Migration Commuting and Transport Patterns in Rural Areas Final Report

Commuting patterns in rural areas

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EXECUTIVE SUMMARY

The aim of this project was to describe commuting in rural areas, and compare these to other types of areas in England.

In order to achieve this 1991 Census data was used to analyse commuter flow data. Analysis was undertaken at two levels: a ward level analysis and an individual level analysis. The ward level analysis looked at the origins and destinations of all commuting into and out of all wards in England. The individual level analysis looked at the characteristics of commuters. These analyses aimed to discern patterns of commuting and their potential causes.

This is the first such study of commuting flows using a comprehensive database (census data), and represents the first robust and reliable insight into commuting in England. Use of the Census allowed a range of specific data sources to be used to enhance reliability (Special Workplace Statistics; Small Area Statistics; Sample of Anonymised Records; Special Migration Statistics). Crucially, use of the Census meant that all areas, and a fully representative sample of individuals, could be included in the analysis. This greatly enhances reliability and validity. For example, this is the first study to assess patterns of commuting into and out of all 8,619 wards in England, generating flow matrices of 74,287,161 cells to discern commuting between each of these wards.

Three types of commuting were considered: commuting balance (in- and out-flows between wards); commuting distance; and commuting mode.

<u>The Commuter Balance</u>

- Urban areas experience the largest volumes of commuting activity, while rural areas experience by far the least overall levels of commuting activity.
- The most rural wards are particularly unlikely to attract in-commuters compared to other wards, but they are also less likely to generate out-commuters than other wards.
- Rural areas have low out-commuting rates: there is NOT a mass exodus of commuters from rural areas.

In general, outward commuting from wards is significantly related to a number of factors. The more employment opportunities there are nearby and the more migrants and self employed people in a ward, the less outward commuting.

However, the higher the population density and percentages of people in social classes I and II, the more outward commuting there will be.

Commuting Distance

- While there are fewer commuters from rural areas, rural commuters will, on average, commute much further than their urban counterparts (as much as 1.6 times further) regardless of whether they travel by car or not.
- Commuting distances are particularly long in some of the more accessible rural wards, especially around London
- London is particularly likely to attract long-distance commuters who use public transport

The higher the proportion of people in a ward from social classes I and II, and the higher the percentages of migrants and people with 2 or more cars in the household, the higher will be the distance of the commute. As would be expected, the more employment opportunities there are nearby, the higher the population density, the lower the distance of the commute, as more urban wards retain more residents as employees.

For non-car commuting, the distance was positively associated with the number of households with 2 or more cars, percentage of people in social classes I and II, females in full time employment and the percentage of people who were unemployed.

Individual level modelling shows that long-distance migrants in rural areas are much more likely to commute a long distance than others in rural areas. This group will include those who have moved from urban to rural areas, whilst retaining their place of employment in an urban centre.

Commuting Mode

- Commuters in rural areas are more reliant on car use than those living elsewhere
- Commuting travel from rural wards is far more dominated by the use of cars than elsewhere.
- Commuting into large urban areas is predominantly made by public transport: this is particularly so from London hinterlands.

The greater the population density within a ward, the greater will be the amount of non-car commuting. Interestingly, the greater the percentages of women in full time employment and the percentages in social classes I and II, the greater the use of non-car modes for commuting.

The reason for the relationship with women in full time employment probably represents uneven access to cars within households, or the fact that the figures include hinterlands of large cities, especially London, where it is both economically necessary, and physically possible for women to have access to the labour market. Indeed, the reason for the positive relationship between outward non-car commuting and social classes I and II is the inclusion of such urban (especially London) hinterlands.

As would be expected, there is a negative association between outward non-car commuting and the percentage of households with 2 or more cars.

Individual level modelling shows that those commuters living in rural areas are significantly more likely to commute by car than commuters living elsewhere - this shows that those living in rural areas are significantly more likely to commute by car controlling for other variables.

Unexplained Variables

Overall, the models we used to help explain commuting patterns performed well. However, they performed least well in 'predominantly urban' and 'predominantly rural' wards. Further work could usefully be conducted in these areas to investigate why this is so.

Summary

Rural areas are not, as some would argue, the sources of large levels of daily out commuting. Instead, rural areas have much less commuting activity per se – both in and out. However, when a person commutes from a rural area, they will undertake the trip predominantly by car, and travel a longer distance than average. This holds true throughout England, though proximity to large cities reduces the dominance of the car.

The role of migrants who move to rural areas is of interest. Indeed, when migrants to rural areas are more prevalent, so will the overall distance of commuting undertaken from that area. However, the volume will on average be much lower. This mirrors the experience of rural areas as a whole.

These findings are based on a thorough analysis of a robust data set. The figures provide an accurate insight of behaviour based upon 19991 data. The work provides a good benchmark for the study of commuting, and can form a first step in what would be a useful longitudinal study.

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Section A Rural travel and commuting: a literature review

Introduction

Sustainability has been put at the core of built environment policy in the UK (eg DoE 1993, DETR 1999). In planning to provide housing and employment opportunities, policy makers increasingly place consideration of environmental impacts as one of the key deciding factors. In moving towards a sustainable environmental policy, transport is a crucial policy area. Reasonable transport links are obviously required for accessing a variety of social, heath related and employment opportunities but transport also has a major impact upon the environment through congestion, atmospheric and noise pollution (ECOTEC 1993, Newman and Kenworthy 1989), land (Kitamura *et al*. 1994) and visual intrusion. Indeed, transportation accounts for 23% of CO_2 emissions (Nijkamp *et al.* 1998). Thus policy makers increasingly must trade off environmental issues with access issues.

It is in rural areas where these tradeoffs have become increasingly problematic, and where a deeper understanding of travel behaviour is essential. While urban areas usually have well-established transportation services with good access across the network, in rural areas transport networks are less dense. Of particular note is the lack of stable and frequent public transport services that often necessitates increased reliance on the car. A picture emerges frequently in rural areas of high car ownership and use by many, coupled with reliance on a poor public transport service by others who do not have car access (particularly young persons, mothers, the elderly and disabled). Thus, while transport policies that aim to provide incentives for public transport use and impose financial and physical restraint of car use may be pertinent for urban areas, where transport choice exists, they may be less pertinent in rural areas where travel choice is much more constrained. The development of transport policies which are in the spirit of the recent DETR White Paper*: A New Deal for Transport,* now made real in the 10 Year Transport Plan, need to be grounded in a deep understanding of rural travel, its true volumes, patterns, trends and determinants.

The concerns about transport-related problems have been catalysed by recent National Road Traffic Forecasts (NRTF) which give a 'most likely' prediction of traffic growth of 38% over the next 20 years with a 'worst case' scenario estimating a growth of 84% by 2031 (DETR 1997). However, these global figures mask differences that may exist between different areas. We must know more about the geography of commuting patterns throughout England as a whole, and target those places where the impacts of changes in commuting behaviour will be most severe in the near future (Anderson *et al*. 1996). Bannister and Gallent (1998) provide some insight into regional difference, noting the negative changes (with regard to sustainability in transport) between 1981 and 1991. They note that trip lengths have increased by 15%, that commuting trips have increased by 2.8%, and the car has increased it's share in commuting trips by 21%. Main problems appear to be in the metropolitan areas where the effects of bus deregulation have been hardest felt.

