a higher level of unemployment in the supergroup. There are no particular industries in which workers are most likely to be employed, but some industries such as information and communication, and the education sector are underrepresented.

8 – Hard-pressed living
The population of this group is most likely to be found in urban surroundings, predominately in northern England and southern Wales. There is less non-White ethnic group representation than elsewhere in the UK, and a higher than average proportion of residents born in the UK and Ireland. Rates of divorce and separation are above the national average. Households are more likely to have non-dependent children and are more likely to live in semi-detached or terraced properties, and to socially rent. There is a smaller proportion of people with higher level qualifications, with rates of unemployment above the national average. Those in employment are more likely to be employed in the mining, manufacturing, energy, wholesale and retail, and transport related industries.