What scope for boosting bus use?

An analysis of the Intrinsic Bus Potential of local authority areas in England

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Urban Transport Group
Wellington House
40-50 Wellington Street
Leeds – LS1 2DE
0113 251 7445
info@urbantransportgroup.org

transport for quality of life

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Report for Urban Transport Group by Lynn Sloman and Sally Cairns of Transport for Quality of Life.

Contact Lynn Sloman, lynn@transportforqualityoflife.com, 01654 781358

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The approach reported here was developed from approaches used for the MOT EPSRC project (EP/K000438/1) and work for the Department for Transport on cycling and walking.

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Foreword

Given the general decline in bus use, the Urban Transport Group is undertaking a research programme into the key factors that are driving bus patronage trends.

In January 2019, we published a report called What's driving bus patronage change? This set out all the potential factors at play and drew some initial conclusions on the common features of areas where bus use is high, or growing, or both.

In order to test these conclusions, and deepen our understanding of the drivers of bus patronage, we commissioned Transport for Quality of Life to undertake further research. This follows on from a similar exercise that Transport for Quality of Life has undertaken for the Department for Transport on active travel. It looks in more detail at the reasons why bus use is higher in some areas than in others, including socio-economic and demographic factors, and considers how much the 'history' of an area (and any pre-existing culture of bus use) may play a part. It also looks in detail at case study areas where bus use is higher than expected, and suggests reasons why these areas may be doing well.

The findings of the research have some important implications for policy-makers. Although they confirm that underlying socio-economic and demographic factors are important determinants of levels of bus use, they suggest that a pre-existing culture of bus use and strong pro-bus policies can both make a significant difference. However, the (limited) variation in currently observed levels of bus use suggest that the existing policy framework is inadequate. Wishful thinking, exhortation and tinkering at the margins will simply not be enough to reverse the overall national decline in bus use.

Given the important role that local public transport could play in reducing transport carbon emissions, much more substantive sustainable transport policies will be needed, if we are to rebuild a culture of bus use for the low or zero-carbon city regions of the twenty-first century. This, in turn, will require substantially increased funding for bus services, giving support to the case for bus funding reform. In recent years, all the main forms of national support for bus services have been reduced which, in turn, has contributed to significant reductions in service levels. Without reformed and increased funding for bus services, this analysis suggests that bus use will continue to decline and it will be difficult for areas to achieve, still less to exceed, their intrinsic potential for bus use.

Jonathan Bray

Director, Urban Transport Group

Executive Summary

The demographic, socio-economic and structural characteristics of an area, including age structure, population density, housing and distances to work, have a strong impact on levels of bus use.

Six factors can be combined to predict nearly 85% of the variability in commuter bus use between local authority areas, and to define the **'Intrinsic Bus Potential'** (IBP) of a local authority area. Areas with a high IBP can be considered "good bus territory".

For any particular level of IBP, bus commute mode share varies by about 8%-points between the 'best-performing' and 'worst-performing' local authority areas.

There is a close correlation between IBP and levels of **bus service provision**. This is not surprising, since in areas with high intrinsic potential for bus use, operators are likely to provide more bus services in order to meet demand.

However, combining levels of bus provision with IBP provides slightly more explanatory power for the variation in bus use than IBP on its own. The combination of IBP and measures of public transport provision can explain over 88% of the observed variability in bus use between local authorities. This means that, other things being equal, better bus services result in increased bus use.

The research identified 25 local authority areas that had significantly higher levels of bus use than expected from their IBP. The selected areas were the ones where bus use exceeded the predicted level by at least 3%-points, or was the highest in its IBP-decile group, or both. In these areas, factors that may be at play include:

- **A pre-existing culture of bus use** that has been maintained over a long period. Examples include Newcastle and Nottingham.
- High levels of **bus provision** (for example in Nottingham, Hackney and Southwark).
- **Bus regulation** in London, which created the right conditions for substantial bus service improvements from 2000 (following the formation of Transport for London), including relatively low fares.
- A **'pro-bus' local context**, in which operators or the local authority (or both) have invested resource, research and development and management focus to ensure the bus 'product' is well-matched to the local market; and use of the private car is restricted or expensive (or both). Examples include Brighton and Reading.
- **Local factors**: for example both Hackney and Southwark outperform their IBP, but at the time of the last census, their rail connectivity was relatively poor for London.
- A **'halo effect',** in which some relatively rural areas with low bus potential that are close to a city with a strong economy have significantly higher levels of bus use than their IBP would predict. Examples include areas close to Brighton, Oxford and Nottingham.

There are several policy implications of the analysis:

- City regions have higher Intrinsic Bus Potential than smaller towns and rural areas, and consequently also have higher levels of bus use. City regions are therefore also the places where investment in bus services is likely to result in the greatest increase in passenger numbers, because they contain a high proportion of people who are likely to

be receptive to bus service improvements. Places with a high IBP but lower-than-expected bus use may have particularly good opportunities to achieve rapid change.

- The significance of the Index of Multiple Deprivation as a predictor of high bus use (both by itself, and as part of the IBP) underlines the important role of bus services in enabling the less well-off to get to work and to fully participate in society, and hence the key role of buses in maintaining social cohesion.
- City regions are rightly pursuing policies to raise incomes and tackle poverty, but these policies could lead to lower levels of bus use (and consequently more car use, carbon emissions and congestion) unless undertaken in parallel with policies to make bus travel more attractive.
- Even the best performing areas are outperforming their IBP by relatively modest percentages (and many are still experiencing a significant year-on-year net decline in bus use, not least due to reductions in services caused by funding cuts, or increases in fare levels relative to the costs of car use). It is clear that if significantly increased bus use is the aim, which is highly likely in any credible national or city region plan for Net Zero carbon emissions, then far more substantial interventions will be needed. These measures might include a combination of making it more difficult or more expensive (or both) to use private cars in urban centres, lower fares and/or an extension of free bus travel to more groups, bus regulation and comprehensive bus networks, and changes to land use planning.

1. Introduction

1.1. UTG commissioned this analysis from Transport for Quality of Life as part of its on-going research into what is driving bus patronage trends. It follows on from a recent UTG report[1] which explored a range of factors relevant to bus patronage decline, under the themes of social and economic change; alternatives to the bus; and public attitudes to bus travel; as well as looking at common factors in areas where bus use is high or is growing.

1.2. The purpose of this report was to explore in more detail why bus use varies at the local authority district (LAD) level. How much is this because some areas are simply “better bus territory” than others? And how much is it because of variation in the service “offer”, in areas that are otherwise fairly similar?

1.3. The analysis builds on work for the Department for Transport (DfT), which identified factors that explain the variation in the amount of walking and cycling at LAD level, and combined these factors to measure the ‘Intrinsic Cycling Potential’ and ‘Intrinsic Walking Potential’ of every LAD[2]. It also builds on a research council project which aimed to understand and predict levels of car ownership and use at smaller geographical scales, and, in part, to understand how far these were related to public transport provision[3].

1.4. This report is structured as follows:

- Sections 2 and 3 describe the data that has been used to explain variation in bus use;
- Section 4 identifies the underlying characteristics that, when combined, offer the best explanation for variations in bus use between LADs, and uses this to define ‘Intrinsic Bus Potential’;
- Section 5 examines how much of the remaining (unexplained) variation in bus use can be accounted for by a measure of bus service provision;
- Section 6 looks at the LADs that have bus use that is higher than predicted by their Intrinsic Bus Potential;
- Section 7 examines historic change in bus use at the LAD-level;
- Section 8 describes case study areas where bus use is higher than predicted, to illustrate the findings from the statistical analysis;
- Section 9 summarises and discusses the findings.

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[1] Bray J and Bellamy S (2019) What’s driving bus patronage change? An analysis of the evidence base. UTG, Leeds. [What’s driving bus patronage change? An analysis of the evidence base]

[2] This work was part of a project to develop a Cycling and Walking Investment Strategy Model, which calculates by how much it is possible to increase cycling and walking nationally by applying varying levels of expenditure under a range of policy scenarios. The project was undertaken for DfT by Transport for Quality of Life, AECOM and Arup. Reference material will be published later in 2019/20.

[3] The MOT project (EP/K000438/1), funded by the UK Engineering and Physical Sciences Research Council under the Research Councils UK Energy Programme. This project was led by Prof Jillian Anable at the University of Leeds, and also involved TRL, University of the West of England, University of Bristol, University College London and University of Aberdeen. Project outputs can be found at [MOT Project].

2. Bus use data

2.1. Data on bus use is available either from DfT Annual Bus Statistics (two sources, one from local authorities and the other from bus operators), or from the Census.

2.2. DfT Annual Bus Statistics are more up-to-date and comprehensive in terms of travel purposes than the Census, but they are only available at the relatively coarse-grained level of local transport authorities. This means that data is only reported for the whole of Greater Manchester, West Midlands etc., rather than for their constituent districts, and no data are available for towns in two-tier areas (e.g. Northampton, Lincoln etc.) where the County Council is the local transport authority. In addition, many of the variables used for our analysis are only available from the 2011 Census, requiring analogous 2011 data, and meaning that more up-to-date bus statistics could not be used anyway.

2.3. However, there are two potential issues with using Census data. The first is that the Census only records the proportion of *commuter* trips that are made by bus, and does not include bus trips for other purposes (shopping, leisure etc.). This raises the question of whether Census data for bus commute mode share provides a good enough indication of overall levels of bus use to be suitable for our analysis.

2.4. Figure 1 shows that, for those areas for which both Census data and Annual Bus Statistics are available, bus commute mode share correlates well with bus passenger journeys per capita (for all trip purposes). We therefore decided that in order to identify the underlying factors that contribute to Intrinsic Bus Potential, it was acceptable to use bus commute mode share as a proxy for overall bus use. We revisit this issue at the end of section 4.

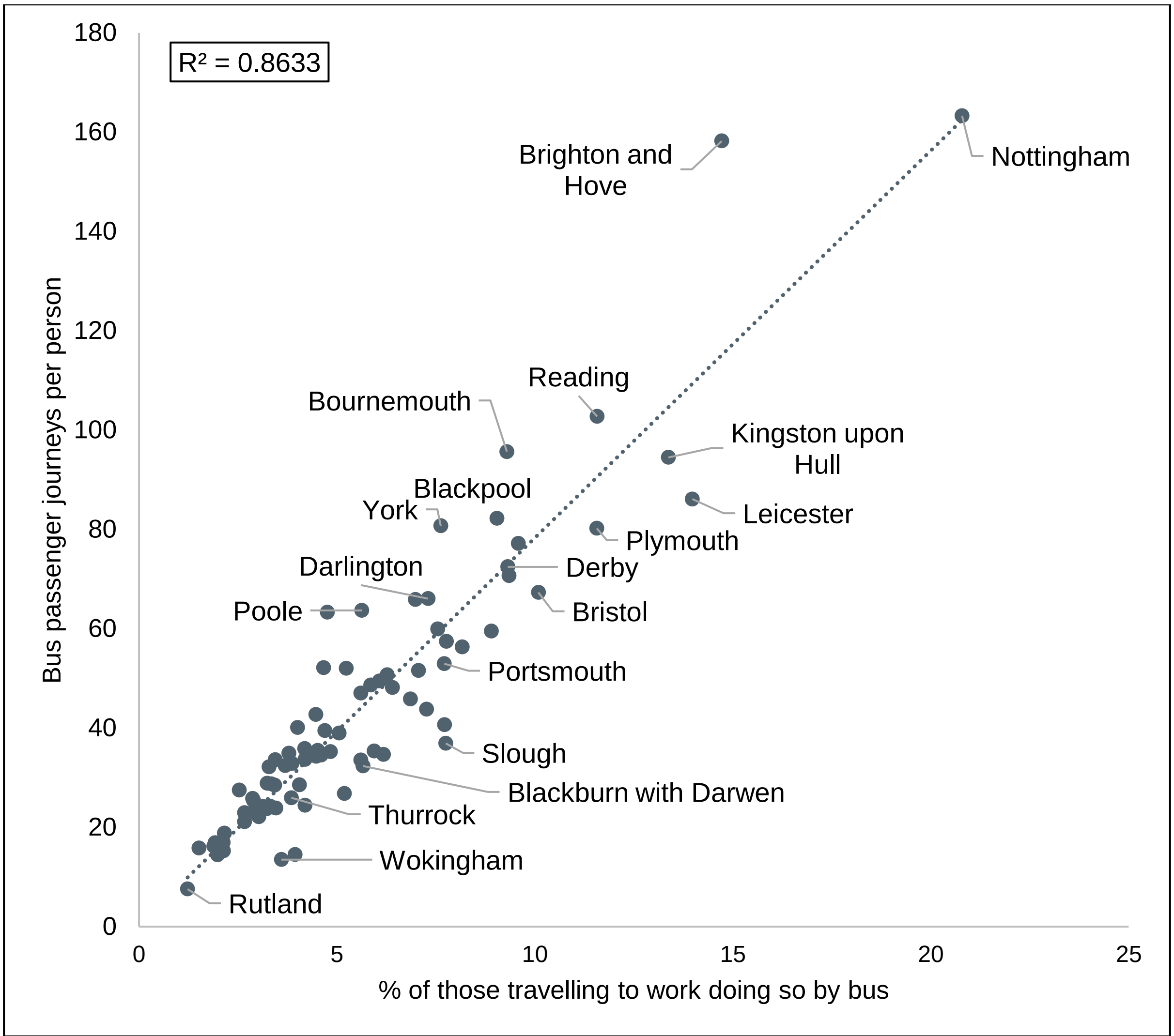
2.5. The second issue is that changes since 2011 in bus use, and in the underlying characteristics of local authorities, may mean that using data from that time produces conclusions that are no longer relevant. However, between 2011 and now, most changes are likely to have been fairly small. Reassuringly, there is a very strong relationship between the number of bus passenger journeys per person in each LAD in 2011/12 and 2017/18 (according to DfT Annual Bus Statistics). Taking out the four areas where bus use increased most during that time (in part due to pro-bus policies), 98% of the variability in local transport authority levels of bus use in 2017/18 can be predicted from 2011/12 data[4].

2.6. Consequently, it was decided that use of 2011 data was valid, and, for each LAD, the proportion of people travelling to work by bus, minibus or coach was calculated from Census Table QS701, as the share of all those travelling to work[5]. Changes in bus use since 2011 are discussed further in section 7.

[4] Bus passenger journeys per person from DfT Annual Bus Statistics BUS0110a (bus operator data) were compared for 2011/12 and 2017/18. For all 89 local transport authorities, the relationship was relatively strong ($R^2 = 0.95$). If Reading, Brighton & Hove, Bath & North East Somerset and Bristol are excluded (the four areas with the greatest increase in bus use over that time), the relationship becomes even stronger ($R^2 = 0.98$).

[5] People working from home were *not* included in the denominator. People whose mode of transport was recorded as ‘other’ *were* included in the denominator.

Figure 1: Relationship between overall bus use and bus commuting



Data sources: Bus passenger journeys per person from DfT Annual Bus Statistics BUS0110a (bus operator data); percentage of those travelling to work doing so by bus from 2011 Census (table QS701). Sample: 82 transport authorities. The DfT statistics contain information for 89 areas, of which six are the Integrated Transport Authorities of Greater Manchester, West Midlands, South Yorkshire, West Yorkshire, Merseyside and Tyne & Wear, and the seventh is London. Census data could not be readily matched to these seven areas and has been excluded from this plot.

3. Explanatory factors for "good bus territory"

3.1. There are a large number of underlying characteristics of a local authority that might be expected to influence how much its inhabitants travel by bus. We considered data relating to:

- Distances travelled to work;
- Employment structure (including measures of social class, the proportion of students and working patterns);
- Population structure (age and gender);
- Urban structure and economics (including density, housing type and ownership, and deprivation);
- Levels of car ownership;

- Traffic conditions;
- Geography (rainfall and hilliness).

3.2. Table 1 outlines the factors considered, the data sources used, and the correlation coefficients between bus mode share for commuting and each of the factors, as calculated using data for 324 local authority districts[6]. The correlation coefficients[7] provide an indication of the relative strength of the relationship between bus mode share for commuting and each of the explanatory factors – i.e. the larger the magnitude of the values (either positive or negative), the stronger the relationship.

Table 1: Potential explanatory factors for bus use

Grey shading indicates that the relationship with bus mode share for commuting was not significant at the 99% confidence level (p>0.01, n=324)

Correlation coefficient	Measure	Source
Distance to work		
-0.71	Avg distance to work (km)	Data from Census table QS702[8]. Percentages calculated as the proportions of all those travelling to work (i.e. excluding those working from home). Those travelling an 'other' distance were also excluded from calculations. Average distance to work also used.
-0.14	% travelling <2km	
0.37	% travelling <5km	
0.67	% travelling <10km	
0.73	% travelling <20km	
0.57	% travelling 5 to <10km	
-0.25	% travelling 10 to <20km	
0.77	% travelling 2 - <10km	
0.69	% travelling 2 - <20km	
0.61	% travelling <30km	
0.51	% travelling 2-<30km	
0.48	% travelling <40km	
0.36	% travelling 2-<40km	
Social grade		
-0.12	% AB	Data from Census table QS613. Data relates to the percentage of usual residents aged 16-64 in different social grade bands (having been assigned the approximated social grade of their Household Reference Person).
0.18	% C1	
-0.47	% C2	
0.36	% DE	
-0.40	% C	
-0.05	% ABC1	

[6] The Isles of Scilly and the City of London were removed from the dataset before analysis, given previous experience that their relatively small populations can lead to anomalous results.
[7] Note that whilst correlation coefficients (R-values) provide an initial measure of relationship strength, determination coefficients (R^2-values) are needed to estimate how much the variation in one factor can be predicted from another, and may be different to the value produced by simply squaring the values given here if a non-linear relationship is assumed. P-values are required to indicate whether each relationship is significant (at a given significance level) or could be an outcome of chance.
[8] All Census data is for 2011 and has been obtained from NOMIS: Nomisweb

<table>
<tr><th>Correlation coefficient</th><th>Measure</th><th>Source</th></tr>
<tr><td colspan="3">Employment structure</td></tr>
<tr><td>0.64</td><td>%16-74 full time students</td><td rowspan="4">Data from Census table QS601. Data relates to the percentage of usual residents aged 16-74 who were (in the week before the Census):
• Full time students (economically active or inactive)
• Working full time
• Working part time
• Not in any of the previous three categories