Rural transport issues

The traditional conception of all rural dwellers as being poor and living in inaccessible areas is both wrong and becoming less widely held. With counterurbanisation, rural areas are now much more affluent and more typically have much higher car ownership than urban areas, particularly amongst lower income groups. Stokes (1995) highlights key statistics from the National Travel Survey which compare rural and urban areas. These statistics include:

- Only 37% of urban residents have cars while 51% of rural residents have cars
- Approximately 25% of the UK population live in households without a car, while in rural areas the figure is 13%
- On average urban residents travel 7,800 miles compared to 9,600 miles travelled by rural residents per year
- 33% of rural workers work outside urban areas, 67% work in towns

Car ownership and use increases with decreasing settlement size and, in part, this is due to the requirement to travel longer distances to reach facilities in rural areas than the travel distances to facilities within urban areas (Cullinane and Stokes 1998). The proximity of road networks is a big determinant of the amount of car based travel (Curtis 1996) and while average trip numbers and time travelled by car by those living in rural areas are very similar to those found in urban areas, the average distances travelled are much higher. With increasing congestion of rural roads (which varies considerably with the seasons) journey times may increase more in the future. CPRE have also produced predictions of future levels of rural traffic conditions. CPRE's traffic trauma map (CPRE 1996) shows likely levels of traffic growth on Rural roads across England over the next 30 years. Estimates indicate a 164% rise over the next 30 years.

Stokes (1995) also discusses whether income in rural areas can be connected to car ownership rates. While 20 to 25% of urban residents on low incomes have cars, in rural areas this figure rises to 43%. However, there remains the question of whether these higher rates of car ownership simply reflect a greater need for cars in more remote rural areas.

Research indicates that car use is positively related to owners' income. In spite of the fact that higher income rural residents travel 230 miles per week compared to 105 miles travelled by those on a lower income, high-income rural residents (about 20% of households) are very unlikely to be affected by a rise in petrol prices. On the other hand, those on a lower income who rely on their car for transport, are going to suffer most from increases in petrol prices.

Another reason why car transport is necessary for many rural residents is the paucity of public transport provided in rural areas. For example:

- Only 46% of rural residents live within 3 minutes walk of a bus-stop compared to 58% of urban residents
- Only 3% of rural residents have a 15 minute or less bus service, compared to 25% of urban residents

A number of reports indicate that public transport provision varies within rural areas, but many rural bus services suffer from instability and infrequency, with off-peak services being particularly poor. Multiple deprivation is evident (Bannister and Evans, 1992) with the lowest income groups having less access to cars, and consequently being more dependent upon rural public transport services. The elderly and single parents seem to be groups particularly encountering this form of social exclusion. Indeed, problems of off-peak service availability make access to part time jobs very difficult and a workshop jointly held by CPRE and the Countryside Agency into rural services, (CPRE and Countryside Agency 1999) noted that there were no national minimum service standards for public transport in rural areas. However, the 10Year Transport Plan (DETR 2000) has established a target of an hourly bus service within a 10 minute walk of more than 1/3 of rural households.

As well as considering rural accessibility, some of the reports reviewed focus on the changing *nature* of rural roads. Work by CPRE (1995) presents case studies from local CPRE groups across England where country lanes are at risk from increasing traffic levels. The case studies consist of ADT flows based on four half-hourly counts, and qualitative experiences. The report also addresses changes in usage of country lanes such as being used for drove roads for milk herds, and emphasises increases in traffic (particularly freight) on them. Survey work undertaken by CPRE volunteers, to establish whether walkers, cyclists and horse riders feel intimidated by traffic on rural roads found that 65% of respondents said they felt threatened either some or all of the time, while only 3% said they felt safe from traffic. Suggested response strategies include:

- Lower speed limits (43% wanted 20mph limits)
- Priority for vulnerable road users (walkers, cyclists and horse riders) on selected country lanes, similar to urban 'Home Zone' areas (72%) (CPRE 1999/1)

<u>Development patterns</u>

Development patterns are inextricably linked with the overall sustainability of the UK. The UK Strategy for Sustainable Development (DETR 1999) has sought to ensure a better quality of life by establishing four basic objectives (measured by 15 headline indicators of a wider range of 150 indicators) to be met at the same time:

- Social progress which recognises the needs of everyone
- Effective protection of the environment
- Prudent use of natural resources
- Maintenance of high and stable levels of economic growth and employment

This adoption of indicators is the culmination of discussions of the efficacy of establishing environmental indicators, and the monitoring of these indicators. The 21st Royal Commission on Environmental Pollution made a strong call for the establishment of environmental standards, and their monitoring (Royal Commission on Environmental Pollution 2000). Importantly the Government response (DETR 2000) agreed that such standards were necessary, though called for advice on their definition, noting that such indicators were defective.

The 1999 Strategy for Sustainable Development provides for an overarching framework for development in the UK, and the themes of sustainable development (physical, economic and social) re-occur in guidance and legislation guiding physical development and transportation in the UK. Indeed, revisions in Planning Policy Guidance since the election of the current Government have further emphasised the importance in physical development[1] upon sustainability, and reinforced the role of the local and regional planning system. Key development issues for rural areas concern housing and pressure on the green belt, and transport.

With regard to housing, the role of the green belts have been reinforced in PPG 2 (Green Belts) which has for the first time set objectives for the use of land within them. In addition, PPG 3 (Housing) has affirmed the importance of re-using urban land for housing to relieve pressure on the countryside. However, while these approaches are theoretically sound, the real impacts on travel, including commuting, of policies which support the guidance are unclear. For example, Curtis (1996) notes that without a detailed understanding of current travel behaviour, it will be impossible to estimate the effects that extended housing growth will have on commuting, should it be allowed in rural England. The study also shows that the travel impacts (including commuting travel) of locating housing development close to good public transport networks, as promoted within PPG13 (Transport), are also unclear.

CPRE (1996/2) examined whether the creation of homes and business premises in the countryside assists those in rural areas, or encourages the flight of people and businesses from our towns and cities. It examines the trend of 'footloose' businesses to move to rural areas, with many jobs being taken up by in-migrants rather than local people.

Using a mixture of empirical evidence and quotations drawn from a list of 37 references, the document focuses on the Consultation Draft for PPG7, and examines whether its content will address the requirements of rural areas. Creation of jobs through relocation of business to local areas does not necessarily mean local employment for local people. This can be caused by: lack of skills base, poor accessibility, better training of in-migrants and lack of child-care facilities. These and other reasons result in developments not meeting the assumed result that development will sustain villages by providing the basis for maintaining local services, schools, shops and post offices, pubs and other features of community life. The report recommends a greater focus on the needs of people, rather than on geographical allocation of space, and greater research into developments that will bring greater benefits to those in rural areas.

Concerns about development patterns are also raised about the apparent inconsistency between the Government's desire to reduce car use, and the continued granting of planning permission to green field sites in locations which are difficult to reach without a car (CPRE 1999/2). The impacts of such development may have contributed to:

[1] Within specific PPGs as well as the PPG1 (General Policy and Principles) which provides strategic guidance on the planning system.

- A 40% increase over last 10 years in distance travelled by car
- The increasing isolation of the 20% of the rural population without a car
- Reduced opportunities to walk or cycle in peace in the countryside

The limited modal choice available at these new business and residential developments is a crucial issue. Both the Royal Commission on Environmental Pollution and UK Strategy for Sustainable Development emphasise the role and responsibilities of the individual and businesses in reducing their impact upon the environment. Specifically in transport, the Transport White Paper (DETR 1998) focuses it's attention upon facilitating more environmentally friendly transport choices for the individual, and promotes the policy of green travel plans to reduce car use to businesses.

