TECHNICAL REPORT

The impact of migration on transport and congestion

Flavia Tsang, Charlene Rohr

RAND EUROPE

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Flavia Tsang, Charlene Rohr

Prepared for the Migration Advisory Committee

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Preface

RAND Europe has been commissioned by the Migration Advisory Committee (MAC) to collate evidence on how economic migrants from outside the European Economic Area (EEA) are likely to impact the UK's transport networks and congestion. This study comprised two research phases. First, we conducted a review of literature on the impact of migration on the use of transport networks and resulting congestion levels. Second, we undertook empirical analyses to examine the impact of migration – both migration from the EEA and from outside the EEA – on the use of transport networks and congestion levels in the UK. This final report consolidates the evidence collected from the two phases and provides some conclusions on migrants' travel behaviour and their likely impacts. Limitations to analysis and how we might overcome them will also be discussed.

This report is prepared for the Migration Advisory Committee (MAC) to inform their thinking on the social impacts of migration. The analyses presented in this report would be of interest to officials in central and local governments responsible not only for migration policies, but also transport and spatial planning issues.

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Summary

The objective of this study was to understand the likely impact of economic migrants from outside the EEA on transport networks and congestion. We addressed this question through two phases of research: a literature review followed by an empirical analysis.

'Economic' migrants are defined as those who have come to the UK with the primary purpose of working. Those from outside the EEA typically hold Tier 1 or 2 work permits. However, since there is a dearth of literature that focuses specifically on these groups and their transport needs, we looked at literature on migrants more generally.

Through our targeted literature review, we identified and reviewed 22 key studies on this topic. We found a dearth of literature on migrants' travel in the UK, with most articles written on the subject originating from the United States. Some relevant papers concerning research in Canada, Australia, Norway and Sweden were also identified. While we were careful not to directly transfer any quantitative findings from studies conducted abroad, many of the key concepts and phenomena observed provided useful insights and informed the direction of our research. The paucity of literature on migrants' travel in the UK also highlighted the need for an empirical study addressing this question for the UK specifically.

In the second phase of this study, we undertook empirical analyses of UK data. The main data source was the Annual Population Survey, complemented by other sources, including the National Travel Survey and the Certificate of Sponsorship data. We cannot observe from these data whether the individual migrated to the UK for the purpose of working, so we had to use the broader category 'non-EEA nationality' as a proxy in the analysis. Our analysis addressed key travel behaviour issues including the geographical distribution of migrants, frequency of travel and characteristics of their journey-to-work (e.g. mode choice, car sharing, and journey time). Findings from this analysis, combined with information from the Department for Transport (DfT), Office of Rail Regulation (ORR) and Transport for London (TfL), were then fed into the analysis of impacts.

Migrants' travel behaviour

The empirical findings using UK data corroborated the findings from literature about migrants' travel behaviour in the US and other countries:

- **Migrants are concentrated in metropolitan areas where public transport provision is high**. Using data from the Annual Population Survey, we found that 40 percent of the non-EEA migrant population live in London, compared with 11 percent of UK nationals.

- **Migrants' travel is strongly associated with the use of non-car-driving modes of travel (including public transport, walking, cycling and car sharing).** Many researchers in the US attributed this finding to migrants' choice of residential locations that are well served by public transport. [1] We found this to be true for the UK as well. However, we also found that non-EEA migrants have a higher propensity to use buses even after taking into account their year of arrival, their socio-demographic characteristics, and their place of residence and work.
- **Migrants tend to 'transport assimilate'**. Previous research found that migrants' travel patterns become increasingly similar to those of the native-born with increasing length of stay. We saw evidence of this reflected in the UK data. We defined 'recent arrivals' as those who had lived in the UK for less than six years,[2] and found that recent arrivals (regardless of nationality) use cars less and tend to use buses, underground/light rail, and walk/cycle more. With the resources available for this study, we were only able to explore one cut-off point. We recommend future research to build on these findings and examine the trajectory of assimilation.

Additionally, our analysis using UK data showed that non-UK-born migrants travel less and mainly for work.

Migrants' travel impacts

Background

Following the analysis of travel behaviour, the impacts of migrants' travel on car, bus, national rail and underground were examined. In this report, we quantify these impacts as far as possible. However, we stress that a number of assumptions are used in these calculation; therefore, the values reported are only approximations indicative of the order of magnitude and should be treated as such.

The impact analysis of car use draws on the Department for Transport's (DfT's) guidelines on the marginal external costs of car traffic, i.e. the costs imposed on society resulting from an additional car kilometre (DfT, 2007b). A wide range of externalities was considered: congestion, infrastructure damage, accidents, local air quality, noise and greenhouse gases. Indirect taxation, such as fuel duty and VAT on fuel, were also taken into account.

The impact analysis of public transport (bus, national rail and underground) looks at the balance between migrants' positive contribution through fare payment and negative contribution through consumption of subsidies. Because of lack of data, the quantitative analysis of impact does not incorporate the negative impact of crowding – although this issue is discussed qualitatively.

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[1] Many researchers also attribute their lower level of car access to be the primary explanations for the lower propensity to use cars. Unfortunately, the primary dataset we used, the Annual Population Survey, does not collect data on car ownership. Although it is possible to examine other datasets (the General Household Survey), the constraints of this study do not permit us to include that analysis.

[2] We chose six years on the basis that defining recent arrivals this way gives the best model fit in the final specification of the multinomial logit model developed. However, we note that this value may be sensitive to the model specification and therefore more testing is needed.

Quantitative Findings

The quantified impacts of transport use, expressed in £ per person per year, are shown in Table 1-1. We emphasise that these are estimates. The impacts of car use are highly negative, in the order of thousands of pounds per migrant per year, indicating an overall cost to society whereas the impacts of public transport were always positive, in the order of tens of pounds per migrant per year (see the first column of Table 1-1). This is not a migrant- specific issue – as we can see from the first two columns Table 1-1- the respective impacts of migrants and UK nationals always have the same sign and similar order of magnitude. In fact, the impact of the average migrants' car travel is 4 percent lower than that of the average national, reflecting the behavioural findings that migrants have a lower propensity to use car. This 4 percent is only indicative. Many assumptions were used in this calculation so we should not treat these as precise values.

Table 1-1: Migrants' travel impacts, in £ per person per year, 2009/2010 prices

	Tier 1 and Tier2 migrants	UK nationals	Absolute difference	% difference
Car	-2368	-2459	91	-4%
Bus	76	68	8	12%
Rail	109	74	35	47%
Underground	40	10	29	284%

Note: The values reported are only approximations indicative of the order of magnitude. Negative means values indicate an overall cost to society; positive values indicate an overall benefit to society.

In interpreting these results, we distinguished between 'population-based' and 'migrant-specific' impacts:

- **The population-based impacts are negative.** Migrants impose a cost on society when they use the transport network, despite the fact that their impact per head is lower than that of a national. The positive impacts associated with their use of public transport cannot offset the negative impacts associated with their car use (as the negative impact is higher by two orders of magnitudes). These results on population-based impacts are shown in the first column of the table.
- **The migrant-specific impacts are positive.** When comparing the impacts by the average migrant and the average national, we can see that the migrant-specific impacts are positive (see the third column in table). The migrant-specific impacts associated with their car use are biggest in absolute terms, while the impacts associated with their use of the underground are biggest in percentage terms.

Qualitative findings

Increased patronage on public transport adds to public transport revenues, and this is incorporated in the calculations made in the quantitative analysis. However, such increases in patronage may also increase crowding, which is seen as a negative externality or cost to other travellers. The additional costs of migrants' impact on crowding on public transport

have not been taken into account in the analysis, because of limitations in the information we have on migrants' travel. Therefore this issue is dealt with qualitatively.

Crowding issues are specific to the mode of public transport. Notably, it is more difficult for rail and underground to address crowding issues by expanding capacity, because additional infrastructure is costly and takes a long time to build. For buses, crowding may be less of an issue as bus operators can respond by providing more buses relatively easily and quickly – in fact, the increased patronage on buses is generally seen as a positive outcome.

This report is prepared for the Migration Advisory Committee (MAC) to inform their thinking on the social impacts of migration. It provides one of the first studies using UK data to offer an empirical evidence base about migrants' travel behaviour and impact.

Acknowledgements

We extend our thanks to the Migration Advisory Committee, an independent body sponsored by the UK Border Agency of the Home Office, whose support made this study possible. Members of the Migration Advisory Committee (MAC) and its secretariat met and corresponded with the research team at RAND Europe in order to develop and steer this research project. We would like to specifically thank Professor Rob Wilson, Mr. Alex Barr, Mr. Daniel Pease, and Ms. Vanna Aldin for their input throughout the study. However, the robustness of the analysis is the responsibility of the authors, and the findings and views presented in this report do not necessarily reflect those of the MAC.

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CHAPTER 1 Introduction

1.1 Policy context

The current coalition government of the UK aims to reduce overall net migration (i.e. including migration flows of British, Other European Economic Area (EEA) and non-EEA nationals) to an annual level of tens of thousands by the end of the current Parliament (MAC, 2010). To help achieve this goal, it has commissioned the Migration Advisory Committee (MAC) to advise on limits on Tier 1 and Tier 2 migrants who are assessed by the points based system.[3] The MAC report 'Limits on Tier 1 and Tier 2 for 2011/12 and support policies' recognises the many contributions of non-EEA Tier 1 and Tier 2 migrants, specifically reporting that these migrants 'have a small positive impact on GDP per head; do not increase inflationary pressure; contribute positively to net public finances; play a small but important part in the provision of education, health and social services; increase pressure in the housing market a little; and probably have little effect on crime and cohesion'(MAC, 2010). The MAC report also recognises that Tier 1 and Tier 2 migrants use public services, such as health and education services, housing and transport. Such migrants may also impact (or be impacted by) crime and may impact social cohesion. Migrants' use of public services is the focus of a series of studies commissioned by the MAC to collate qualitative and quantitative evidence on the impact of Tier 1 and Tier 2 migrants on a range of public sector services. This study focuses on the collation of evidence on how migration is likely to impact transport networks and congestion. The outcomes of this study will feed into the MAC's framework for economic cost-benefit analysis (see Dustmann and Frattini (2010) for more information about this framework).

The MAC's framework for economic cost-benefit analysis examines the government surplus or deficit related to migration by measuring the difference between the revenue gained through taxes paid by migrants and the expenditure on providing public services

[3] Tier 1 and Tier 2 cover 'highly skilled' and 'skilled' immigrants respectively. The Tier 1 General visa are granted to highly skilled immigrants based on an assessment of their qualifications, previous earnings, UK experience, age, English language skills and available maintenance funds. Tier 1 General holders can enter the country even without a job offer. However, the Tier 1 General route will be replaced by a new Tier 1 'exceptional talent' category, focusing on scientists and artists. On the other hand, Tier 2 visas are for skilled immigrants entering the country with job offers and sponsorships from an employer to fill gaps in the UK labour force. Returned British migrants are not included in this category.

consumed by migrants. The analysis takes into account differences between the various subpopulations, e.g. between migrants from different countries of origin, and from different arrival cohorts. In the expenditure calculation, the framework distinguishes between 'pure public goods' and 'other public goods and services'. 'Pure public goods' refers to goods that are 'non-rival in consumption', i.e. they are provided at the same cost regardless of the level of migration; therefore, the marginal cost of providing the good to a migrant would be zero. Expenditure on pure public goods is effectively consumed by everyone in the population. For instance, national defence is considered a pure public good which arguably needs to be provided in the same amount and at the same cost regardless of the level of migration. On the other hand, 'other public goods and services' refers to goods and services that are 'rival' in consumption, i.e. an increase in population may require more of the goods and services to be provided and thus increase the overall cost. In this case, the expenditure on the goods and services for each sub-population relates to the level of use. For instance, waste disposal is considered to fall into the category of 'other public goods/services' as its consumption would increase with the level of migration.

Transport can be considered both a 'pure public good' and 'other public goods and services' depending on the level of congestion. Uncongested transport links may be considered non-rival services, whereas congested or near-congested links can be thought of as rival. When migrants use congested or near-congested links, they are adding 'costs' to all travellers, in terms of additional travel time due to increased congestion or discomfort due to crowding. Moreover, they may increase the need for additional transport provision. Therefore, in order to understand the impact of migrants on transport networks we need to understand where and how they travel, and the current level of congestion. In this study we do not have data detailed enough to allow us to examine congestion link by link, although we will use location and area type as indicators of existing congestion levels when examining the impact of migrants' use of transport.

In addition to the use of the findings from this study by the MAC in their cost benefit analysis, there are further reasons why a study on migrants' travel behaviour is of policy interest. Migration changes both size and composition of the general population. A better understanding of travel patterns of migrants will improve our understanding of future infrastructure needs.

1.2 Structure of this report

The aim of this study is to provide an evidence-based analysis on the impact of migration on the demand for transport networks and levels of congestion in the UK. This report comprises two parts; Part one reviews relevant literature and Part two presents an empirical analysis of UK data.

PART ONE – LITERATURE REVIEW

CHAPTER 2 Background

2.1 Structure of Part one

The first part of this report, which reflects work undertaken in the first phase of a study to understand the likely impact of migration on traffic congestion, looks into evidence on transport patterns of migrants and impacts on transport and congestion from existing literature. After a brief discussion on methodology, the rest of Part one is structured as follows. Chapter 3 discusses the observed travel patterns of migrants in terms of a range of characteristics, including mode choice, car ownership, licence holding, and location decisions of individuals. Because there is little UK-focused research on migrants' travel, we present the known evidence in the UK about the travel of ethnic minorities as a proxy in Chapter 4. The caveats related to using ethnic minorities as a proxy will be discussed. Finally, Chapter 5 summarises the findings from this literature review and identify gaps in evidence.

2.2 Methodology

We conducted a targeted review of relevant data and studies in order to provide the MAC with evidence on migrants' use of transport networks and levels of congestion. Although this methodology is more prone to selection and publication bias than a full systematic review or a Rapid Evidence Assessment,[4] it was judged to be appropriate given the time and budget constraints for this project. The search methods by which evidence has been identified, and the criteria for determining the relative status of included studies, are outlined here so that it is transparent and comprehensible to the MAC and the wider audience for the research.

Search methods and inclusion criteria

The literature search was undertaken by a trained librarian. The databases and search terms used are outlined in Table 2-1. Further details of the search are provided in Appendix A.

From the long-list of 'hits' returned from the search, abstracts of articles identified were then assessed by a research analyst as being topical or methodologically relevant. Only

[4] The Government Social Research (GSR) Service provides a useful discussion of the pros and cons of each of these review methods (http://www.civilservice.gov.uk/networks/gsr/resources-and-guidance/rapid-evidence-assessment/what-is). The targeted literature review approach we used in this study is an improvement from the 'literature review' method described in the GSR website in that we are systematic in how the studies were found and transparent in how studies are included.

those studies that provide primary evidence (i.e. generate new qualitative or quantitative data) were selected. The resources available for this study did not allow a review of the full text of all the relevant literature identified. Therefore, the selection of articles for full text review also took into account: the need to ensure the inclusion of articles reporting from a range of countries, not just the US and the need to include studies that focus on different aspects of migrants' travel, e.g. use of public transport, car ownership, and location decisions.

Our search revealed other lines of enquiry that are related to, but are not within, the scope of this study. These include studies looking at safety issues related to migrants' transport, specifically by car, and studies looking at the impact of transport on migrants' access to employment. They are excluded from this review.

Using this methodology, the search yielded 21 studies that were considered of high relevance for the present work. One additional study was identified by the MAC, therefore, the total number of studies reviewed was 22.

Table 2-1: Search terms and articles selected

Database search	Search terms	Number of hits	Number of potentially relevant articles	Number included for full text review
Transport Research International Documentation Database	Immigra* OR migra*	250	62	15
European Transport Conference	Immigra* OR migra*	12	1	1
ScienceDirect	See Table A1in Appendix A	12	4	4, all captured in TRID
UK Department for Transport	Immigrant OR migrant	32	2	0
Transport for London	Immigrant OR migrant	4	0	0
Greater London Authority, Regional Development Agencies and Strategic Migration Partnerships (Google search)	"migrant worker" transport site:.gov.uk See more in footnote*	Reviewed first 20 hits	7	2
Policy Hub	Immigrant OR migrant	41	26	0
'Snowballing', i.e. using the biographies of relevant articles to identify more articles	N.A.	N.A.	N.A.	3

* Notes: Other search strings used were: '"migrant worker" transport "development agency"', and '"migrant worker" transport "Strategic Migration Partnership"'.

CHAPTER 3 Travel behaviour of migrants

In order to use Dustmann and Frattini's cost-benefit framework – the framework used by the MAC – we need to understand the current level of congestion on the UK's transport networks. Specifically, if migrants travel on uncongested transport links their impact on congestion is likely to be negligible, whereas if they use congested or near-congested links then they would add additional costs to other travellers, either through longer journey times caused by greater congestion on the road network or through increased discomfort resulting from increased crowding on public transport. Therefore, to understand the impact of migrants' travel we need to look at how they travel – specifically what modes of transport they use – and where they travel (we use their home and work locations as proxies). This chapter therefore looks at the evidence from published literature on different facets of migrants' travel patterns, including mode choice and location decisions. Car ownership and licence holding are also examined because of their importance in influencing mode choice.

The MAC is most interested in the situation of 'economic' migrants from outside the EEA (i.e. those who have come to the UK with the primary purpose of working). They typically hold Tier 1 or Tier 2 work permits. However, there is no available literature that focuses specifically on these groups, so we look at literature on migrants more generally.

Most papers written on the subject of migrants' travel patterns are from the United States. Some relevant papers reporting research in Canada, Sydney, Norway and Sweden are also identified, but there is scant evidence from the UK. From the studies reviewed, there seems to be a general consensus that migrants tend to be more reliant on public transport for travel, and that other 'non-car' modes, such as walking and cycling, are also more commonly used. Additionally, car sharing, both by getting lifts and borrowing cars, is also more prevalent as a result of migrants' lesser access to cars.

The observed differences in travel patterns between the native-born and migrants, on a macro level, may simply be due to the differences in the socio-economic composition between the two groups, such as the difference in the distribution of age, income, education level and employment status. On a micro level, the observed differences in the travel patterns of migrants, over and above the differences in socio-economic characteristics, may be a manifestation of their needs, constraints and preferences. The following sections summarise the known differences from existing literature.

3.1 Mode choice

3.1.1 Public transport

Macro level

Experience in the US shows that migrants are over-represented in the public transport market (Myers, 1997; Blumenberg and Evans, 2010). Blumenberg and Evans (2010) described the macro level changes in public transport in California between 1980 and 2000. During this period, overall public transport usage increased by 18 percentage points. This increase can be entirely attributed to migrants, as the usage by the native-born declined by 17 percentage points in the same period (Blumenberg and Evans, 2010). In 2000, nearly half (48 percent) of public transport users in California were migrants. This over-representation is more pronounced in some metropolitan areas of California; for instance, while migrants in Los Angeles comprised 36 percent of the population, they contribute to nearly two-thirds of all public transport commuter journeys. However, Blumenberg and Evans observed a tendency to 'transport assimilate', with migrants switching to use of private vehicles with increased time living in the US.

Micro level

The micro level influences on migrants' higher public transport usage are multi-faceted. Many researchers identify migrants' choice of living in areas that are well served by public transport and their lower level of car access to be the primary explanatory factors. We will examine these issues in more detail in sections 3.2 and 3.3. Heisz and Schellenberg (2004), who analysed commuting data from the 1996 and 2001 Canadian censuses, found that recent migrants were much more likely than native-born citizens to use public transport to commute to work, even after controlling for age, gender, income and distance to work. Lo et al. (2010) noted that recent migrants in Canada must often rely on public transport to meet their immediate transport needs, as they cannot afford access to a private vehicle.