Both employees and self-employed people are included in the full time and part time categories. Full time is (probably[9]) defined as 31+ hours per week.</td></tr>
<tr><td>-0.25</td><td>%16-74 working full time</td></tr>
<tr><td>-0.68</td><td>%16-74 working part time</td></tr>
<tr><td>-0.03</td><td>%16-74 not student or working</td></tr>
<tr><td>0.05</td><td>% Higher managerial, administrative and professional</td><td rowspan="3">Data from Census table QS607. Data relates to usual residents aged 16-74. These have been assigned to the National Statistics Socio-economic Classification (NS-SeC), which provides an indication of socio-economic position based on details of occupation. Percentages are proportions of those recorded in NS-Sec categories 1-7 (excluding category 8 which includes those who have never worked, are long term unemployed or full-time students). In accordance with National Statistics advice[10], the NS-Sec categories have been combined as follows:
• 1+2
• 3+4
• 5+6+7</td></tr>
<tr><td>-0.38</td><td>% Intermediate</td></tr>
<tr><td>0.08</td><td>% Routine and manual</td></tr>
<tr><td colspan="3">Age and gender</td></tr>
<tr><td>0.13</td><td>% 0-17</td><td rowspan="7">Data from Census table KS102. Data relates to the percentage of the usual resident population in different age bands, and the median age for residents in the area.</td></tr>
<tr><td>0.76</td><td>% 18-29</td></tr>
<tr><td>-0.36</td><td>% 30-64</td></tr>
<tr><td>-0.66</td><td>% 65+</td></tr>
<tr><td>0.72</td><td>% 18-64</td></tr>
<tr><td>-0.73</td><td>% 30+</td></tr>
<tr><td>-0.73</td><td>Median age</td></tr>
<tr><td>-0.22</td><td>% female</td><td>Data from Census table KS101. Data relates to the percentage of the usual resident population that is female.</td></tr>
<tr><td colspan="3">Urban structure and economics</td></tr>
<tr><td>0.77</td><td>Population density</td><td>Data from Census table KS101. Data relates to the number of usual residents per hectare.</td></tr>
<tr><td>0.72</td><td>% in terraced housing, flat, maisonette or apartment</td><td>Data from Census table QS401. Data relates to the percentage of the usual resident population in households living in terraced housing (including end terraces), flats, maisonettes or apartments. (Those living in communal establishments are excluded from the figures.)</td></tr>
</table>

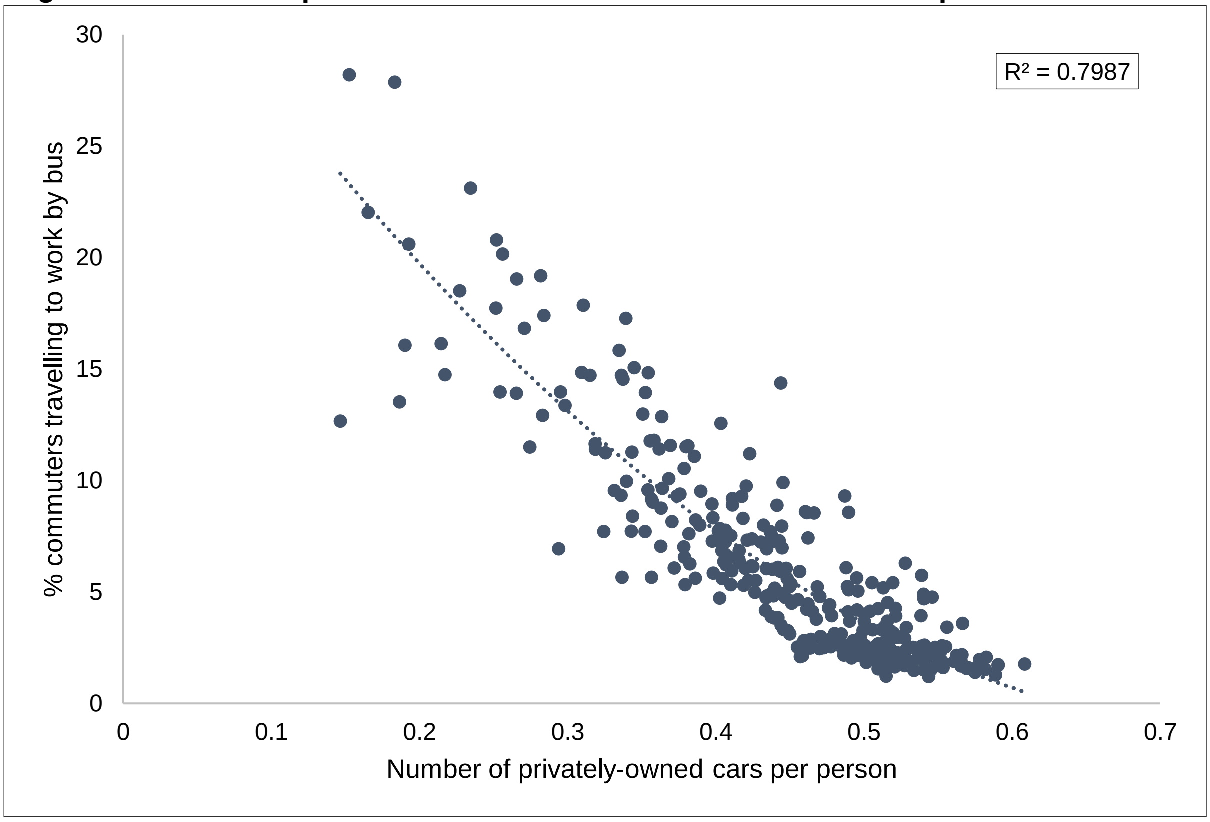
[9] The NOMIS definition for this table does not specify this, but this is the definition used in QS604
[10] See section 7 here: [ONS Socio-economic classification]

Correlation coefficient	Measure	Source
0.81	% in rental accommodation	Data from Census table KS402. Data relates to the percentage of households that are in private or social rental accommodation. (Those living in communal establishments are excluded from the figures.)
0.67	2010 IMD score	The local authority district average score for the Index of Multiple Deprivation (from the 'English indices of deprivation 2010: local authority summaries' file[11]).
0.02	Gross disposable household income per person	2011 data taken from the local authority gross disposable household income dataset produced by the ONS[12].
-0.10	Mean total weekly income per household	2011 data taken from the small area income estimates produced by ONS[13]. The mean value for MSOA values within each local authority district was calculated and used[14].
-0.16	Mean net weekly income per household after housing costs (equivalised)	
Car ownership		
0.87	% households without cars	Data from Census table KS404. Data relates to the percentage of households with no cars. (Those living in communal establishments are excluded from the figures.)
-0.88	Cars per person	Data on the number of private cars in each local authority district in 2011 kindly supplied by DfT[15], which has then been divided by the usual resident population.
Traffic conditions		
0.76	2011-12 journey times for all traffic	Data from DfT table CGN0201b[16]. Data are for weekday morning peak (7-10am) average journey times on locally-managed A-roads, in minutes per mile, in 2011/12.
Geography		
-0.15	Measure of hilliness	Data downloaded from the Propensity to Cycle Tool website. Values are described as giving 'the average fast route gradient (%) of commute trips in the relevant zone with fast route distance <10km'.[17]
-0.06	Rainfall	Data generated from Met Office information about average April rainfall between 1981- 2010. MSOA values produced by Ian Philips at the University of Leeds as part of the MOT research project[18]. For this work, local authority district values were generated as the mean of the relevant MSOA values.

11 Indices of deprivation 2010
12 ONS Gross disposable household income
13 ONS Small area income estimates
14 Arguably, population-weighted average values would produce slightly more accurate figures.
15 Data received 12th June 2018, personal correspondence in relation to CWIS model.
16 DfT Congestion Statistics
17 Data downloaded 8th May 2018 from PCT. Note that current values downloadable from the PCT website differ from the ones used here.
18 Met Office 5km – 5km gridded data, supplied through the MetOffice data portal, was assigned to MSOA centroids using the Extract Data to Points tool in ESRI ARCGIS 10.2. Use of Met Office data contains public sector information licensed under the Open Government Licence v1.0.

3.3. As Table 1 shows, there is a close relationship between levels of bus use and levels of car ownership. This relationship is illustrated in Figure 2. It is possible to predict 80% of the variability in bus use from the number of cars owned per person alone.

Figure 2: Relationship between bus use and levels of car ownership

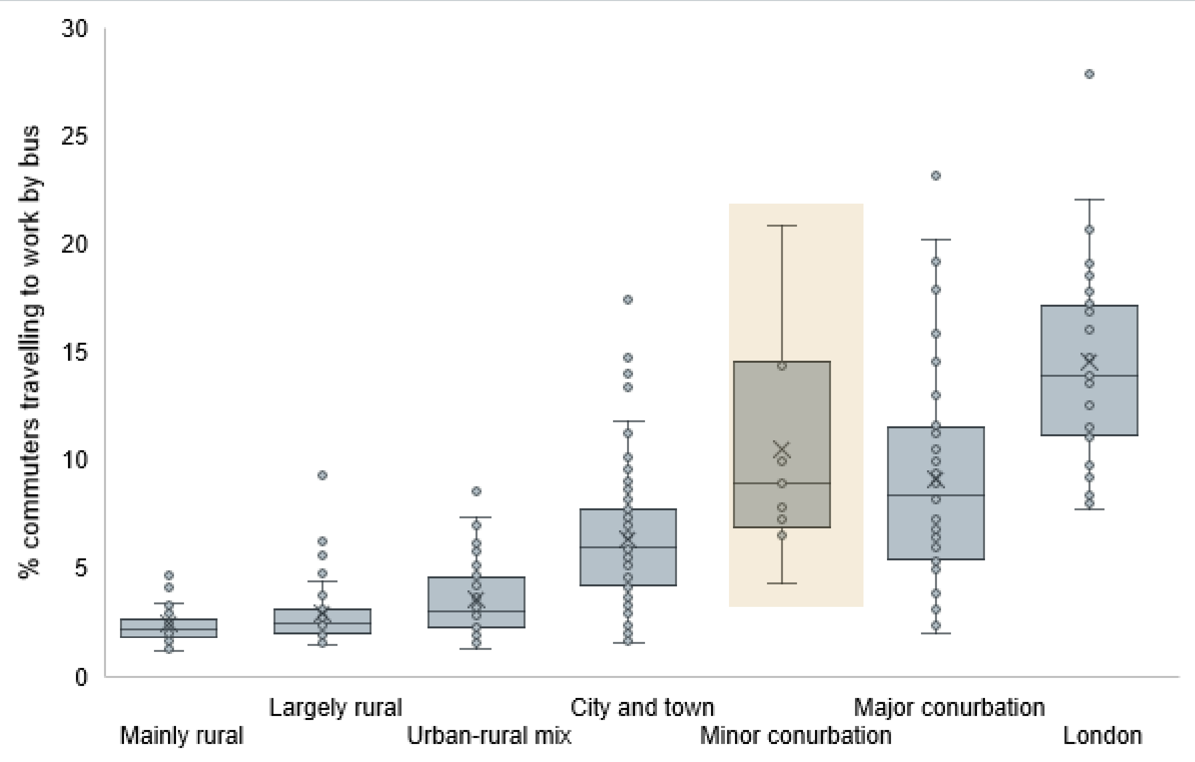


Sample: 324 local authority districts

3.4. There are also strong relationships with a number of other characteristics including distances to work, age structure, population density and housing – whilst, of course, many of these characteristics are also related to each other. For example, measures of car ownership are usually related to measures of urban structure.

3.5. As one check on the significance of urban structure, levels of bus use in different types of areas as defined by the Rural-Urban Classification (produced by the Office for National Statistics) were considered. The results are shown in Figure 3. This shows that urban areas typically have higher levels of bus use than rural areas, as would be expected. It is also notable that London local authorities have higher levels of bus use than other LADs that are part of major conurbations. However, there is also considerable variation within each category, indicating that the degree of urbanisation is only one of a number of factors affecting bus use.

Figure 3: Levels of bus use in different types of urban area



Dots indicate individual LADs, with 324 LADs used in the analysis. Boxes indicate the upper and lower quartiles of the data; central horizontal line indicates the median; and 'X' indicates the mean. The vertical lines extending from the boxes provide a further measure of the distribution of the data[19], with the implication that values beyond these lines are outliers. The LADs with the highest value in each category are, respectively, Copeland/West Oxfordshire/S Norfolk (Mainly rural); Rushcliffe (Largely rural); Lewes (Urban-rural mix); Oxford (City and town); Nottingham (Minor conurbation); Manchester City (Major conurbation excluding London); and Hackney/Southwark (London).

The data for minor conurbations should be treated with caution, as only nine LADs are classified as such, including Nottingham (which affects the top end of the distribution), making this form of presentation less robust for this category.

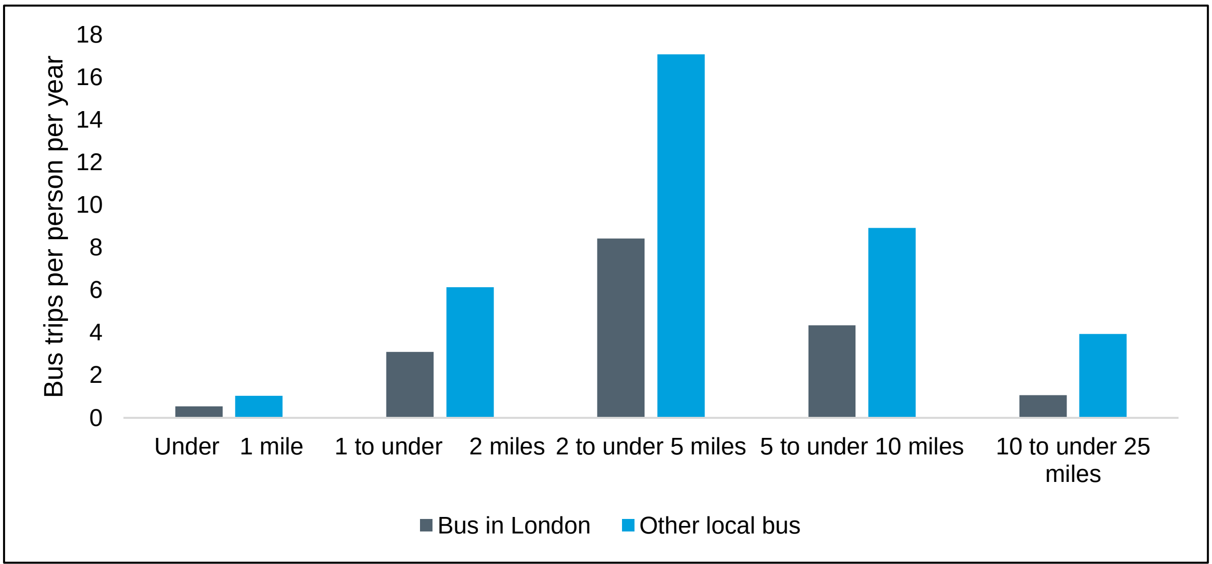
3.6. Corroboration of the importance of some of the factors listed in Table 1 is also available from other sources. For example, Figures 4 and 5 use data from the National Travel Survey to show the relevance of journey distances, and age, to the number of bus journeys made.

3.7. One relatively strong correlation in Table 1 appears counter-intuitive. This is the positive correlation between bus commute mode share and peak-period journey times (for all traffic). This appears, at first sight, to suggest that congestion is good for buses, contrary to experience that passengers do not want slower journeys. However, at the LAD level, longer journey times will simply reflect that an area is more urbanised, with a greater concentration

[19] The whiskers extend up from the top of the box to the largest data element that is *less than or equal to* 1.5 times the interquartile range (IQR) and down from the bottom of the box to the smallest data element that is *larger than or equal to* 1.5 times the IQR. Values outside this range are considered to be outliers and are represented by dots. Excel's automated plotting function does not show dots for the individual points at the end of the whiskers. Hence, for example, a dot for Nottingham (at the top of the minor conurbation whisker) is not shown.

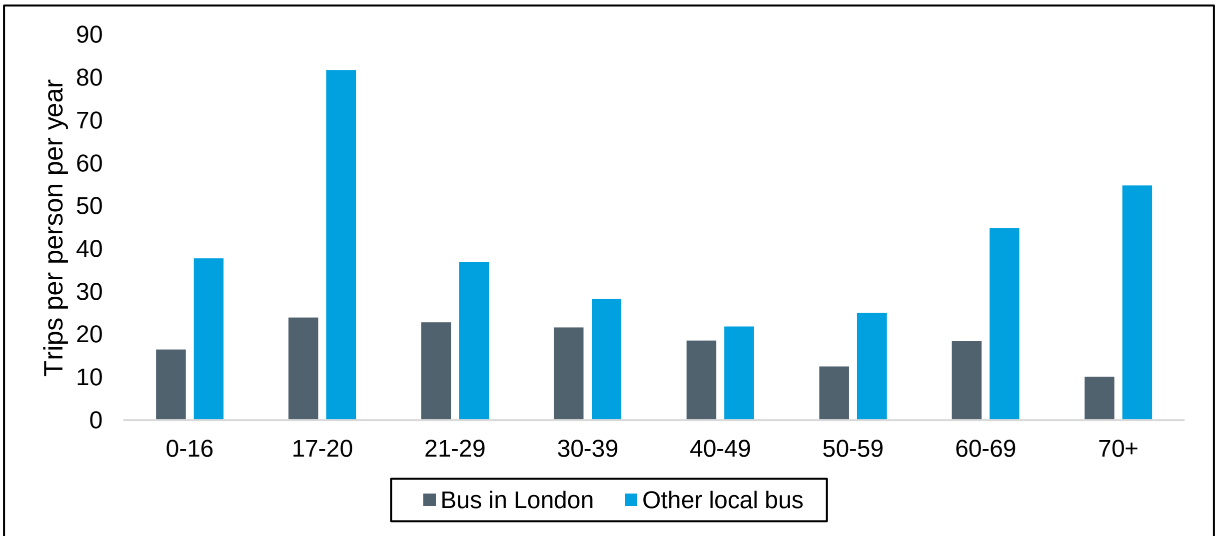
of activity, and it is this indirect effect that is causing the positive correlation. Where bus priority measures give buses an advantage over (relatively slow-moving) other traffic, there might also be a direct effect.

Figure 4: Distribution of bus trip lengths, England 2017



Source: National Travel Survey, table NTS0308[20]. Note that there are no trips of 25 miles or longer by bus in the table. The denominator for both 'bus in London' and 'Other local bus' is the total England population (*not* the London / non-London population).

Figure 5: Levels of bus use by different age groups, England 2017



Source: National Travel Survey, table NTS0601[21]. The denominator for both 'bus in London' and 'Other local bus' is the total England population (*not* the London / non-London population).

[20] NTS03 modal comparisons
[21] NTS03 modal comparisons

4. Defining Intrinsic Bus Potential

4.1. The next stage was to generate an 'Intrinsic Bus Potential' (IBP) factor that could explain as much as possible of the variability in levels of bus use between local authorities, using a combination of *underlying characteristics* that might be expected to influence bus use, but excluding, at this stage, any measures of the quality or amount of bus services.

4.2. The IBP is primarily an analytical tool, to assess how a local authority's bus commute mode share compares with what might be expected from its inherent characteristics. It is important to keep in mind that there are many possible combinations of underlying characteristics that could give reasonably good explanatory power, and an alternative combination might work better for a different time period, or at a different geographical scale. However, it is unlikely that use of a different combination would produce substantially different conclusions for this particular dataset and time period.

4.3. In order to generate our IBP, approximately 150 regression analyses were carried out, using different combinations of the factors listed in Table 1[22].

4.4. The factors finally selected are those that interact with each other in a way that provides the greatest explanatory power, as measured by the R^2-value generated in the regression analyses. As such, they tend to be relatively weakly correlated to each other. (If they were strongly correlated to each other, the degree of additional explanatory power provided by each variable would be small). Note that each individual factor is not necessarily highly correlated (positively or negatively) with bus commute mode share (i.e. the factors chosen are not the ones with the largest correlation coefficients in Table 1).

4.5. There is also a choice as to whether to maximise explanatory power by using as many factors as possible, or to minimise the number of factors for simplicity. Beyond about five or six factors, there are diminishing returns: each extra factor that is added makes a relatively small addition to the explanatory power (with the coefficient of determination increasing by less than 1%).