This CPRE document (1999/2) cites mismatches between transport policy and development on the ground, supporting its case with summaries of developments under consideration, recently approved or underway. CPRE note that integrated land use and planning proposes that new development should be located where it reduces the need to travel. Transport planning should assist with this, aiming to reduce car dependency in the longer term (CPRE 1995). This has to some extent been addressed by revisions in PPG13 (Transport) which aims to integrate land use planning and transport planning, as well as raising consideration of the linkages with environment, health and economic policies. Issues of integration are discussed below in Transport Solutions and Rural Areas.

Commuting and development

Given the paucity of public transport, and high car ownership levels, as well as the physical changes in land use in and around rural areas, the debate continues as to whether the levels of commuting are significantly higher in rural areas. Although most agree that rural commuters are more likely to use cars and commute further, some have suggested that the overall impact on consumption levels and pollution is negligible. Breheny (1995a,b) challenges the conventional view, apparently held by most planners, governments and academics (e.g. Commission of the European Communities 1990, DoE 1994, Bourne 1992), that commuting and, therefore, energy consumption (Naess and Sandberg 1996) and pollution, will be substantially reduced by encouraging the development of more compact cities (Breheny *et al*. 1993). In his view policies favouring urban containment are 'draconian' and have gained surprising strength of support given that they are relatively untested.

There is also strong support from some quarters that the economy of rural areas should provide a diverse and sustainable range of employment opportunities (Gordon and Richardson 1990). If rural employment growth has the added benefit of reducing out-commuting from rural areas, the argument in favour of such expansion may be given added weight.

Unfortunately, most of the analyses of rural commuting issues (including the work by Breheny) have been based on rather crude aggregations of data for large geographical areas. No attempt has been made to disaggregate flows to

understand local area commuting networks, nor has anyone been able to offer robust comparisons of the different types of commuting that affect rural areas. Bluntly, we currently know very little about the true scale of these types of movement and the way they relate to commuting behaviour in rural England.

Transport solutions in rural areas

The aforementioned Transport White Paper (DETR 1998) sets the main framework for solutions to transport problems. The focus of the White Paper is upon moving towards a quicker, safer, punctual and environmentally friendly transport network. Integration is the key to realising this system: integration of modes, integration of travel information, and integration of transport objectives across local, regional and national scales, as well as with other policy areas. The ultimate objective is to move modal split away from private car use.

The major vehicle for realising this integration is the Local Transport Plan. The Plan should develop policies and initiatives in line with the White Paper to be presented as part of the bidding process to central Government. Importantly, and developing the theme of the UK Strategy of Sustainable Development, qualitative and quantitative policy targets should be set, as well as a monitoring regime established to monitor progress. Indeed, the first round of LTP submissions in July 1999 were preceded by many local authorities undertaking benchmarking data collection exercises as a first step in the development of their monitoring programmes.

Policies stressed for rural areas are innovative flexible community transport schemes, fully integrated Countryside Traffic Strategies, as well as support for traditional rural bus services. However, many commentators have suggested transport solutions that will be sympathetic to the needs of rural areas, recognising the constraints on transport choice which exist in these areas.

Stokes (1996) examined what could be done to improve the current traffic situation taking into account the travel behaviour of residents in rural areas. The paper analyses and discusses findings from the national travel survey in the context of rural travel behaviour. The paper focuses on the announcement in 1994 by The Royal Commission on Environmental Pollution calling for petrol prices to be doubled within the next ten years. Those against the policy argued that rural residents would suffer greatly, in particular harming health, leisure and educational opportunities. The paper concludes that if petrol prices were to continue to rise, doubling in cost over the next 10 years, people on a low income living in rural areas in particular would suffer from using the car. As rural areas do not have many alternative modes of transport, the rural poor would suffer from a more isolated lifestyle. This has been countered by what we would regard as the rather unrealistic view that if prices rise slowly people on lower incomes living in rural areas would have time to change their lifestyle, perhaps relocating their home in a more suitable location for facilities and activities needed.

Reducing the demand for road transport needs to include discouragement of unnecessary car use, improving traffic management measures, provision

of fiscal measures, and specific measures to tackle freight traffic. Support of improved transport choices needs to include improvements in public transport and improvements for walkers and cyclists. A workshop investigating rural services by CPRE and the Countryside Agency identified that spatial planning of public transport services, and the promotion of transport modes including DRT can ensure wise spending of resources (CPRE and Countryside Agency 1999).

Much of the research into commuter trends in rural areas focuses on the impacts of transport policy. For example Stokes (1995) reviewed the impacts of a sharp and sudden rise in petrol price which would have large negative effects on lower income people who have to use cars for work, especially those in rural areas. A slower rise could give time for a geographical shift in the population. As a large proportion of traffic mileage is clocked up by a small number of drivers, a ration on mileage would cut traffic on the roads considerably.

As stated above, to do nothing would result in roads being overloaded with cars, but to increase petrol prices could have extremely negative impacts on lower income rural residents who consider they need their car to get around. Linciano (1997) examined car usage / ownership in the UK, with the aid of empirical modelling. Using NTS and Family Expenditure Survey data sets, he concludes that ownership of a vehicle, rather than running costs, affects vehicle usage. The implication of this is that to control car utilisation it would be better to discourage car purchase than try to restrict use through the control of running costs. Policies are needed to manage travel, in particular by increasing alternative modes of transport, which would result in a reduction in car dependency amongst rural car users.

Stokes (1995/2) suggests two solutions to the effects of increasing petrol pricing:

- Electronic road pricing for all roads including A and B roads, rural residents would benefit as they would have un-tolled travel on minor / rural roads
- Increase petrol prices to extreme amounts and issue smart cards to only allow a certain amount of litres of petrol a month at a reduced rate and then the rest could be bought at a higher cost. This would limit travel and the number of journeys made. In conjunction with improved public transport this could offer further discounts on alternative modes of transport

Previous sections indicate that relationships between travel and urban form exist – the more densely populated an area, the less car use there is. However, there is a need for much more depth in analysis if changes in urban form are to be seen as transport solutions *per se* (Culinane and Stokes 1998, Curtis 1996, McClafferty and Preston 1997). The findings of recent research (ESTEEM Model – EPSRC Grant number GR/L77300) into the effects of urban form on travel have shown that new developments have marked effects on neighbouring areas, affecting not only travel behaviour, but also the vitality of the area. This research modelled the impacts of intensification, decentralisation and new town developments on travel. This finding points to the importance of considering the wider impacts of development location, and not just the impacts of transport. In addition the research stressed the importance of the availability of new jobs within new developments. Without such jobs, travel patterns would be seriously impacted, and energy efficiency of the

settlements drastically reduced. Finally the research highlighted the importance of the leisure/personal business trip which has increased in distance by 35% between 1985 and 1995, while the work trip has increased by 18% (Titheridge *et al*. 1999).

Key messages

The existing literature identifies a number of issues facing rural traffic and commuting. The core to these documents is the examination of rising trends of rural traffic, commuting and car ownership. Key problems for rural areas include:

- The strong links between rural poor, social exclusion and non-car ownership
- Poor access to quality and high frequency public transport, with particular problems for off-peak travel
- The importance of urban form in the transport and sustainability debate, though the lack of detailed knowledge of the relationship
- Resulting impacts of high car traffic levels on rural roads, including loss of amenity, particularly for those walking, cycling or riding horses

There are, however, key limitations or areas completely omitted by existing research. Existing reports pay particular attention to the relationships between income and car ownership. While these issues contribute in part to rural travel patterns and behaviour, concentration on them masks other issues, such as local service provision, local employment and local accessibility using public transport.

Insufficient attention is paid to the nature of rural traffic and journey types. Many proposals for addressing rural traffic problems would have considerable implications for freight companies, self employed persons, those dependent on vans (builders, rural delivery services etc.). Most reports equate traffic problems with car usage; this simplistic approach does not address the full picture.