Only one study by Chatman and Klein (2011) in New Jersey in the US found that the effect of migrant status is diminished when controlling for a number of observables. While other studies have controlled for spatial characteristics of home location, Chatman and Klein included characteristics of the workplace and included variables representing the occupation of the individual migrant in the model. The use of these different observables may be the reason why their findings are different from other studies on the subject.

Other researchers have explored the attitudinal factors that might lead to higher public transport use. Douma (2004) conducted focus groups with Latino, Somali and Hmong migrants in the US and found that Latino migrants were open to 'more social' types of travel, 'prefer a friendly atmosphere' and were not so concerned with privacy, while Somali migrants expressed concerns about physical security and discrimination when riding the bus. The Hmong group found not being able to read and speak English a major barrier to their public transport use (as well as other modes of transport).

To inform an assessment of whether this finding is applicable to the UK it is noted that language barriers featured prominently in a number of UK studies (Cierpial et al., 2010; DfT, 2007a; DfT, 2003). However, these studies tended to focus on the lower income and less educated migrant sub-groups, which typically come from the 'A8 countries' (i.e. Czech

Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia or Slovenia), so it is unlikely that they are applicable to the situation of skilled Tier 1 and Tier 2 migrants.

3.1.2 Walking and cycling

Macro level

In the US, when looking at aggregate statistics, it is found that migrants are twice as likely to cycle (0.8 percent of all trips) as native-born Americans (0.4 percent of all trips) (Smart, 2010). Chatman and Klein (2009), using data from the 2007 American Community Survey on commute trips, found higher bicycle usage overall (for both migrants and native-born), but a smaller difference between migrants and the native-born (3.9 percent for migrants and 3.0 percent for the native-born).

Micro level

The difference is more pronounced (migrants are more likely to walk and cycle) when income, education, and residential location factors are controlled for. Smart (2010), using the 2001 National Household Travel Survey in the US, found that the odds of choosing cycling over driving is 41 times higher for migrants than for native-born Americans.[5] In particular, migrants from East and Southeast Asia are more likely than others to use a bicycle, having an odds ratio of 76 relative to native-born Americans.[6] Smart's model showed female migrants had a lower propensity to cycle, which provided some support for the hypothesis that the role of women in some cultures may influence their choice of mode for travel.

Consistent with the assimilation hypothesis, i.e. that the differences in behavioural patterns between migrants and the native-born diminish with increasing length of stay, Smart found that the higher propensity to cycle drops rapidly, with the odds roughly halving in the first four years.

3.1.3 Car sharing

Macro level

Data from the 2007 American Community Survey suggest that migrants are about 50 percent more likely to carpool than native-born Americans. The commute mode share for carpooling is 16.0 percent for migrants, considerably higher than the 9.4 percent identified for the native-born (Chatman and Klein, 2009).

Micro level

To examine the more nuanced aspects of migrants' car sharing behaviour, Lovejoy and Handy (2011) examined the car sharing behaviour (including getting lifts and borrowing cars) of Mexican migrants in California using focus groups. The authors used social exchange theory, which views all interactions between people as 'an exchange of goods, material and non-material'. The authors found that both negotiated, in which explicit compensation is involved, and non-negotiated exchanges, which involve favours and guilt, were reported to be common among participants.

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[5] Odds ratios are not the same as probabilities. As an example, 29-in-100 chance for immigrants versus 1-in-100 chance for native-born Americans would produce an odds ratio of 41.

[6] For example, a 434-in-1,000 chance for immigrants versus a 10-in-1,000 chance for native-born Americans would produce an odds ratio of 76.

Lovejoy and Handy also found that the participants largely drew support (getting lifts and borrowing cars) from within the community of recent migrants, who had limited resources to offer. The main issues faced by those offering lifts were unlicensed drivers and uninsured or poorly maintained cars.

Lovejoy and Handy noted that respondents had a long-term goal of obtaining their own car, reflecting in their view that migrants were 'upwardly mobile and evolving'. This aspiration makes them different from other transport-disadvantaged groups, such as the elderly and disabled.

The understanding gained through social exchange theory could be transferrable to the UK context. However, Lovejoy and Handy provided no explicit evidence to support the theory that an ethnic community would enjoy easier exchange of resources, because their study only included the participants from one community (i.e. there is no comparison group). Also, the effect of the extent of a recipient's social network on ease of finding rides cannot be established, as it is difficult to separate the effect of network size from other factors, such as an extroverted personality which may result in both a larger network and finding rides more easily.

3.2 Car use, car ownership and licence holding

Macro level

A key influence of car use is licence holding and car ownership (Sherman, 1967; Broecke, 1988; de Jong et al., 2004). Not having a licence or access to a car is a constraint to car travel. But the relationship between licence holding, car ownership and car use is not strictly causal, as the decisions of whether to buy a car or to acquire a driving licence can themselves be a result of the individuals' needs, constraints and preferences.

In Norway, acquiring a driving licence is expensive, costing a minimum of 5800 USD.[7] As part of the Norwegian government's effort to minimise traffic fatalities through 'setting high standards for drivers on the Norwegian roads', the licence acquisition process is long and expensive. In addition to a theoretical test and multiple obligatory training modules, obligatory practical tests for driving in special conditions (e.g. low-light condition) are priced separately. Affordability is an issue for migrant households in Norway (Priya and Uteng, 2009).

In the US, Tal and Handy (2005) found that car ownership, at an aggregated level, is lower for migrants. In their analysis of the 2001 National Household Transportation Survey, they found that recent migrants (i.e. those who had been living in the US for less than five years) have the lowest number of cars per person (0.45). There seems to be a process of assimilation, in which migrants who had lived in the US for 5–10 and 10–25 years had higher car ownership levels, e.g. 0.55 and 0.58 cars per person respectively. Those who had lived in the US for more than 20 years had 0.79 cars per person, a car ownership level that is comparable to the native-born (0.81).

[7] This information is from 2006. A conversion rate of 1 USD = 5.09 NOK is used.

Moreover, data from the 2007 American Community Survey suggest that migrants are less likely to drive alone. The commute mode share for driving alone is 66.0 percent for migrants, considerably lower than the 79 percent identified for the native-born (Chatman and Klein, 2009).

Micro level

Similarly, with individual-level data, Ma and Srinivasan (2010) found that the longer migrants stayed in the US, the more likely they were to have the same car ownership level as that of a similar US-born individual. Ma and Srinivasan also observed a cohort or period effect: the migrants who entered the US during the period from 1990 to 2000 had an inherently higher propensity for car ownership compared with migrants who entered during 1980 to 1990, who in turn had a higher propensity for car ownership compared with migrants who entered during 1970 to 1980 and so on. Lo et al. (2010) observed a similar cohort effect in Canada, where recent migrants of today are less likely to rely on public transit than recent migrants of previous decades.

A study by Tsang and Daly (2010) in Sydney, Australia similarly found that the probability of having a driving licence or owning a car was lower for those who were not born in Australia. Because of data limitations, the authors were not able to test whether foreign-born adults moved towards higher car ownership levels with increased time in Australia; nor were they able to ascertain whether foreign-born status precipitates different *a priori* attitudes to licence holding or car ownership.

Tal and Handy (2010) in the US examined the difference in car ownership levels among migrants of different origins (Canada, Central and South America, Europe and Scandinavia, Eastern Europe and Russia, East Asia, Indian Subcontinent, Caribbean/Atlantic Islands). Those from East Asia had a markedly lower level of car ownership, after controlling for other socio-demographic effects. The authors also examined another important indicator of car use: yearly miles driven. They found that migrants from Central and South America and from East Asia are associated with lower yearly miles driven, relative to the native-born and other migrants. In this study the analysis of mode use suggests that if recent migrants have a private vehicle they are less likely to use public transport, relative to the native-born citizens. This tendency is less strong for East Asian migrants.

There may also be other structural or institutional factors that limit migrants' car access. As most new low-status migrants have little or no credit history, Smart (2010) speculated that poor access to mainstream sources of financing and insurance would be a barrier to obtaining a car. Smart cited Cohen (2008), who found that ethnic minorities in the US faced significant discrimination in obtaining finance and therefore had to pay higher finance mark-up rates than white citizens.

3.3 Location decisions

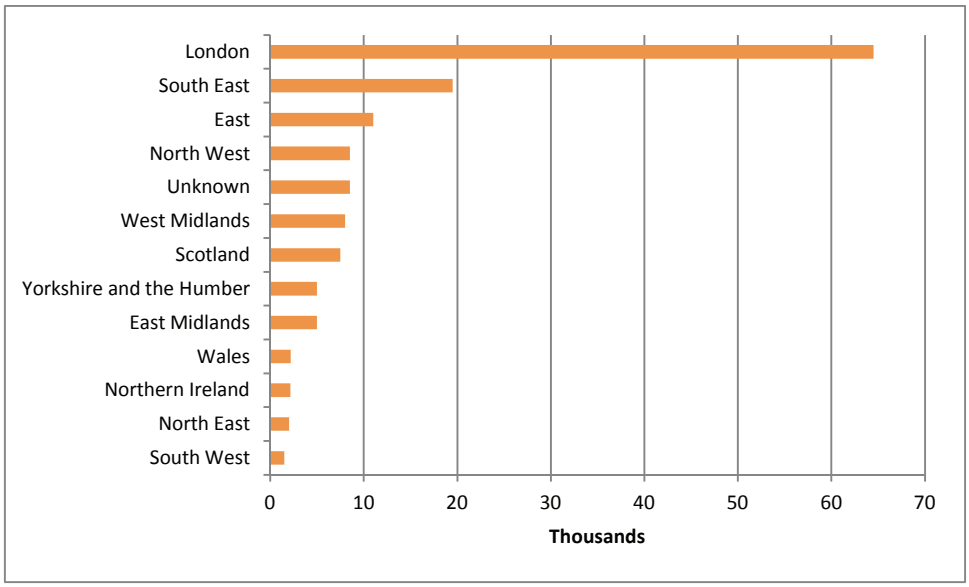
While migration may influence social and economic decisions at the national, regional and local level, transport and congestion are largely local issues. Evidence of congestion impacts show that an extra one thousand people on an already congested transport system, as is the case in London, is expected to be greater than the impact of the same number of people

added to a non-congested network. Moreover, as evidence indicates migrants are disproportionately concentrated in London and South East England, it is possible that the average migrant may have a bigger impact on transport than the average UK national. This impact is more likely to be higher on the public transport network than on the road network.

Migrants tend to gravitate towards cities when choosing a place to live. In the UK, the majority of newly arrived migrant workers live in cities like London, Birmingham and Edinburgh (Robinson, 2002). Of all the newly arrived migrant workers in 2000–01, 43 percent settled first in London according to Robinson's analysis of National Insurance records.[8] Similarly, close to 70 percent of the migrant workers who moved to the West Midlands resided in the West Midlands Metropolitan County (Robinson, 2002).

Robinson (2002) also provides some useful descriptive statistics on the location of new migrant workers by Government Office Region or county. Her data are presented in Figure 3-1. London and South East England attracted the highest number of migrant workers, whereas North East England, Northern Ireland and Wales attracted the lowest number.

Figure 3-1: Region/Country of residence of new migrant workers, 2000-01



Source: Robinson (2002)

Additionally, Robinson (2002) found that migrants are attracted to areas with a high concentration of people from their own ethnic groups. For instance, 80 percent of the migrant workers who chose Bradford as their place of residence were Asian or were from the Middle East.

[8] The National Insurance (NI) number is the individual's reference number for the social security system in the UK. Immigrants who come to the UK to take up employment need to register for an NI number as soon as they arrive, although refugees and asylum seekers do not need to register immediately. Robinson's analysis of the NI records includes immigrants from the EU.

Studies have looked into migrants' co-location with people of the same ethnic origins in 'ethnic enclaves'. This tendency is more likely for new migrants, as a result of their desire to tie into social and cultural networks provided by the ethnic enclaves, as well as their willingness to live in crowded conditions in poor quality housing as a transition phase (Pamuk, 2004). The more settled migrants then move to middle-class neighbourhoods once their economic situation improves (Pamuk, 2004), but the ethnic enclave persists as new migrants arrive to build their networks and social capital.

3.4 Why are migrants different?

In this chapter, we have reviewed evidence which shows that migrants' travel behaviour is different from that of their native counterparts in their new country, even after controlling socio-demographic and location effects.

To understand the mechanisms underlying why they are different, here we provide a brief discussion on a paper by Weinberger and Goetzke (2010) on how preferences are formed. One line of enquiry on this subject is the influence of previous experience on current preferences. Weinberger and Goetzke (2010) approached the question of preference formation by considering what the chooser believes to exist in their choice set, i.e. if the chooser has no awareness of a certain option, the option is effectively absent from his/her choice set. They used the habitual driver as an example. When a new bus service is introduced, it often has no impact on the decisions of the habitual driver, as 'the person who regularly drives may not be aware when a change in bus service could improve his/her travel'. They further hypothesised that people who have previously lived in an environment with relatively lower levels of car ownership are likely to continue to have lower levels of car ownership in their new city. Weinberger and Goetzke tested their hypothesis by examining the car ownership level of households that had recently relocated within the US ('internal migration'). Their empirical findings, from a joint car ownership and household location model, confirmed the link between previous experience and current preferences. They found that households that had previously lived in central areas of cities show a preference for relocating to central areas of cities; and in the cases where such households moved to a suburban neighbourhood, they tended to own fewer cars than their suburban counterparts. Although their analysis was conducted in the context of internal migration within a country, it would be reasonable to expect this theory of preference formation to hold true for international migration.

This preference formation theory is also consistent with the process of transport or spatial assimilation described in many of the papers reviewed, as assimilation is simply the expression of new preferences learned through new experiences.

CHAPTER 4 Travel of ethnic minorities in the UK

US evidence shows that the travel patterns of migrants are similar to those of racial and ethnic minorities (Tal and Handy, 2010). Because of the dearth of literature looking at the specific travel patterns of migrants in the UK (academic and grey literature included), in this chapter we review available evidence about the travel patterns of different ethnic groups.

However, we note that recent migrants might differ in important ways from people who are of the same ethnic group who are not migrants. For example, Smart (2010) included race as an explanatory variable in his multinomial logistic mode choice models and showed that the effect of migrant status is significant over and above the effect of ethnicity. Therefore, it may be wrong to assume that migrants have the same travel patterns as other members of their ethnic group, especially given the evidence in assimilation (see Chapter 3).

4.1 Evidence on mode choice of ethnic groups

Owen and Green (2000) analysed the 1991 UK Census data and found that people from minority ethnic groups were more than twice as likely as white people to use public transport to travel to work. In particular, three-fifths of Black-African workers relied on public transport for their commuting journeys. Admittedly, the data that supported this study are out of date, but it is one of the few UK-specific studies on the subject published in academic literature. Therefore, it is included in this review.

4.2 Evidence on car ownership of ethnic groups

Data from the 2009 National Travel Survey indicate that there is substantial variation in car ownership cross ethnic groups (DfT, 2010). The proportion of adults (aged 17+) living in a household with at least one car was highest among those from White and Asian backgrounds (83 percent for White British, 83 percent for Pakistani and 81 percent for Indian). In contrast, only 60 percent of adults from Black backgrounds live in a household with a car. Although the proportion of adults living in households with a car is similar for that from White British, Pakistani and Indian backgrounds, the proportion of non-drivers is higher for Asian (26 percent) compared with White adults (13 percent).

4.3 Evidence on trip length and frequencies of ethnic groups

Differing levels of trip making is also observed across ethnic groups (DfT, 2010). According to the 2009 National Travel Survey, adults from a White background made the most trips on average (1,030 trips per person per year), compared with 863 trips by those from an Asian background, and 859 trips by those from a Black background.

In terms of journey length, Owen and Green, using 1991 UK Census data, found that white people on average commute 0.9 kilometres further than those from minority groups, with the exception of the Chinese who tend to travel further than white citizens. People from Pakistani and Bangladeshi backgrounds tended, on average, to travel the shortest distances to work.

4.4 Evidence on geographic concentrations of ethnic groups

The UK's ethnic populations are highly concentrated in London. In 2001, the City of London housed over two-thirds of the national Black population, two-fifths of the Indian population, a third of the Pakistani, other South Asian, mixed and Chinese populations, and almost half of the other non-White population (see Table 4-1 adapted from Stillwell, (2010)). Ethnic minorities represented 29 percent of the 7.2 million residents in London in 2001. Within London, each of these groups is concentrated in different localities. We refer interested readers to Stillwell (2010) for details. Migrants' tendency to live in London, where public transport provision is high, is likely to reinforce their higher propensity to use public transport and reduced requirement for owning a car.

Table 4-1: Population by ethnic group, Great Britain and London

	Great Britain		London		London's share of
	Number	Share	Number	Share	GB
White	52,481,200	91.9	5,103,203	71.2	9.7
Black	1,147,597	2.0	782,849	10.9	68.2
Indian	1,051,844	1.8	436,993	6.1	41.5
POSA*	1,276,892	2.2	429,700	6.0	33.6
Mixed	673,796	1.2	226,111	3.2	33.6
Other	229,324	0.4	113,034	1.6	49.3
Chinese	243,258	0.4	80,201	1.1	33.0
Total	57,103,911	100	7,172,091	100	12.6

*POSA refers to Pakistani and Other South Asia.
Source: Stillwell (2010) based on 2001 Census Special Migration Statistics

4.5 Evidence on the impact of ethnic groups

A study by MigrationWatch UK examined the impact of migration on road transport (MigrationWatch, 2011). Using the travel pattern of existing ethnic minorities as a proxy, their approach considered the relationship between car traffic growth and population growth, the contribution of immigration to population growth, and the relationship between traffic growth and congestion. They projected that:

- By 2025, migration may contribute to 16 percent of the total increase in forecast traffic in England, and up to £5 billion of congestion costs would be incurred as a result.

- By 2035, 5,900 kilometres of additional road will need to be built as a result of migration.

However, a number of highly simplified assumptions were used in this study, which called into question the quality of their estimates. These included:

- '[V]irtually all net migrants will be from BME [Black and Minority Ethnic] communities' and they have the same travel pattern as settled ethnic minorities.
- Migrants' lower propensity to travel and their concentration in areas of high congestion 'cancel each other out'.
- Road length increases linearly with traffic, ignoring the possibility that road capacity is not always adjusted upwards with traffic and a potential outcome is worsening congestion.
- The focus was on road traffic only, and did not consider migrants' use of public transport.

We therefore do not consider the findings of this study to be reliable. A well-designed study to understand the impacts of migrants should:

- recognise migrants may or may not come from minority ethnic groups
- distinguish the difference between settled migrants and recent migrants, as a number of studies reviewed in Chapter 3 found that migrants' travel pattern tend to 'transport assimilate' (i.e. over time migrants' travel behaviour become more similar to that of non-migrants)
- analyse the increased use of transport in congested areas separately from non-congested areas, following the discussion on 'rival' and 'non-rival' goods and services in Chapter 1
- examine the impacts on public transport as well as on the road network, given that a number of previous studies found that migrants tend to use public transport more relative to non-migrants (see Chapter 3).

This is the approach taken in the empirical part (Part two) of this study.

CHAPTER 5 Conclusions from the literature review

The MAC is most interested in the travel behaviour of 'economic' migrants from outside the EEA (i.e. those who have come to the UK with the primary purpose of working and hold Tier 1 or 2 work permits). However, there is no available literature that focuses on these groups specifically, so we look at literature on migrants more generally.

This literature review on migrants' travel behaviour has found that migrants' travel is strongly associated with the use of non-car-driving modes, namely public transport, walking, cycling and car sharing. In particular, the high level of public transport usage of migrants makes them an important market segment for public transport providers.

A common analytical framework adopted by many of the studies is the theory of 'transport assimilation', i.e. the travel behaviour of migrants becomes increasingly like that of the native-born as the length of stay increases. The evidence on assimilation is clear, but there are no consistent findings on the time required to 'transport assimilate'. The studies reviewed indicated a range of four to 20 years. This is a large range and we do not recommend taking these numbers at face value, as it is not clear whether they may be the result of data aggregation (e.g. grouping of years in intervals).