4.6. After some exploration, the decision was made to exclude car ownership variables, on the basis that it was possible to achieve almost the same level of predictive power from other combinations of variables[23], and since car ownership can arguably be seen as an outcome of underlying characteristics, rather than a causative factor affecting mode use in an area.

4.7. The final combination chosen to create the IBP comprised:

- % households in rental accommodation
- Index of Multiple Deprivation
- Average morning peak journey times

[22] Regressions were conducted in sequence – initially using as many variables as possible, then dropping variables with the least significant coefficients, and running the equations again. The most significant variables were also excluded, and separate regression analyses were run, to try to draw out the importance of secondary measures, and to assess the effects of substituting between particular measures. The process was also reversed, and regressions were run, adding in one variable at a time, to assess whether each provided an improvement in predictive power.
[23] Using a model which included car ownership as well as the final variables chosen would have increased predictive power by only about 1%. The correlation coefficient (R-value) between the final IBP created and cars per person was -0.93.

- The proportion of people travelling 2-20km to work (of those travelling to work)
- % 16-74-year-olds who are full-time students
- % 16-64-year-olds classed as social grade C1

4.8. In combination with other variables, the proportion of people classed as social grade ‘C1’ *or* the proportion of people working full-time and part-time, provided roughly equal explanatory power. We decided to use the ‘C1’ variable because the interaction between the proportion of part-time workers and bus commute mode share may be complex (since the Census records ‘usual’ mode of travel to work and is not weighted by frequency of travel).

4.9. Adding gross disposable household income would produce a slightly better fit. However, we concluded that this was probably acting as a ‘London specific’ measure, rather than as a direct indicator of income. Analysis at County level (excluding the major metropolitan areas) also indicated gross disposable household income was less useful as an economic measure than the Index of Multiple Deprivation – perhaps partly because it does not provide an indicator of the proportion of people who are less well-off in areas that also have people with relatively high incomes (since the incomes of the two groups are averaged together).

4.10. Contrary to our initial expectations, age bands were not used to define the IBP. This is because the proportion of full-time students was largely substituting for the proportion of 18-29 year olds in regression analyses.

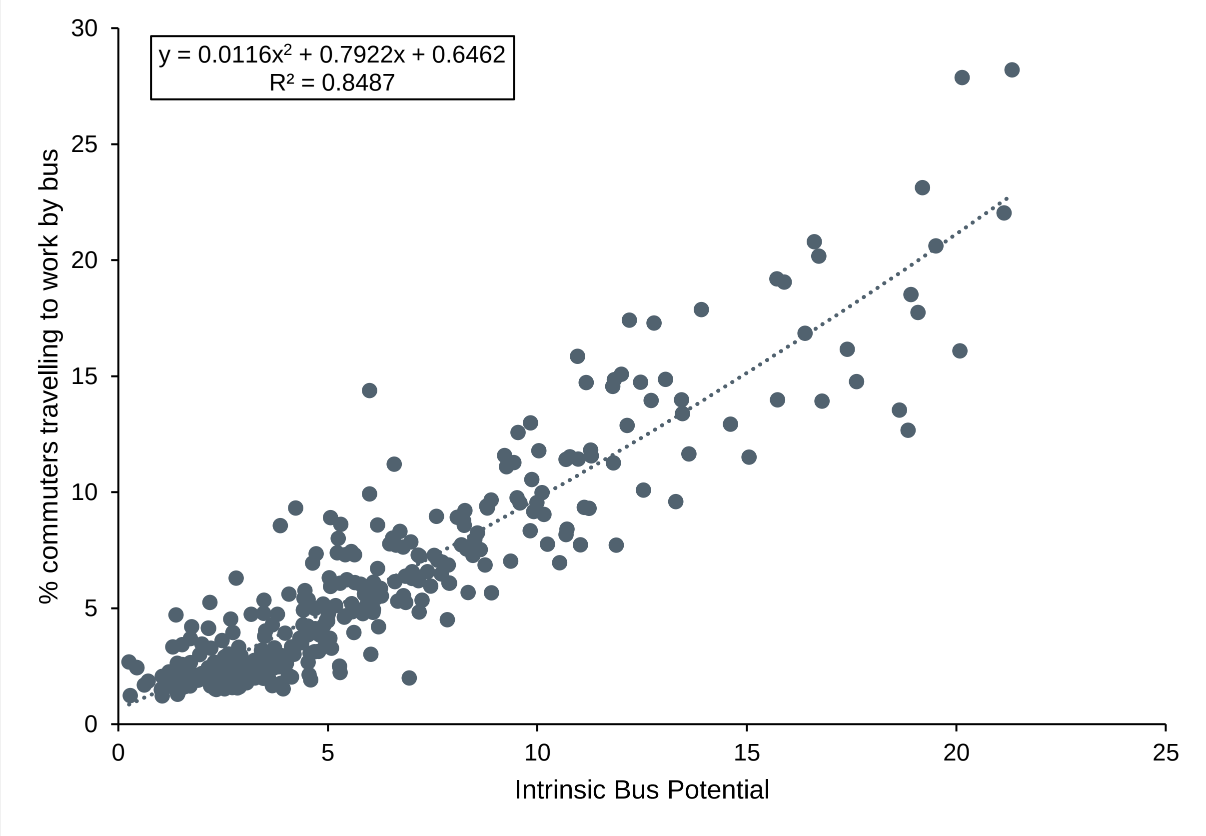
4.11. A linear regression model containing the six factors was able to predict 84.5% of the variability in commuter bus use[24], according to the following relationship:

IBP = 0.132(%rental) + 0.143(IMD) + 0.975(journey times) + 0.153(%2-<20km) + 0.214(% students) + 0.167(C1) - 19.056

4.12. Figure 6 shows the relationship between the measure of Intrinsic Bus Potential that this produces, and the observed levels of bus mode share for commuting. (Note that the R^2 value of the trendline is slightly higher because a non-linear trendline has been plotted.)

[24] Both the overall model and the individual coefficients were statistically significant at the 99% confidence level (p values of all coefficients <0.01; significance of F statistic for overall regression also <0.01; sample 324 local authority districts).

Figure 6: Relationship between Intrinsic Bus Potential and bus use



Sample: 324 local authority districts

4.13. We carried out several checks of the validity of the IBP, in order to understand whether it was (a) an effective predictor of bus use for <u>all journey purposes</u> (not just commuting), and (b) an effective predictor of bus use in <u>different time periods</u> (not just in 2011).

4.14. To carry out the first check, we generated IBP values for county and unitary authorities[25]. These were compared with:

- Census bus mode share for commuting in 2011 (i.e. the same measure as used in the LAD analysis)
- the DfT measure of bus passenger journeys per person in 2011/12 (used in Figure 1)

4.15. The respective coefficients of determination (R^2 values) were 0.82 and 0.67[26]. The fall in R^2 when comparing with the DfT statistics (about bus travel for all purposes) is partly because bus commute mode share (the measure on which IBP is based) takes no account of bus travel by retired people[27]. Another issue with the DfT measure of bus use is that it is derived

[25] We did this for 82 county and unitary authorities (excluding the six Integrated Transport Authorities and London, which cover too large an area for a single figure for the IBP to be meaningful).
[26] Coefficients of determination calculated from the best fit lines between the variables. If assuming linear relationships, the R^2 values are 0.80 and 0.66, with the p-values of the IBP coefficients being <0.01.
[27] Regression using the components of the IBP and the proportion of over 65s in 2011/12 increases the coefficient of determination with the 2011/12 DfT data to 0.74. However, the relationship is

from bus boardings, so where services cover a wider area than one authority, figures 'per capita' may be increased by those boarding services for journeys to the neighbouring authorities. Since the IBP is designed to relate to bus use *by those living in the area*, this will be another reason why it relates less well to the DfT figures.

4.16. To carry out the second check, we looked at the correlation between IBP (using 2011 data) and the 2001 Census data on the share of commuters travelling to work by bus. Although weaker than the relationship with the 2011 Census data (R^2=0.85), it was still relatively strong (R^2=0.75). This drop in R^2 will partly reflect changes in underlying characteristics over time[28].

4.17. Therefore, whilst there are limitations, the relationship between IBP and overall levels of bus use, and between IBP and bus commute mode share at a different date, appears strong enough for us to conclude that IBP is a useful measure of what level of bus use would be expected in a particular area, as a result of its intrinsic characteristics. In other words, the IBP score of an area provides a helpful indicator of whether or not it is "good bus territory".

5. Understanding the significance of public transport provision

5.1. So far, our analysis has focused on the significance of intrinsic characteristics, and not taken any account of the amount of public transport in each LAD. The next stage is to consider the extent to which public transport provision affects bus commute mode share. For this, we used the following datasets:

- DfT accessibility statistics on journey times to reach key services. These are partly a measure of the rurality of an area, with longer journey times to key services in more sparely populated areas. However, they take account of actual public transport journey times from bus and rail timetables and hence provide a (relatively crude) measure of public transport provision.
- Metrics of bus and rail provision developed as part of the MOT research project. Of these, the most useful proved to be 'bus departures per hectare', which is the number of buses stopping at all bus stops in a LAD in a one-week period, normalised to take account of area.

5.2. We used these data because they were the only figures available at LAD level. (Department for Transport statistics on bus provision are only available at the local *transport authority* level.) However, it is clear that they only provide a partial indication of service provision. For example, they do not provide information on fares, reliability or whether services are concentrated on a few 'honeypot' routes or offer a comprehensive network.

5.3. Table 2 indicates the relationship between bus commute mode share and these different measures of public transport provision, as calculated for the 324 LADs. In all cases, data are

complicated as a greater proportion of over 65s in an area may indicate a lower proportion of young people.

[28] As another check on the validity of IBP for different time periods, we looked at how the correlation between IBP and the DfT measure of bus passenger journeys per person changed between 2011/12 and 2017/18 (using the IBP values for county and unitary authorities). R^2 fell from 0.67 in 2011/12 to 0.60 in 2017/18.

for 2011[29]. The relationship between bus commute mode share and one measure of public transport provision, bus departures per hectare, is shown in Figure 7.

5.4. Table 3 indicates the relationship between IBP and measures of public transport provision. The relationship between IBP and bus departures per hectare is shown in Figure 8.

Table 2: Relationship between bus commute mode share and public transport provision

Correlation coefficient	Measure	Source
Department for Transport accessibility statistics		
-0.63	Travel times by walking or public transport to 8 key services	Accessibility statistics are published by DfT. These give travel times to 8 key services (employment centres, primary schools, secondary schools, further education institutions, GPs, hospitals, food stores and town centres) by public transport or walking (where the quicker of the two modes is chosen, albeit that walking is always assumed to take at least 5 minutes and travel times are capped at 120 minutes). Data for 2011 were used. Travel times (in minutes) to the relevant services have been added together to produce an overall metric. Travel times to two sub-clusters of services were also considered: those where services tend to be closest (primary schools and food stores) and those typically located slightly further away (secondary schools and GPs).
-0.54	Travel time by walking or public transport to primary schools/food stores	
-0.58	Travel time by walking or public transport to secondary schools/GPs	
Measures developed in the MOT project		
0.74	Bus departures per person	The NaPTAN (National Public Transport Access Nodes) database provides details of all public transport stops in Britain[30]. Separately, there is a database of all public transport timetable information. Until October 2011, this information was held in the National Public Transport Data Repository (NPTDR)[31]. This has since been replaced with the Traveline National DataSet (TNDS)[32]. Mainstream rail and long-distance coach services were included in the earlier NPTDR, but are not included in the TNDS data. They have also been excluded in this analysis, given the alternative measure of rail provision available (below). Both datasets include information on buses, 'metro' and ferry services. TNDS includes a separate 'underground'
0.45	Ferry and metro departures per person	

[29] The accuracy and reliability of both the DfT accessibility statistics and the underlying datasets used for the MOT project are reported to have improved since 2011. However, 2011 figures have been used here for comparison with the 2011 Census bus commute mode share data.
[30] NaPTAN. Contains public sector information licensed under the Open Government Licence v3.0.
[31] National Public Transport Data Repository Contains public sector information licensed under the Open Government Licence v3.0.
[32] This provides public timetable information for bus, light rail, ferry and tram services in Britain, and is updated on a weekly basis: Traveline National Dataset. Contains public sector information licensed under the Open Government Licence v3.0.

<table>
<tr><th>Correlation coefficient</th><th>Measure</th><th>Source</th></tr>
<tr><td>0.75</td><td>Bus, ferry and metro departures per person</td><td rowspan="4">category. In theory, all underground services were included within the 2011 metro category, although numbers seem low compared with 2016 figures. 2011 NPTDR data for bus, metro and ferry services are reported here, with the exception that 2010 data are used for Southampton, Portsmouth and parts of Hampshire, as recommended by NPTDR given a lack of 2011 data. In 2011, there were 74 LADs where metro or ferry departures were recorded.

In the MOT project, new metrics of public transport provision were generated by linking the stops and timetable information together. This was used to get a measure of the number of weekly service departures taking place from each stop. In 2011, input data was available for about 20,000 services (excluding coach and rail), calling at over 300,000 stops. Data were summed together to give a total value for all the stops in each MSOA[33].

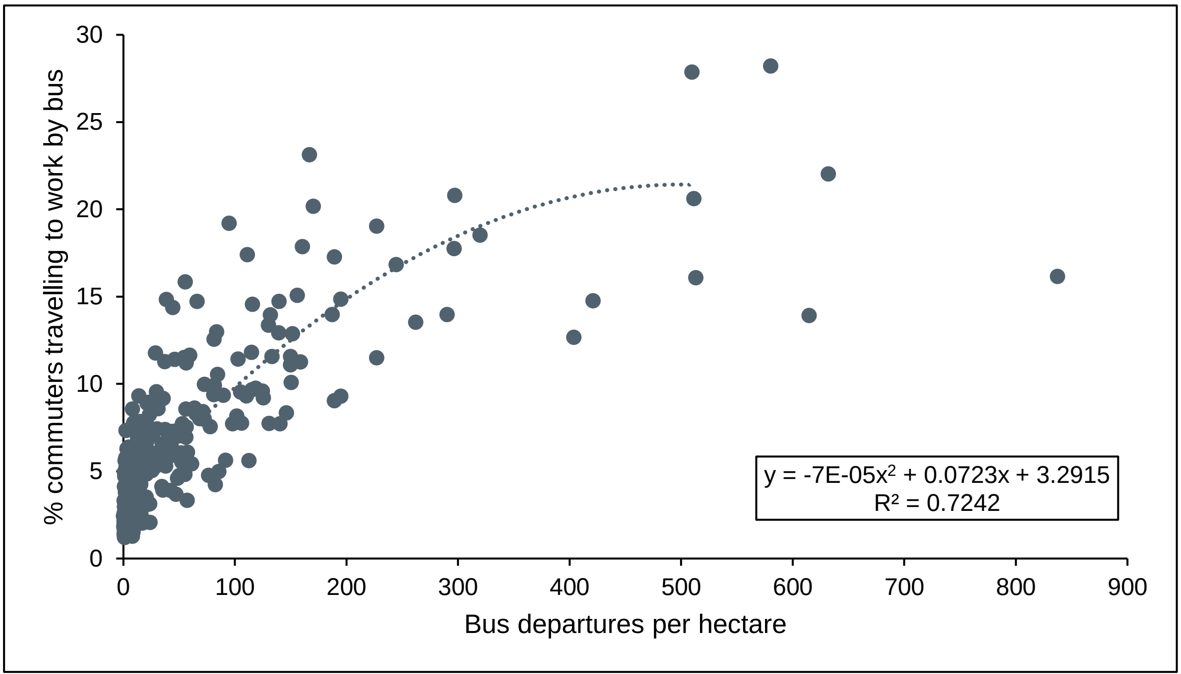
In this project, the MSOA values have then been summed together to produce LAD values, and then divided by the usual resident population, and the area in hectares (taken from Census table KS101), to produce LAD-level public transport provision metrics.</td></tr>
<tr><td>0.76</td><td>Bus departures per hectare</td></tr>
<tr><td>0.38</td><td>Ferry and metro departures per hectare</td></tr>
<tr><td>0.74</td><td>Bus, ferry and metro departures per hectare</td></tr>
<tr><td>0.56</td><td>Rail service indicator</td><td>The Office of Rail and Road (ORR) provides data for Britain about all rail stations' location and usage (in terms of total numbers of passengers entering, exiting or changing[34]). There are about 2,500 stations in total. In the MOT project, this was used to generate MSOA-level rail provision indicators, calculated by looking at all stations within a 30 km radius of each area centroid, using station usage as a proxy for rail station value, and assuming an inverse relationship with the square of the distance (i.e. ∑1/d2*station usage). In this project, the MSOA values calculated using 2011-12 data were averaged for each LAD, to give an indicator of rail provision.</td></tr>
</table>

Table 3: Relationship between IBP and public transport provision

Correlation co-efficient	Measure
0.81	Bus departures per hectare
0.71	Bus departures per person
-0.70	Travel times by walking or public transport to eight key services

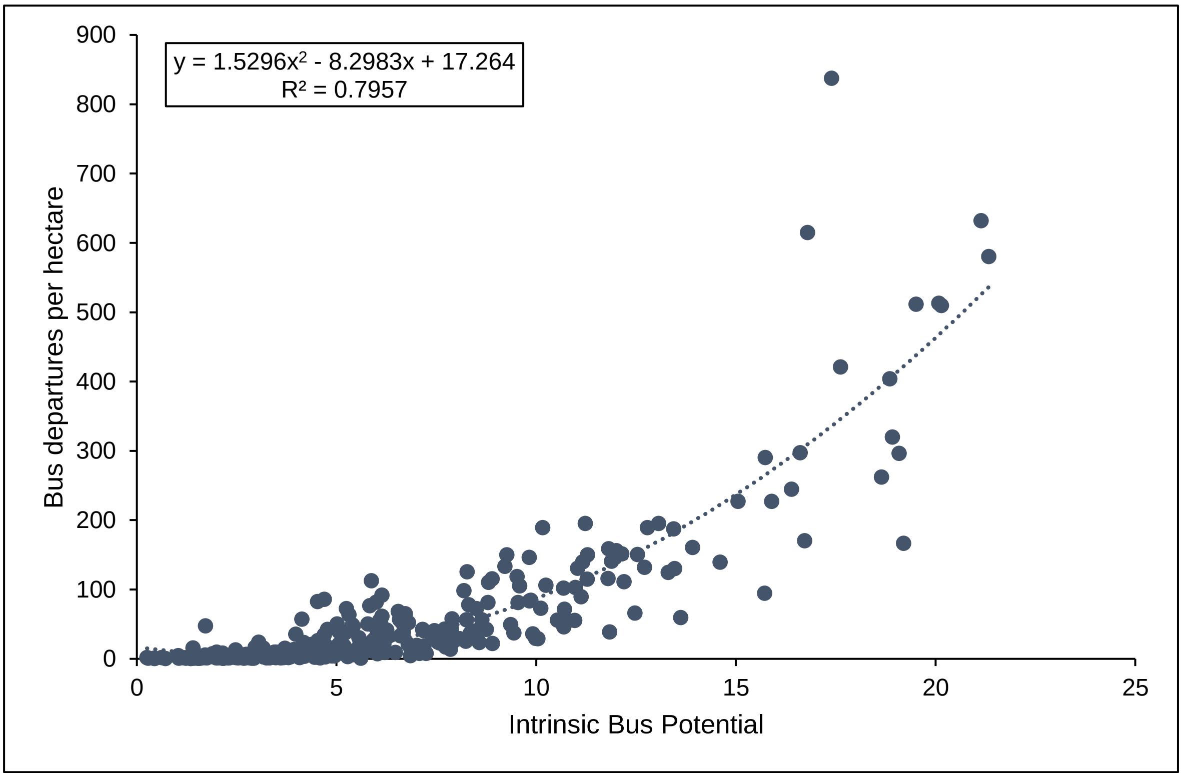
[33] The methodology for this work was developed as part of the EPSRC MOT research project and undertaken by TRL. Preliminary checks for robustness were undertaken on the data at the time. However, further validation checks would be useful, given the complexity of the underlying sources.
[34] ORR Station usage estimates

Figure 7: Relationship between bus use and bus departures per hectare



Sample: 324 local authority districts. Note that the parabolic trendline does not make sense for the higher numbers of bus departures. However, the considerable improvement in fit compared to using a linear trend line suggests that a relationship of this form is the most meaningful if considering the majority of LADs, where bus departures per week are 400 or less.