Consideration has not been given to the potential use of different modes for different journey types, journey distances, and the individuals undertaking the journey. More detailed research into these areas may produce a more realistic (albeit more complex) set of strategies to address rural travel and commuting issues.

Attitudinal issues lie at the core of traveller behaviour. Much of the work carried out in this area makes assumptions about people's behaviour, but it does not attempt to seek out the rationale behind such patterns. Overall, there is a need to focus more specifically on rural commuting, and the potential causes of this behaviour data.

Section B Project objectives and research design

Objectives

This study describes commuting patterns in English rural areas. This is achieved. mainly through comparisons with the patterns for non-rural areas. This comparison is based upon the ONS 6-fold urban/rural ward categorisation developed by the ONS which uses data on the physical boundaries of urban land from the Ordnance Survey (see Boyle and Pearce 2000 for a discussion of this choice). Wards are assigned one of six categories depending on where the majority of its population was judged to reside (Figure 1).

<Fig 1 here>

Two broad types of 1991 census information were used in the study. First, data on commuting flows between and within the 8,619 wards in England (the smallest zones for which commuting flow data were available from the 1991 census). However, while these data provide the most geographically detailed information about commuting flows available in the UK, we have little information about the people involved in these flows. Secondly, we therefore extracted individual-level data from the 1991 Census Sample of Anonymised Records (SAR). This is the largest sample of individuals for which we have reliable information on socio-economic and demographic characteristics. This data provides a good deal of information about individuals (allowing us to examine who commutes furthest and by which modes), however, for confidentiality reasons the data are geographically restricted (we can only identify 'rural' areas relatively crudely). Thus, each dataset is imperfect but, in combination, these analyses provide a comprehensive examination of commuting in England.

Specifically, we aimed to examine three types of commuting at the ward level: commuting balance (in- and out-flows between wards); commuting distance; and commuting mode. For each of these three types we aimed to *describe* the general patterns and to *explain* the underlying causes for these patterns. Once the modelling work had been undertaken and we had a good idea of the underlying causes of the commuting patterns, we then examined areas where the patterns of commuting appears unusual. This allowed us to identify which wards remain difficult to explain and where further work might most usefully be conducted.

At the individual level we also considered: commuting balance; commuting distance; and commuting mode and the aim here was to examine whether certain individuals were more or less likely to commute at all, commute over long distances, or commute by car. In particular, we aimed to see whether those in rural areas had different commuting characteristics than those elsewhere. Overall, therefore, we aimed to examine whether the commonly held assumption that commuting patterns are particularly unusual in the more remote rural areas in England is true.

Ward-level data

Special Workplace Statistics (ward-level commuting flows)

We extracted three main matrices of flows from the Special Workplace Statistics (SWS). These were the intra- and inter-ward flows of total commuters, car commuters and non-car commuters. Each matrix included 74,287,161 cells ($8,619^2$) and the three matrices contained 1,716,082, 1,092,230 and 623,852 individuals respectively[2].

To calculate the distances commuted by each individual, the distance between each pair of wards in the dataset was calculated as the Euclidean (straight-line) distance between the population-weighted centroids of each ward.

Special Migration Statistics (ward-level migration flows)

Data on inter- and intra-ward migrants were also extracted to allow comparisons of commuting and migration patterns. These are based on all the census respondents and involve the analysis of matrices which also contained 74,287,161 potential flows. In all of the work considering commuting patterns for migrants, long-distance migrants were defined as those who have moved 20kms or more in the previous year, while short distance migrants were those who moved less than 20kms.

Small Area Statistics (ward-level counts)

The most commonly used set of data from the 1991 census are the Small Areas Statistics (SAS) which include cross-tabulated counts of individuals for different scales of analysis. The smallest areal unit for which these data are supplied are Enumeration Districts (EDs), although most information is analysed at the ward-level. The explanatory variables were derived from this source.

Commuting measures

Commuting is a diverse and complex social event that can be measured in numerous ways. It was essential, therefore, to identify a series of commuting measures that were relatively simple to understand, but which reflect the diversity of commuting patterns. Thus, only a selection of the commuting measures that were actually calculated were retained in the analyses (Table 1). These are described under the three headings of: commuting balance; commuting distance; and commuting mode. The first five of these measures were calculated separately for total commuters, car commuters and non-car commuters, while the final measure compares car and non-car commuters. Note that only the asterixed variables were used in the modelling work.

Table 1 Ward-level commuting measures

Commuting measures	Brief explanation

[2] Note that these data are a 10 percent sample of the total 1991 population and that we have multiplied them by 10 in subsequent analyses to allow comparisons with appropriate denominators.

Commuting balance	
In-commuters	Total in-commuters to a ward
Out-commuters	Total out-commuters from a ward
In-commuting rate	Commuters leaving a ward as a proportion of the economically active resident in that ward
Out-commuting rate *	Commuters arriving in a ward as a proportion of the economically active resident in that ward
Commuting distance	
Average out-commuting distance *	Average distance out-commuted from each ward
Commuting mode	
Car out-commuters as % of all out-commuters *	The percentage of out-commuters from each ward who travel by car

* Variables used in the modelling analyses

Explanatory variables

A series of explanatory variables were extracted for each of the 8,619 wards, mainly from the Census Small Area Statistics data (Table 2).

Table 2 Ward-level explanatory variables

Explanatory variables	Brief explanation
Employment opportunities	The relative location of each ward in relation to the employment opportunities in every other ward
Population density	Population density is a simple indicator of rurality
% working in agriculture	The percentage of the economically active working in agriculture
% working at home	The percentage of the economically active working at home
% unemployed	The percentage of the economically active who were unemployed
% public housing	The percentage of residents living in public housing
% one-year migrants	The percentage of residents who were one-year migrants
% retired	The percentage of residents who were retired
% households with 2+ cars	The percentage of households with two or more cars
% females in full-time work	The percentage of economically active females in full-time work
% females partners in social class I or II	The percentage of females in social class I or II who were married or cohabiting
% self employed	The percentage of the economically active who were self-employed
% social class I and II	The percentage of the economically active in social class I or II

Of particular interest is the specially constructed ‘employment opportunities’ measure, indicating which wards had high or low numbers of employment

opportunities located nearby (Figure 2).

<Fig 2 here>

Ward-level analysis

The commuting measures can be used in a purely descriptive manner to help understand how commuting varies across different types of wards (below we compare the values across the six categories of the ONS Census non-rural / rural classification).

They can also be compared to ward-level explanatory variables to help us understand what the potential causes of these different patterns are. The ward-level commuting measures and explanatory variables were therefore compared using regression models in SPSS.

Finally, we need to consider what is 'left to be explained'. We would hope that our regression models would aid our understanding of the variables that are most associated with commuting balance, distance and mode. Of course, these models do not 'fit' the data perfectly as the r^2 values were all well below 100% - indeed we would be very suspicious if they did fit perfectly. Therefore, the commuting in some wards will have been estimated better than other wards and it is useful to summarise where the models work best.

Individual-level data

Sample of Anonymised Records (individual-level information)

For the first time in 1991, individual-level information was released from the Census. Two files are available: a one percent sample of households (where individuals within households could be linked together) and a two percent sample of individuals. The household file, which was utilised here, is geographically crude, providing only a regional identifier (there are ten in England) but an additional variable has been added to this sample based on the ONS ward group classification (see Boyle *et al*. 2000 for further details). This divides wards into 14 groups based on a cluster analysis of forty 1991 census variables. Although it is impossible to identify the precise ward that each individual lives in, it is possible to identify the 'ward-type' in which they live. Two of these 14 categories are 'rural' and 'rural fringe' and those extracted from the household file who were living in these categories could be compared to individuals living elsewhere.