Much of the evidence comes from the US, although we have also identified studies from Canada, Australia, Norway and Sweden. The transferability of findings from studies conducted outside the UK to the UK context requires careful consideration. In particular, in the US, Canada, and Australia, car driving is more common and trip distances are generally longer. Additionally, findings specific to the Latino community in the US are likely to have little relevance to the UK, as Latinos form only a very small sub-group of the migrant population. However, evidence on the travel behaviour of East and Southeast Asians in the US may be applicable to migrants from those groups in the UK. In fact, Tal and Handy (2010) and Smart (2010) have identified distinctive travel patterns within this group.

In the UK, there is a dearth of literature (grey or academic) on the specific travel patterns of migrants. This research gap may be a reflection of the availability of data. The main data source for studying travel behaviour in the UK is the Department for Transport's National Travel Survey (NTS). However, the NTS, unlike the US's National Household Transportation Survey, does not collect information on migration status or country of birth. It does, however, collect information on respondents' ethnicity and has been used to provide evidence on the travel patterns of ethnic minorities in the UK. The relevant findings on ethnic minorities are reported in Chapter 4. However, we caution that it cannot be assumed that migrants have similar travel behaviour to their more settled

counterparts in the same ethnic group. In fact, studies undertaken by Smart (2010) suggested that the effect of migrant status is additional to the effect of ethnicity.

Another limitation of the available research, which is perhaps again related to data limitations, is that the majority of the studies on the travel behaviour of migrants focus on migrants' travel to work. There is a lack of the understanding of the full picture of migrants' travel and activity patterns (e.g. shopping and other trips they make). As a result, the full extent of the social and recreational travel needs and habits of migrants have not been captured.

In Part two of this report we will present a data review and empirical analyses, in which we will ascertain to what extent the evidence base of the impacts of migration on traffic congestion can be improved.

PART TWO – EMPIRICAL ANALYSIS

CHAPTER 6 Introduction

6.1 The need for a UK-focused study

The first part of this report looked into the available evidence on the travel patterns of migrants and impacts on transport and congestion from existing literature.

We found that there is a dearth of literature on UK migrants' travel. Most articles written on the subject of migrants' travel patterns are from the United States, with a few from Canada, Australia, Norway and Sweden. The transferability of findings from studies conducted outside the UK to the UK context is questionable. In particular, mobility culture in the US, Canada, and Australia is very different from that in the UK, where car driving is less ubiquitous and journey distances are typically shorter. Therefore, there is a need for original, UK-focused research.

In Part two of this report we aim to address the question 'what is the impact of migration on the demand for transport networks and levels of congestion in the UK?' using UK data.

6.2 Analytical framework

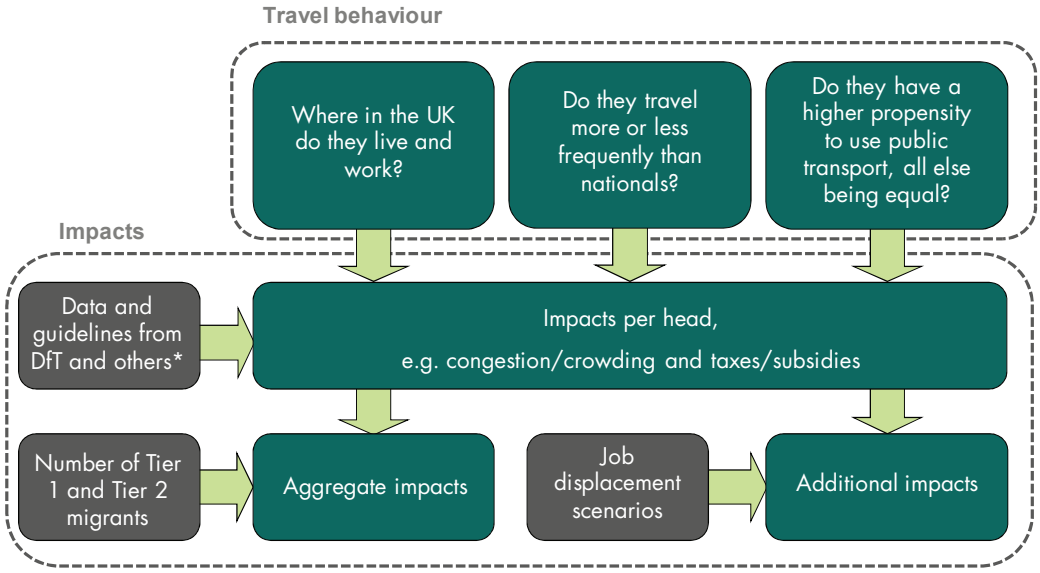
We develop a framework to understand migrants' travel behaviour and the associated impacts of their travel. This is illustrated in Figure 6-1. The starting point in this framework is a series of travel behaviour questions on geographical distribution, travel frequencies and key characteristics (e.g. mode choice and journey time) of migrants' journey-to-work. The second stage of the framework draws information from the Department for Transport (DfT) and other relevant organisations, which feed into our analysis of impacts.

The situation of Tier 1 and Tier 2 migrants is of particular interest to the MAC. Therefore, in the next step in the framework the transport impacts per head are multiplied by the number of Tier 1 and Tier 2 migrants in the UK to provide aggregate estimates of the total impact of travel.

Furthermore, we look at the additional impacts considering different possible levels of job displacement by Tier 1 and Tier 2 migrants.

The impacts associated with car driving, bus, national rail and underground are examined separately. More details of our approach will be discussed in the rest of the report.

Figure 6-1: A framework to understand migrants' travel behaviour and the associated impacts of their travel



Notes:

*In addition to the DfT, other organisations from which we sourced data include the Office of Rail Regulation and Transport for London.

6.3 Structure of Part two

The rest of Part two is structured as follows. Chapter 7 discusses information on key definitions, a description of our methods and the data used to support the analysis. Chapter 8 presents the analysis of travel behaviour (including the geographic distribution of migrants' residential location, their travel frequencies, and the key characteristics of their travel to work). Chapter 9 examines the impacts of migrants' travel by mode.

CHAPTER 7 Definitions, methods and data

7.1 Definition of 'migrants' in this empirical analysis

In the following empirical analysis, unless otherwise stated, migrants are defined by non-UK nationality. Nationals of EEA or Switzerland are labelled as 'EEA migrants' for brevity. Those from the rest of the world are labelled as 'non-EEA migrants'.

The European Economic Area (EEA) covers Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, the Republic of Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK. Additionally, Iceland, Liechtenstein and Norway are included, despite not being members of the European Union (EU), as their nationals have the same rights as EU citizens to live and work in the UK. Furthermore, although Switzerland is not in the EEA, its nationals can enjoy the same rights as those for EEA countries. Essentially, the 'EEA migrants' in this report refers to those who are not UK nationals and yet do not need to apply for permission to live and work in the UK.

The focus of the analysis is on non-EEA migrants, i.e. those who need to apply for permission to live and work in the UK. Data for UK nationals and EEA migrants are presented as comparators.

7.2 Method

In order to provide an empirical evidence base to the research question of 'what is the impact of migration on the demand for transport networks and levels of congestion in the UK?', we use a combination of methods:

- **Sub-group comparison** to provide descriptive statistics on the travel behaviour of three population groups: UK nationals, EEA migrants, and non-EEA migrants. This includes an analysis of the geographic pattern of migrants' home and work locations using Geographic Information System tools.
- **Multivariate analysis** to test whether migration status-related variables (e.g. nationality, length of residence in the UK and country of birth) are statistically significant factors affecting travel behaviour, all else being equal.
- **Impact analysis** to understand the specific impacts of Tier 1 and Tier 2 migrants on highway and public transport.

7.3 Data

Having examined six national and two regional data sources on travel behaviour, we judge that the best primary data source for analysis is the UK Annual Population Survey. It provides information on migrant status (nationality, length of stay in the UK, and country of birth) as well as travel related variables (method of travel to work, length of journey to work and licence holding). Additional analysis on car ownership will be supported by analysis of the General Lifestyle Survey.

In general, we find that information on migration status and place of birth are seldom collected in travel surveys. A number of datasets have been examined for use for the study but were rejected on the basis that they do not contain information on migrant status; these datasets include the National Rail Travel Survey, the London Travel Demand Survey and the West Midlands Household Travel Survey.

The most common resource for travel behaviour analysis in the UK, the National Travel Survey (NTS), has only started collecting country of birth data since 2010.[9] This dataset is yet to be available for analysis outside the Department for Transport (DfT) at the time of writing. From our data scoping at an early stage of this study, we found that the 2010 NTS was the only data source that can provide information on the travel frequency of migrants. We therefore submitted a request to DfT for bespoke tabulations of travel frequency to support this research. The findings based on these tabulations are reported in Chapter 8 and are used as input for the impact calculation in Chapter 9.

Additionally, to analyse the spatial distribution of migrants that entered the UK through the points-based system specifically, we use the Home Office's administrative data on the location of Tier 2 sponsors.[10] Knowing the location of sponsors (i.e. employers) provides a good indication on where migrants travel to in their journeys to work.

Of all the sources reviewed, none of the datasets can provide information on the time at which migrants tend to make their journeys. This data gap leads to a limitation to this study. Congestion is normally only experienced when the demand exceeds capacity, usually during the morning and evening peaks. Therefore, in order to understand migrants' impact on congestion, an understanding of their travel by time of day would be useful. Unfortunately no data exist to support this analysis.

More detailed descriptions of the relevant data sources are presented in Appendix B.

[9] The National Travel Survey collected data on 'national identity' in 2009. This data item was collected only in that year. It has been discontinued, and data on country of birth are collected instead from 2010.

[10] It is not possible to have the same information for Tier 1 holders because they do not require sponsors and are not tied to specific jobs.

CHAPTER 8 Migrants' travel behaviour

This chapter considers, in turn:

- Where in the UK do migrants live and work?
- How frequently do they travel?
- What are the key characteristics of their travel to work?

We provide descriptive statistics on the travel behaviour of three population groups: UK nationals, EEA migrants, and non-EEA migrants.

8.1 Migrants' geographical distribution

Congestion occurs when travel demand exceeds capacity, and the problems are generally location specific. On a typical day in the UK, during most hours, most parts of the road and public transport network function well with little congestion. However, congestion is a major problem during peak hours in major urban areas, with close to 90 percent of lost time on the roads in the UK estimated to be on urban roads, particularly in London (Eddington, 2006). Similarly for national rail, the majority of lines into London are significantly above capacity during peak period (Eddington, 2006).

Adding more people to an underused road or public transport network may have little or no consequence on congestion, whereas adding more people to an already congested network will aggravate the problem. Thus, the impacts associated with migrants' travel depend on which road and public transport service they use. In this section, we seek to understand where migrants typically travel by examining their home and work location.

Home location

We present a table comparing the residential location distribution by region for UK nationals, EEA migrants and non-EEA migrants, sorted in order of importance for the non-EEA group (Table 8-1). The area classification (London, metropolitan, and other) is colour-coded. It can be seen that 40 percent of non-EEA migrants and 35 percent of EEA migrants live in London, compared with 7 percent of UK nationals. Also, a high proportion of non-EEA (19 percent) and EEA (20 percent) migrants live in the South East and East of England, although this pattern is also true for UK nationals (23 percent). Not all metropolitan areas are popular among non-EEA migrants, with those in the north (Merseyside, and Tyne and Wear) having low levels of non-EEA migrants.

Table 8-1: Distribution of residential location, by nationality

Region	Area classification	Distribution of residential location within each group		
		UK	EEA	non-EEA
Outer London	London	7%	18%	21%
Inner London	London	4%	17%	19%
South East	Other	14%	12%	12%
East of England	Other	9%	8%	7%
West Midlands Metropolitan Area	Metropolitan	4%	3%	6%
East Midlands	Other	7%	6%	5%
Greater Manchester	Metropolitan	4%	4%	5%
South West	Other	9%	6%	4%
West Yorkshire	Metropolitan	4%	2%	3%
Rest of Scotland	Other	5%	5%	3%
Wales	Other	5%	2%	2%
Strathclyde	Metropolitan	4%	2%	2%
South Yorkshire	Metropolitan	2%	1%	2%
Rest of North West	Other	5%	3%	2%
Rest of West Midlands	Other	5%	3%	2%
Rest of Yorkshire and Humber	Other	3%	2%	1%
Tyne and Wear	Metropolitan	2%	1%	1%
Rest of North East	Other	3%	1%*	1%
Northern Ireland	Other	3%	3%	1%
Merseyside	Metropolitan	2%	1%	1%
		100 %	100%	100%

Source: Annual Population Survey, Oct 2009–Sep 2010

The colour coding indicates area classification:

London | Metropolitan | Other

*Note: We tested the statistical robustness of the proportion of migrants living in each area within the migrant groups. All but the proportion for EEA migrants living in the rest of the North East are statistically robust (i.e. they have coefficients of variations less than 20 percent). The value for EEA migrants living in the rest of the North East has a large coefficient of variation (22 percent). Therefore, it is considered statistically unreliable.

Workplace (Employers') location

As noted earlier, it is the situation of Tier 1 and Tier 2 migrants that is of particular interest to the MAC. In this section, we look at their employers' locations to shed light on the destinations of the journeys to work of this specific group of migrants. The MAC provided RAND Europe with data on the postcodes of Tier 2 sponsors[11] [12] from the UK Border Agency Certificates of Sponsorship (CoS) database to support this analysis.

The CoS provides over 92,000 data points with postcode information of the sponsors of out-of-country Tier 2 applicants during the period of Dec 08 to May 11. These data were

[11] This tier includes ministers of religion, sportspersons, intra-company transfers and those who have been offered a skilled job to fill a gap in the workforce that cannot be filled by a settled UK worker.

[12] We do not have information on the employer location for Tier 1 migrants because they can enter the country even without a job offer.

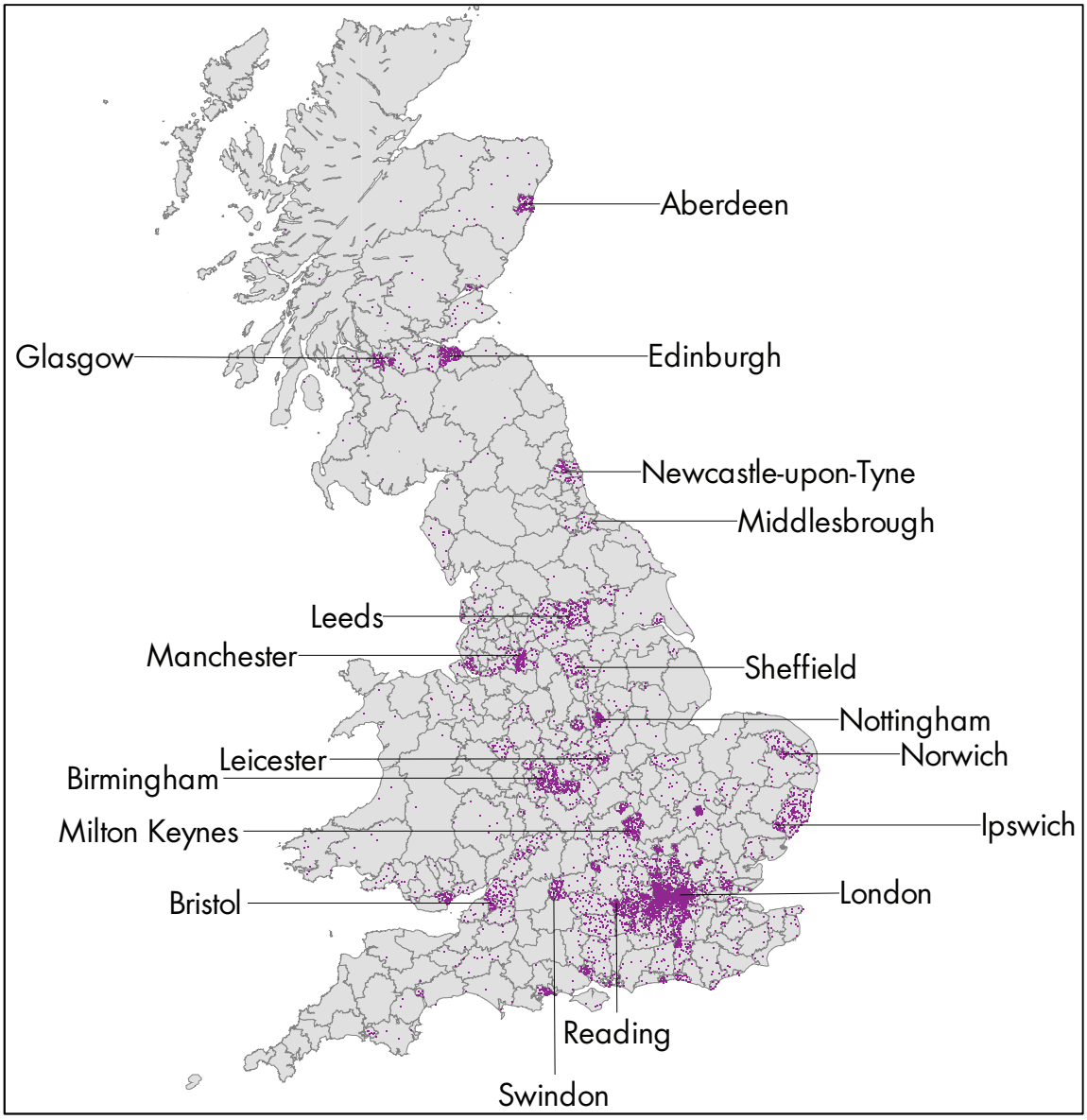
processed by the research team using Geographic Information System software. We first merged the CoS database with Ordnance Survey's Code-Point Open database and geocoded the location of the Tier 2 sponsors. Ninety-five percent of the postcode data were successfully geocoded using this method.[13] After that, we linked the data to maps of local authority districts and plotted the results in a dot density map of Great Britain[14] (Figure 8-1). In the map, each dot represents 10 applicants (i.e. jobs) and is randomly distributed within the boundary of its local authority district. The map aims to provide an impression of the locations where the number of applicants is high (as opposed to where the number of employers is high). For example, if an employer sponsored 50 applicants, it shows up on the dot density map as five dots somewhere in the local authority district, rather than one dot at the precise location. It can be seen in Figure 8-1 that the dots tend to be concentrated in the major UK cities. We label some of them for easy reference. London appears as the main centre of Tier 2 sponsors. A detailed examination of the database reveals that the top five local authority districts for Tier 2 sponsors are all located in London (including City of London, Tower Hamlets, Westminster, Southwark, and Camden).

A limitation of this analysis is that the location of the sponsor may not always be the actual workplace location of the Tier 2 migrant. For instance, it is possible that sponsorships are submitted from the headquarters of an organisation, although the worker is expected to work at a local branch. We do not have information on the extent to which the dot density map is affected by this.

[13] Some of the reported postcode information does not exist in the Code-Point Open database. Reasons for this include: sponsors located in Northern Ireland, or postcode addresses that are newer than Code-Point Open data itself, or an error in the reported postcode.

[14] Northern Ireland is not included because we do not have access to a database for geocoding the postcode addresses data.

Figure 8-1: Distribution of Tier 2 sponsors in Great Britain



Source: RAND Europe analysis of UK Border Agency management information data on Certificates of Sponsorship, Dec 2008–May 2011.