Figure 8: Relationship between IBP and bus departures per hectare



Sample: 324 local authority districts.

5.5. Intuitively, we might expect that IBP, bus service provision and bus commute mode share would all be related. In areas of "good bus territory" with high IBP, bus operators would provide many services in order to meet demand, and a high proportion of commuters would travel to work by bus. This is indeed the case: as shown in Table 2 and Figure 7, there is a strong relationship between the number of bus departures per hectare and bus commute mode share (R^2=0.72), and as shown in Table 3 and Figure 8, there is also a strong relationship between the number of bus departures per hectare and IBP (R^2=0.80).

5.6. Nevertheless, combining our measures of public transport provision with IBP provides slightly more explanatory power for the observed variation in bus use than we already have from IBP on its own. Regression analysis combining measures of public transport provision with the IBP is able to explain about 88.5% of the variability in observed public transport use (an improvement of 3.5%). Regression using measures of public transport provision and the individual factors that make up the IBP gives a similar result[35].

5.7. This suggests that better (or worse) bus provision is playing at least some part in determining whether areas with similar intrinsic characteristics have higher (or lower) levels of bus use.

5.8. However, as already mentioned, the measures that we were able to use were limited in what they tell us about the quality of the bus service offering in each area.

6. Local authorities with higher than expected bus use

6.1. The next stage of the work was to identify some 'best performing' LADs, (as defined by the amount by which their actual bus use exceeds their predicted bus use), in order to qualitatively examine their characteristics in more detail. We used two approaches to select LADs for closer analysis:

- Every LAD for which bus commute mode share was at least 3%-points higher than predicted by its Intrinsic Bus Potential was selected (22 LADs, Table 4)[36];
- LADs were ranked in order of Intrinsic Bus Potential, divided into ten groups (deciles), and the LAD in each decile with the largest positive difference between actual and predicted bus commute mode share was selected (Table 5).

6.2. There is considerable overlap in the local authorities selected using these two approaches. Taken together, they produce a list of 25 LADs. The first method produces a list weighted towards local authorities at the "high" end in terms of their IBP, while the second method produces a list of LADs that are evenly spread across the range of IBP.

[35] A comparison of a model using the constituents of the IBP measure, compared with a model that uses these and measures of public transport provision, produces an increase in the R^2 value of about 3.5%, and a test of the difference between the two models suggests that this increase is statistically significant ($p<0.01$). The model containing both the IBP measure and measures of public transport provision also yields a 3.5% increase in the R^2 value, with an overall F-statistic $p < 0.01$.
[36] 3% is an arbitrary cut-off, simply chosen to provide a manageable number of authorities to consider in more detail. An alternative approach would have been to pick the 'top 20' – at which point, Leeds and Liverpool would have been excluded from consideration. The 'top 25' would have added Manchester, West Oxfordshire and Sandwell into the list (with West Oxfordshire already identified through the alternative approach).

Table 4: LADs where actual bus commute mode share is >3%-points above the figure predicted by its IBP

IBP range	Very low (0-5)	Low (5-10)	Medium (10-15)	High (15-20)	Very high (20-25)
Number of the 324 LADs with IBP in this range	164	105	35	16	4
LADs with actual bus commute mode share > 3%-points above expected	Lewes Rushcliffe Vale of White Horse	Broxtowe Crawley Gedling Hillingdon Oadby & Wigston Sunderland Swindon	Birmingham Brighton & Hove Croydon Gateshead Hounslow Leeds Oxford	Liverpool Newcastle-upon-Tyne Nottingham	Hackney Southwark
Proportion with bus commute mode share >3%-points above expected	2%	7%	20%	19%	50%

Table 5: ‘Top-performing’ LADs in each IBP decile group

	IBP range	Top-performing LAD	Actual bus commute mode share	Predicted bus commute mode share	Difference between actual and predicted bus commute mode share
Lowest decile	0 – 1.74	West Oxfordshire	5%	2%	+2.9%
2nd decile	1.74 – 2.59	Cherwell	5%	2%	+2.8%
3rd decile	2.59 – 3.32	Vale of White Horse	6%	3%	+3.3%
4th decile	3.32 – 3.98	Lewes	9%	4%	+4.7%
5th decile	3.98 – 4.96	Rushcliffe	9%	4%	+5.1%
6th decile	4.96 – 5.98	Swindon	9%	5%	+3.9%
7th decile	5.98 – 7.17	Gedling	14%	6%	+8.6%
8th decile	7.17 – 9.31	Reading	12%	9%	+2.6%
9th decile	9.31 – 12.10	Gateshead	16%	11%	+5.1%
Top decile	12.10 – 21.34	Southwark	28%	21%	+6.6%

6.3. It is striking that 18 of the 25 LADs fall into five geographical clusters:

- London local authorities (Hillingdon, Croydon, Hounslow, Southwark and Hackney);
- Newcastle-upon-Tyne, Gateshead and Sunderland;
- Nottingham and its neighbouring districts of Gedling, Broxtowe and Rushcliffe;
- Oxford and its neighbouring districts of Vale of White Horse, Cherwell and West Oxfordshire;
- Brighton & Hove and its neighbouring district of Lewes.

The other seven are Birmingham, Liverpool, Leeds, Reading, Swindon, Crawley and Oadby & Wigston.

6.4. For Nottingham, Oxford and Brighton, it appears that there is a 'halo effect', whereby rural LADs which would be expected to have very low levels of bus use do better than predicted because of their proximity to a city with good bus performance. This might be because travel patterns in these rural LADs are strongly influenced by an economically strong city centre, leading to a critical mass of potential bus passengers on radial corridors and hence better bus frequencies. It might also be because the built-up area of the city extends into part of the surrounding rural districts, so that a proportion of their population is functionally part of the main urban area.

6.5. Figure 9 shows the 25 selected LADs (labelled, colour-coded by geographical cluster, and marked with orange squares) on the plot of IBP vs bus commute mode share.

6.6. Figure 10 shows the same 25 LADs on a plot of car ownership per person vs bus commute mode share. This shows that the higher than predicted bus commute mode share of the 25 LADs cannot be because they are all areas where car ownership is abnormally low.

Figure 9: Relation between IBP and bus commute mode share, with 'best-performing' LADs highlighted

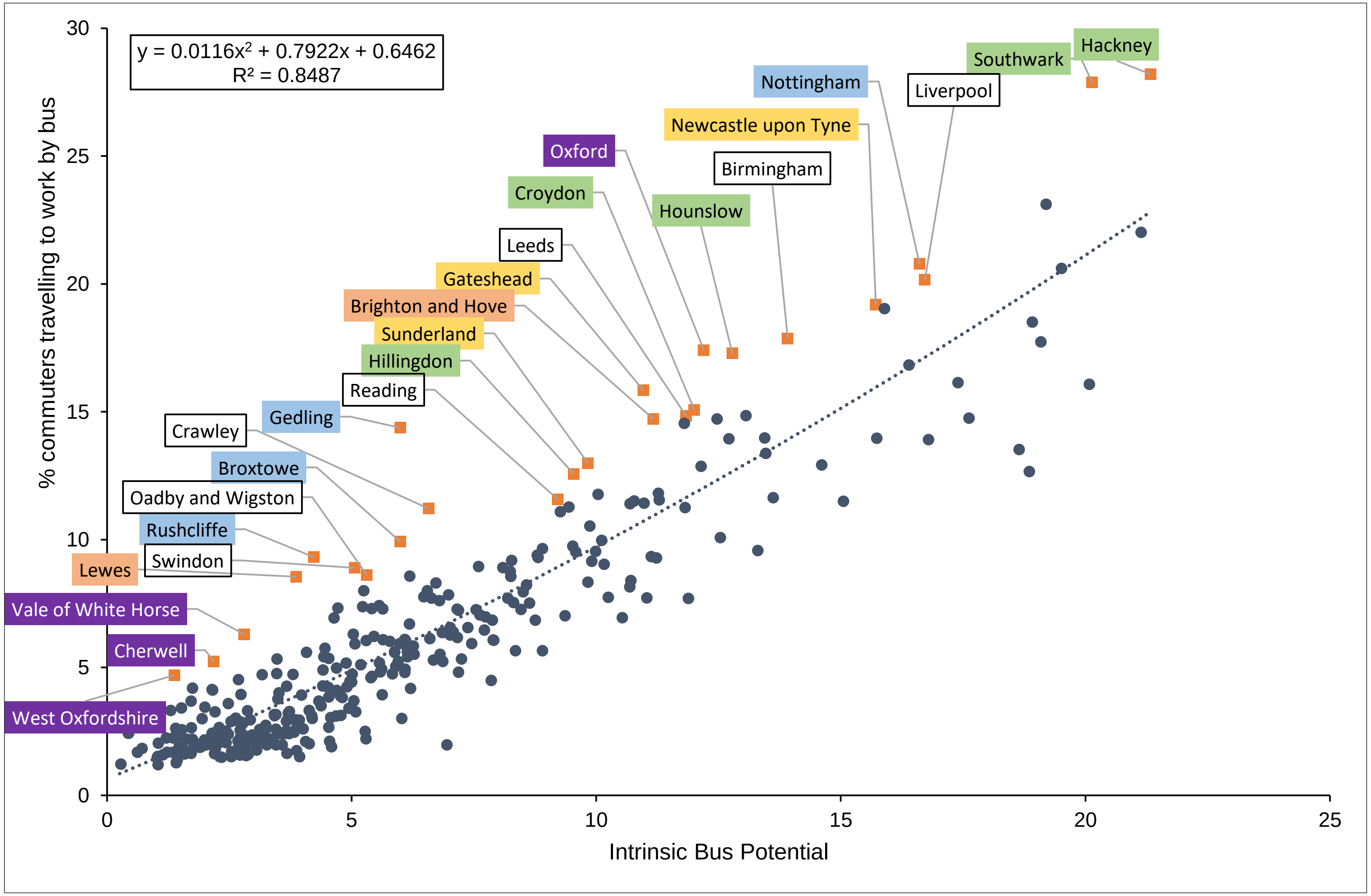
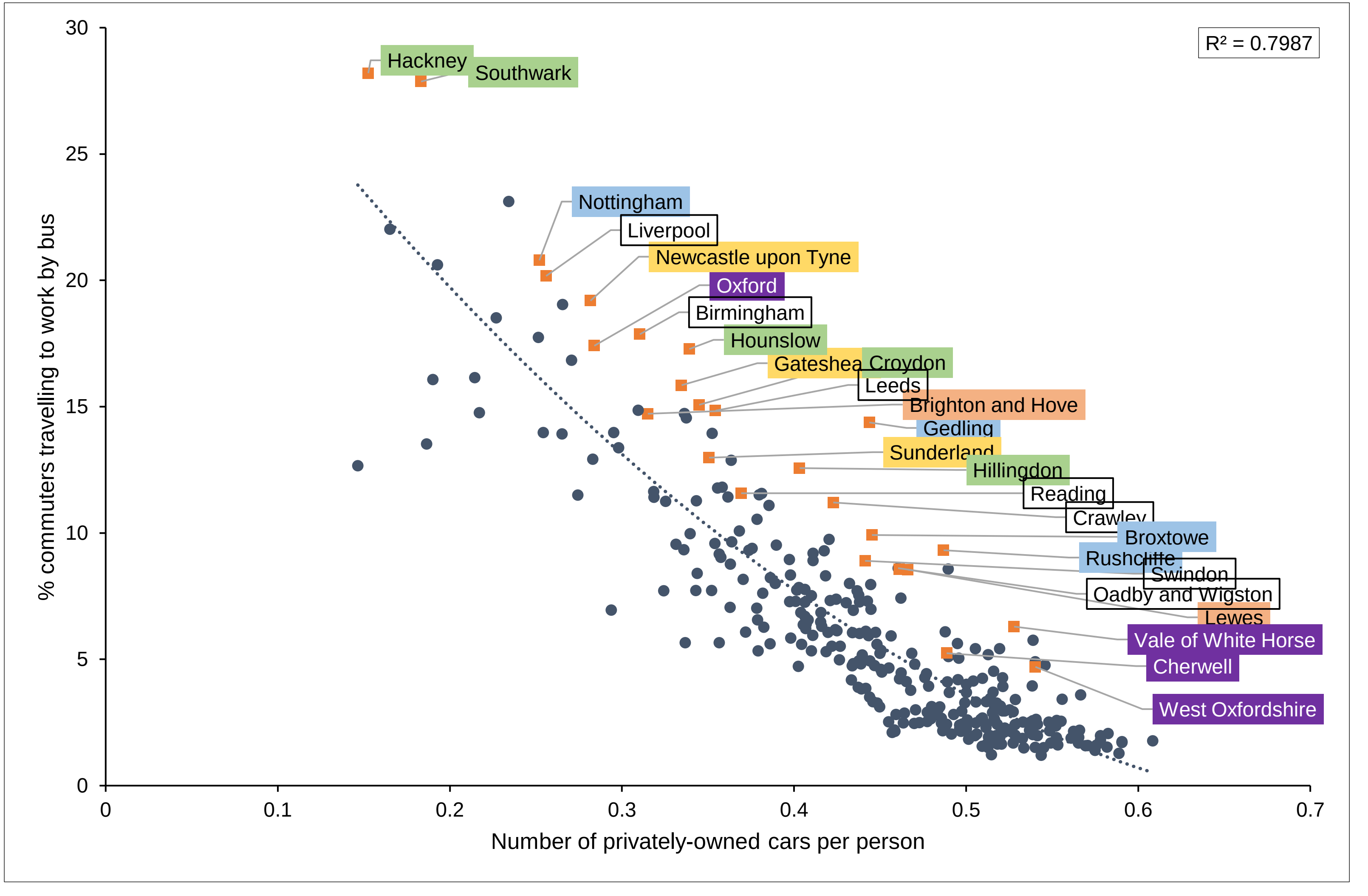
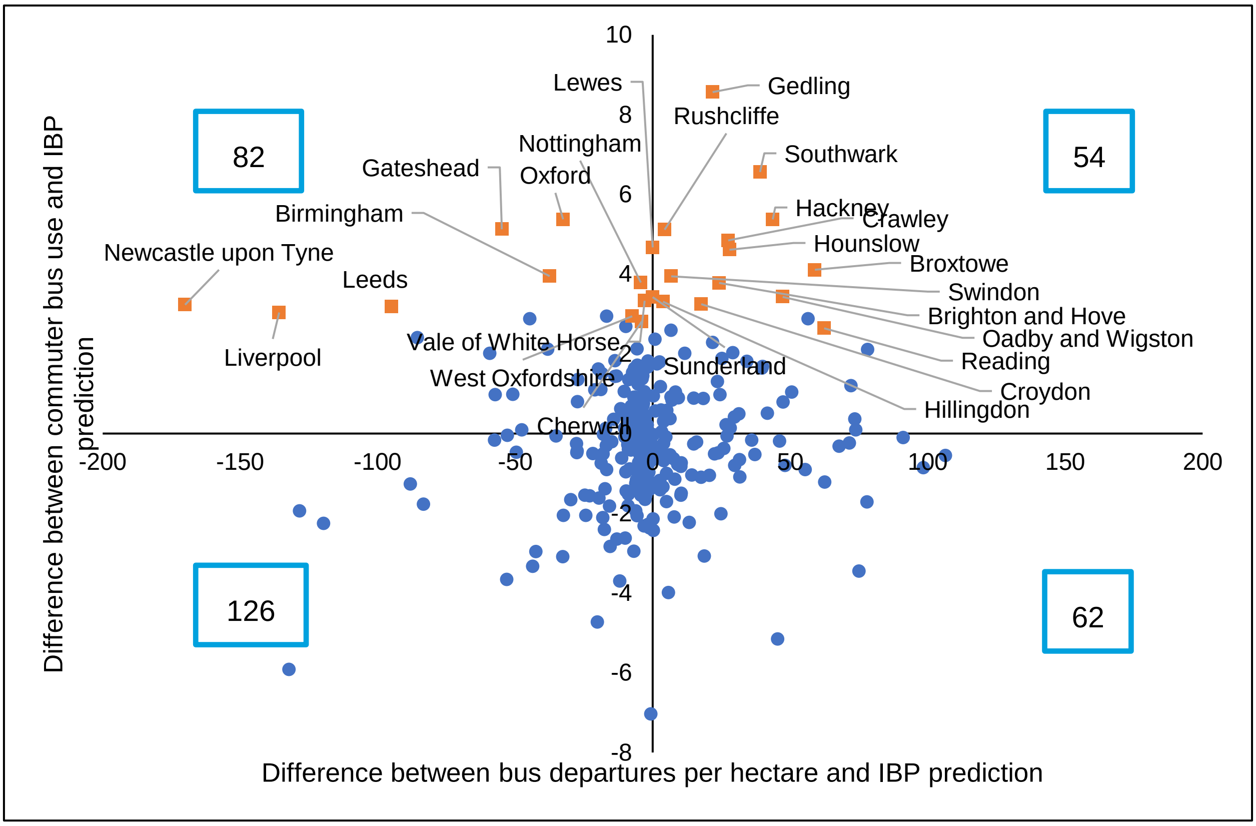


Figure 10: Relation between car ownership and bus commute mode share, with 'best-performing' LADs highlighted



6.7. We next examined the *difference* between actual bus use and the IBP prediction of bus use, plotted against the *difference* between actual bus provision and IBP prediction of bus provision. Figure 11 shows the result. There are several points to note. First, the LADs are distributed across all four quadrants of the graph. There are 54 LADs where both bus provision and bus use are more than would be predicted from their IBP, but also 82 LADs where bus provision is less than predicted from IBP but bus use is higher than predicted. Focussing on the 25 best-performing LADs (shown as orange squares), they are fairly evenly split between ones with less than predicted bus provision and ones with more than predicted bus provision.

Figure 11: How bus provision and bus use vary, compared to IBP predictions



Sample: 324 local authority districts (of which three are not shown: Westminster and Kensington & Chelsea, with a difference between bus departures per hectare and IBP prediction >200; and Manchester, with difference between bus departures per hectare and IBP prediction <-200). Figures in boxes indicate the number of LADs in each quadrant of the graph.

6.8. This suggests that even if the amount of bus provision (as measured in terms of bus departures per hectare) is playing a role in the higher than predicted bus use in some areas, it cannot be the whole story, and other factors must also be contributing.