A total of 222,674 individuals living in England in 1991, who were resident in households, and were economically active were extracted from the household sample and, as described above, these were divided between those resident in 'rural areas' (22,809) and those resident elsewhere (199,865). A key distinction was also made between non-migrants, short-distance migrants (those who had moved less than 20kms during the previous year) and long-distance migrants (those who had

moved 20kms or more during the previous year).

Explanatory variables

A list of individual-level explanatory variables were used in the individual-level modelling, some of which match those used at the area level in the analyses described above. They were the same for each pair of models and are listed in Table 3. In each case, the models compare the probability of a particular outcome between each of the categories for each variable.

Table 3 Individual-level explanatory variables

Explanatory variables	Category explanation
Residential location	Non-rural; rural
Migrant status	Non-migrant; short-distance migrants (<20kms); long-distance migrant (20km+)
Occupation	Other; professional / managerial; agricultural worker
Housing tenure	Owner occupied; private renting; public renting
Higher qualifications	No higher qualifications; higher qualifications
Age	< 30; 30-44; 45+
Employment status	Other; self-employed; unemployed / government scheme
Sex	Male; female
Ethnicity	White; non-white
Marital status	Other; married / remarried
Car ownership	< 2 cars; 2+ cars

Individual-level analysis

The individual-level models were fitted using GLIM (a generalised linear modelling package). Separate logit models were fitted to test a series of hypotheses. In the first model, the characteristics of those who commute were compared to the characteristics of those who did not commute. The aim here was to determine whether those living in rural areas commuted less than those living elsewhere and the entire sample of 222,674 was included in this model. We can therefore test whether commuting is influenced by living in rural areas, controlling for other characteristics.

The second model was only fitted for those 166,914 individuals who did commute. The aim here was to identify whether individuals living in rural areas have longer commuting distances than those living elsewhere (distinguishing between those who commuted less or more than 30km), controlling for other effects expected to influence an individual's commuting behaviour.

The third model goes further to examine whether long-distance migrants who were in rural areas were especially likely to commute long distances. The sample is therefore those 16,592 commuters who lived in rural areas and in-migrants are

compared to other residents.

The fourth model was fitted for those 166,914 who did commute (in rural and non-rural areas). Here we were especially concerned to compare the use of cars for those in rural and non-rural areas. Once again, results are provided for a simple one-variable model and a more complex model with a number of explanatory variables.

The final model was only fitted for those 16,592 commuters living in rural areas. This allows us to investigate whether those living in rural areas were more likely to commute by car and, in particular, whether recent long-distance migrants were especially likely to commute by car.

Section C Results

The results of the ward- and individual-level analyses are divided into a series of sections and in each case we comment on three levels of analysis: commuting balance; commuting distance; and commuting mode. At the ward level, we first compare the selected commuting measures across all six non-rural / rural classes of ward, allowing major differences to be identified through the urban/rural continuum. Second, we then provide maps of these across all 8,619 wards in England to provide a visual representation of the patterns. Third, we undertake some analysis of a series of explanatory variables chosen to help explain these commuting patterns. Fourth, we examine those wards where the commuting patterns were especially difficult to explain.

At the individual-level, we present the results of the logit modelling of individual level data from the SAR where we are interested in the individual characteristics that influence commuting distance and mode.

Descriptive analysis of ward-level commuting patterns

Describing commuting by ONS non-rural / rural classification

The mean values for each of the commuting measures explained above are summarised in Table 4 by the ONS Census non-rural / rural classification. Note that the in- and out-commuting rates can be multiplied by 100 to provide percentages and that the distance measure is in kilometres.

Table 4 Ward-level commuting measures (averages) by ONS Census non-rural / rural classification

Commuting measures	ONS Census non-rural / rural classification					

	Wholly urban	Predominantly urban	Mixed urban	Mixed rural	Predominantly rural	Wholly rural
Commuting balance						
Total in-commuters	240.0	149.2	75.5	61.7	60.8	29.5
Total out-commuters	221.4	198.6	116.6	91.2	71.7	48.3
Total in-commuting rate	0.84	0.49	0.43	0.43	0.49	0.34
Total out-commuting rate	0.66	0.63	0.61	0.59	0.59	0.54
Car in-commuters	158.0	116.3	62.4	51.8	49.3	24.8
Car out-commuters	140.7	151.2	97.1	77.3	61.5	42.4
Car in-commuting rate	0.51	0.39	0.35	0.36	0.4	0.28
Car out-commuting rate	0.43	0.49	0.51	0.5	0.51	0.48
Non-car in-commuters	82.1	32.8	13.2	9.9	11.5	4.7
Non-car out-commuters	80.7	47.4	19.5	13.9	10.3	5.9
Non-car in-commuting rate	1.4	0.1	0.08	0.07	0.09	0.05
Non-car out-commuting rate	0.23	0.14	0.01	0.09	0.09	0.07
Commuting distance						
Total average distance out-commuted	10.0	12.5	14.2	14.9	14.6	16.5
Car average distance out-commuted	11.2	13.4	14.9	15.4	14.8	16.8
Non-car average distance out-commuted	8.5	10.6	12.1	14.2	14.0	15.4
Commuting mode						
Car out-commuters as % total commuters	64.6	77.5	83.9	84.5	85.7	87.5

Commuting balance

The most rural wards are particularly unlikely to attract in-commuters compared to other wards, but they are also less likely to generate out-commuters than other wards

Some interesting and consistent trends are apparent in the data for total commuting. First, the total numbers of in- and out-commuters fall consistently from the wholly urban to the wholly rural wards and there is a wider gap between these urban and rural wards in the figures for in commuting than out commuting.

However, while the total in-commuting rates were lowest for the wholly rural wards and highest for the wholly urban wards, there was not a consistent decline in the other types of wards between these two extremes. There was a consistent decline in the out-commuting rates from wholly urban to wholly rural wards. Only the wholly urban wards had higher in-commuting rates than out-commuting rates. Note also that car out-commuting rates were higher for wholly rural areas than they were for wholly urban areas, but were lower for non-car commuting.

Commuting distance

Commuters from rural areas have longer commutes than those in urban areas, regardless of whether they travel by car or not.

The average distances commuted by car or non-car modes were shortest in the most urban areas and longest in the most rural areas and the increase was reasonably consistent through each of the six categories of ward.

Commuting mode

Commuters in rural areas are more reliant on car use than those living elsewhere

Finally, the percentage of commuters who travelled by car demonstrates a consistent rise from the more urban to the more rural areas.

Mapping commuting patterns

Commuting balance

Rural areas have low out-commuting rates

Figures 3 and 4 provide the total in- and out-commuters by ward. These maps are a useful demonstration of the dominance of urban centres in both attracting and generating inter-ward commuters. The highest values in Figure 4 are especially concentrated in the large metropolitan wards.

<Figs 3-6 here>

Figures 5 and 6 provide the in- and out-commuting rates (based on the economically active population resident in each ward). Figure 5 appears relatively random with little urban / rural distinction. This demonstrates that while urban centres may attract large numbers of in-commuters, there may be few economically active residents in these wards. On the other hand, while rural wards may only attract small numbers of in-commuters, their resident populations may also be relatively small. Figure 6 does display a clearer pattern as the most remote rural areas have low out-commuting rates (e.g. parts of the South West, East Anglia, along the Welsh border, and the North West). This is an interesting finding, as many assume that these more remote rural areas lose relatively large numbers of out-commuters. In fact, while more accessible rural areas have become popular residential areas for commuters, the more remote areas do not appear to generate as many out-commuters to urban areas.