Explanatory notes:

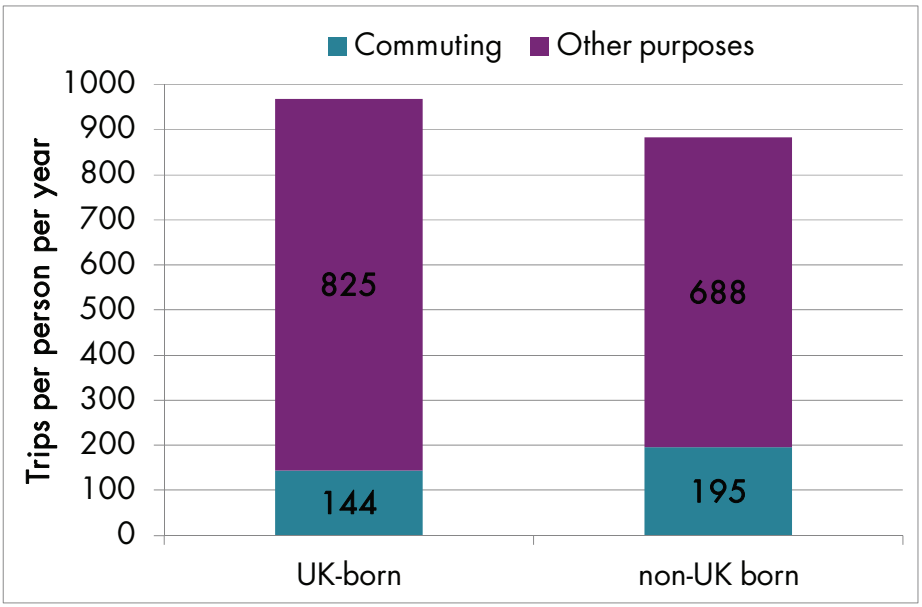
- Each dot represents 10 applications (i.e. jobs).
- The dots are randomly distributed within the relevant district, rather than being placed in the exact location of the sponsors. This helps to preserve the preserve the anonymity of the sponsors, but comes with the limitation that some of the dots appear in rural areas where there is no business.
- It is emphasised that each dot shows the approximate location of the sponsor, which may or may not be the actual workplace location of the Tier 2 migrant, e.g. it is possible that sponsorships are submitted from the headquarters of an organisation, although the worker is expected to work at a local branch.
- An example of this is the high concentration of dots on the Suffolk Coast (near Ipswich), which is due to high number of applications (close to 1,400) from one business.

8.2 Travel frequencies

The demand that migrants place on the UK's transport network also depends on how frequently they travel. Information on travel frequencies is not available from the Annual Population Survey, but we are able to draw on data from DfT's National Travel Survey.[15] However, we note that the NTS collects data on country of birth but not on nationality, so in this analysis migrants are defined as those who were born outside the UK. The comparator is UK-born people (because of small sample sizes, it is not possible to separate those who were born in the EEA as a second comparator).

The findings on travel frequencies, expressed in number of trips per person per year, are shown in Figure 8-2. We find that the non-UK-born (including employed and unemployed) on average make fewer trips than the UK-born. However, when considering the breakdown between commuting and travel for other purposes, we find that the non-UK-born make more commute trips on average than the UK-born. This result can be explained by the fact that the non-UK-born group has a higher employment rate (in the NTS sample 58 percent of them are employed, compared with 47 percent for the UK-born).

Figure 8-2: Travel frequencies, by country of birth



Note: This analysis is performed on a sample of 17,151 UK-born and 1,919 non-UK-born people (NTS, 2010).

Using these data, we calculate that the average number of commute trips per year for an employed non-UK-born person is 336 (we divide the 195 commute trips per year per non-UK-born, employed or unemployed, by the 58 percent that are employed). This figure is a key input to the subsequent impact analysis in Chapter 9.

[15] The National Travel Survey (NTS) has only started collecting country of birth data since 2010. This dataset is not available for analysis outside the Department for Transport (DfT) at the time of writing. We therefore submitted a request to DfT for special tabulations of travel frequency to support this research.

The observation that non-UK-born people, on average, generate more commute trips but fewer other trips is an important finding, as it highlights the importance of examining all aspects of migrants' travel (rather than narrowly focusing on journey-to-work) in the impact analysis.

Because of the poor information on migration status in the NTS survey, we had to use the Annual Population Survey (APS) as the main information source on migrants' travel behaviour. However, being a survey of the labour market rather than of travel behaviour, the APS collects data on journey-to-work only. Therefore, we are limited to examining the key characteristics of migrants' journey-to-work in the next section. In Chapter 9, when discussing the impact analysis, we will explain the assumptions we adopt in order to mitigate this data limitation.

8.3 Journey-to-work

Although it is not ideal that the unavailability of data means we can only provide a characterisation of migrants' journey-to-work (instead of all trips for different purposes), there are good reasons why journey-to-work deserves particular attention. Journeys to work are arguably the most relevant trips in the context of congestion. They tend to take place mostly in the morning and evening peaks, when our transport infrastructure is at capacity and when congestion is a problem. Therefore, the focus on journeys to work is in effect a focus on peak hour travel.

In the following, we look at the key characteristics of migrants' journey-to-work in terms of mode choice, level of car sharing, journey times, and proportions living and working in the same local authority district – all of which will have implications on the impact that migrants' travel have on the network.[16]

8.3.1 Mode choice

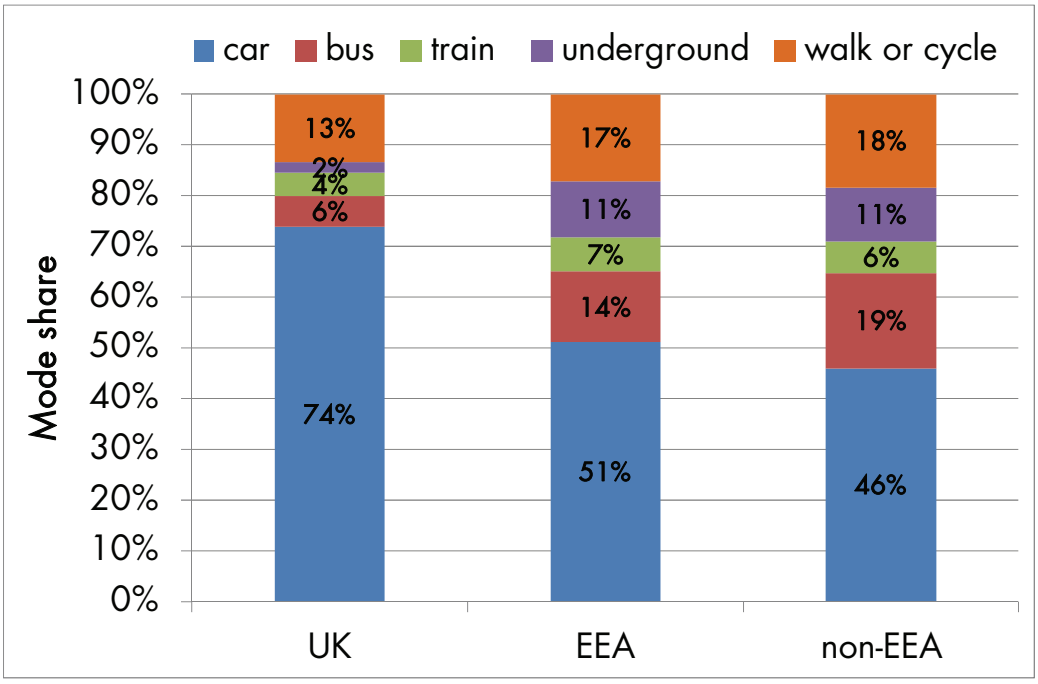
Our findings on mode choice are summarised in Figure 8-3. It is much less common for non-EEA migrants to travel to work by car than UK nationals (46 percent of non-EEA migrants compared with 74 percent of UK nationals). Instead, more of them take the bus to work (19 percent of non-EEA migrants compared with 6 percent of UK nationals). More of them use underground (11 percent of non-EEA migrants compared with 2 percent of UK nationals). More of them also walk or cycle (18 percent non-EEA compared with 13 percent of UK nationals). Also, it is slightly more common for non-EEA migrants to take the train to work; however, the difference (6 percent of non-EEA migrants compared with 4 percent of UK nationals) is not statistically significant. The chart also suggests that EEA and non-EEA migrants have a similar pattern in mode choice.

The differences between the mode choice of migrants and nationals presented here are likely to be a consequence of their higher concentration in metropolitan areas as well as other possible distinctive socio-demographic characteristics of the group (e.g. relatively young compared with the overall population, see MAC (2010)). In section 8.4 of this

[16] We originally intended to examine the proportion of workers in shift work as well, in order to provide an indication of the proportion of trips that take place outside peak hours. However, these data are not available in the APS database we received from the ESDS government, so we could not undertake this analysis.

report, we develop models that control for the socio-demographic and locational characteristics, and explore whether the characteristic of being migrant *per se* has an impact on mode choice.

Figure 8-3: Mode choice, by nationality



Source: Annual Population Survey, Oct 2009–Sep 2010

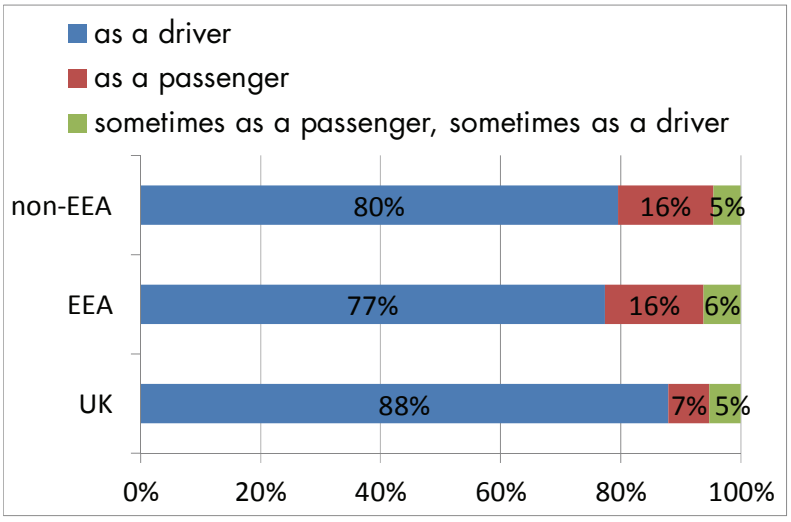
8.3.2 Car sharing

Furthermore, for car users, we examine the split between being a driver and a passenger (Figure 8-4). This distinction is important for analysis of congestion because each car driver corresponds to one car on the road network, providing a good indicator of congestion impacts.

We see from Figure 8-4 that non-EEA (and EEA) migrants are less likely to make car journeys as drivers and are more likely to be passengers, compared with nationals.

Unfortunately, the APS data do not neatly divide car users into drivers and passengers. It also includes a group that travels 'sometimes as a passenger, sometime as a driver' (representing 5–6 percent of the population). In the analysis of migrants' impacts of car use in Chapter 9, we use the simple assumption that 50 percent of this group are drivers and 50 percent are passengers to estimate the number of cars on the network. This group is quite small so the error introduced by this assumption is expected to be small.

Figure 8-4: Car sharing, by nationality

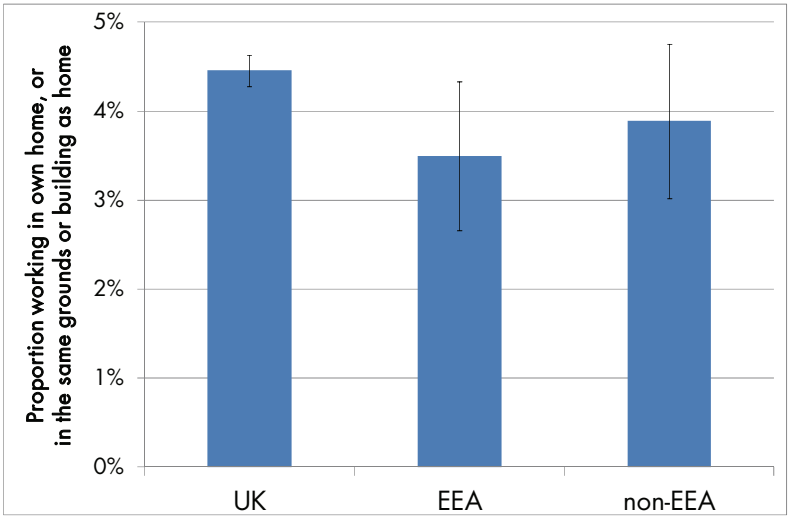


Source: Annual Population Survey, Oct 2009–Sep 2010

8.3.3 Working from home

We also look at the level of home working, as higher levels of home working imply lower demands on the transport network. Across all three groups, the proportion of workers who work from home is approximately 4 percent. We show the 95 percent confidence intervals in Figure 8-5, which illustrate that the small differences between groups are not statistically significant.

Figure 8-5: Proportion working from home, by nationality

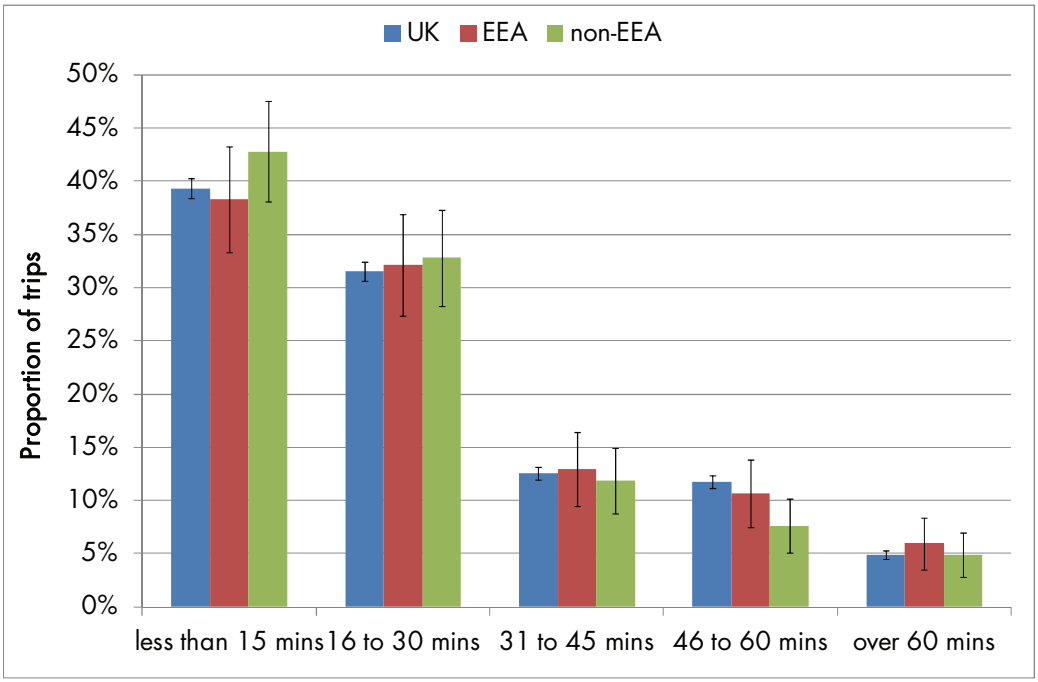


Source: Annual Population Survey, Oct 2009–Sep 2010

8.3.4 Journey time

Additionally, we find that self-reported travel times of journey-to-work are effectively the same across UK nationals, EEA migrants and non-EEA migrants (Figure 8-6). We show the 95 percent confidence intervals in the chart, which confirm that the small differences between groups are not statistically significant.

Figure 8-6: Distribution of journey-to-work time, by nationality



Source: Annual Population Survey, Oct 2009–Sep 2010

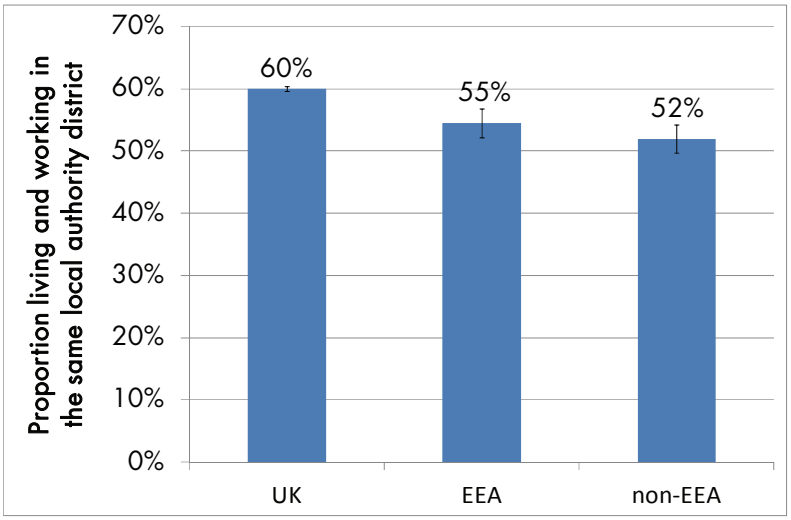
Note: All data points, except for two, are considered statistically robust, i.e. with coefficients of variation less than 20 percent (ONS, 2008). The two data points that are less statistically reliable are the 'over 60 mins' groups for EEA migrants and non-EEA migrants. Their coefficients of variation are 21 percent and 22 percent respectively.

8.3.5 Living and working in the same local authority district

The analysis above shows that the journey lengths in terms of time are effectively the same for the different groups, but this does not necessarily mean that the journey lengths in terms of distance are the same. In fact, an analysis of the proportion of workers living and working in the same local authority district reveals that it is less common for EEA and non-EEA migrants to live and work in the same local authority district (Figure 8-7). This finding implies that the journey-to-work distance may be slightly longer for EEA and non-EEA migrants than for UK nationals. However, the difference is not large, considering the confidence intervals.

Journey *distance* is an important input to the impact calculations in Chapter 9. However, data on the respective journey-to-work distances for migrants and UK nationals are not collected by the APS or other sources. The analyses in this section, on journey *times* and on the proportion of workers living and working in the same local authority, provide some indication. It is likely that the journey-to-work distance for migrants is longer, but only by a small amount. In the absence of observed data directly relevant to journey distances, we assume their journey distances are the same in the impact calculations made in Chapter 9.

Figure 8-7: Proportion living and working in the same local authority district



Source: Annual Population Survey, Oct 2009–Sep 2010

8.4 Are migrants' mode choices different from nationals, all else being equal?

To provide further insights into migrants' travel behaviour, we seek to understand the extent to which migrants' distinctive travel pattern (as seen in the descriptive statistics presented in section 8.3) is a result of their personal characteristics, such as age, gender, income and qualifications, their location, or a result of the fact that they are migrants. Therefore, this section looks at whether nationals and migrants with similar personal characteristics make similar transport decisions.

More specifically, the objective of the following analysis is to test whether migration status-related variables (nationality and length of residence in the UK) are statistically significant in explaining their choice of travel mode, while controlling for other observables (e.g. socio-demographic and location effects).

We focus on commuting only, in part because it is the most important travel purpose in the context of congestion and in part because of data limitations (discussed earlier).

8.4.1 Background

Individuals have a number of transport choices (car, bus, train or walk) in order to get to their workplace. Their personal characteristics can have an influence on their choice of mode, as will their location (for example, people in urban areas have much better public transport provision and are therefore more likely to use public transport than those who live in rural areas). As such, we model the choice of transport mode for journey to work as a function of location and socio-economic characteristics.

Standard least square regression techniques would not be appropriate for this analysis as the outcome variables are discrete (e.g. car, bus, train or walk), rather than continuous. There are various econometric techniques that are suitable for modelling and understanding the extent to which factors influence the probability of making a set of

discrete choices. One of the most common is the multinomial logit model, e.g. Train, (2009). It is the technique we use in this analysis.[17]

8.4.2 Data and approach

We define mode choice (car, bus, rail, underground and walk/cycle) as the dependent variable and estimate the coefficients of explanatory variables using multinomial logit regression techniques. The approach involves introducing explanatory variables to model one by one. Those explanatory variables that are statistically significant and not highly correlated with one another are selected for the final model.

The explanatory variables tested as potentially affecting mode choice are informed by the literature review. As discussed in the first section of this report, migrants' choice of living in large metropolitan areas provides only partial explanation of their higher propensity to use public transport. Many researchers find, even after controlling for spatial and infrastructure characteristics of home location, migrant status is still a significant explanatory factor correlating with mode choice. Only one study, Chatman and Klein (2011), found that the effect of migrant status on mode choice is statistically insignificant when controlling for workplace location and occupation. These previous findings are taken into consideration for the development of the multinomial logit model in the current work.