6.9. There are a number of other reasons why bus commute mode share in a LAD might be higher than predicted from its IBP:

- **Concentration of population and /or employment** in a small part of the area (e.g. along a few main corridors), enabling more frequent bus services than would be possible if population or employment sites were dispersed. Concentration might be due to topography (e.g. housing and workplaces concentrated in valleys or along a coastal strip), or due to strong land use planning policies that have restricted development to locations that can be served by public transport.

- Strong local authority policy of providing **priority to buses** in terms of road space allocation, leading to less congested bus routes and faster bus journey times, and hence making commuting by bus more attractive.
- Cooperation between bus operator and local authority to provide **a good bus 'offer'** through investment in infrastructure including, for example, high quality waiting facilities, real-time information, new buses etc.
- A policy of keeping **fares low**, and integration of ticketing across the whole bus network and all operators.
- A proactive approach to **building bus use**, matching the product to the local market, including kick-start investment in new services; development of new types of service (e.g. commuter buses) and services to new destinations; and good marketing, publicity and promotion.
- A long-term **culture of bus use**, partly related to the factors described above, meaning that people making decisions about housing, employment and travel choices factor in patterns of bus provision.

6.10. We examined the extent to which these factors may be playing a role in higher than predicted bus use in four areas: Nottingham and its surrounding districts; Brighton & Hove and Lewes; Newcastle, Gateshead and Sunderland; and the London LADs. These case studies are described in section 8.

7. Change in bus use over time

7.1. It is also useful to understand how levels of bus use have changed over time in different areas. For this, we looked at Census data for bus commute mode share between 1981 and 2011, and (for unitary authorities) DfT Annual Bus Statistics between 2009/10 and 2017/18.

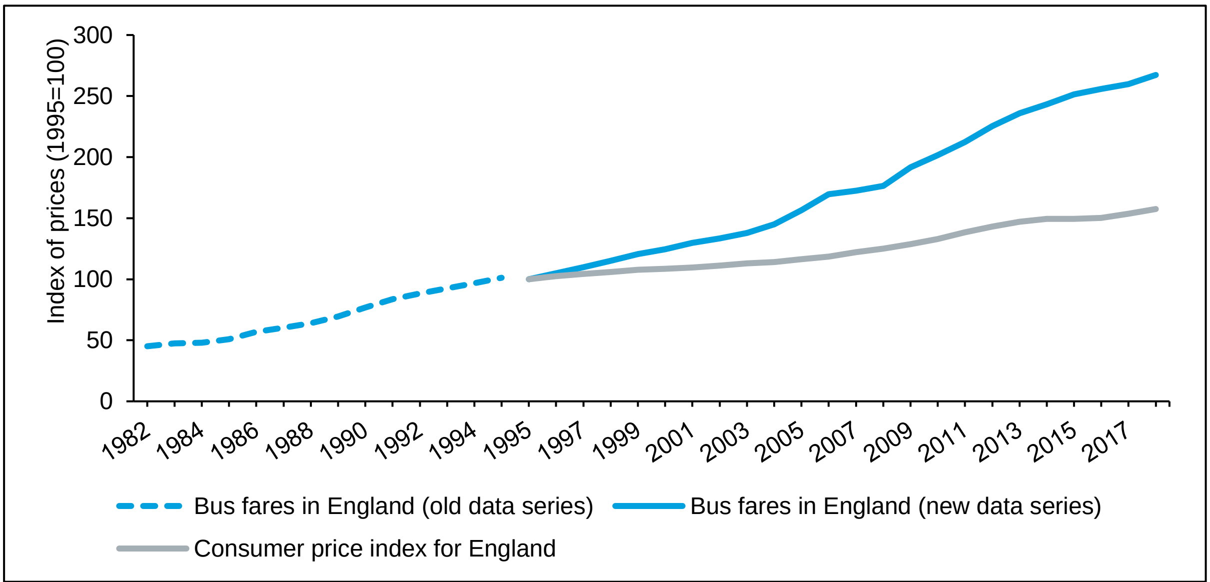
7.2. Over this period, there have been enormous changes in bus services. For example, Figure 12 shows the dramatic increase that has taken place in bus fares – which is considerably greater than the increase in general living costs, or in the costs of car ownership and use; whilst Figure 13 shows the changes in bus mileage. Although there was initial growth in bus mileage outside London following deregulation in 1985/6 (not least due to 'bus wars' on lucrative corridors), this has been followed by long-term decline. Specifically, over the last 20 years[37], bus fares have more than doubled (a 56% increase after adjusting for inflation), and bus mileage outside London has fallen by nearly 20%. Inevitably, these changes have had a major effect on bus use.

7.3. Between 1981 and 1991, bus commute mode share fell in 323 out of 324 LADs[38]. The drop was dramatic, exceeding 5%-points in about a third of LADs. Falls in bus use were largest for the LADs that started with the highest bus mode share: the general pattern was that the higher they started, the further they fell (correlation coefficient R= -0.86 for correlation between 1981 bus mode share and %-point change in bus mode share from 1981 to 1991).

[37] Calculations compare 1998 and 2018 fares data, and 1997/8 and 2017/8 mileage data.
[38] The exception was Corby, where bus commute mode share marginally rose.

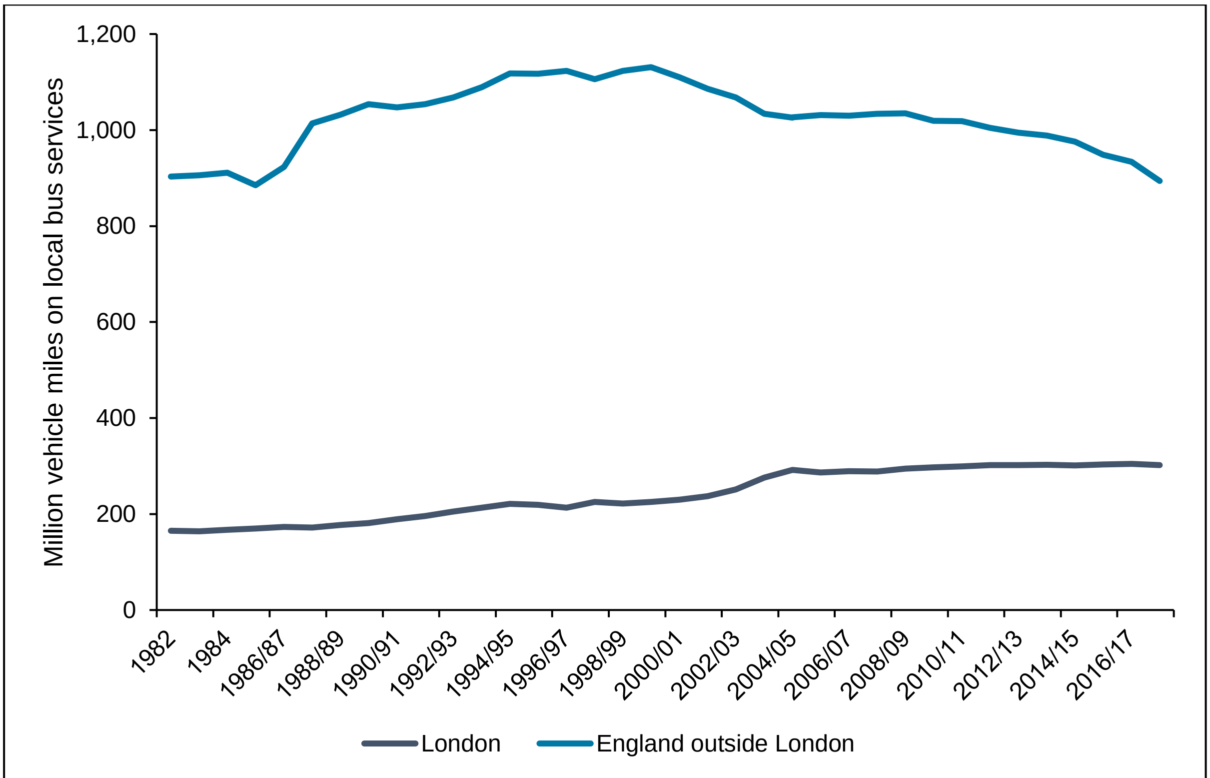
Figure 14 illustrates the change in bus commute mode share in LADs that started with a bus mode share of 25% or more, and compares this with change in car ownership[39].

Figure 12: Changes in bus fares over time



Source: DfT table BUS0405a (including historic data)

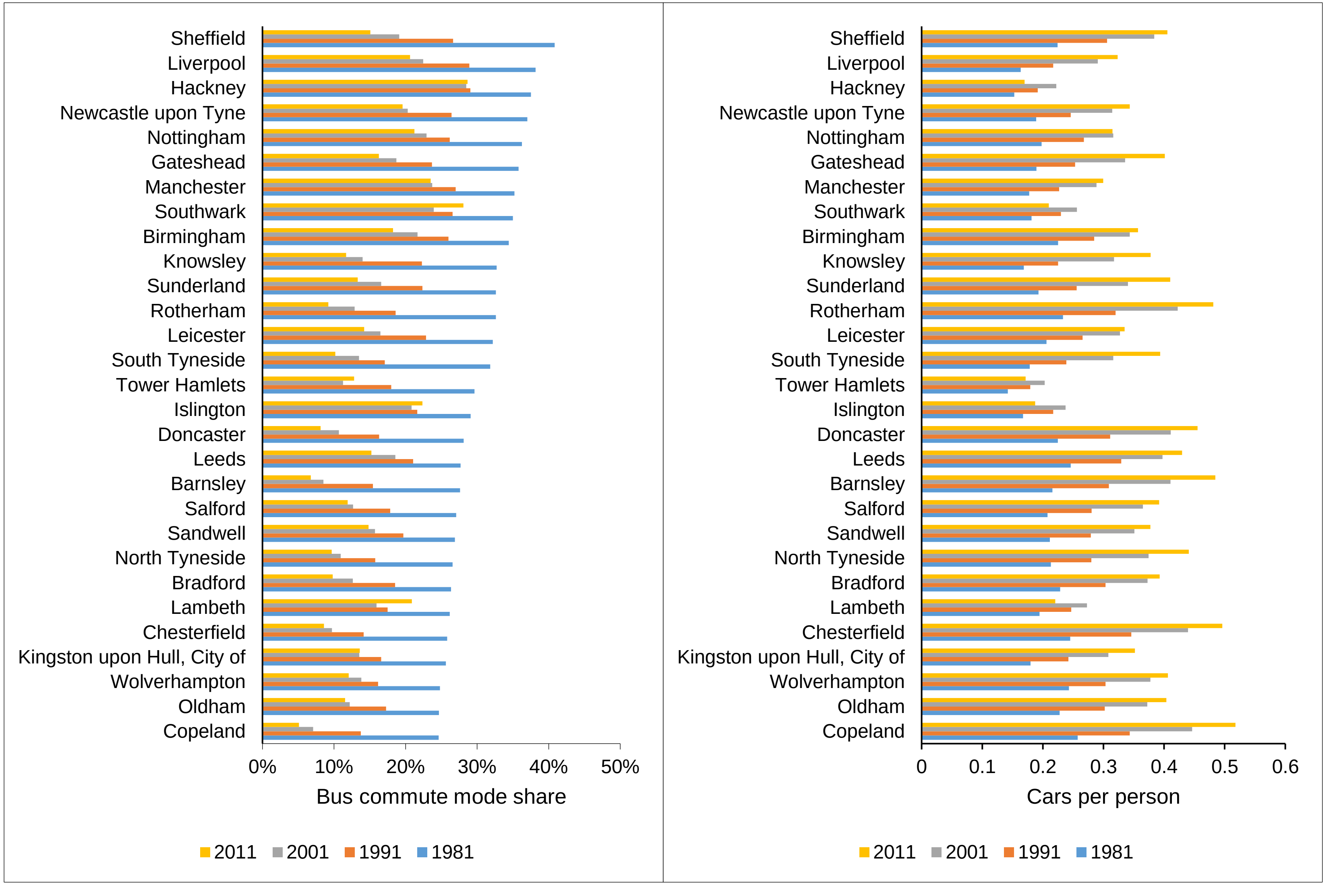
Figure 13: Changes in bus mileage over time



Source: DfT table BUS0203.

[39] Cars per person calculated from Census tables.

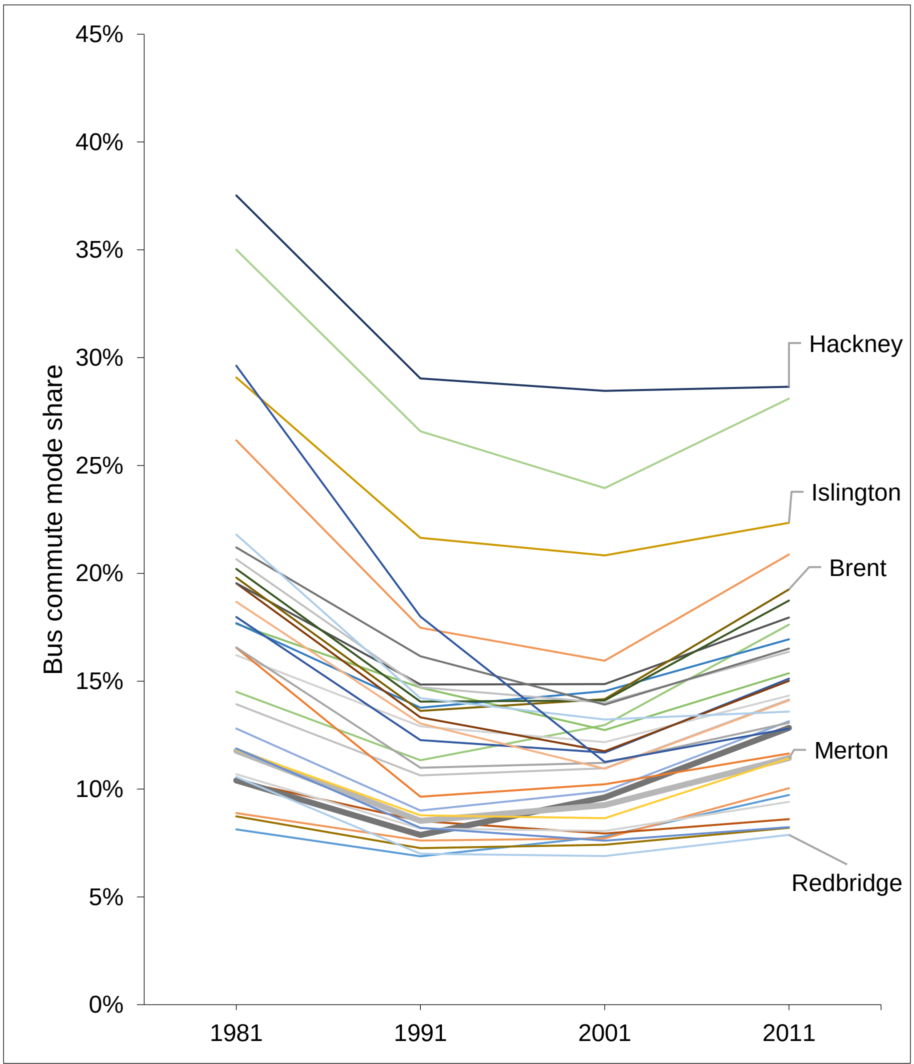
Figure 14: Change over time in bus commute mode share, and cars per person, for LADs with >25% bus mode share in 1981



7.4. Between 1991 and 2001, the picture was still generally one of decline, but bus commute mode share was stable or marginally increased in 49 LADs (in most cases by <1%-point).

7.5. Between 2001 and 2011, there is a marked difference between the pattern in London and the pattern elsewhere. In London, there was an increase in bus commute mode share in all 32 boroughs[40] in this period (Figure 15), reversing the previous trend of declining bus use. There were increases of more than 2%-points in two-thirds of boroughs. The biggest absolute increase was in Brent, where bus commute mode share rose from 14% to 19%.

Figure 15: Change over time in bus commute mode share in 32 London boroughs



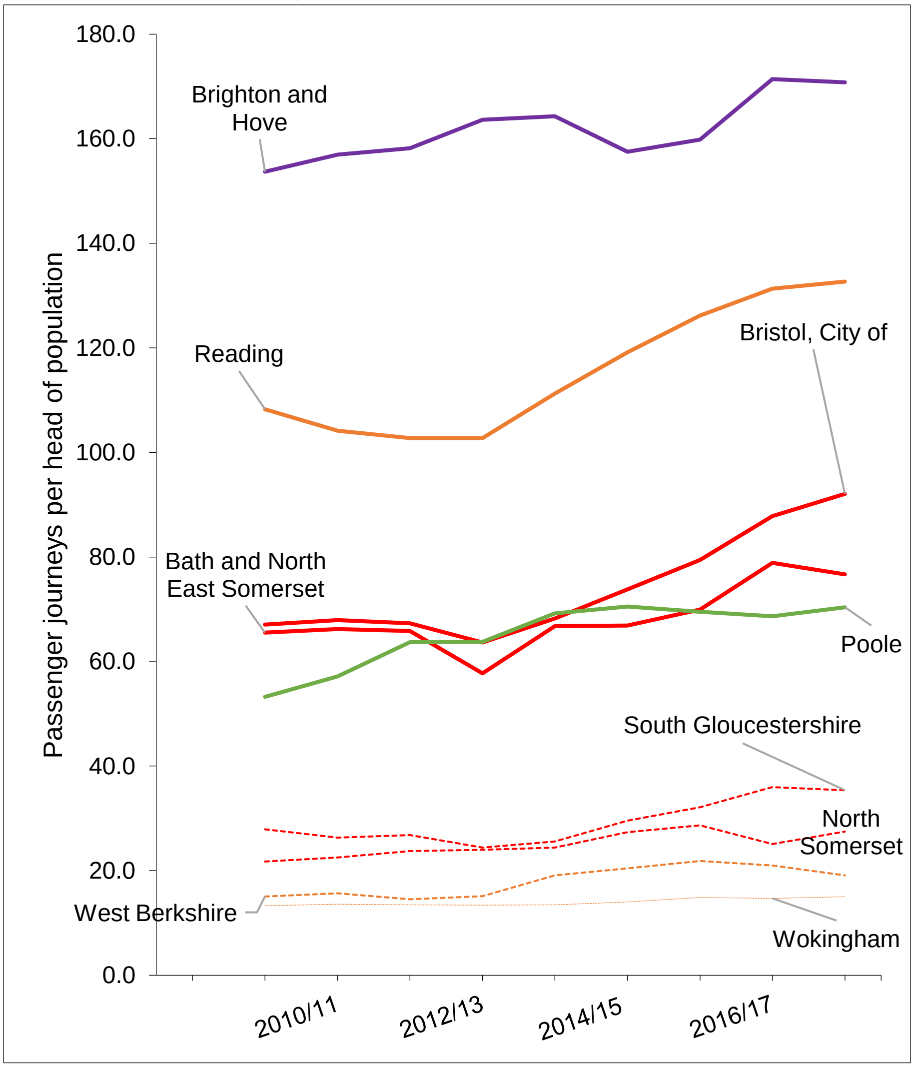
7.6. Outside London, bus use continued to fall in most LADs between 2001 and 2011, but at a slower rate than before. However, in 75 LADs, bus commute mode share increased, and the increase was over 1%-point (i.e. non-trivial) in 14 LADs: most notably Crawley (+5%-points); Slough and Lewes (both +3%-points); and Canterbury, Spelthorne, Cambridge, Bournemouth and Brighton & Hove (+1.4 to +1.6%-points).