Commuting distance

While relatively few people commute from the most remote rural centres, those that do are forced to travel long distances on the whole

Commuting distances are long in some of the more accessible rural wards, especially around London

London is particularly likely to attract long-distance commuters who use public transport

Figure 7 provides the average distance commuted by ward and this clearly

demonstrates that those living in urban areas tend to commute shorter distances than those who reside in more rural wards. However, the pattern is not simply one of long commuting distances in the remote rural fringe and shorter commutes in other areas. While the commuting distances are shorter in the urban centres, they are long in many of the more accessible rural areas, particularly in a wide belt around London.

<Fig 7 here>

Comparing Figures 8 and 9 it is also clear that the longest distances commuted by car are not as clustered as they are for non-car commuters (note that the colour scheme is reversed for these two maps). The focus around London for long-distance non-car commuters is striking (although the distances commuted within central London are obviously shorter).

<Figs 8-9 here>

Commuting mode

Commuting travel from rural wards is far more dominated by the use of cars than elsewhere.

Of particular interest are the patterns of high out-commuting rates by car (Figure 10) and non-car (Figure 11). The former is much more dispersed than the latter which is strongly focussed on London especially. Indeed, the patterns for London are opposite in these two maps with high rates of non-car out-commuting and low rates of car out-commuting. Overall, these maps suggest that in the more rural areas car-commuting is more common than commuting by other means. This reflects the fact that public transport is a more realistic option for commuting in urban and more accessible rural areas than it is in the more remote rural areas.

Figure 12 displays the percentage of out-commuters who travel by car. This allows the identification of those wards where the provision, or use, of public transport is less than we would hope and not surprisingly, the percentages of out-commuters using cars are much higher in the more rural areas than elsewhere.

<Figs 10-12 here>

Ward-level modelling analysis of commuting

Following the descriptive analysis above, here we report the results from seven regression models[3] where the aim is to attempt to understand some of the underlying reasons for the patterns of commuting described below. In each model the 13

[3] The first three use the out-commuting rate for total, car and non-car commuters as the dependent variable; the next three the log of the average distance out-commuted for total, car and non-car commuters; and the seventh car commuters as a percentage of total commuters.

explanatory variables described above are used to explain each dependent variable. Five of these variables (% public housing, % working at home, population density, % working in agriculture, employment potential) were log transformed.

The results are reported in Tables 5, 6 and 7. The signs of the parameters signify if the relationships are positive or negative (+/-), and are reported only if they were significant at the 0.05 significance level, thus highlighting those variables that are associated with the dependent variables.

Commuting balance

Table 5 Commuting balance modelling results

Explanatory variables	**Total out commuting rate**		**Car out commuting rate**		**Non-car out commuting rate**	
	Positive	Negative	Positive	Negative	Positive	Negative
Log % public housing				-	+	
Log % work home	+				+	
% retired			+			-
% migrants		-		-		-
Log population density	+		+		+	
% unemployed		-		-	+	
Log % agriculture		-		-		-
% households 2+ cars	+		+			-
Log employment potential		-		-		-
% female full-time	+		+		+	
% female I&II couple			+			-
% self employed		-		-	+	
% social class I&II	+		+		+	
R^2	63.6		62.6		67.2	

\+ = Positive significant parameter
\- = Negative significant parameter

Total commuters

The first three models allow us to compare the results for total, car and non-car out-commuting rates (Table 5). The first model has a high r^2 value of 63.6 and only three of the parameters were insignificant. Focussing on the five most important explanatory variables demonstrates that total out commuting was negatively associated with the percentage of migrants and self-employed workers and employment potential. It is possible that, on average, the self-employed are more likely to work from home while people living in areas with high employment potential are less likely to need to commute elsewhere for work. The migrant variable actually had the highest t-value and this is more difficult to explain. Wards that attract high percentages of migrants appear to have low out-commuting rates although, we

should not assume that this is necessarily because migrants themselves are less likely to commute than non-migrants (see below).

The two most significant positive parameters were for population density and the percentage of the economically active in social classes I and II. Densely populated urban areas have higher out-commuting than less densely populated rural areas and those in higher social classes are known to commute further than average.

Car commuters

The second model also fits well (r^2 = 62.6) and only one variable was insignificant. The five most significant parameters showed that out-commuting rates by car are negatively associated with the percentage of self-employed workers, migrants, unemployed and employment potential. The most significant positive parameter was for the percentage of two car households.

Non-car commuters

The model for out-commuting rates by non-car modes also fitted well (r^2 = 67.2) and all the variables were significant. The most significant variables were different to those in the models above, however. Opposite to the model for cars there was a strong negative association with households with two or more cars. The percentage retired was also negatively associated with non-car out-commuting rates. The highly significant positive parameters were population density (forms of travel other than the car are used more in urban centres), the percentage of economically active females in full-time employment (there is some evidence that women are more likely to use public transport than men) and the percentage of economically active in social classes I and II (these areas will correspond with relatively well-off areas, especially those around London where public transport use is high).

Commuting distance

The same explanatory variables were used for the models of the average distance out-commuted (Table 6).

Table 6 Commuting distance modelling results

Explanatory variables	**Total average out-commuting distance**		**Car average out-commuting distance**		**Non-car average out-commuting distance**	
	Positive	Negative	Positive	Negative	Positive	Negative

Log % public housing			+			
Log % work home		-		-		-
% retired	+				+	
% migrants	+		+		+	
Log population density		-		-		-
% unemployed	+				+	
Log % agriculture			+			-
% households 2+ cars	+		+		+	
Log employment potential		-		-		-
% female full-time	+			-	+	
% female I&II couple		-				-
% self employed		-				-
% social class I&II	+		+		+	
R^2	47.2		36.1		20.8	

+ = Positive significant parameter
- = Negative significant parameter

Total commuters

As shown in Table 6 the distance model for total commuters did not fit quite so well ($r^2 = 47.2$) as the out-commuting rate model. Both population density and employment potential were both negatively associated with long commuting distances, which is not surprising. The percentages of households with two or more cars, the percentage of the economically active in social classes I and II and the percentage of migrants were positively related to the distances commuted, perhaps related to the fact that some migrants who move to rural areas may continue to commute to urban areas following their move (the individual-level analyses below confirm that migrants tend to commute longer distances than non-migrants).

Car commuters

The model for the distance commuted by car had a poorer fit with an r^2 of 36.1 (Table 6). Four variables were insignificant. As in the model for total commuters, the high negative residuals were population density and employment potential. The most significant positive parameters were for migrants, households with two or more cars and high percentages of those in social classes I and II.

Non-car commuters

The results for average distances commuted among non-car travellers are different. The r^2 value was quite poor at 20.8 suggesting that the chosen variables are quite poor at explaining this dependent variable. The highest negative parameter was for employment potential – wards with a large number of jobs nearby had lower average non-car out-commuting distances. The four most significant positive parameters were for wards with high percentages of households with two or more cars, unemployed, females in full time work and economically active in social classes I and II. These demonstrate slightly conflicting, but sensible results. Some areas with relatively well off individuals have high average non-car commuting distances – areas around London may be typical of these. On the other hand, wards with high

percentages of unemployed may have few employment opportunities nearby which is typical of the 'spatial mismatch' of jobs and workers in many cities. Also, these are likely to be poorer wards where people are less likely to own cars and are therefore more likely to use other forms of transport.