Previous research (see Part one) also found that lower car ownership is a key explanation for migrants' higher propensity to use public transport. Unfortunately, car ownership information is not available in the Annual Population Survey so we are not able to test its effect on mode choices for travelling to work in the UK.

This analysis is performed on a sample of 22,029 individuals in the Annual Population Survey (Oct 2009–Sep 2010). In the sample, the proportion of UK-born is 94 percent, EEA is 3 percent and non-EEA is 3 percent.

8.4.3 Model testing

Migrant variables

Taking into account the findings from previous studies and data limitations, the migrant status variables tested are: EEA nationality, non-EEA nationality and 'recent arrival' (since 2004).[18] Recent arrivals include EEA, non-EEA and even naturalised citizens. The inclusion of this variable allows us to examine whether there is any evidence for transport assimilation. To determine a cut-off point for 'recent arrival', we ran a series of models to identify the cut-off point which gives the best model fit (in econometric terms, a higher log-likelihood). This turns out to be 2004, i.e. being six years in the UK.

In developing the model, we also find that when the variable 'recent arrival' is included, the explanatory power of nationality diminishes (there is one exception, which will be

[17] Another appropriate technique is probit modelling. Logit and probit models have different assumptions for the distribution of the error term. Probit is more complex because there is no closed-form solution for the choice probability, so it is less commonly used in the field of transport.

[18] We decided not to include the 'country of birth' variable – it is strongly correlated with the 'nationality' variable so we can only include one or the other.

discussed shortly). This means that year of arrival is a better explanatory factor than nationality. This result matches other researchers' finding on transport assimilation.

Socio-economic variables

The socio-economic variables tested include: gender, age, income, education (three types of higher degrees) and occupation (eight groups). These variables are needed so we can identify migrant effects separately from socio-economic effects. We note in passing that the socio-demographic effects on the mode choice outcomes appear to be sensible. For instance, lower income people tend to use buses while higher income people tend to use trains.

Regions

Region of residence and region of work are also tested. We start with the 20 area types available in the Annual Population Survey dataset, and retain only the ones that are found to be statistically significant for at least one of the travel modes. Working in Central London, for instance, is found to be a strong predictor for use of bus, rail, underground and walk/cycle modes (i.e. lower propensity for car use) for travelling to work.

8.4.4 Main findings

The final model contains 95 significant parameters (28 for bus, 29 for rail, 15 underground/light rail, and 23 for walk/cycle). The detailed model results are shown in Appendix C.

A central finding of the study is that, even after controlling for socio-demographic and locational effects, 'recent arrival' (i.e. arrival in the UK after 2004) is associated positively with the use of three modes (bus, underground/light rail, and walk/cycle). When the variable 'recent arrival' is included, the explanatory power of nationality diminishes. The only area which nationality still has an effect (even after controlling for year of arrival and other observables) is bus use, which is positively correlated with being a non-EEA migrant (Table 8-2).

Nationality (i.e. variables representing EEA and non-EEA nationality) are not observed to be correlated with choice of rail for travel to work. Arrival since 2004 is not associated with rail either (Table 8-2). There are two possible interpretation of this: (i) there is no relationship between the variables, or (ii) the sub-sample of rail users is not large enough. We can only be certain that a relationship cannot be found, but we do not know for certain that there is no relationship.

Table 8-2: Effect of migrant status on mode choice, Annual Population Survey (Oct 2009–Sep 2010)

	Bus	Rail	Underground/ light rail	Walk/cycle
EEA nationality				
non-EEA nationality	+			
Recent arrival (after 2004)	+		+	+

Note:

Car is the comparison mode.

Control variables include: gender, age, income, education (three types of higher degrees), occupation (eight groups), and home/work locations (28 region dummies).

'+' indicates a positive statistically significant effect identified. All effects identified in this part of the model happened to be positive.

8.5 Migrants' travel behaviour – summary

In this chapter, we use descriptive statistics and multinomial logit modelling to shed light on migrants' travel behaviour. There are differences observed between migrants and nationals, as well as differences within the migrant population.

The key findings are:

- **Non-UK-born migrants travel less and mainly for work**. They tend to live in large cities and in the South East, and make more commute trips but fewer total trips per person.
- **Recent arrivals use cars less** (regardless of EEA or non-EEA nationality). They tend to use buses, underground/light, and walk/cycle more (which is equivalent to saying they use cars less).
- Over and above the effect of recent arrival, **non-EEA migrants have a higher propensity to use buses even after taking into account their year of arrival, socio-demographic, and place of residence and place of work characteristics**. Given this relatively greater utilisation of buses – a service that includes government subsidies – there may be important fiscal impacts worth investigating. As such, the following chapter explores the fiscal impacts associated with migrants' travel behaviour.

Many of the statistics presented in the current chapter will be used as input to the impact calculation in Chapter 9.

CHAPTER 9 Impact analysis

The previous section looked at migrants' travel behaviour. This section considers the impact of their travel on the transport network. This chapter considers in turn the impact of migrants' travel on car, bus, national rail and underground.

We seek to quantify these impacts as much as possible. The impact analysis of car use draws on the Department for Transport's (DfT's) guidelines, in which a wide range of externalities is considered: congestion, infrastructure damage, accidents, local air quality, noise and greenhouse gases. Indirect taxation, such as fuel duty and VAT on fuel, are also taken into account.

As for the impact on buses, national rail and underground, we look at the balance between their positive contribution through fare payment and negative contribution through consumption of subsidies. We also look at the impact on overcrowding, but because of data limitations we are limited to looking at these impacts qualitatively.

9.1 Assumptions

Before presenting estimates of the costs of these impacts, we wish to emphasise that such an analysis, particularly for Tier 1 and Tier 2 migrants, requires a number of assumptions; therefore, the final values calculated should only be treated as approximations indicative of the order of magnitude, but not as precise values.

Assumption 1: 2009/2010 base year. Because the data supporting this analysis come from multiple sources, we have to accept slight mismatches in the time periods being studied (e.g. data from MAC's Limits report were representative of 2009, data from the Annual Population Survey were representative of the period between October 2009 and September 2010, data on trip rates of non-UK born were representative of NTS 2010, etc). In general, the final values represent the situation in 2009/10.

Assumption 2: Non-EEA migrants as a proxy. The travel behaviour of non-EEA migrants as observed from the Annual Population Survey is used as a proxy for that of Tier 1 and Tier 2 migrants. This is the best assumption we can make, given the absence of data on the specific travel behaviour of Tier 1 and Tier 2 migrants.

Assumption 3: All Tier 1 and Tier 2 migrants are in full employment. Every Tier 1 and Tier 2 migrant is assumed to be in employment, and therefore has an impact on transport and congestion through his/her journeys to work as well as other (non-commute) travel.

Assumption 4: Journey-to-work distances are the same for migrants and nationals. As discussed previously in sections 8.3.4 and 8.3.5, it is likely that the journey-to-work distance for migrants is longer, but only by a small amount. In the absence of observed data directly relevant to journey distances, we assume their journey distances are the same.

Assumption 5: Mode share for non-commute travel. A serious shortcoming in the data available from the Annual Population Survey is that the travel behaviour information (e.g. mode choice) is limited to journey-to-work only. However, the calculation of impacts requires information on mode of travel used in non-commute journeys as well. To come up with an estimate, we make the following assumption: people's choice of mode in their travel to work is a strong indicator of their car and public transport access, preference and habits and therefore a strong indicator of their mode choice in their non-commute travel.

More specifically, we segment the population of Tier 1 and Tier 2 migrants into two groups: (i) those who travel to work by the mode in question and (ii) those who travel to work by other modes. We then estimate the mode share of their non-commute travel, conditioned on the mode share of their commute travel. This analysis of mode choice for non-commute travel is supported by data from DfT's National Travel Survey (2002–2008).

We summarise the mode share for non-commute travel in Table 9-1. For example, we can see that those who travel to work by car use car 87 percent of the time for non-commute travel, whereas those who travel to work using other modes use car less, 70 percent of the time for non-commute travel. The sample of population included in this calculation is all people, i.e. both migrants and nationals, as it is not possible to distinguish migrants from nationals in pre-2010 NTS, and the 2010 NTS do not provide a big enough sample size for this kind of analysis. Because the vast majority of 'all people' are nationals, this method captures the non-commute mode share for nationals better than that for migrants. Thus, the values in the first three columns of Table 9-1 may seem high for migrants. However, at least some of this bias will be corrected in the subsequent impact calculations which take into account the fact that migrants have a smaller travel to work by car group and a larger travel to work by public transport group (see the last two columns in Table 9-1). The values in Table 9-1 will be used in the subsequent analysis.

Table 9-1: Estimated mode share in non-commute travel

Mode	Estimated mode share in *non-commute* travel			c.f. Mode share in *commute* according to the APS*	
	Those who travel to work by the mode in question	Those who travel to work by a mode that is NOT the mode in question	All people who travel by the mode in question	UK national	Non-EEA
Car	87%	70%	75%	74%	46%
Bus	35%	7%	7% **	6%	19%
National Rail	9%	1%	1% **	4%	6%
Underground	22.0%	0.4%	0.4% **	2%	11%

Source: NTS (2002–2008)

Notes:

* These two columns do not add up to 100, as the mode share for walking and cycling is not shown.

** The majority of the UK population uses car in their commute travel. Therefore, only a small proportion of the population are represented in the first column for bus, national rail and underground. As a result, columns two and three are effectively the same for these three modes.

9.2 Car

9.2.1 Background

The impact analysis of car use draws on the Department for Transport's (DfT's) guidelines on marginal external costs of car traffic, i.e. the costs imposed on society resulting from an additional car kilometre (DfT, 2007b). A wide range of externalities is considered: congestion, infrastructure damage, accidents, local air quality, noise and greenhouse gases. However, car driving does generate a fiscal gain for Great Britain's accounts through indirect taxation, such as fuel duty and VAT on fuel, and these gains are also taken into account. These marginal external costs are expressed in pence/km. To measure the specific impacts of Tier 1 and Tier 2 migrants, we estimate their annual total trip length in km and multiply it by the marginal external costs, or:

*Net fiscal impact of car use=Total kilometres driven * External cost per kilometre*

9.2.2 Assumptions

Before we proceed with the impact calculation, we again emphasise that this analysis involves a number of assumptions; therefore, the final values calculated should only be treated as approximations indicative of the order of magnitude, rather than precise values.

In addition to the key assumptions outlined in Section 9.1, there are further assumptions specific to the calculation of car impacts. First, the DfT's estimates of marginal external costs of car congestion are disaggregated by road type (motorways, A roads and other roads) and area type (conurbations, other urban and rural). In the absence of a model of the transport network, we do not have information on the type of roads used for migrants' journeys, so we have aggregated the DfT values so that they represent average impacts

across all road types. The aggregation is calculated based on traffic volume by road type in 2010 obtained from another DfT table (DfT, 2011b).

Second, as for the disaggregation by area type (conurbations, other urban and rural), we are able to retain the distinction between conurbations versus the rest of the country from home location information provided in the APS data. However, it is not possible to distinguish between other urban and rural locations, as our data on home location do not reveal this level of geographical classification. We have therefore assumed that none of the trips take place in rural areas, on the basis that the majority of Tier 1 and Tier 2 migrants' employers are located in cities or urban areas (see map in section 5.1). This may lead to a slight over-estimate of the congestion costs.

The aggregated marginal external costs are shown in Table 9-2. The values in this table are used in the subsequent calculation. For example, the first cell of the table indicates that one additional car on the road in a conurbation imposes £0.41, per kilometre, of marginal costs to society through worsening congestion. The original values in DfT's guidelines can be found in Appendix D.

Table 9-2: Estimates of marginal external costs for cars, pence per kilometre, 2010 costs in 2010£

Cost type	Conurbations	Other urban
Congestion	-41.0	-14.9
Infrastructure damage	-0.1	-0.1
Accidents	-2.9	-3.6
Local air quality	-1.1	-0.6
Noise	-0.2	-0.2
Greenhouse gases	-0.5	-0.4
Indirect taxation*	5.7	5.2

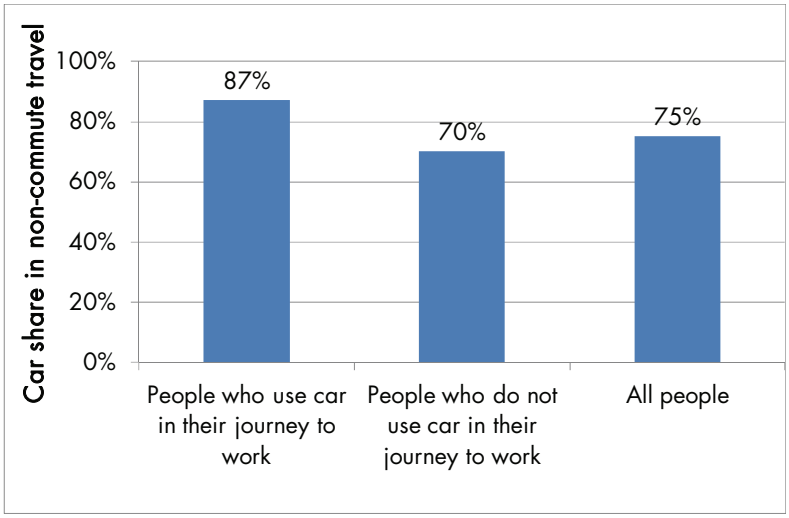
Source: DfT (2007b)

Notes:

* DfT's Webtag unit 3.9.5 assumed indirect taxation stays constant in real terms since 2006. We refined their assumptions by implementing a real change adjustment based on more recent data from DfT's Webtag unit 3.6.5.

Lastly, in section 9.1, we discussed the assumption needed for estimating the mode share in non-commute travel. Here we present the values we will use in the subsequent calculations in Figure 9-1. This set of values will be applied to both migrants and nationals.

Figure 9-1: Car share in other (i.e. non-commute) travel, all people segmented into two groups, 2008 NTS



Source: NTS (2008)

9.2.3 Steps towards calculating impact costs of car travel

Once the assumptions and the key inputs are defined, the steps to calculate the marginal external costs are reasonably straightforward. We first calculate the impacts per head, starting with the information we had from Chapter 8, i.e. the geographic distribution of non-EEA migrants (from section 8.1), the car mode share of their journey to work (46 percent, from section 8.3), the proportion of car drivers (also from section 8.3), the total commute trips per employed non-UK-born person per year (section 8.2), and average trip length of car trips (for all people from NTS 2009).

From these, we estimate the total car kilometres, per year by each Tier 1 or Tier 2 migrants, and multiply this total length by the marginal external costs. The distinction between conurbations versus urban areas is carried throughout, so the effect of Tier 1 and Tier 2 migrants being likely to live in London and other large metropolitan areas is reflected in the final values.

An illustrative calculation of the average impact per Tier 1 and Tier 2 migrant on car congestion is shown in Table 9-3.

Table 9-3: Illustrative calculations, impacts due to car use, commuting only, per Tier 1 and Tier 2 migrant, 2009/10 prices

	Variable	Calculations		Notes and assumptions
		Conurbations	Urban areas	
A	Distribution of residential location	63%	37%	APS, Oct 09–Sep 10, non-EEA migrants
B	Car mode share of journey to work	46%	46%	APS, Oct 09–Sep 10, non-EEA migrants
C	Proportion of car driver	82%	82%	APS, Oct 09–Sep 10, non-EEA migrants
D	Commute trips per employed Tier 1 and Tier 2 migrant per year	336	336	Special data extraction from NTS (2010), non-UK born

	Variable	Calculations		Notes and assumptions
		Conurbations	Urban areas	
E	Average length of car trips in miles	8	8	NTS (2009)
F	Average trip lengths in km	14	14	E x 1.609344
G	Estimated total annual commute trip length by Tier 1 and Tier 2 (km)	1079*	640*	A x B x C x D x F (Each cell represents the value for a fraction of the average Tier 1 or 2 migrant)
H	Marginal external costs of car congestion per Tier 1 and Tier 2 migrant (£), by location	-442	-95	G x Corresponding value in Table 9.2
I	Marginal external costs of car congestion per Tier 1 and Tier 2 migrant (£), all areas	-537**		Sum across conurbations and urban areas in H

Notes:

*Our calculations carry more significant digits than shown in here. Readers may obtain a slightly different value than presented because of rounding. For example, multiplying A, B, C, D, and F together, readers will get 1118 and 657 for G (instead of the value presented).

**The final value in this calculation -£537 populates the first cell in Table 9-4.

9.2.4 Results

Thus far, we have illustrated the calculation for the marginal external costs of car congestion for commute travel. Using a similar approach, other marginal external costs that are associated with Tier 1 and Tier 2 migrants' car use, e.g. infrastructure damage, accidents, local air quality, and noise, are calculated and reported in Table 9-3. The values reported represent impacts per head per year.

Taking into account both commute and non-commute travel, the negative impacts of Tier 1 and Tier 2 migrants' car use per head per year (due to congestion as well as infrastructure damage, accidents, etc) are found to be in the order of -£2760, while their total positive contributions resulting from indirect taxation are in the order of +£392 (see the last column in Table 9-4). These give a net negative in the order of -£2368 per head per year. Here, we reiterate the warning that a number of assumptions and averages have gone into these estimates, so they should be treated as an indication of the order of magnitude only. Furthermore, we emphasise that we have more confidence in the estimates for journey-to-work, as we have better information to support the calculation (particularly regarding the mode choices of migrants). Strong assumptions have been used to approximate mode share for other (non-commute) travel.

There were 148,480 main Tier 1 and Tier 2 migrant applications granted in 2009 (MAC, 2010). From the information in Table 9-4, we calculate that the aggregate total impact of 148,480 Tier 1 and Tier 2 migrants is -£351m.

Table 9-4: Estimates of marginal external costs for cars, per Tier 1 and Tier 2 migrants, 2010 costs in 2010£

	Marginal external costs, in million £		
Cost type	journey-to-work	other travel	Total
Negative impact			
Congestion	-537	-1852	-2389
Infrastructure damage	-2	-6	-8
Accidents	-54	-186	-240
Local air quality	-16	-55	-71
Noise	-4	-15	-19
Greenhouse gases	-7	-26	-33
Positive impact			
Indirect taxation	95	298	392
Sub-total for negatives	-621	-2139	-2760
Sub-total for positives	95	298	392
Net	**-526**	**-1841**	**-2368**

Note:

Because a number of assumptions and averages have been used in the calculation, the values reported here should be treated only as an indication of the order of magnitude, but not precise values.

The breakdown between the different costs of car travel shows that the largest externality from car use is congestion. This is because it has the largest unit value as shown in Table 9-2, i.e. this is not a migrant specific issue. However, in terms of accidents, there may be good reasons to suspect that the value reported in Table 9-4 is an underestimate, as some studies indicate that migrants are more likely to be involved in road accidents (see, for example, Consunji et al. (2010)). This topic is outside the scope of the current study, but we would recommend migrants' impacts on road safety to be investigated in future work.

Marginal impacts considering jobs displaced

The above calculations look at the marginal external costs to society as a result of Tier 1 and Tier 2 migrants' car use, assuming every journey to work (i.e. job) is additional to the society: in other words, the -£2368 calculated assumes a job displacement level of 0 percent. However, in reality jobs taken up by Tier 1 and Tier 2 migrants could possibly be performed by UK nationals, so that some of these journeys to work may take place anyway. Thus, in this section we apply the same calculations as made above to an employed UK national, using the travel behaviour of nationals.

We find that the average UK national generates a net impact of car for travel to work in the order of -£2459 (Table 9-5), a larger negative number than the -£2368 for Tier 1 and Tier 2 migrants. This result takes into account the countering effects that UK nationals are less likely to be living in conurbations but have a higher propensity to use a car. The greater negative impact of UK nationals is, therefore, due to the fact that UK nationals are more likely to drive a car.