[40] Excluding City of London, where the resident population is small.

7.7. More recent bus use data from Annual Bus Statistics (available only for unitary authorities)[41] shows that from 2009/10 to 2017/18, bus trips per person increased in 18 LADs. The greatest increases in bus trips per capita have been in Reading, Bristol, Poole, Bath & NE Somerset, and (sustained) in Brighton, with bus trips per person increasing by at least 11 per person per year (Figure 16). There have been smaller upward trends in several LADs that are adjacent to these areas including West Berkshire and Wokingham (adjacent to Reading); and South Gloucestershire and North Somerset (adjacent to Bristol), as well as other locations including Southampton, Milton Keynes and Oxfordshire. However, the upward trend noted in Slough between 2001 and 2011 has not been sustained and bus use in Bournemouth is relatively stable. (This dataset does not include data for other LADs listed in paragraph 7.6, i.e. Crawley, Lewes, Canterbury, Spelthorne, and Cambridge, because they are part of county authorities.)

7.8. It is notable that *all* the LADs where bus use is growing are in the south of England. (However, absolute levels of bus use are still relatively high in parts of the north.)

Figure 16: Change over time in bus passenger journeys per capita, for unitary authorities with the greatest upward trends, 2009/10 to 2017/18



[41] DfT Annual Bus Statistics BUS0110a (bus operator data)

8. Case studies

This section looks in more detail at four case study areas where bus commute mode share in 2011 was higher than predicted by the IBP.

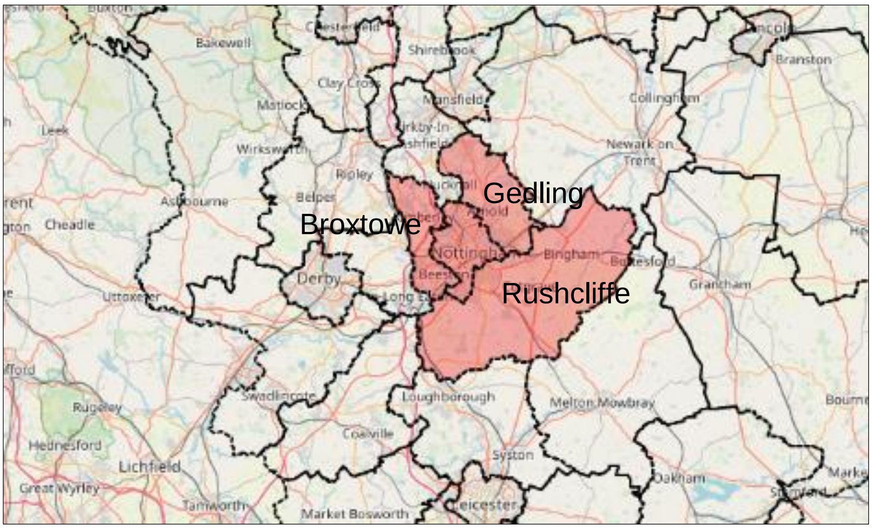
CASE STUDY 1: Nottingham and surrounding districts

8.1. At 21%, Nottingham's bus commute mode share is one of the highest outside London, beaten only by Manchester (23%). Neighbouring East Midland cities Derby and Leicester had bus commute mode shares of 9% and 14% respectively in 2011.

8.2. Nottingham's high bus commute mode share is nearly 4%-points higher than its IBP would predict. The three district councils that surround the City of Nottingham (Gedling, Broxtowe and Rushcliffe) also have bus commute mode shares that are higher than predicted from their IBP, by 4-6%-points.

8.3. Most LADs with an IBP>15 (of which Nottingham is one) are in London, and part of the explanation for Nottingham's higher than predicted levels of bus use could be that it is being compared with London LADs which also have access to the Underground (and therefore have lower levels of bus use). However, this cannot be the explanation for the higher than predicted bus use in the three surrounding LADs.

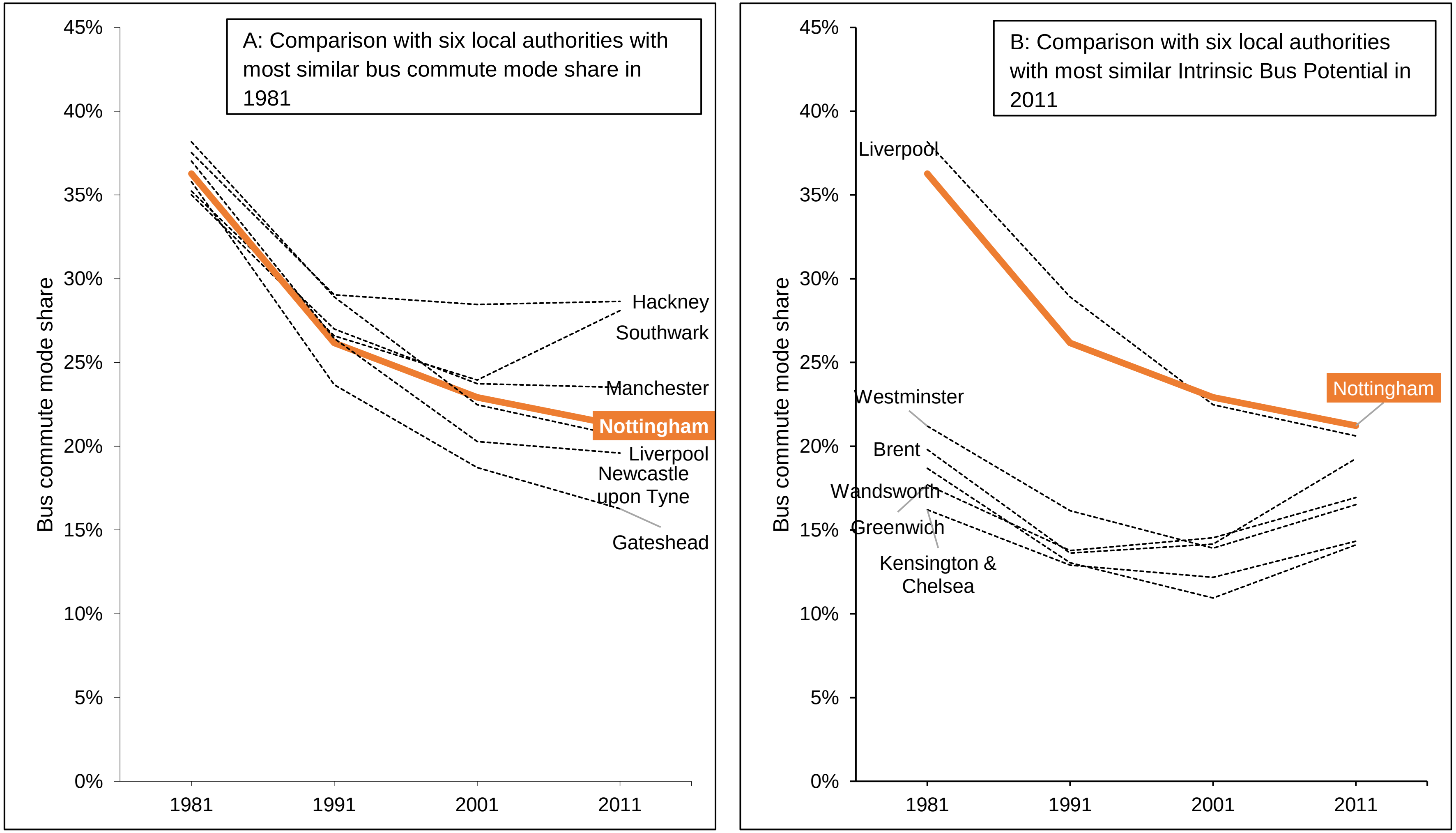
Figure 17: Nottingham and its surrounding districts



8.4. The high level of bus use in Nottingham has existed since at least the 1980s. Census data shows that Nottingham had one of the highest levels of bus use in England in 1981, with a bus commute mode share of 36%, as shown in Figure 16A. Other places with comparable levels of bus use at that time were all much larger cities (e.g. Manchester, Liverpool). Bus use fell sharply in the 1980s, in common with the trend elsewhere, and continued to decline during the 1990s and 2000s, although more slowly.

8.5. Recent data for total public transport patronage (all trip purposes, bus and tram) shows rising tram use, which has replaced capacity on high frequency bus routes. Total public transport use rose 23% from 2003 to 2018. This was in the context of rising population, but public transport use per capita was stable. Even though Nottingham has a tram (and Derby and Leicester do not), bus trips per capita for all trip purposes in 2017/18 in Nottingham were about double those in these towns (Nottingham 145; Derby 67; Leicester 75 trips per capita).

Figure 18: Change in bus commute mode share over time in Nottingham



'Most similar' defined as the three LADs with higher values, and the three LADs with lower values.

Table 6 describes some factors that may be contributing to the higher than predicted levels of bus use in Nottingham and the surrounding districts. In summary, the city benefits from a long-standing culture of bus use dating back to at least the 1980s. From about 2000, there was a combination of a good bus 'offer', and a proactive local authority that is supportive of buses. The main bus company is largely owned by the city council, which may have helped to ensure synergy with the aims of the authority. Political stability in the local authority has been helpful in ensuring a consistent policy direction. The amount of bus provision is also high – in fact, in 2011, Nottingham had the largest number of bus departures per hectare of any local authority outside London. The City has taken complementary measures to restrain traffic, including introducing a workplace parking levy in 2012, with revenue then reinvested in improving the public transport offering[42].

Table 6: Factors that may be contributing to high bus use in Nottingham

Factor	Likely to be significant?	
More bus provision?	Y	In 2011, bus departures per hectare in Nottingham were the highest in England outside London (at 300 departures per week per hectare). Broxtowe, Gedling and Rushcliffe also had fairly high bus departures per hectare compared to LADs with similar IBP (Broxbourne = 81 bus dep/ha, Gedling = 44 bus dep/ha, ranking 14th and 38th respectively out of 105 LADs with IBP in the 'low' range of 5-10; Rushcliffe = 14 bus dep/ha, ranking 22nd out of 164 LADs with IBP in the 'very low' range of 0-5).
Concentration of population / employment in certain corridors or areas?	N	Not a significant factor in Nottingham. However, this may be contributing to the higher than predicted bus use in Broxtowe and Gedling, as part of the population in these districts lives next to, and is functionally part of, the Nottingham urban area.
Good 'bus offer' from operator?	Y	There are two main operators. Nottingham City Transport (mostly owned by the council) completely restructured its bus network in 2001, introducing fast, high quality services along main corridors, with 10-minute day-time frequencies, midnight departures, newer buses, and colour-coded routes. Changes to routing (stopping all buses in the city centre instead of running them across the city) improved journey time reliability. Trent Barton serve settlements in surrounding districts and have repeatedly won awards for customer service. Robin Hood ITSO multi-operator smart ticket (Pay As You Go and Seasons) has been in place for a number of years. Contactless Payment across bus and tram with multi-operator capping will be rolled out from March 2020.
Supportive local authority policies?	Y	The city council has been politically stable over many years, and consistently supportive of public transport. There has been a strong focus on 'place-making' and integration between land-use planning and public transport. Most public parking in the city centre is council-owned and there has been a policy of making all-day parking about double the cost of bus travel, to encourage mode shift. The council also has a long track record of working with employers to encourage mode shift (and introduced the workplace parking levy in 2012). It has been very successful at securing funding from government via competitive funding programmes such as Local Sustainable Transport Fund and Better Bus Areas, and using this to encourage bus use.

[42] Campaign for Better Transport [Nottingham's workplace parking levy]

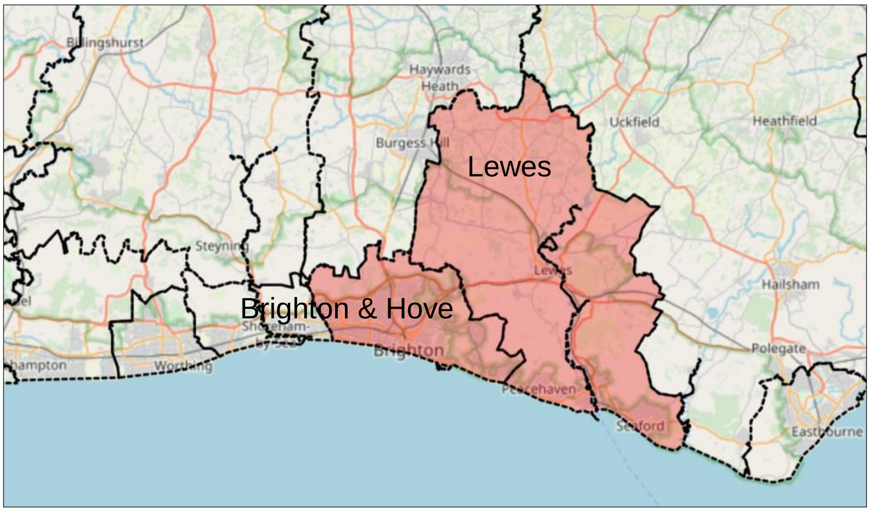
Factor	Likely to be significant?	
Long-term culture of bus use?	Y	Nottingham had one of the highest levels of bus use in England in 1981, with a bus commute mode share of 36%.

Sources: Anable et al. (2004) Smarter Choices – changing the way we travel: Case study reports: Nottingham public transport information and marketing; DfT Bus Statistics BUS0110; Nottingham Local Sustainable Transport Fund Expression of Interest (2011); interview with Nottingham City Council officer in 2015.

CASE STUDY 2: Brighton & Hove and Lewes

8.6. Bus commute mode share in Brighton & Hove in 2011 was 15%. This is nearly 4%-points higher than its IBP would predict. Neighbouring Lewes had a bus commute mode share in 2011 of 9%, which is nearly 5%-points higher than its IBP would predict.

Figure 19: Brighton & Hove and Lewes



8.7. Census data shows that Brighton had a fairly high bus commute mode share in 1981, at 23%, as shown in Figure 20A. This was one of the highest levels of bus use (7th out of 97) for LADs categorised as 'RUC4, urban city and town' in the ONS Rural-Urban Categorisation. Other places with comparable levels of bus use at that time included Southampton and parts of Greater Manchester (Rochdale and Tameside). Brighton's bus commute mode share in 1981 is also towards the upper end of the range shown by the six LADs that had the closest IBP to Brighton in 2011 (Figure 20B).

8.8. Bus use in Brighton fell sharply in the 1980s, in common with the trend elsewhere, but during the 1990s, bus commute mode share was stable. From 2001, it began to increase, showing a markedly different trend to other local authorities.

8.9. Recent data for overall bus patronage (i.e. for all journey purposes) shows that this increase in bus use in Brighton was sustained. There were 157 bus trips per capita in 2010/11, rising to 171 trips per capita in 2017/18[43]. This means Brighton now has probably one of the highest levels of bus use in the south-east outside London[44].

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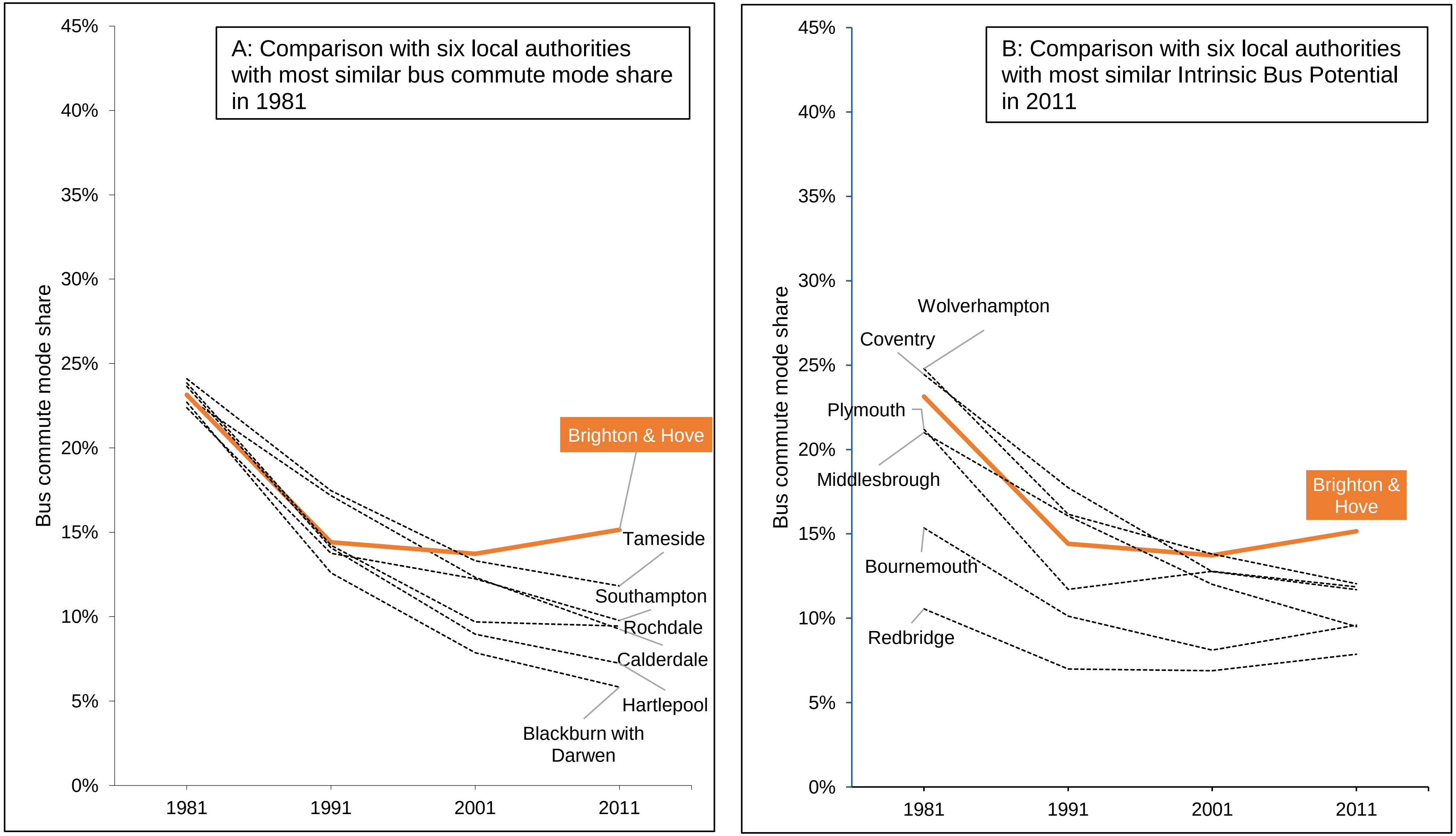
[43] DfT bus patronage statistics derived from local authority data (BUS0110b) show a slightly different pattern for Brighton & Hove from the statistics derived from bus company data (BUS0110a), which we have mainly used here and elsewhere.

[44] Bus trips per capita are only reported at county / unitary level, so it is possible that some non-unitary towns in the south-east could have higher levels of bus use than Brighton & Hove.

Figure 20: Change in bus commute mode share over time in Brighton & Hove



'Most similar' defined as the three LADs with higher values, and the three LADs with lower values.