Commuting mode

The final model considers the percentage of the total out-commuting that was done by car (Table 7). The model fitted well (r^2 = 68.8) and only one variable was insignificant. The most significant negative parameters were population density, the percentage unemployed and the percentage in social classes I and II. The two highest positive parameters were for two car households and the retired. This will not be related to the retired themselves, of course, but will be related to the types of areas that the retired live in.

Table 7 Commuting mode modelling results

Explanatory variables	**% car commuters of total commuters**	
	Positive	Negative
Log % public housing		-
Log % work home		-
% retired	+	
% migrants		-
Log population density		-
% unemployed		-
Log % agriculture		
% households 2+ cars	+	
Log employment potential		-
% female full-time		-
% female I&II couple	+	
% self employed		-
% social class I&II		-
R^2	68.8	

\+ = Positive significant parameter
\- = Negative significant parameter

Unusual commuting patterns, yet to be explained

Overall, these models have helped our understanding of the variables that are most associated with commuting balance, distance and mode. Of course, these models do not 'fit' the data perfectly as the r^2 values were all well below 100% - indeed we would be very suspicious if they did fit perfectly.

Table 8 provides an indication of where the average residuals for each ONS Census non-rural / rural classification were especially higher or lower than we would expect.

Table 8 Ranked residual values by ONS Census non-rural / rural classification

Commuting dependent variables	**ONS Census non-rural / rural classification**					
	Wholly urban	**Predominantly urban**	**Mixed urban**	**Mixed rural**	**Predominantly rural**	**Wholly rural**
Commuting balance						
Total commuters	+	-	-		+	
Car commuters	+	-		-	+	
Non-car commuters	+	-	-		+	
Commuting distance						
Total commuters	-	+			-	+
Car commuters	-	+	+		-	
Non-car commuters		+	-	+	-	
Commuting mode						
Car out-commuters as % total commuters		+	+	-	-	

+ = particularly high positive residuals (observed values are higher than expected)
- = particularly low positive residuals (observed values are lower than expected)

'Predominantly rural' wards had higher out-flows of commuters than expected, once the variables were controlled for in the models above, and 'predominately urban' areas had smaller out-flows of commuters than expected, once the variables were controlled for in the models above. However, these patterns were reversed for the distances commuted. 'Predominantly rural' wards had lower average distances than expected, while 'predominantly urban' wards had higher.

Certainly, controlling for the factors expected to influence commuting, 'predominantly urban' and 'predominantly rural' wards were the most unusual and further work could usefully be conducted in these areas to investigate why this is so.

These residuals can be mapped at the ward-level for all seven models (Tables 6-8), although here we have included those which are most striking. Figure 13 clearly shows how the non-car out-commuting rates are much higher than expected in a wide commuting belt around London. Figure 14 also shows that a wide band around London and the more rural areas in the North East had higher average distances than expected, based on the variables included in the models. On the other hand, more rural wards, especially in the West Midlands and South West, had lower average out-commuting distances than expected. Finally, Figure 15 shows that car use was proportionally high in rural East Anglia, the rural South West and parts of the North West, including around Manchester and Liverpool, and parts of the West Midlands. Many of the wards to the south and east of London, on the other hand, have lower percentages than expected.

Overall, these maps show the sheer size of the London labour market and the fact that the use of public transport is unusually high in the surrounding commuting belt.

<Figs 13-15 here>

Individual-level modelling analysis of commuting

The analyses above provide for a good description of commuting activity, and the modelling results in particular are useful for identifying the types of wards that have unusual commuting patterns. However, we cannot assume that these modelling results refer to the individuals who live there, even if we are reasonably confident that these relationships exist. For example, we have shown that the percentage of people in social class I and II in the ward is strongly related to many of the commuting measures (Table 6), but this does not necessarily mean that those individuals in these classes have unusual commuting patterns themselves. It could be that individuals in other social classes, who happen to live in these types of areas, have unusual commuting behaviour. *The individual-level modelling presented below solves this problem*, allowing us to identify the characteristics of people who are more likely to commute, commute over longer distances and are more likely to commute by car. The results are presented in Tables 9-13.

Commuting balance

Controlling for the characteristics of individuals, we aimed to test whether living in a rural area influences the likelihood of commuting? The results from fitting a model using all 222,674 individuals in our sample demonstrated that those living in rural areas do commute less, even when their other characteristics are accounted for. The results for the other explanatory variables are of interest, confirming some of the results presented in the ward-level modelling analysis. Table 9 shows who were significantly more and less likely to be commuters.

Table 9 Odds of being a commuter

Significantly more likely to commute	Significantly less likely to commute
• Professionals / manager	• Those in rural areas
• Those with higher qualifications	• Long-distance migrants
• Short distance migrants	• Agricultural workers
• Females	• Those in private renting
	• Those in public housing
	• Those aged 30 and above
	• Self-employed
	• Unemployed / Government scheme
	• Married / remarried
	• Those with two or more cars

Those living in rural areas are therefore less likely to commute to a place of work than those living elsewhere, partly because they work at home, but mainly because rates of economic inactivity are higher.

Commuting distance

Long-distance v short-distance commuters

Of those 166,914 in the sample who do commute, we examined whether those living in rural areas were more likely to commute long distances (30km or more), rather than short distances. Table 10 confirms the increased odds for rural residents, controlling for other explanatory variables. Among the other explanatory variables it is particularly interesting that long-distance migrants have the highest probability of commuting long distances of all the groups.

Table 10 Odds of commuting a long distance (>30km)

Significantly more likely to commute long distances	Significantly less likely to commute long distances
• Those in rural areas	• Agricultural workers
• Long-distance migrants	• Those in private renting
• Professionals / managers	• Those in public housing
• Those with higher qualifications	• Those aged 45 and above
• Short distance migrants	• Self-employed
• Married / remarried	• Unemployed / Government scheme
• Those with two or more cars	• Females
	• Non-whites

Long-distance v short-distance commuters in rural areas

The results above show that those living in rural areas commute further. They also show us that long-distance migrants tend to commute further, but they do not show us whether those long-distance migrants *who are resident in rural areas* commute further than other rural residents. We therefore fitted a model based on a sample that only includes those 16,592 commuters resident in rural areas.

Table 11 Odds of commuting a long distance (>30km) in rural areas

Rural residents significantly more likely to commute long distances	Rural residents significantly less likely to commute long distances
• Long-distance migrants	• Agricultural workers
• Professionals / managers	• Those in private renting
• Those with higher qualifications	• Those in public housing
• Short distance migrants	• Self-employed
• Married / remarried	• Unemployed / Government scheme
• Those with two or more cars	• Females

This shows that long-distance migrants in rural areas are much more likely to commute a long distance than others in rural areas and this group will include those who have moved from urban to rural areas, whilst retaining their place of employment in an urban centre.

Commuting mode

Car commuters v non-car commuters

We then tested the likelihood that those commuters living in rural areas are more likely to commute by car (Table 12) than commuters living elsewhere. This shows that those living in rural areas are significantly more likely to commute by car controlling for other variables. In fact, rural residents are 1.6 times more likely to commute by car than those in other areas, reflecting the lack of public transport in these areas.

Table 12 Odds of commuting by car

Significantly more likely to commute by car	Significantly less likely to commute by car
• Those in rural areas	• Those in private renting
• Short-distance migrants	• Those in public housing
• Professionals / managers	• Unemployed / Government scheme
• Those aged 30 and above	• Females
• Self-employed	• Non-whites
• Short distance migrants	• Those with two or more cars
• Married / remarried	

Car commuters v non-car commuters in rural areas

Finally, we fitted models only for those 16,592 commuters living in rural areas (Table 13). The aim here is to test whether long-distance migrants living in rural areas are more likely to commute by car than others. The results showed that when controlling for other variables long-distance migrants are not significantly more likely to commute by car compared to others.