Table 9-5: Estimates of marginal external costs for cars, 150,000 UK nationals, 2010 costs in 2010£

	Marginal external costs, 2010 values in 2010£		
Cost type	journey-to-work	other travel	total
Congestion	-614	-1860	-2474
Infrastructure damage	-3	-8	-11
Accidents	-81	-244	-325
Local air quality	-20	-60	-80
Noise	-6	-18	-24
Greenhouse gases	-10	-30	-40
Indirect taxation	131	364	495
Sub-total for negatives	-733	-2221	-2954
Sub-total for positives	131	364	495
Net	**-601**	**-1857**	**-2459**

Note: * The last two columns are not used in the analysis of *additional* impacts. Only the impacts of commuting are considered for UK nationals, as we expect most of their non-commute travel would have taken place within the UK with or without a job.

However, in this analysis, we are interested in *additional* impacts. Therefore, we omit UK nationals' non-commute impact, as we expect most of their non-commute travel would have taken place within the UK with or without a job.[19] As a result, assuming a 100 percent job displacement rate, i.e. all jobs taken up by Tier 1 and Tier 2 migrants are instead taken up by UK nationals, the additional impact by each Tier 1 and Tier 2 migrant would be the difference between -£2368 and -£601 (i.e. -£1767). In reality, the job displacement level is probably somewhere in-between 0 percent and 100 percent. We show the results of some alternative assumptions about displacement rates in Table 9-6.

This checks the sensitivity of results to the 100 percent displacement assumption. Results indicate changing the displacement rate to 50 percent increases the negative effect by 17 percent.

Table 9-6: Estimates of additional marginal external costs for cars by Tier 1 and Tier 2 migrants, under different job displacement assumptions

Assumed job displacement rate	Tier 1 and Tier 2 migrants' additional impacts *per head* £, 2010 prices	Tier 1 and Tier 2 migrants' additional impacts, total for 148,480 migrants, million £, 2010 prices
0%	-2368	-351
25%	-2217	-329
50%	-2067	-307
100%	-1766	-262

[19] An assumption here is that an employed person and an unemployed person make approximately the same number of non-commute trip.

9.3 Public transport (bus, national rail and underground)

In our analysis of travel behaviour, we find that migrants tend to use public transport more than UK nationals. Higher public transport use is generally perceived positively, providing higher fare revenue for public transport operators that may translate into better quality of service for all users. However, public transport is subsidised by the government, so migrants' use of public transport also means that they consume subsidy. Thus, in assessing migrants' impact on public transport, we look at the balance between their positive contribution through fare payment and negative contribution through consumption of subsidies.

Additionally, higher demand for public transport may mean higher crowding on UK buses, trains and metros and underground. However, it is difficult to quantify the 'cost' of the increase in crowding imposed on other people by migrants,[20] so at the end of this chapter we explore the relevant issues qualitatively.

Crowding issues are specific to the mode of public transport. Notably, it is more difficult for rail and underground to address crowding issues by expanding capacities because additional infrastructure is costly and takes a long time to build. However, based on our analysis, crowding on buses may be less of an issue.

In the following, we discuss the impact of Tier 1 and Tier 2 migrants' use of public transport on bus, national rail and underground separately.

9.3.1 Bus

In this section, we examine the quantitative impacts of Tier 1 and Tier 2 migrants on bus fares and subsidies.

Background on how fares and subsidies work

This analysis draws on statistics about fare and subsidy for buses on DfT's website (DfT, 2011a). We note that this information is representative of England only, due to the unavailability of some of the data (e.g. the operating costs for buses in Northern Ireland, and subsidy for Scotland, Wales and Northern Ireland).[21] Since 92 percent of all non-EEA migrants live in England, this analysis represents the impacts of the majority of non-EEA migrants.

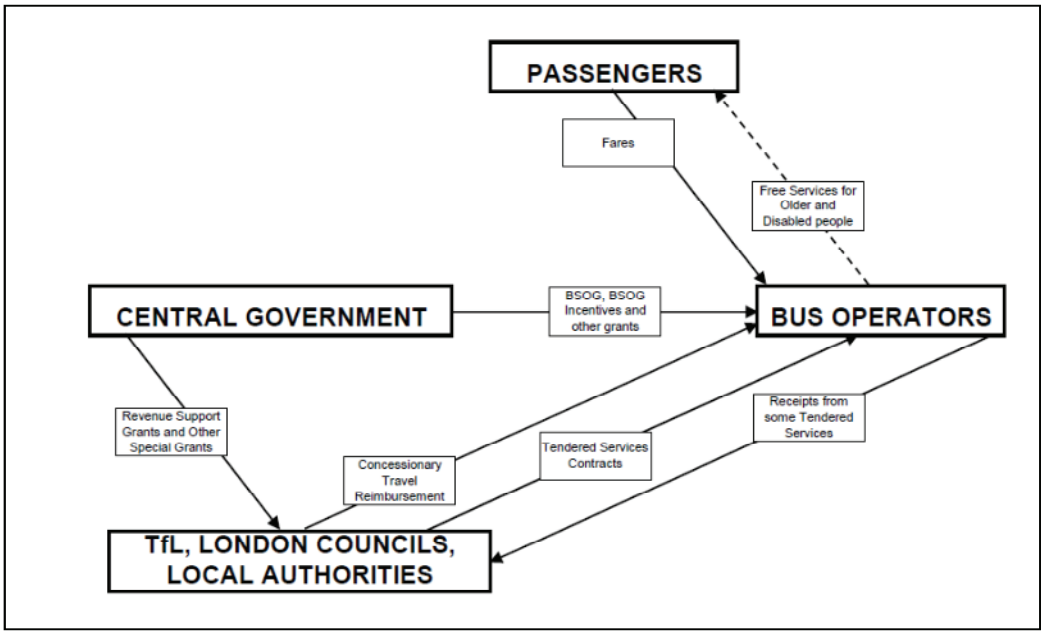
The funding flows between the government and the bus industry in England are complex. Bus operators receive funding from government through multiple channels: directly from central government, indirectly from central government through the local authority, as

[20] We are aware of some recent work that has been done to quantify the value of crowding, e.g. Whelan and Crockett (2009) *An Investigation of the Willingness to Pay to Reduce Rail Overcrowding*. However, to use this information, we require detailed information on the travellers' purpose of travel (business and non-business), the route used by migrants and the crowding condition of the train (in terms of passenger per sq. metre). We do not have such detailed information for T1 and T2 migrants so it was not possible to compute the crowding impacts. We therefore decided to address these issues qualitatively.

[21] Such data may be available from Transport Scotland, the Welsh Assembly Government and the Department for Regional Development in Northern Ireland; however, the constraints of this study (namely time) do not allow us to collect bus data from all these different government departments.

well as directly from local authorities. An overview of the funding flows is depicted in Figure 9-2.

Figure 9-2: Funding flows between Government and the Bus Industry in England



Source: DfT (2011a)

As shown in Figure 9-2, the main types of subsidy (often called grants) are:

- Bus Service Operators Grant (from central government directly to the bus operator, typically based on bus kilometres run)
- Revenue Support Grant and other special grants (from central government to local authorities on a non-ring-fenced unhypothecated basis)
- Tendered services contracts (paid by local authorities to bus operators, typically to support routes where passenger demand is too low to sustain themselves financially, e.g. evening services)
- Concessionary Travel Reimbursement (paid by local authorities to bus operators to support the statutory Concessionary Travel Scheme, i.e. free off-peak travel for all eligible older or disabled citizens in England, as well as some discretionary schemes)

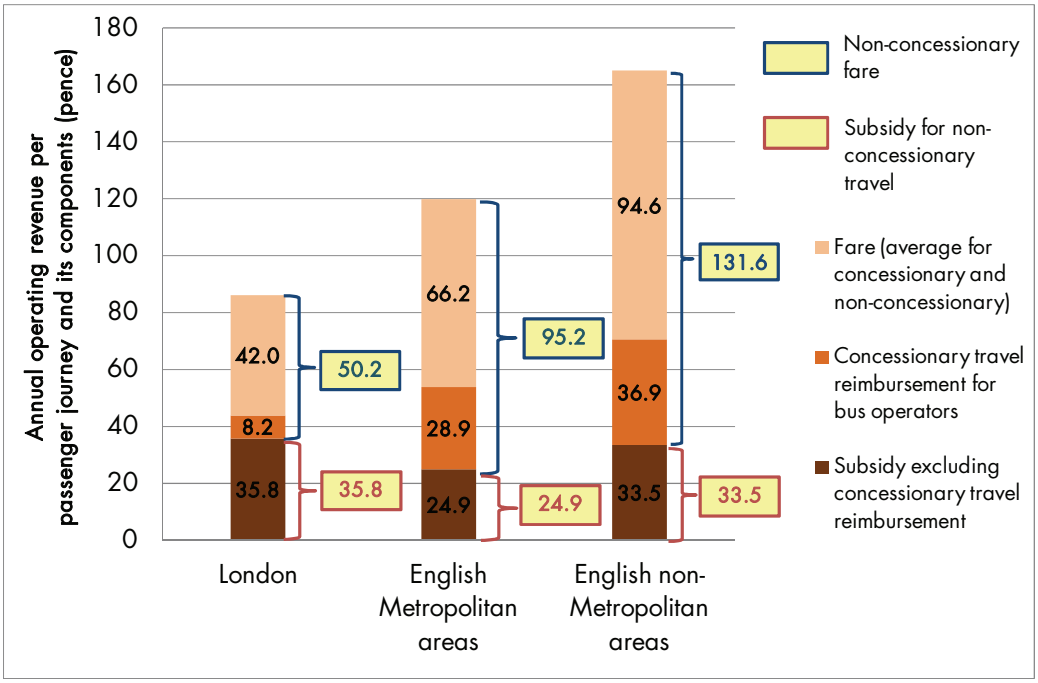
Assumptions

Since Tier 1 and Tier 2 migrants are typically young and employed (MAC, 2010), we can reasonably assume they are highly unlikely to be eligible for concessionary travel. Therefore, our bus subsidy calculation includes all of the above except for Concessionary Travel Reimbursement.

As for the impact on fares, we estimate non-concessionary fare per migrant passenger journey by taking the total operating revenue per passenger journey, subtracting the known total government subsidy per passenger journey, then adding in Concessionary Travel Reimbursement to compensate for the fact that Tier 1 and Tier 2 migrants' fares are typically unsubsidised.

The subsidy and non-concessionary fare per passenger journey are shown in Figure 9-3 (see the values in the boxes with red and blue borders). The detailed calculations are explained in the notes under the figure. The data are disaggregated by London, English metropolitan and English non-metropolitan areas, allowing us to set up our calculation in a way that captures the distinctive geographical distribution of migrants.

Figure 9-3: Subsidy and non-concessionary fare per passenger journey, at 2009/10 prices



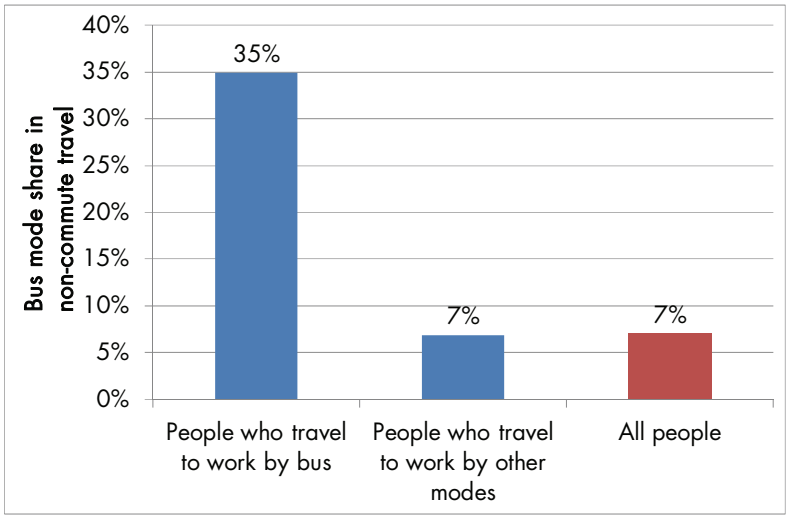
Note:
The total height of the bars represents the operating revenue per passenger journey.
The fare/subsidy per passenger journey is calculated as follows:

- Subsidy for non-concessionary travel = Total net government support excluding concessionary travel reimbursement
- Non-concessionary fare = Operating revenue – Total net government support excluding concessionary travel reimbursement

Source: DfT (2011a)

Another assumption we make is in relation to the mode share in non-commute travel, as discussed previously in Section 9.1. From NTS (2002–2008) data we estimated that those who commute by bus use buses 35 percent of the time for non-commute travel, whereas those who commute using other modes use buses less, i.e. 7 percent of the time for non-work travel (see Figure 9-4). These values are used in the subsequent impact calculation. We note in passing that in NTS 2002–2008, those who travel to work by bus are a minority, so the average for all people is almost identical to the group that travels to work by other modes.

Figure 9-4: Bus share in non-commute travel, all people segmented into two groups



Source: NTS, 2002–2008

Step towards calculating net impact of migrant on bus fares and subsidy

After setting out the assumptions and the key inputs, we calculate the fare contribution and subsidy consumption as follows. We use the information we have about the geographic distribution of non-EEA migrants (from section 8.1), the bus mode share of their journey to work (from section 8.3), the total trips per employed non-UK-born person per year (section 8.2, for commute and non-commute separately). From these, we estimate the total annual bus trips for Tier 1 and Tier 2 migrants, and multiply this by the non-concessionary fare contribution journey passenger journey and subsidy per passenger journey respectively. The distinction between London, English metropolitan, and English non-metropolitan is carried throughout, so the effect of Tier 1 and Tier 2 migrants being likely to live in London and other large metropolitan areas is reflected in the final values.

As an illustration, Table 9-7 shows the steps for calculating fares and subsidies related to Tier 1 and Tier 2 migrants' commute travel. The method used to calculate the fares and subsidies associated with Tier 1 and Tier 2 migrants' non-commute travel is the same and is not repeated here.

Table 9-7: Illustrative calculations, impacts on bus fares and subsidies through commuting, per Tier 1 and Tier 2 migrant, 2009/10 prices

	Variable	Calculation			Notes and assumptions
		London	English metropolitan	English non-metropolitan	
A	Distribution of residential location	43%	20%	37%	APS, Oct 09–Sep 10, non-EEA migrants
B	Bus mode share of journey to work	24%	26%	12%	APS, Oct 09–Sep 10, non-EEA migrants
C	Commute trips per employed person per year	336	336	336	Special data extraction from NTS (2010), non-UK born
D	Estimated number of annual bus trips for the average Tier 1 and Tier 2 migrant, by location	35	17	15	A x B x C (Each cell represents the value for a fraction of a person)
E	Non-concessionary fare per passenger journey (pence)	50.1	95.2	131.6	Bus statistics for England, DfT (2011a)
F	Subsidy per passenger journey (pence)	35.8	24.9	33.5	Bus statistics for England, DfT (2011a)
G	Estimated revenue contribution by location per Tier 1 and Tier 2 migrant (£), by location	17.6*	16.2*	19.2*	D x E (Each cell represents the value for *a fraction of* the average Tier 1 or Tier 2 migrant)
H	Estimated subsidy consumed per Tier 1 and Tier 2 migrant (£), by location	12.6*	4.2*	4.9*	D x F (Each cell represents the value for *a fraction of* the average Tier 1 or Tier 2 migrant)
I	Estimated total revenue contribution per Tier 1 and Tier 2 migrant (£)	53.0			Sum across London, English metropolitan and English non-metropolitan in G
J	Estimated total subsidy consumed per Tier 1 and Tier 2 migrant (£)	21.7			Sum across London, English metropolitan and English non-metropolitan in H
K	Net impact per Tier 1 and Tier 2 migrant (£)	31.3			I – J

Notes:

*Our calculations carry more significant digits than shown in here. Readers may obtain a slightly different values from the ones presented here because of rounding. For example, multiplying D and E, readers will get 17.5, 16.2 and 19.2 for G (instead of the value presented); and multiplying D and F, readers will get 12.6, 4.2 and 4.9 for H (instead of the value presented).

Results

The main results for bus impacts are shown in Table 9-8. First, we find that Tier 1 and 2 migrants make a positive contribution in the order of +£76 per head per annum through their bus use. We emphasise that a number of assumptions and averages are used in this calculation, so the final value should be treated only an indication of the order of magnitude.

Table 9-8: Impacts on bus fares and subsidies, per person, £ in 2009/10 prices

		Tier 1 and Tier 2 migrants	UK nationals	UK nationals (commute travel only)
Commute	Fares	53.0	18.4	18.4
	Subsidies	21.7	5.8	5.8
Other	Fares	72.7	78.1	0.0
	Subsidies	28.0	22.5	0.0
Net		76.0	68.1	24.3

Second, for comparison, we carry out the same calculation for UK nationals (see the second column of Table 9-8). The net impact of UK nationals' bus use is in the order of +£68 per head per annum. This value is less than the contribution by Tier 1 and Tier 2 migrants, reflecting their lower bus usage. In this calculation, we apply the same assumption for fares and subsides to UK nationals (i.e. no concessionary fares), on the basis that our comparison group is those UK nationals who are employed and therefore are also unlikely to be qualified for concessionary fares. In reality, we expect a small proportion of UK nationals are qualified for concessionary fares, and thus the contribution by UK nationals is likely to be lower than the value reported here.

Third, we return to the issue of marginal impacts at different job replacement levels. If we assume all jobs taken up by Tier 1 and Tier 2 migrants are additional jobs that would not exist otherwise, then the net impact of their bus travel is +£76 per head per annum. At the other extreme, we could assume all jobs taken up by Tier 1 and Tier 2 migrants would otherwise be jobs for UK nationals. In this case, for UK nationals we include the impacts associated with their commute travel only (i.e. £24 per head per annum). Their non-commute travel is ignored, as these trips would take place in the UK anyway, with or without a job (assuming an employed person and an unemployed person make the same number of non-commute trips). Consequently, the additional impact by Tier 1 and Tier 2 migrants would be the difference between £76 and £24 per head per annum (i.e. £52 per head per annum). In reality, the job displacement level is somewhere in between these two extremes, and the additional impact of Tier 1 and Tier 2 migrants' bus use would be in the range of +£52 to +£76 per head per annum.

Finally, we look at total impact across all Tier 1 and Tier 2 migrants. There were 148,480 Tier 1 and Tier 2 applications granted in 2009 (MAC, 2010), of which 92 percent resided in England (according to the distribution of non-EEA migrants in the APS). Therefore, we estimate that Tier 1 and Tier 2 migrants' contribution through their bus use in England in 2009 was in the order of +£10m (£76 x 148,480 x 92 percent), if a zero job replacement

level is assumed; and their contribution was in the order of +£7m (£52 x 148,480 x 92 percent), if a 100 percent job replacement level is assumed. We hereby stress again that these values are approximations only and should be treated as such.

9.3.2 National Rail

Similar to the analysis of bus impact (outlined in section 9.3.1), we examine quantitatively Tier 1 and Tier 2 migrants' impacts on rail fares and subsidies. Their calculation can be expressed as follows:

Subsidy for the average Tier 1 and Tier 2 migrant

= *Total annual trip length x Subsidy per passenger kilometre*

Revenue contribution by the average Tier 1 and Tier 2 migrant

= *Total annual trip length x Passenger revenue per passenger kilometre*

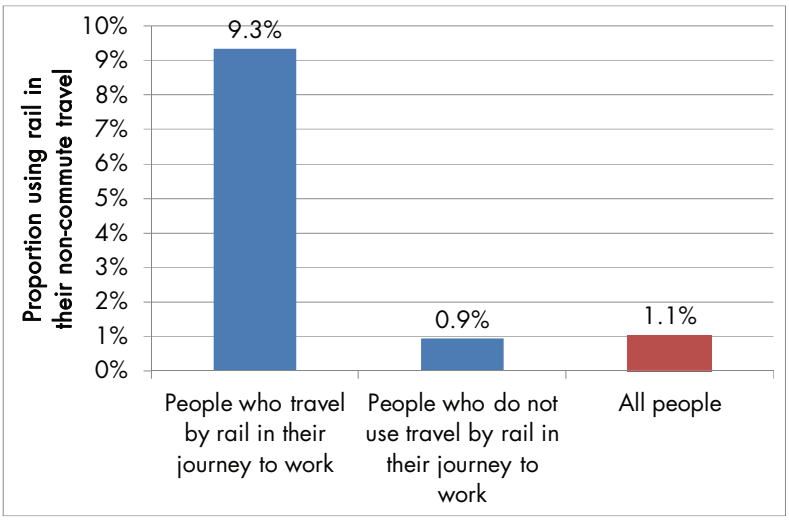
Assumptions

However, a number of assumptions need to be made in order to calculate these equations.