8.10. Table 7 summarises factors that may be contributing to the higher than predicted levels of bus use in Brighton & Hove and Lewes. In summary, the city has a long-standing culture of bus use dating back to at least the 1980s. It has several local characteristics which are not captured in its IBP score but which make it a good area for buses: notably, a concentration of population along a few corridors, which makes it easier to provide a commercially viable frequent service, and a significant population of transient seasonal workers[45]. The local authority and the main bus company have worked together over several decades to improve the bus 'offer', and have been innovative in improving and marketing bus services.

Table 7: Factors that may be contributing to high bus use in Brighton & Hove

Factor	Likely to be significant?	
More bus provision?	N	In 2011, there were 140 bus departures per hectare per week in Brighton. This was similar to the bus provision in urban areas of similar size and IBP, such as Plymouth, Portsmouth and Southampton, and meant that Brighton ranked 13th out of 35 LADs with similar IBP in the 'medium' IBP range of 10-15. Lewes had 8 bus departures per hectare per week, and ranked 41st out of 164 LADs with similar IBP in the 'very low' range of 0-5.
Concentration of population / employment in certain corridors or areas?	Y	Brighton's coastal geography means that the population is concentrated along a few corridors. There are some rail corridors which do provide for commuting but this is limited compared with larger conurbations and there is no light rail system. The strong economy of the town results in high travel demand along those corridors, justifying more frequent bus services which in turn attract more passengers. The city has a significant population of transient seasonal workers. It also has several large outlying housing estates which lack local services or jobs, from which there is strong demand to travel to the city centre.
Good 'bus offer' from operator?	Y	In the late 1990s, bus frequencies on most routes were increased to every 10 minutes or better; routes were colour-coded and a 'Metro' brand developed for the five most frequent cross-city routes; express commuter services between housing estates and the city centre were brought in; there was investment in new buses; and comprehensive timetables (also covering Stagecoach and Arriva services) were produced. A flat fare was introduced in 2001 (initially £1). This was heavily promoted and was said to have 'completely demystified the use of buses', offering simplification and value for money. Both the bus company and the council were innovators around this time, winning awards for marketing, customer care and passenger information technology. More recent improvements include dual door buses to reduce dwell time and improve punctuality, contactless payment, and wifi and USB charging ports on most buses.
Supportive local authority policies?		Brighton & Hove became a unitary council in 1997, and this provided an opportunity to be more proactive from the early 2000s. At about that time, the council's public transport lead officer reported that his team was encouraged to 'think big' with full line manager and political support. There was close cooperation with Brighton & Hove Buses. The council introduced a bus priority information and management system in 2002, linked with traffic lights to give priority to buses and provide real-time information. There was investment in improving bus stops (including information, shelters, and accessible boarding). The number of parking enforcement officers was doubled in the early 2000s, helping to reduce bus delays. More recently, the city used Local Sustainable Transport Fund monies to make bus improvements on Lewes Road (a key corridor serving both universities), including a bus lane, more frequent

[45] Other characteristics, like the high proportion of students, are already captured in the IBP.

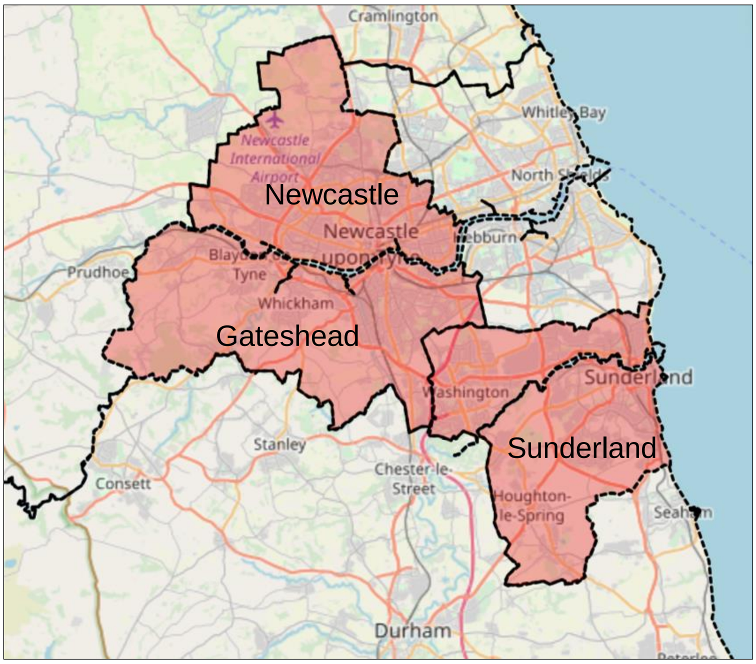
Factor	Likely to be significant?	
		services, upgrades to real time information etc. Other current work includes bus stop accessibility improvements to enable dual door buses to be used. There is a consistent message from operators and the council that buses are a sustainable choice, which resonates with Brighton's many 'green-minded' residents.
Long-term culture of bus use?	Y	Amongst the 97 LADs categorised as 'RUC4, urban city and town' in the ONS Rural-Urban Categorisation, Brighton had the seventh highest bus mode share for commuting in 1981, at 23%.

Additional case study information from Anable et al. (2004) Smarter Choices – changing the way we travel volume 2: Case study reports. Brighton public transport information and marketing

CASE STUDY 3: Newcastle, Gateshead and Sunderland

8.11. Bus commute mode share in Newcastle in 2011 was 19%, more than 3%-points higher than predicted by its IBP. Gateshead had a bus commute mode share in 2011 of 16%, more than 5%-points higher than predicted by its IBP, and Sunderland had a bus commute mode share in 2011 of 13%, more than 3%-points higher than predicted by its IBP.

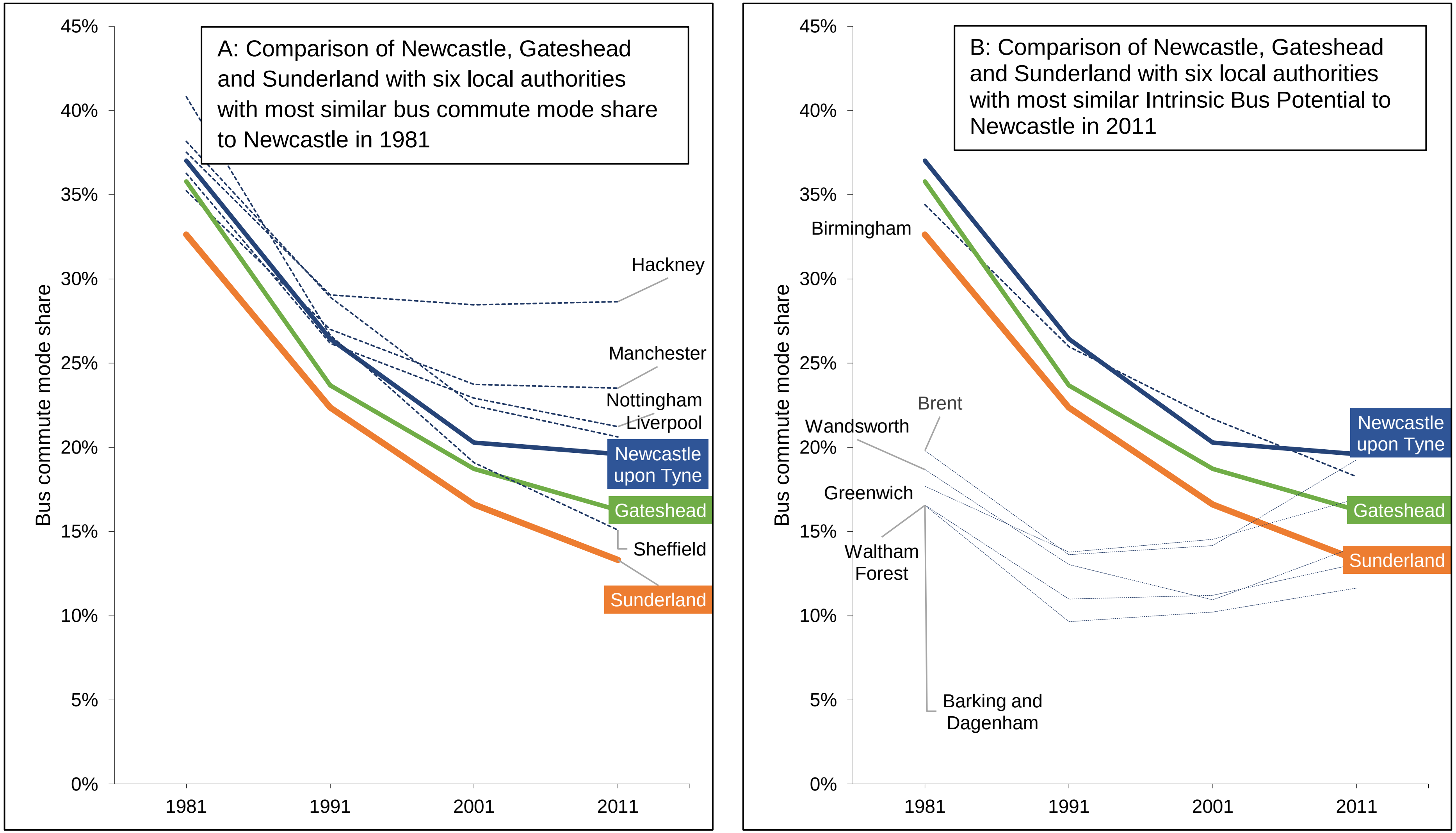
Figure 21: Newcastle, Gateshead and Sunderland



8.12. The high level of bus use in this area has existed since at least the 1980s. Census data shows that in 1981, Newcastle had the fourth-highest bus commute mode share of any LAD (37%), while Gateshead was sixth-highest (36%) and Sunderland was 11th highest (33%), as shown in Figure 22A. Bus use fell sharply in the 1980s and 1990s, and continued to decline during the 2000s, although more slowly in Newcastle than in Gateshead and Sunderland.

8.13. Recent data for overall bus patronage (i.e. for all journey purposes) for the whole of Tyne & Wear ITA (not available in disaggregated form for the individual local authorities) shows that there has been a continued decline in bus use. There were 118 bus trips per capita in 2010/11, falling to 96 trips per capita in 2017/18.

Figure 22: Change in bus commute mode share over time in Newcastle



For chart A (most similar bus commute mode share in 1981), the six LADs with closest values to Newcastle are Hackney, Liverpool and Sheffield (higher) and Manchester, Gateshead and Nottingham (lower). For chart B (IBP), 'most similar' is defined as the three LADs with higher values than Newcastle, and the three LADs with lower values than Newcastle.

8.14. Table 8 considers what factors may be contributing to the higher than predicted levels of bus use in Newcastle, Gateshead and Sunderland. A significant factor is that Tyne & Wear has a long culture of bus use, having had some of the highest levels of bus use in England in the 1980s. Bus use is high despite the existence of the Tyne & Wear Metro (which might be expected to abstract some commuter trips from the bus, but may help to increase the overall attractiveness of public transport). The local heavy rail network is very limited compared with other conurbations (key sections having been converted to Metro operation).

8.15. It is worth noting that low levels of car ownership are not enough to explain the high bus use in Newcastle. Figure 10 shows that levels of bus use in Newcastle are high even compared to other LADs with similarly low car ownership (i.e. Newcastle plots above the best-fit line in Figure 10).

Table 8: Factors that may be contributing to high bus use in Newcastle

Factor	Likely to be significant?	
More bus provision?	N	In 2011, there were 95 bus departures per hectare per week in Newcastle, 55 in Gateshead and 83 in Sunderland. The level of bus provision in Newcastle and Gateshead was low compared to other large urban areas with similar IBP (such as Liverpool, Leeds, Wolverhampton), although the level of bus provision in Sunderland was mid-to-high compared to similar areas (such as Bradford and Rochdale).
Concentration of population / employment in certain corridors or areas?	N	Not likely to be a significant factor.
Good 'bus offer' from operator?	?	Although there are good aspects of bus services in Tyne & Wear, there have also been some challenges, which were noted in the Tyne & Wear ITA Bus Strategy in 2012 (e.g. lack of integration between competing operators' services; high fares; lack of a high frequency core strategic network, complexity of the network).
Supportive local authority policies?	Y	The PTE maintains and invests in high quality interchanges, provides passenger information and offers a range of multimodal tickets. It has also invested in bus priority measures and provides financial support for a network of non-commercial services and non-statutory concessions. Existence of the metro improves the overall public transport network, although there is the potential for competition with bus use.
Long-term culture of bus use	Y	There was a strong culture of bus use in Tyne & Wear in the past. In 1981, Newcastle had the fourth-highest bus commute mode share of any local authority district (37%), while Gateshead was sixth-highest (36%) and Sunderland was 11^{th} highest (33%).

CASE STUDY 4: London boroughs

8.16. Five London boroughs (Croydon, Hackney, Hillingdon, Hounslow and Southwark) had a bus commute mode share in 2011 that was 3 to 7%-points higher than would be predicted by their IBP. They are a mix of outer and inner London boroughs, and cover a range of IBPs from low to very high, as shown in Table 9. They all have some high frequency 'metro-style'

Underground or Overground services, so their higher levels of bus use cannot in general be explained by unusually poor alternatives (although the only Underground station in Hackney is at the edge of the borough, so it is poorly connected to central London by Underground).

Table 9: London boroughs with higher than predicted bus use

		IBP category	Bus commute mode share (2011)	Number of high frequency 'metro' (Underground and Overground) stations
Inner London	Hackney	Very high	29%	1 Underground; 12 Overground
	Southwark	Very high	28%	8 Underground; 2 Overground
Outer London	Croydon	Medium	15%	0 Underground; 2 Overground (plus 1 tram line, Croydon Tramlink)
	Hounslow	Medium	17%	11 Underground
	Hillingdon	Low	13%	15 Underground

8.17. Historic patterns of bus use are very different for the inner and outer boroughs. Hackney and Southwark, in inner London, have always had very high levels of bus use. Although their bus commute mode shares fell between 1981 and 2001, they still had the highest bus use in England in 2001, and their bus commute mode share increased between 2001 and 2011, as shown in Figure 23.

8.18. In contrast, Hillingdon had much lower levels of bus commuting in the 1980s, as shown in Figure 24A. But whereas bus use in other areas declined, bus use in Hillingdon (and also in Hounslow, not shown) has risen since 1991. Croydon shows a fairly similar pattern except that bus use only started to rise in 2001.

8.19. Table 10 summarises the key factors that are likely to have contributed to the increase in bus use in London since 2001, focussing particularly on the five boroughs where bus use is higher than predicted by their IBP. Following establishment of Transport for London and an increase in funding for buses in 2000, all London boroughs benefited from more frequent bus services, a simple fare structure, low fares, and speeded-up bus boarding (and hence shorter journey times) due to introduction of the Oystercard in 2003.

8.20. According to one calculation, on average, bus fares in London are only 60% of the cost elsewhere[46]. According to other recent reports[47], the difference can be 4 or 5 times – with London's flat fare of £1.50 contrasting with fares of up to £6 for a single journey of five miles in other locations.

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[46] DfT bus statistics, table BUS0501, provides information on passenger fare receipts; table BUS0103 provides information on total passenger journeys, and table BUS0105 provides information on the number of concessionary passenger journeys. Using the method recommended by a review of the DfT's bus fares index (Bus Fares Review) suggests that, per non-concessionary journey, in 2017/18, 83 pence was received in London, compared to £1.40 in England outside London. The values are lower than might be expected due to passenger use of period and multi-modal tickets. The review notes that values outside London will be inflated by a small amount of revenue generated by passengers travelling on concessionary tickets who pay a reduced tariff – although in 2009/10, this was estimated to be only about 3% of total revenue.

[47] Pidd H (5/5/19) 'Massively unfair' gulf in bus fares between London and rest of England Article in The Guardian.

8.21. In inner London boroughs such as Hackney and Southwark, additional factors are the introduction of the London congestion charge in 2003, very high levels of bus provision, and a pre-existing culture of bus use. Low car ownership may also be a contributory factor, as these boroughs have some of the lowest levels of car ownership in England (as shown in Figure 10).

8.22. In Croydon, Hounslow and Hillingdon, the higher than predicted bus use may be related to concentration of local employment. All three boroughs contain areas with very high jobs density (Croydon town centre, Heathrow airport in Hounslow, and Uxbridge town centre in Hillingdon)[48]. Both Hounslow and Hillingdon have east-west Underground services but the town centres of Uxbridge and Hillingdon are mainly connected to Heathrow by bus.

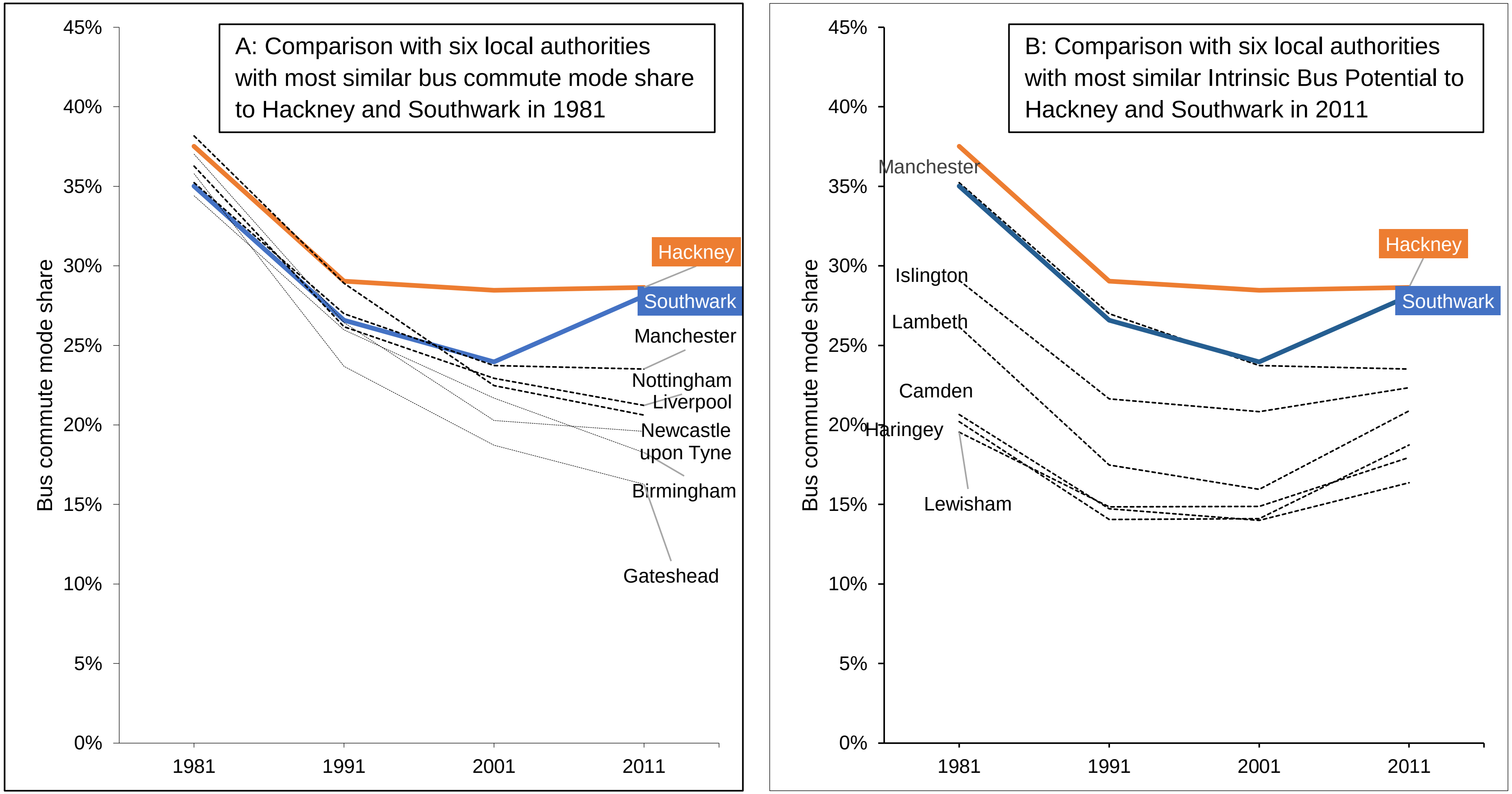
Table 10: Factors that may be contributing to high bus use in London

Factor	Likely to be significant?	
More bus provision?	Y	In 2011, there were 580 bus departures per hectare per week in Hackney, 510 in Southwark; 189 in Hounslow; 156 in Croydon and 81 in Hillingdon. The level of bus provision in Hackney and Southwark was nearly the highest in the country (Hackney ranked 4th and Southwark ranked 7th; all other LADs in the 'top ten' were in inner London). However, the level of bus provision in Hounslow, Croydon and Hillingdon was fairly typical of what might be expected for LADs with similar IBP[49].
Concentration of population / employment in certain corridors or areas?	N/Y	Not likely to be significant factor in inner London boroughs (Hackney and Southwark), but may be a factor in Croydon, Hounslow and Hillingdon, which contain areas with very high jobs density (Croydon town centre, Heathrow airport in Hounslow and Uxbridge town centre in Hillingdon).
Good 'bus offer'?	Y	The bus 'offer' in London improved significantly in 2000, following the election of Ken Livingstone and formation of Transport for London. Service frequencies increased, a £1 flat fare was introduced (now £1.50), and the introduction of the Oystercard helped speed up bus boarding, making journeys quicker. Regulation of bus services in London makes it possible for TfL to provide a comprehensive network and means that a higher proportion of fares revenue is retained and reinvested.
Supportive local policies?	Y	Transport for London, and successive Mayors, have given investment in bus services in London a high priority. Introduction of the congestion charge in central London in 2003 made driving into the centre less attractive and helped encourage bus use. Land use planning policy has discouraged car-dependent development.
Long-term culture of bus use	Y	There was a strong culture of bus use in Hackney and Southwark in the past. In 1981, Hackney had the 3rd-highest bus commute mode share of any local authority district (38%), while Southwark was 8th-highest (35%). However, Croydon, Hounslow and Hillingdon in outer London did not have a strong culture of bus use at that time.