Table 13 Odds of commuting by car in rural areas

Significantly more likely to commute by car in rural areas	Significantly less likely to commute by car in rural areas
• Short-distance migrants	• Agricultural workers
• Professionals / managers	• Those who do not own their home
• Those in public housing	• Unemployed / Government scheme
• Those aged 30-44	• Females
• Self-employed	• Non-whites
• Short distance migrants	
• Married / remarried	
• Those with two or more cars	

Note that while those with two or more cars were less likely to commute by car than others in general (Table 12), those with two or more cars who were residents in rural areas were much more likely to commute by car (Table 13). In fact, they were 3.6 times as likely.

Section D Conclusions and further work

No previous analysis of ward-level commuting data for the whole of England has been carried out to date. This study allows the most detailed comparison of rural commuting patterns with those in various types of urban area and the results provide a series of interesting findings.

Our results confirm that commuting behaviour in rural England is not simple to summarise. For example, those living in rural areas are less likely to commute than those living elsewhere, either because they are more likely to be either unemployed or to work from home. On the other hand, those that do commute are more likely to commute long distances.

The ward level analysis shows that, with regard to **commuting balance**, the most rural wards are particularly unlikely to attract in-commuters compared to other wards, but they are also less likely to generate out-commuters than other wards. In addition, rural areas have low out-commuting rates.

With regard to **commuting distance**, it has been shown that commuters from rural areas have longer commutes than those in urban areas, regardless of whether they travel by car or not. While relatively few people commute from the most remote rural centres, those that do are forced to travel long distances on the whole.

It should be noted that commuting distances are particularly long in some of the more accessible rural wards, especially around London, and indeed that London is particularly likely to attract long-distance commuters who use public transport.

Commuting mode analysis shows that commuters in rural areas are more reliant on car use than those living elsewhere. Commuting travel from rural wards is far more dominated by the use of cars than elsewhere.

Our stereotypical impression of the most remote rural areas having especially high out-commuting distances is true if we simply compare the distances commuted with those elsewhere (Table 4). However, the variables used in our models have helped explain this and, once controlled for, the patterns in these rural areas are not particularly unusual (Tables 7 and 8). In particular, nearby employment opportunities were shown to be negatively related to out-commuting rates, to the distance commuted and to the percentage of commuters using cars.

Certainly, the overall impression from the residuals (those wards that were least well explained) is that predominantly urban and predominantly rural wards, rather than wholly urban or wholly rural wards, have the most inexplicable commuting patterns and that these are in opposite directions:

- Predominantly urban areas have fewer out-commuters than we would expect and longer average commuting distances
- Predominantly rural areas have much higher out-commuting rates than expected, but these flows tend to be over shorter distances than we would expect
- The patterns for wholly rural areas are not especially unusual, once we control for

the explanatory variables in our models

Some key messages from the individual-level analyses were that:

- Those living in rural areas are less likely to commute than those resident elsewhere (rates of economic inactivity are higher)
- Considering only commuters, those living in rural areas commute further than those in non-rural areas
- Those in rural areas are more likely to commute by car than those elsewhere.
- Focussing only on those that live in rural areas, long-distance recent in-migrants are more likely to commute further than other residents

The importance of the migrant in explaining commute behaviour is of note, due to the counterurbanisation trend that has dominated internal migration patterns in England during the last few decades. This has resulted in significant population increases in much of rural England, matched by declining populations in the more densely populated urban centres. Indeed, it is well established that internal migration accounts for the majority of population change in most areas, as the levels of fertility and mortality are much more stable. And, although there is some evidence that the population decentralisation trend is waning in Britain (Champion 1994), rural areas continue to gain population at a faster rate than metropolitan and industrial districts (Townsend 1993) suggesting that this problem will continue into the future.

Intuitively, therefore, we would expect that counterurbanisation will have had a significant impact on commuting patterns – there may be an integral link between commuting and migration in rural areas, and we explore this issue below. Those migrating into more peripheral rural areas often retain work and leisure links with urban centres, preferring the extra travel burden to the negative externalities associated with urban living, and this is likely to result in longer commuting and leisure-related journeys. In light of these issues, the relationship between travel behaviour and urban form, in particular urban density and size, has become the focus of much interest among academics, planners and the government (Chinitz 1990, Handy 1997).

It is significant, however, that while the relationship between urban form and travel behaviour has been the focus of analyses (e.g. Frost *et al*. 1997), the role of the migrant, the key element of urban travel *change,* has been conspicuous by its absence. While Camstra (1996) has discussed the relationship between commuting distance and residential location, in the specific context of gender and lifestyle differences, only Curtis (1996) has paid specific attention to the travel behaviour of migrants. Research into the travel characteristics of 1,168 adult residents in new residential developments illustrates the importance of personal travel in migration. The research showed that access-related factors are both the most important limiting factors in the decision to move (nearly three times as important as any other factor) and the reason for choice of the area (slightly higher than financial reasons). Interestingly, access to work and access to other locations, such as family, friends and local shops are nearly of equal importance as a limiting factor in the decision to move, while the reason for choice of the area is due mainly to access to other facilities (34% of the total) rather than work (20%). The primary push-factor

associated with the decision to move, however, was clearly housing related for this sample.

The dynamic of the change associated with migration is an important challenge and opportunity for rural areas, and transport planning within them. With individuals changing their travel patterns upon a re-location it is also a time at which they have to re-evaluate and plan their new journeys. It is here that behaviour can be influenced – for example using direct marketing approaches as utilised within mobility management research. Indeed, as many migration moves are stimulated by job relocations and changes, the opportunity exists, via green travel planning policies, to facilitate and enable businesses to ”do their bit” in a move towards a sustainable society, as called for in the UK Strategy for Sustainable Development.

Further work

- We have had to use data from the 1991 Census. The results are valid, and provide a strong benchmark for further work, however, the results are obviously somewhat dated, and the study could be updated once commuting figures are made available from the imminent 2001 Census.
- We have been unable to consider change in commuting behaviour through time. Although ward-level commuting and migration flow data are available from the 1981 Census, many wards’ boundaries changed between 1981 and 1991. Shortly, 1981 census flow data will have been re-estimated for 1991 ward boundaries allowing changes to be examined in detail.
- The definition of rural England has been borrowed from the ONS. This classification has some advantages, such as the fact that it is a standard definition that has been used in other studies, and it provides six types of area rather than a simple rural versus non-rural binary variable. On the other hand, the classification is based on just one of several methods of defining rurality. The very definition of 'rural' used in many studies may not be sustainable. As rural settlements grow, particularly as dormitory towns in the hinterland of urban areas, they may cease to meet the criteria for 'rural'. This means that were such definitions to be used in long-term studies, the data may be corrupted as settlements outgrow their 'rural' status.
- It would be possible to extend this analysis to consider different types of commuters, rather than simply distinguishing between total, car and non-car commuters (even though these are the key commuting groups we felt to be of interest). For example, it might be of interest to consider commuters broken down by occupational class.
- The focus of the analysis is entirely on commuting patterns. However, multi-function trips are becoming increasingly important as people combine shopping and dropping the children at school on the way to work, for example. No data are provided in the 1991 census on travel behaviour except for the journey to work. Also, while the National Travel Survey provides information on these types of trips, the geographical detail available from this study is limited, due in part to confidentiality constraints. Perhaps the only solution is to carry out a detailed survey in one or more case study areas. This would also information on the attitudes of rural residents and their views about transport and commuting issues in rural areas. Comparing the commuting patterns of recent migrants with non-migrants might be especially interesting.

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