For commute and non-commute travel, we use the same assumption for passenger revenue per passenger kilometre. Although commuters tend to travel during peak period when fares are more expensive, they also tend to buy season tickets to save on fares, therefore it is not clear whether they pay more or less per kilometre for the travel. The ORR yearbook only provides the average value. In the absence of better information, we assume the fare per kilometre is the same for both commute and non-commute.

Also, similar to what has been assumed for computation of the car and bus impacts, have made assumptions about the rail mode share of non-commute travel. Using data from DfT's National Travel Survey (2002–2008), we find that those who travel to work by rail use rail 9 percent of the time for their non-commute travel, and those who travel to work by other modes use rail only 0.9 percent of the time for their non-commute travel (Figure 9-5).

Figure 9-5: Rail share for non-commute travel, all people segmented into two groups



Source: NTS (2002–2008)

Steps for calculating the net impact of migrants on rail through fares and subsidy

The key input to this calculation comes from the Office of Rail Regulation's National Rail Trends (ORR, 2011). The method is largely the same as the ones described in the bus impact section, except this calculation is based on the number of passenger kilometres rather than number of journeys (as for bus). The choice of units (between numbers of passenger kilometre versus number of journeys) was entirely data driven.

Similar to what we have done for car and bus, we provide a table showing each step of the calculation (see Table 9-9). The calculations are shown for the computation of the average net impact on rail travel (in £) per Tier 1 and Tier 2 migrant for commute travel only.

Table 9-9: Illustrative calculations, impacts on national rail fares and subsidies, per Tier 1 and Tier 2 migrant, 2009/10 prices

	Variable	Calculation	Notes and assumptions
A	Train mode share for journey to work	6.3%	APS, Oct 09–Sep 10, non-EEA migrants
B	Commute trips per employed person per year	336	Special data extraction from NTS (2010), non-UK born
C	Average trip length in km	40.1	ORR (2011), Chart 1.1b and 1.2b
D	Estimated total annual trip kilometres for commute travel by average Tier 1 and Tier 2 migrant (km)	843.8*	A x B x C
E	Passenger revenue per passenger kilometre (pence/km)	12.1	ORR (2011), Table 1.3c
F	Subsidy per passenger kilometre (pence)	1.2	ORR (2011), Table 6.2c
G	Revenue contribution by the average Tier 1 and Tier 2 migrant (£)	102.0*	D x E
H	Subsidy for the average Tier 1 and Tier 2 migrant (£)	10.3*	D x F
I	Average net impact (£) per Tier 1 and Tier 2 migrant	91.7	G - H

Notes:

*Our calculations carry more significant digits than shown in here. Readers may obtain a slightly different value than presented because of rounding, e.g. multiplying A, B, and C together, readers will get 848.8 for D (instead of 843.8); multiplying D and E together, readers will get 102.1 for G (instead of 102.0); and multiplying D and F together, readers will get 10.1 for H (instead of 10.3).

Results

The key results on the impacts of Tier 1 and Tier 2 on rail are shown in Table 9-10. We find that Tier 1 and Tier 2 migrants make a net positive contribution in the order of +£109 per head per annum through their use of rail (see the first column of the table).

This is compared with £+74 per head per annum for a UK national (see the second column).

Table 9-10: Impacts through rail fares and subsidies, per person, £ in 2009/2010 prices

		Tier 1 and Tier 2 migrants	UK nationals	UK nationals (commute travel only)
Commute	Fares	102.0	66.0	66.0
	Subsidies	10.3	6.7	6.7
Non-commute	Fares	19.5	16.6	
	Subsidies	2.0	1.7	
Net		109.2	74.2	59.3

Again, the marginal impacts depend on the job replacement level assumed. If we assume all jobs taken up by Tier 1 and Tier 2 migrants are additional jobs, then the marginal impact of their rail travel is +£109 per head per annum (i.e. the same as the net impact cited in the last paragraph). At the other extreme, if we assume all jobs taken up by Tier 1 and Tier 2 migrants could otherwise be jobs for UK nationals then the net impact of their rail travel is the difference between £109 and £59 per head per annum (the first and the third column of the table), i.e. £50 per head per annum. The impact of non-commute travel for UK nationals is omitted in this case because we expect that they make non-commute trips in the UK anyway, with or without a job. Therefore, the range of the marginal impacts is £50 to £109 per head per annum.

We can then multiply the value by the number of Tier 1 and Tier 2 migrants to calculate the total impact on rail for all Tier 1 and Tier 2 migrants. The aggregate impact of 148,480 migrants is £16m if a 0 percent job displacement is assumed and £7m if a 100 percent job displacement is assumed.

We stress again that values reported in this section are not precise estimates. They are only meant to be indications of order of magnitude.

9.3.3 Underground

The data about fares and subsidies for passenger journeys on the London underground are taken from TfL's annual report (2011). Therefore, the analysis reflects the situation in London only, i.e. light rail and tram outside London are excluded.[22]

Other assumptions and method used are largely the similar to the ones described in the bus and rail impact sections so are not repeated here. An illustrative calculation is shown in Table 9-11.

[22] The fares and subsidies reported do not reflect the situation for light rail or tram in the UK, e.g. Docklands Light Railway, Croydon Tramlink, Nottingham Express Transit, Midland Metro, Sheffield Supertram, Tyne and Wear Metro, Manchester Metrolink and Blackpool Tramway, are excluded from this analysis.

Table 9-11: Illustrative calculations, impacts on underground fares and subsidies, per Tier 1 and Tier 2 migrant, 2009/10 prices

	Variable	Calculation	Notes and assumptions
A	Underground mode share of journey to work	10.6%	APS, Oct 09–Sep 10, non-EEA migrants
B	Commute trips per employed person per year	336	Special data extraction from NTS (2010), non-UK born
C	Estimated total number of commute trips by underground by the average Tier 1 and Tier 2 migrant	35.7	A x B
D	2009/10 fares revenue per passenger journey	1.5	TfL Annual Report (2011)
E	2009/10 subsidy per passenger journey (£)	0.7	TfL Annual Report (2011)
F	Revenue contribution by the average Tier 1 and Tier 2 migrant (£)	54.9	C x D
G	Subsidy for the average Tier 1 and Tier 2 migrant (£)	23.6	C x E
H	Net	31.2	F - G

Notes:

*Our calculations carry more significant digits than shown in here. Readers may obtain a slightly different value than presented because of rounding. For example, multiplying A and B, readers will get 35.6 for C (instead of 35.7); multiplying C and D, readers will get 53.6 for F (instead of 54.9); and subtracting G from F, readers will get 31.3 for H (instead of 31.2).

The key results for underground impacts are shown in Table 9-12. Tier 1 and Tier 2 migrants make a positive contribution in the order of +£40 per head per annum through their use of underground. This is compared with +£10 per head per annum for UK nationals. The four-fold difference in impact is the result of the five-fold difference in the mode share of underground, observed in the journey-to-work data for non-EEA migrants in the Annual Population (11 percent for non-EEA migrants and 2 percent for UK nationals).

We also consider the issues of marginal impacts and different job replacement levels. On one hand, if we assume 0 percent replacement (i.e. all jobs taken up by Tier 1 and Tier 2 are additional jobs that would not exist), then the marginal impact is the same as the net impact, i.e. £40 per head per annum as cited above. On the other hand, if we assume 100 percent replacement (i.e. all jobs taken up by Tier 1 and Tier 2 could otherwise be jobs for UK nationals), then the marginal impact is the difference between £40 and £4 per head per annum (the first and the third column in Table 9-12), i.e. £36 per head per annum.

Table 9-12: Impacts through fares and subsidies, underground, per person, £ in 2009/2010 prices

		Tier 1 and Tier 2 migrants	UK nationals	UK nationals (commute travel only)
Commute	Fares	54.9	10.2	10.2
	Subsidies	31.2	5.8	5.8
Non-commute	Fares	28.1	10.4	
	Subsidies	12.1	4.5	
Net		39.6	10.3	4.4

9.4 Crowding on buses

As noted earlier, higher demand for public transport may mean higher crowding on UK buses, trains and metros and underground. However, it is difficult to quantify the 'cost' of the increase in crowding imposed on other people by migrants,[23] so in this section we explore the relevant issues qualitatively.

Because of the importance of bus travel for non-EEA migrants, we specifically look into the impact of crowding on buses in greater detail.

Crowding is an area of concern for travellers using public transport. In a Passenger Focus survey of over 3800 bus passengers in England outside London (Passenger Focus, 2010), respondents ranked the statement 'all passengers are able to get a seat on the bus for the duration of their journey' as the third most important area for improvement, after punctuality and service frequency.

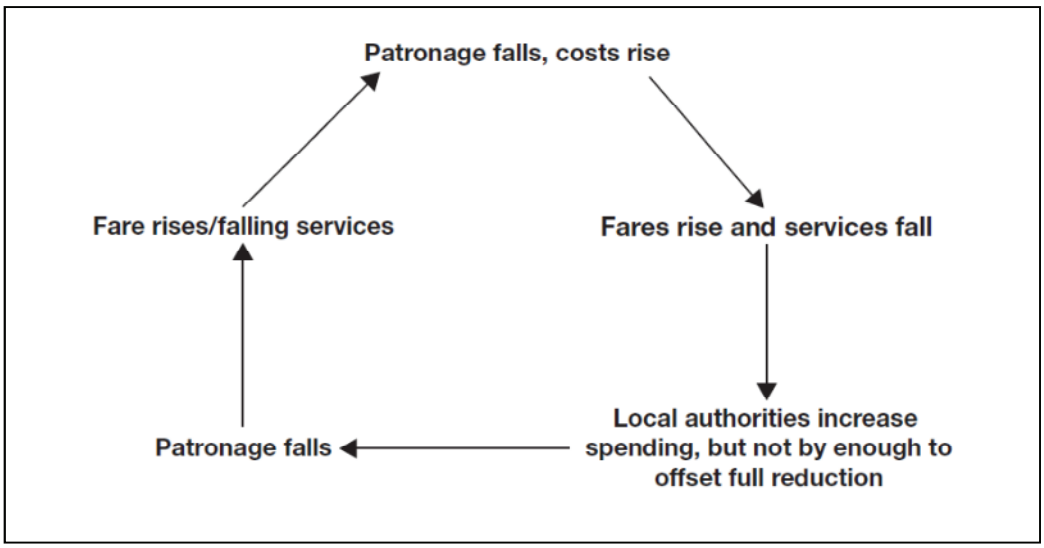
For bus operators, it is relatively straightforward to address crowding problems by providing more buses, either on existing routes or new routes, within a relatively short time frame. In a written statement submitted to the Transport Committee at the House of Commons (2002), FirstGroup (a major transport operator in the UK) said: 'As demand expands, it is in operators' interests to invest in more buses to meet it. The business case for doing so is overwhelming and so is the benefit to passengers – since more buses on a service not only mean more capacity but more frequent services.'

If this statement is true, then the problem of crowding should be self-fixing. Why, then, do we have crowding problems on buses? The problem is likely to be bus operators' failure to respond (or react swiftly enough) to the increase in demand. A detailed discussion of the underlying reasons is beyond the scope of the current study. The point here is that increased patronage *per se* is not the problem.

[23] We are aware of some recent work that has been done to quantify the value of crowding, e.g. Whelan and Crockett (2009) *An Investigation of the Willingness to Pay to Reduce Rail Overcrowding*. However, to use this information, we require detailed information on the travellers' purpose of travel (business and non-business), the route used by migrants and the crowding condition of the train (in terms of passenger per sq. metre). We do not have such detailed information for T1 and T2 migrants so it was not possible to compute the crowding impacts. We therefore decided to address these issues qualitatively.

In fact, declining bus patronage is a major concern. In the DfT publication 'Putting Passengers First' (2006), the UK DfT set out the Government's proposals for the future direction of bus policy. It describes how bus patronage outside London has been in long-term decline since the 1950s and how bus patronage relates to a 'spiral of declining services and rising subsidy' (DfT, 2006). Admittedly, the actual relationship between patronage, fare and subsidy is much more complex than the situation depicted in the figure. Fares and service quality depend on other external factors as well, for example, limited market competition between bus operators often leads to higher prices and lower quality for bus users (Office for Fair Trading, 2010). Nonetheless, the message in the 'Putting Passengers First' report is clear: increased bus patronage is welcome.

Figure 9-6: Relationship between patronage, fares, services and subsidy



Source: DfT (2006)

9.5 Summary on impacts

In this chapter, both negative and positive impacts of migrants' use of transport are considered. In examining the impacts of their car use, our approach covers a range of negative impacts, such as congestion, infrastructure damage, accidents, local air quality, noise and greenhouse gases, as well as positive impacts, such as fuel duty and VAT on fuel. In examining the impacts of their public transport use, we look at the negative impacts through consumption of subsidies as well as the positive impacts through fare payment. We also examine the impact on overcrowding, but are limited to looking at these impacts qualitatively because of data limitations,

In closing, we summarise the quantitative impacts per head by mode. The impacts of car use are negative, in the order of thousands of pounds per person, whereas the impacts of public transport are positive, in the order of tens of pounds per person. The impacts of migrants and UK nationals always have the same sign and order of magnitude.

Table 9-13: Impacts per head by mode, £ per migrant per year, 2009/10 prices

	Tier 1 and Tier 2 migrants (assuming 0% job replacement)	UK nationals	UK nationals (commute travel only)	Marginal impact assuming 100% job replacement
Car	-2368	-2459	-601	-1767
Bus	76	68.1	24.3	51.7
Rail	109.2	74.2	59.3	49.9
Underground	39.6	10.3	4.4	35.2

In analysing the results, we examined the marginal impacts of migrants' travel at different job replacement levels. On one extreme, we assume 0 percent job replacement, i.e. all jobs taken up by Tier 1 and Tier 2 migrants are assumed to be additional jobs to the UK that would not exist otherwise. On the other extreme, we assume 100 percent job replacement, i.e. all jobs taken up by Tier 1 and Tier 2 migrants would otherwise be jobs for UK nationals. We show both of these in Table 9-13.

CHAPTER 10 Conclusions

The objective of this study was to provide an evidence-based analysis on the impact of migration on the demand for transport networks. The research was conducted in two phases. The first phase reviewed relevant literature (Part one) and the second phase (Part two) analysed relevant UK data.

In the first phase of this study, we found scant evidence from UK studies on migrants' specific travel pattern and impact. This finding highlighted the need for original UK-focused analysis.

In the second phase of this study, we undertook empirical analyses based on UK data. The main data source was the Annual Population Survey, complemented by other sources including the National Travel Survey and the Certificate of Sponsorship data. Our analysis addressed key travel behaviour questions that influence the impact of migrants' travel, including the geographical distribution of migrants, frequency of travel and characteristics of migrants' journey-to-work (e.g. mode choice, car sharing, and journey time). These, combined with information from the Department for Transport (DfT), Office of Rail Regulation (ORR) and Transport for London (TfL) were then fed into the analysis of impacts.

Key findings on behaviour

The empirical findings using UK data corroborates the findings from literature about the US and other countries.

- **Migrants are concentrated in metropolitan areas where public transport provision is high**. Using data from the Annual Population Survey, we find that 40 percent of the non-EEA migrant population live in London, compared with 11 percent for UK nationals.
- **Migrants' travel is strongly associated with the use of non-car-driving modes (including public transport, walking, cycling and car sharing)**. Many researchers in the US attributed this to migrants' choice of residential location that are well served by public transport. [24] We found this to be true for the UK as well. However, we also

[24] Many researchers also attribute migrants' lower level of car access to be the primary explanations for the lower propensity to use cars. Unfortunately, the primary dataset we used, the Annual Population Survey, does not collect data on car ownership. Although it is possible to draw on other datasets (the General Household Survey) the constraints of this study do not permit us to include that analysis.

found that non-EEA migrants have a higher propensity to use buses even after taking into account their year of arrival, socio-demographic, and place of residence and work.

- **Migrants tend to 'transport assimilate'**. Previous research found that migrants' travel patterns become increasingly similar to those of the native-born population with increasing length of stay. We saw evidence of this from our analysis of UK data. We defined 'recent arrivals' as having lived in the UK for less than six years[25] and found that recent arrivals (regardless of nationality) use cars less and tend to use buses, underground/light rail, and walk/cycle more. With the resources available for this study, we were only able to explore one cut-off point. We recommend future research to build on this and examine the trajectory of assimilation.

In addition to the above, a further issue that has been explored less often in previous studies is migrants' frequency of travel. On this issue we found that:

- **Non-UK born migrants[26] travel less, and travel mainly for work**. The fact that non-UK born migrants make more commute trips on average was not surprising because of their higher employment rates, but the fact that they make fewer overall trips is interesting. Underlying this finding, there may be behavioural or social network related explanations. The resource available for this study does not allow us to explore the underlying reasons in detail, but this could be a line of enquiry in future studies.

This finding had an important implication on the impact calculations, as it highlights the importance of examining all aspects of migrants' travel, not just their journey to work.

The Annual Population Survey, being a survey of the labour market rather than of travel behaviour, collects data journeys to work only. Therefore, we had to rely on assumptions to estimate the mode share of non-commute travel in our impact calculations. The details were explained in section 9.3. Given the importance of these assumptions in our calculation, this is also an area where further research would be welcome.

Quantifying impacts

Following the analysis of travel behaviour, the impacts of migrants' travel on car, bus, national rail and underground were examined. We sought to quantify these impacts as much as possible.

The impact analysis of car use draws on the Department for Transport's (DfT's) guidelines on marginal external costs of car traffic, i.e. the costs imposed on society resulting from an additional car-kilometre (DfT, 2007b). A wide range of externalities is considered: congestion, infrastructure damage, accidents, local air quality, noise and greenhouse gases. However, car driving also generates a fiscal gain for Great Britain's accounts through indirect taxation, such as fuel duty and VAT on fuel, and these are also taken into account.

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[25] We chose six years because defining recent arrivals this way gives the best model fit in the final specification of the multinomial logit model developed. However, we note that this value may be sensitive to the model specification and therefore more testing is needed.

[26] We note the slight change in definition here. In this report, unless otherwise stated, migrants are defined by their nationality. However, this particular piece of data comes from the National Travel Survey (2010), in which nationality information is not collected (only country of birth, which is slightly different).

In assessing migrants' impact on buses, national rail and underground, we look at the balance between their positive contribution through fare payment and negative contribution through consumption of subsidies. Due to lack of data, the negative impact of crowding was examined qualitatively, rather than quantitatively.

Key findings on impacts

The impacts of car use were found to be negative, in the order of thousands of pounds, whereas the impacts of public transport were positive, in the order of tens of pounds. The quantified impacts, expressed in £ per migrant per year, are shown in Table 10-1. Positive values indicate a net benefit to society. This is not an issue specific to migrants, as we have shown in Chapter 9 that the respective impacts of migrants and UK nationals always have the same sign and order of magnitude.

Table 10-1: Migrants' travel impacts, in £ per migrant per year, 2009/2010 prices

	Tier 1 and Tier 2 migrants (assuming 0% job replacement)	Marginal impact (assuming 100% job replacement)
Car	-2368	-1767
Bus	76	52
Rail	109	50
Underground	40	35

Note:

The values reported are only approximations indicative of the order of magnitude.