[48] These are clearly illustrated in an ONS graphic of employees per square km in London available here: [Number of employees per square km in each London LSOA, 2013](#).

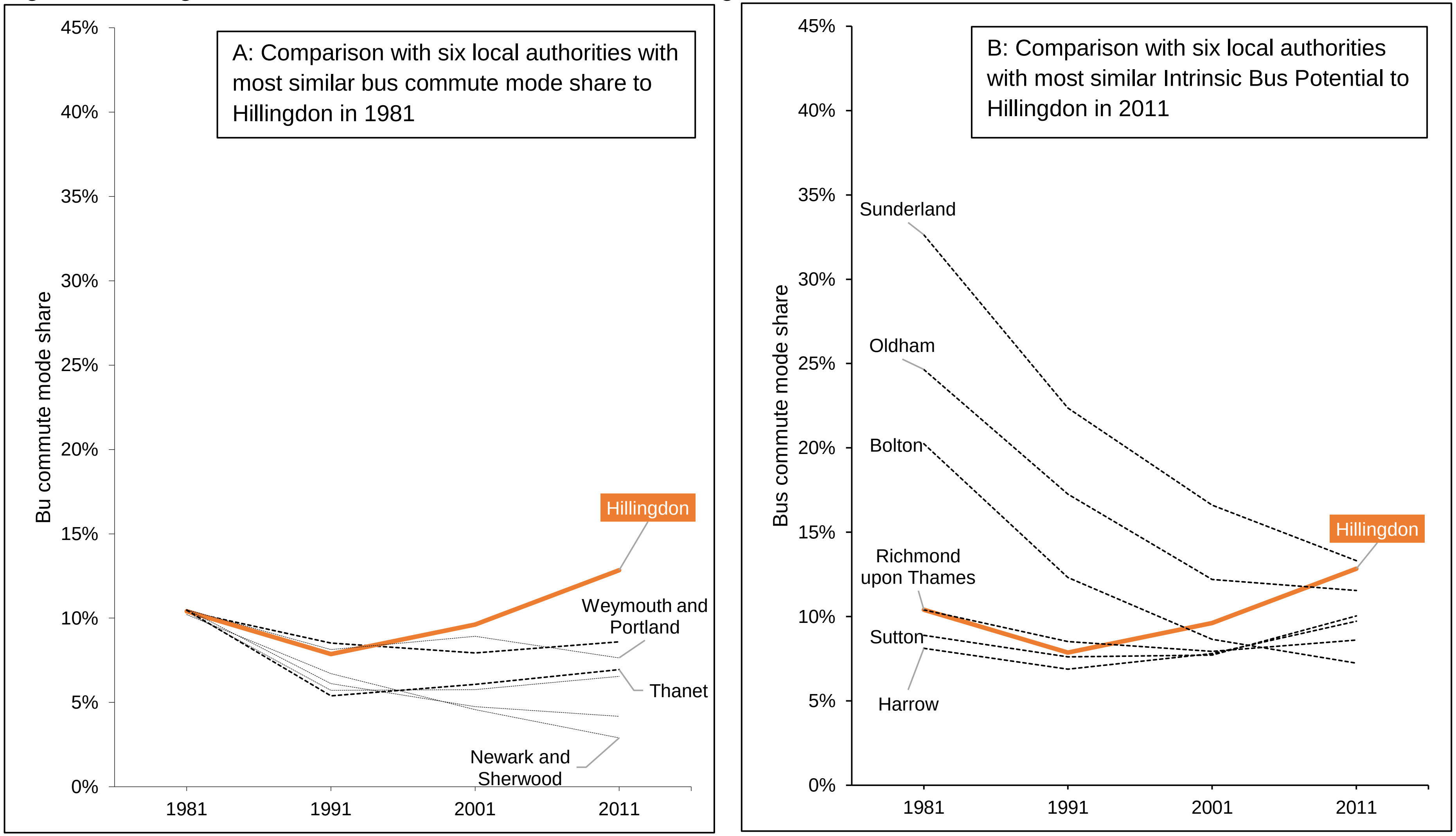
[49] This is also true for other characteristics, such as population density, where the outer London boroughs are not that dissimilar to other places with similar IBP.

Figure 23: Change in bus commute mode share over time in Hackney and Southwark



For chart A (most similar bus commute mode share in 1981), the six LADs with closest values are Birmingham (ranked below Southwark); Manchester, Gateshead and Nottingham (ranked between Hackney and Southwark); and Liverpool (ranked above Hackney). For chart B (IBP in 2011), the six LADs with closest values are Islington (ranked between Hackney and Southwark); and Camden, Lambeth, Manchester, Lewisham and Haringey (ranked below Southwark); there are no LADs with higher IBP than Hackney.

Figure 24: Change in bus commute mode share over time in Hillingdon



'Most similar' defined as the three LADs with higher values, and the three LADs with lower values.

9. Discussion and conclusions

Underlying characteristics that determine 'Intrinsic Bus Potential'

9.1. This analysis has shown the strong effect on travel patterns of an area's demographic, socio-economic and structural characteristics, including age structure, population density, housing and distances to work. These characteristics affect levels of car ownership and also the extent to which people travel by bus.

9.2. From examination of a large number of these characteristics, we have identified six factors which, when combined, can predict nearly 85% of the variability in commuter bus use, and can be used to define the 'Intrinsic Bus Potential' (IBP) of a local authority. The factors are: the proportion of households living in rental accommodation; the Index of Multiple Deprivation; the proportion of students; the proportion of the working population in social grade C1; the proportion of the working population travelling between two and twenty kilometres to work; and rush-hour traffic travel times.

9.3. Individually, these factors are not necessarily the most important determinants of bus use (that is, they do not necessarily have the largest correlation coefficients), although they are all positively correlated with higher bus use. However, taken together, they provided the greatest explanatory power of a variety of combinations that we assessed.

9.4. In some cases, the relationship between bus use and these six factors intuitively makes sense. For example, bus operators are already well aware that more deprived areas, and areas with a large student population, tend to have high levels of bus use.

9.5. Other factors are more surprising. In particular, it is counterintuitive that places with longer rush-hour travel times (i.e. more congestion) have higher levels of bus use. This is partly because more congested areas tend also to be built to higher densities, with concentrated travel demand, and hence tend to support more bus services. It may also be because congested areas are more likely to have invested in bus priority measures, giving buses a relative advantage over general traffic.

9.6. There are several implications of the analysis:

- The view often expressed by bus professionals that some areas are "good bus territory" and others are not so good is supported by the evidence. Underlying characteristics of an area, which are not amenable to influence by operators or local transport authorities, have a major effect on levels of bus use.
- City regions have higher Intrinsic Bus Potential than smaller towns and rural areas, and consequently also have higher levels of bus use. City regions are therefore also the places where investment in bus services is likely to result in the greatest increase in passenger numbers, because they contain a high proportion of people who are likely to be receptive to bus service improvements.
- The significance of the Index of Multiple Deprivation as a predictor of high bus use (both by itself, and as part of the IBP) underlines the important role of bus services in enabling the less well-off to get to work and to fully participate in society, and hence the key role of buses in maintaining social cohesion.

- City regions are rightly pursuing policies to raise incomes and tackle poverty, but these policies could lead to lower levels of bus use (and consequently more car use, carbon emissions and congestion) unless undertaken in parallel with policies to make bus travel more attractive.

9.7. The data on which the analysis is based is from the 2011 Census, and changes in the six factors that comprise the IBP in the eight years since the Census was undertaken mean that some areas may now have slightly more potential than they did then, and others slightly less. However, comparison of datasets for different time periods (using 2001 and 2011 Census data, and 2011/12 and 2017/18 DfT bus use data at the coarser-grained level of local transport authorities) suggests that the relationship between IBP and bus use is robust. Bus passenger journeys per person in 2017/18 are very strongly correlated with figures in 2011/12. Even though the IBP score of a local authority as calculated for this study is based on its underlying characteristics in 2011, it therefore still provides a helpful indicator of whether or not the area is “good bus territory” in 2019.

Effect of service levels on bus use

9.8. There is a close correlation between IBP and levels of bus service provision. This is not surprising, since in areas with high intrinsic potential for bus use, operators are likely to have provided more bus services in order to meet demand.

9.9. Nevertheless, combining all of the measures of public transport provision (such as the number of bus departures per hectare per week) with IBP provides slightly more explanatory power of the variation in bus use than IBP on its own. The combination of IBP and measures of public transport provision can explain over 88% of the observed variability in bus use between local authorities. This means that, all other things being equal, better bus services result in increased bus use. Data on more aspects of bus provision – such as variation in fares – could provide additional explanatory power.

9.10. The study looked in detail at some areas that had higher levels of bus use than would be expected from their IBP alone. Some, but not all, of these ‘outperforming’ areas had high levels of bus service provision. For example, in 2011, Nottingham had one of the highest bus commute mode shares outside London, nearly 4%-points higher than predicted by its IBP, and it also had the highest level of bus service provision outside London, at 300 departures per week per hectare. Similarly, Hackney and Southwark had bus commute mode shares that were 5-7%-points higher than predicted by their IBPs, and had some of the highest levels of bus service provision in the country, at more than 500 departures per week per hectare.

Culture of bus use

9.11. Although ‘geography’ (i.e. demographic, socio-economic and structural characteristics) is an important determinant of bus use, ‘history’ also plays a role. Looking at local authority areas that currently have high bus use, either in absolute terms or relative to what their IBP would predict, many have had even higher bus use in the past. The implication is that certain places have a long-term culture of bus use, and people have made, and continue to make, decisions about housing, employment and travel based on patterns of bus provision.

9.12. Almost all the areas with higher bus use than would be expected from their IBP also had very high levels of bus use in 1981, suggesting that a pre-existing culture of bus use is an important influence on current levels of bus use. However, it is possible to build bus use where a bus culture is absent. This is shown by some outer London boroughs (Croydon, Hillingdon and Hounslow) which now have higher levels of bus use than predicted by their IBPs, but had quite low levels of bus use in 1981. For example, Hillingdon had around half the bus commute mode share of Bolton in 1981 (10% versus 20%), but by 2011 its bus commute mode share was nearly double that of Bolton (13% versus 7%). High levels of bus use in the past are also no guarantee of continued success – a strong 'bus culture' can be lost. The most striking example of this is Sheffield, where bus commute mode share fell from 41% in 1981 (the highest in England) to 15% in 2011. This suggests that removing strong pro-bus policies (very low fares and an extensive network in this case) can fundamentally undermine a culture of bus use.

Other factors influencing bus use

9.13. It is possible to identify a number of other factors that have contributed to areas having bus use that is high in absolute terms, or higher than expected from their IBP; or to increases in bus use that buck the national downward trend. These are city-wide bus improvements that were possible in the context of bus regulation in London; a 'pro-bus context' in some areas outside London; certain local factors; and a 'halo effect' that has benefited some relatively rural areas close to cities with strong economies.

Bus regulation

9.14. First, London boroughs stand out as having very high levels of bus use. Bus use in London increased between 2001 and 2011, reversing an earlier pattern of decline and in contrast to the continued downward trend in most of the rest of the country. The upward trend was shown by every London borough, including boroughs in outer London with relatively low bus potential. London's success between 2001 and 2011 was the result of a major improvement in the bus 'offer' following the election of Ken Livingstone and the formation of Transport for London in 2000. TfL increased service frequencies, introduced a £1 flat fare (now £1.50), and developed the Oystercard which simplified public transport use and speeded up bus boarding. The fact that London's buses remained regulated was crucial to enabling these changes across all operators and all boroughs (although regulation *on its own*, without effective governance structures and adequate funding, had not been sufficient to halt the decline in bus use in the two decades before 2001). The congestion charge is also likely to have played a role in encouraging bus use in London, but this was only politically possible because public transport services (including buses) were good.

Pro-bus context: investment and supportive policies

9.15. In places with a 'pro-bus context', operators or the local authority (or both) have invested resource, research and development, and management focus to ensure that the bus product consistently matches the needs of the local market. Use of the private car is restricted or expensive (or both), either due to the nature of the area or because of measures taken by the local authority to restrain car traffic. In some of these areas the main operator is municipally owned.

9.16. Examples of places with a pro-bus context include Nottingham, Brighton, Reading and possibly Bristol.

9.17. In Brighton, bus use is nearly 4%-points higher than its IBP would predict. Bus use has been rising since 2001 and Brighton probably now has one of the highest levels of bus use in the south-east outside London. The local authority and the bus operator have worked together over several decades to improve the bus 'offer' and have been innovative in improving and marketing services.

9.18. Nottingham similarly has a long track record of improving the bus 'offer', coupled with supportive policies to restrain car use (including the introduction of the workplace parking levy, which has the added benefit of generating funds for public transport investment) and a strong focus on place-making and integration between land use and public transport.

9.19. In Reading, increases in bus use are fairly recent. Reading already had a bus commute mode share in 2011 that was nearly 3%-points higher than its IBP would predict (12%), but has seen pronounced growth in bus travel since then. Its municipal operator is able to reinvest all fare revenues into improving the service, enabling a more comprehensive network that runs late into the evening and seven days a week, and Reading Buses has worked with the local authority to reduce fares in certain areas. In central Reading, there is considerable on-street bus priority, and car parking charges are relatively high.

9.20. Bristol had a bus commute mode share in 2011 that was *lower* than its IBP would predict (10%), but has seen significant growth in bus use since then. This 'catching up' with areas with comparable IBP may be partly due to major investment in the Greater Bristol Bus Network, which achieved significant improvements in bus reliability and journey times, in turn enabling higher service frequencies on a number of routes ('kick-started' by local authority investment using the Local Sustainable Transport Fund). Other factors which have been suggested in Bristol include the increase in the number of students living in the city centre and travelling by bus to UWE; and the expansion of residents' parking schemes around the central area of the city, which has removed a reservoir of free commuter parking.

9.21. It is important to note that there are many other places where the amount of effort that has gone into improving bus services is substantial, and yet bus use has not responded. A 'pro-bus context' is not, therefore, a guarantee of success.

Local factors

9.22. There are some local factors which may play a part. For example, in Brighton a high population of transient seasonal workers and the concentration of employment and housing along a few key corridors may be significant; and in Hackney poor connectivity to the Underground (at the time of the last Census) is likely to have boosted bus use.

Halo effect

9.23. There is also evidence of a 'halo effect', in which some relatively rural areas with low bus potential that are close to a city with a strong economy have significantly higher levels of bus use than their IBP would predict. There are examples of this from areas around Nottingham, Oxford, Brighton, Bristol and Reading. This effect may also operate at a finer scale: for example, the higher than predicted bus use in some outer London boroughs may be partly related to the 'pull' of places within those boroughs with a strong concentration of jobs. Pro-active policies to extend services beyond urban boundaries may therefore offer an opportunity to increase bus use in areas which have traditionally been seen as less good bus territory.

Policy implications: what should be done to increase bus use?

9.24. This analysis shows that many of the factors that influence bus use are outside the control of bus operators or transport authorities, and that even those areas that outperform what might be expected from these background factors do so by relatively modest percentages. It also shows that even some areas which do better than expected are still experiencing year-on-year reductions in bus patronage.

9.25. However, there is a difference of about 8%-points between the best performing and worst performing local authority areas. This is still a significant amount of bus patronage. There are measures which operators (in a deregulated environment) and both local and national government (in both regulated and deregulated environments) can take which can increase bus use.

9.26. The key policy lessons from this report are therefore that:

- London shows that a combination of bus regulation, high levels of investment in services, and policies that discourage car use can be very effective.
- Outside London, a pro-bus context can be established or built on through operators or authorities (or both) investing time and resource in ensuring the product meets the needs of the local market. This can be enhanced through measures which make car use more expensive or difficult and/or sometimes through municipal ownership of the local bus company. Places with a high IBP but lower-than-expected bus use may have particularly good opportunities to achieve rapid change, as shown in Bristol.
- A long-term view is needed in order to build and sustain a culture of bus use, and a strong bus culture can easily be lost.
- Without a significant increase in funding for bus services, enabling reductions in fares, and widespread improvements in services, it is highly likely that there will be continuing decline in bus use and many areas will continue to fail to realise the potential of the bus.

With Parliament and many local authorities declaring a ‘climate emergency’ and looking to achieve Net Zero on short timescales, this analysis suggests that more radical measures are needed in order for the bus to play its part in reducing carbon emissions from the transport sector. The recent Committee on Climate Change ‘Net Zero’ report indicates that a shift from cars to other modes is required, alongside the switch to electric cars, in order for carbon emissions to be cut to net zero by 2050. Other work by the Tyndall Centre and University College London suggests that substantial reductions in car use are needed well before 2050 (e.g. by 2030) in order for us not to exceed carbon budgets. The changes necessary to achieve this are likely to include a rebalancing of the relative advantages and costs of driving and bus travel, more comprehensive bus networks, and changes to land use planning. With such changes, substantial increases in bus use might become possible.