In interpreting these results, we examined the marginal impacts of migrants' travel at different job replacement levels. On one extreme, we assume 0 percent job replacement, ie all jobs taken up by Tier 1 and Tier 2 migrants are additional jobs to the UK that would not exist otherwise. On the other extreme of 100 percent job replacement, all jobs taken up by Tier 1 and Tier 2 migrants would otherwise be jobs for UK nationals. For example, the results suggest that the marginal impacts of the average migrant are in the region of -£2000 per head per year (based on the values -£2368 and -£1767 in the table). We discussed at length how we arrived at these values in Chapter 9.

We stress again a number of assumptions are used in the calculation; therefore, the values reported are only approximations indicative of the order of magnitude and should be treated as such.

With regard to migrants' impacts on public transport, an area that is important but difficult to quantify is crowding. In this report, we explored the relevant issues qualitatively. Crowding issues are specific to the mode of public transport. Notably, it is more difficult for rail and underground to address crowding issues by expanding capacity because additional infrastructure is costly and takes a long time to build. For buses, crowding may be less of an issue as bus operators can respond by providing more buses relatively easily and quickly. In fact, the increased patronage on buses is generally seen as a positive outcome.

Limitations to analyses

There are a number of limitations to the empirical analyses reported. Most are a result of data limitations.

A key limitation is that we do not have data about Tier 1 and Tier 2 specifically (apart from the Certificate of Sponsorship data on Tier 2 migrants' employer locations). In general, we have had to look at broader categories of migrants, e.g. EEA and non-EEA, and have made assumptions about the behaviour of Tier 1 and Tier 2 migrants on the basis of the behaviour of these other groups.

Because the data supporting this analysis come from multiple sources, we have to accept slight mismatches in the time periods being studied (e.g. data from MAC's Limits report were representative of 2009, data from the Annual Population Survey were representative of the period between October 2009 and September 2010, data on trip rates of non-UK born were representative of NTS 2010, etc).

The main dataset supporting the empirical analysis is the APS. It is intended to be a survey of the labour market, rather than a survey of travel behaviour. Therefore, using the APS to support the current study comes with a number of limitations. We used other datasets to complement the APS where appropriate (e.g. using the NTS for travel frequencies), but gaps still exist. The main limitation is that it can only support analyses of one aspect of migrants' travel – journeys to work – but not analyses of the full picture of their total travel.

A second limitation is that it does not support analyses of migrants' travel by time of day. Congestion is normally only experienced at particular times of day (the morning and evening peaks). During other times of the day, transport networks normally operate below their capacity, so technically there is no congestion. We acknowledge that an understanding of what time migrants tend to travel would be highly informative. However, such an analysis is not possible using existing data.

Nevertheless, the focus of our analysis – journeys to work – is arguably the most relevant aspect in the context of congestion. They take place mostly at the morning and evening peaks, when our transport infrastructure is at capacity and when congestion is a problem. Therefore, our focus on journeys to work is in effect a focus on peak hour travel.

In the report we do not quantify the impact on congestion associated with migrants' use of public transport; this is only done for cars. For some modes (e.g. buses) it is likely that supply will be elastic, and so not including congestion effects may be appropriate. However, this will not be the case for modes such as the national rail and underground. We are aware of some recent work that has been done to quantify the value of crowding, e.g. Whelan and Crockett (2009). However, to use this information, we need to have detailed information on the traveller's purpose of travel (business and non-business), the route used by migrants and the crowding condition of the train (in terms of passenger per square metre). We do not have such detailed information so it was not possible to compute the crowding impacts. With additional resources we might be able to compute estimates with the aid of a transport model, but it would still be an approximation.

Future research

At an early stage of this project when the literature search was being conducted, we identified a number of papers that explored safety issues related to migrants' use of transport. At the time, the project team along with the MAC decided that this topic is out of scope, given the resource and time available for the current study. However, we believe

safety is also a topic of policy relevance and recommend it to be investigated in future studies.

Another area that has not been covered in the current study is migrants' impacts on the provision of transport through taking up jobs operating buses, trains and taxis. This study has focused on migrants' impact on the transport network through their travel patterns, but their impact on provision of transport is another subject that merits further investigation.

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APPENDICES

Appendix A – Databases and search terms

Databases

We conducted our search in academic and grey literature databases. The academic databases we used were:

- the Transport Research International Documentation (TRID)[27] database
- the Proceedings of the European Transport Conference (ETC)[28] database, and
- ScienceDirect[29]

The TRID and the Proceedings of the ETC have a strong focus on transport research. With over 900,000 records worldwide, the TRID is arguably the most comprehensive database for transport research, but the Proceedings of the ETC is chosen to complement the TRID to maximise the number of European studies captured. In these two academic databases, we undertook a title, abstract and keywords search using the variant terms for migration, such as 'migration' 'migrant', 'immigration', and 'immigrant'.

ScienceDirect is a more general academic database, covering journals in a wide range of subjects from physical sciences and engineering to social sciences and humanities. In this database, we used a comprehensive set of keywords and search strings, representing the two main components of the primary review question (transport and migration), to target relevant literature. The keywords used are documented in the next section.

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[27] The TRID database integrates the content of two major databases, the Organisation for Economic Co-operation and Development's (OECD's) Joint Transport Research Centre's International Transport Research Documentation (ITRD) Database and the US Transportation Research Board's (TRB's) Transportation Research Information Services (TRIS) Database. The TRID indexes over 900,000 records of transportation research worldwide.

[28] The ETC is a major annual event for European transport practitioners and researchers. Each year, more than 200 papers are presented at the conference. The proceedings repository contains the papers from each conference held since 1996.

[29] ScienceDirect is an information source for physical sciences and engineering, life sciences, health sciences, as well as social sciences and humanities. The database covers 3300 journals and book Series.

Our preliminary search in the academic databases revealed that most of the academic studies on the subject of migrant travel come from the US, which led us to focus our grey literature search on identifying UK-based evidence. We retrieved relevant grey literature through searches conducted in the following websites of relevant UK government departments and stakeholder organisations. These include:

- the UK Department for Transport (DfT)
- Transport for London (TfL)
- the Policy Hub (http://www.nationalschool.gov.uk/policyhub/), and
- the Greater London Authority, Regional Development Agencies (RDAs) and Strategic Migration Partnerships (SMPs), using Google[30]

Additionally, because US-evidence indicated that migrants' travel patterns are to some extent similar to those of people of the same ethnic groups (Tal and Handy, 2010), we conducted an additional search targeting publications related to ethnic groups' travel patterns. We started from two known DfT publications (DfT, 2003) and used their bibliographies (a process known as 'snowballing') to identify additional academic and non-academic articles. The limitations of using ethnic minorities' travel patterns as a proxy for migrants are discussed in Chapter 4.

Search terms

The search terms we used, divided according to the two main components of the primary review question, are given below. Truncation was used as appropriate, for example in order to capture the terms 'migrant', 'migrants' and 'migration', we used a wildcard character 'migra*'.

Table A-1: Search terms

Group 1 – Migration	Group 2 – Transport
migra*	Congestion
migra*	transport*
	'travel demand'
	'travel pattern'
	'public transport*'
	'car use' or 'auto use' or 'automobile use'
	'car ownership' or 'auto ownership' or 'automobile ownership'
	'mode choice'
	'trip frequenc*'
	'trip distance'
	'journey frequenc*'

[30] The search strings used were: '"migrant worker" transport site:.gov.uk'; '"migrant worker" transport site:.org.uk'; '"migrant worker" transport "development agency"'; and '"migrant worker" transport "Strategic Migration Partnership"'.

Group 1 – Migration	Group 2 – Transport
	'journey distance' 'residential location' 'licence holding' 'driver's licen*' 'driving licen*'

Appendix B – Data scoping

Data

This appendix describes the various data sources we have examined and explains why we chose the Annual Population Survey (APS) as our main data source.

Identifying relevant datasets

The Annual Population (APS) will be the primary data source for our analysis. We judge this to be the best source to examine key aspects of travel behaviour by migrants after examining a number of national and regional data sources, including:

- the Annual Population Survey (APS) and the related Quarterly Labour Force Survey
- the General Lifestyle Survey (formerly known as the General Household Survey)
- the National Travel Survey (NTS)
- the National Rail Travel Survey (NRTS)
- the London Travel Demand Survey (LTDS), and
- the West Midlands Household Travel Survey (WMHTS)

In general, we find that migration status and place of birth are seldom asked in travel surveys. In the four travel surveys examined, only the NTS collects country-of-birth data and this is a very recent development (since 2010).

The APS was chosen to be the primary data source, as it contains both migrant status variables (nationality, length of residence in the UK and country of birth variables) as well as travel related variables. Although the information on travel is limited (notably, there is no information on the respondents' travel other than their journey to work), it is judged to be the best available dataset for this study.

There are a number of datasets related to the APS, notably the Quarterly Labour Force Survey (QLFS). We chose the APS over the QLFS as the main data source, as the APS includes additional sample size boosts to the QLFS.

Of all the sources reviewed, none of the datasets can support analyses of migrants' travel by time of day. This data gap leads to a limitation to this study. Congestion is normally only experienced when the demand exceeds capacity, usually during the morning and evening peaks. Therefore, in order to understand migrants' impact on congestion, an understanding of their travel by time of day would be useful. Unfortunately no data exist to support this analysis.

In the following, we provide a short description of each of these sources, followed by a table summarising the key migration, transport, location and socio-economic variables in each dataset.

Detailed descriptions

Quarterly Labour Force Survey (QLFS)

The Quarterly Labour Force Survey (QLFS) is a household-based labour market survey encompassing population, economic activity and qualifications. It collects detailed data on migrant status, such as country of birth and length of residence in the UK. Some (limited) transport information is collected, including method of travel and journey length for the journey to work.

General LiFestyle Survey (GLF)

The General LiFestyle Survey (GLF) (formerly General Household Survey (GHS)) collects information on a wide range of topics from people living in private households in Great Britain. These topics include: household and family information, housing tenure and household accommodation, and consumer durables such as car ownership. Data relevant to migrant status, such as country of birth and length of residence in the UK, are covered in the survey.

The National Travel Survey (NTS)

The UK National Travel Survey is a household survey on travel behaviour in Great Britain. It was first collected in 1965/66, and has been conducted annually since 1988. It collects information about trips made by members of households within a designated travel week, covering: trip purpose, method of travel, time of day and trip length; and respondents' personal characteristics such as age, gender, and employment status, and household characteristics such as household income and car availability. The NTS started collecting nationality data only in recent years, since 2009.

The National Rail Travel Survey (NRTS)

The National Rail Travel Survey (NRTS) is a survey of passenger trips on the national rail system, which aims to provide a comprehensive picture of weekday rail travel in Great Britain. The NRTS collects data on many aspects of rail journeys, including frequency of rail trips, season tickets, time of day of travel, in addition to individuals' background data. No data on migrant status are collected.

The London Travel Demand Survey (LTDS)

The London Travel Demand Survey (LTDS) is an annual survey, conducted by Transport for London. It is based on an annual sample survey of 8,000 randomly selected households in London and the surrounding area. Survey respondents are interviewed at home and asked about the trips they made on a particular day, their access to transport, their cars and public transport tickets, and other factors affecting your travel. No data on migrant status are collected.

The West Midlands Household Travel Survey (WMHTS)

The West Midlands Household Travel Survey was collected to support Local Transport Plan submissions across the West Midlands Region. Data have been collected in 2001 and 2011 to coincide with the Census. The dataset includes a range of relevant transport variables such as trip frequency, method of travel, car ownership, licence holding, etc. However, data on migrant status are not collected.

Table 10-2: The key migration, transport, location and socio-economic variables

		Annual Population Survey (and Labour Force Survey)	National Travel Survey	National Rail Travel Survey	London Travel Demand Survey	General Household Survey (formerly General LiFestyle Survey)	West Midlands Household Travel Survey
Migrant status	Nationality	x					
	Country of birth	x	x Available from 2010 only			x	
	Length of residence in the UK	x				x	
Transport	Method of travel	x (Home to work only)	x	x	x		x
	Length of journey (time or distance)	x (Home to work only)	x	x	x		x
	Travel frequency		x	x	x		x
	Car ownership		x	x	x	x	x
	Licence holding	x	x		x		x
Location	Home	x Local Authority District	x		x		x
	Work	x (if one lives and work in the same Local Authority District)	x		x		x

		Annual Population Survey (and Labour Force Survey)	National Travel Survey	National Rail Travel Survey	London Travel Demand Survey	General Household Survey (formerly General LiFestyle Survey)	West Midlands Household Travel Survey
	Working from home	x	x		x		x
Other key socio-economic variables	Employment status	x	x	x	x	x	x
	Income	x	x	x	x	x	x
	Age	x	x	x	x	x	x
	Qualifications	x					x
	Household structure	x	x	x	x		x
	Ethnicity	x	x	x	x	x	x
Additional notes		Require a special licence for Local Authority level data	2010 data not available on UK data archive yet			Require a special licence	

Appendix C – Results of the multinomial logit model

Car is the base outcome								
	Bus		Rail		Underground/ light rail		Walk/cycle	
	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio
Migrant status								
EEA nationals	0.10	0.56	0.16	0.6	0.35	1.29	-0.04	-0.29
non-EEA nationals	0.76	5.32	-0.09	-0.34	0.43	1.64	0.19	1.48
Year of arrival	0.86	5.14	0.46	1.59	0.82	2.9	0.38	2.57
Socio-demographic background								
Gender: male as base category	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Gender: female	0.51	7.77	-0.25	-2.83	0.09	0.72	0.12	2.59
Age	-0.02	-7.56	-0.01	-3.52	-0.02	-3.13	-0.01	-5.23
Gross income	0.00	-8.04	0.00	1.82	0.00	-0.22	0.00	-7.9
Type of higher degree: no higher degrees as base category	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Type of higher degree: doctorate	0.55	1.52	1.08	4.12	0.81	1.56	1.01	5.21
Type of higher degree: masters	0.22	1.36	0.57	3.78	0.47	2.35	0.43	3.96
Type of higher degree: postgraduate certificate in education	-0.10	-0.34	-1.20	-2.47	-0.15	-0.31	-0.23	-1.22
Occupation: elementary occupations as base category	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Occupation: managers and senior officials	-1.01	-8.4	0.84	3.86	0.20	0.72	-1.50	-17.15
Occupation: professional occupations	-1.26	-9.42	0.87	3.96	0.05	0.18	-1.20	-13.92
Occupation: associate professional and technical	-0.82	-7.77	0.71	3.27	-0.03	-0.12	-1.23	-15.84
Occupation: administrative and secretarial	-0.34	-3.53	1.07	4.89	0.22	0.76	-1.09	-13.83
Occupation: skilled trades occupations	-1.25	-7.88	-0.48	-1.57	-0.78	-1.79	-1.24	-12.91
Occupation: personal service occupations	-0.39	-3.75	0.10	0.36	-0.30	-0.88	-0.46	-6.28
Occupation: sales and customer service occupations	0.10	1.03	0.92	3.67	0.17	0.49	-0.22	-2.94

Car is the base outcome								
	Bus		Rail		Underground/ light rail		Walk/cycle	
	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio
Occupation: process, plant and machine operatives	-1.28	-7.77	-0.32	-1.02	-1.32	-2.31	-1.17	-11.99
Region of residence								
South East as base category	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Merseyside	0.57	3.19	0.97	4.87	-15.50	-0.01	-0.47	-3.09
West Midlands Metropolitan Area	0.80	2.35	-1.07	-2.22	0.57	0.27	0.08	0.34
Rest of West Midlands	-0.65	-2.66	-1.64	-3.82	-15.43	-0.01	-0.22	-1.86
East of England	-0.62	-1.7	0.70	2.83	2.74	4.48	-0.01	-0.03
Inner London	2.40	9.05	-0.74	-3.09	4.55	8.16	2.20	10.38
Outer London	1.25	5.28	0.19	0.93	4.34	7.82	0.60	3.24
Wales	-0.28	-0.71	-0.52	-1.1	-19.10	-0.01	-0.72	-2.72
Strathclyde	-0.27	-0.44	-3.28	-5.72	-12.16	-0.01	0.24	0.53
Rest of Scotland	-0.47	-0.93	-3.47	-8.31	1.03	0.66	0.05	0.12
Northern Ireland	0.12	0.37	-1.86	-1.84	-14.84	0	-0.49	-2.14
Region of work								
South East as base category	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Tyne and Wear	1.06	6.76	-0.53	-1.57	5.16	7.1	-0.27	-2.01
Rest of North East	0.46	2.44	-1.56	-3.04	-14.52	0	-0.07	-0.59
Greater Manchester	0.78	5.6	-0.42	-1.78	3.21	4.13	-0.06	-0.57
Rest of North West	0.25	1.58	-1.20	-3.59	0.95	0.79	-0.11	-1.05
South Yorkshire	0.58	2.89	-0.79	-1.85	3.32	3.86	-0.12	-0.82
West Yorkshire	0.65	3.66	0.18	0.73	-14.56	0	-0.23	-1.69
Rest of Yorkshire and Humber	0.41	2.25	-1.35	-2.9	-14.54	-0.01	0.32	2.92
East Midlands	0.45	3	-1.44	-3.87	2.06	2.51	0.12	1.25
West Midlands Metropolitan Area	0.13	0.37	1.00	2.18	0.82	0.38	-0.40	-1.69
East of England	0.28	0.77	-1.03	-3.19	-1.91	-1.59	-0.05	-0.22
Central London	1.70	5.98	4.31	20.21	4.63	7.39	0.67	2.82

Car is the base outcome								
	Bus		**Rail**		**Underground/ light rail**		**Walk/cycle**	
	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio	coefficient	t-ratio
Inner London	0.71	2.52	2.69	11.33	3.06	4.88	-0.27	-1.14
Outer London	0.11	0.43	0.61	2.49	1.31	2.08	-0.59	-3.06
South West	0.08	0.53	-0.99	-3.84	0.43	0.36	0.08	0.87
Wales	-0.01	-0.04	-0.19	-0.37	4.62	3.96	0.37	1.37
Strathclyde	1.27	2.06	4.09	7.11	-11.91	-0.01	-0.61	-1.31
Rest of Scotland	1.30	2.59	2.79	7.13	-15.45	-0.01	-0.20	-0.51
Outside UK	-17.15	0	3.02	3.9	5.51	3.34	0.08	0.07
Constants								
Modal constants	-2.35	-13.53	-3.12	-10.84	-7.30	-9.22	-0.48	-4.17

Appendix D – Marginal external costs for cars: values before aggregation

		Conurbations			Other urban			Rural			All area types
Cost type	Congestion band	Motorways	A roads	Other Roads	Motorways	A roads	Other Roads	Motorways	A roads	Other Roads	Weighted average
Congestion	Average	5.7	53.4	26.2	n/a	22.2	5.6	3.9	2.1	5.5	13.1
Infrastructure	All	0	0.1	0.1	n/a	0.1	0.1	0	0.1	0.1	0.1
Accident	All	0	2.9	2.9	n/a	2.9	2.9	0	0.7	0.7	1.5
Local air quality	All	0.7	0.9	1	n/a	0.5	0.5	0.3	0.2	0.2	0.4
Noise	All	0.2	0.2	0.2	n/a	0.2	0.2	0	0	0.1	0.1
Greenhouse gases	All	0.3	0.4	0.4	n/a	0.3	0.3	0.3	0.3	0.3	0.3
Indirect taxation	All	-3.7	-4	-4.7	n/a	-3.3	-4.2	-3.9	-3.1	-3	-3.6
Total	All	3.2	54	26.2	n/a	22.9	5.5	0.6	0.3	3.8	11.9

Source: Table A1 in DfT (2007) Webtag unit 3.9.5: Detailed Guidance on Major Scheme Appraisal in Local Transport Plans. Available: http://www.dft.gov.uk/webtag/documents/expert/unit3.9.5.php [Accessed 24 November 2011]