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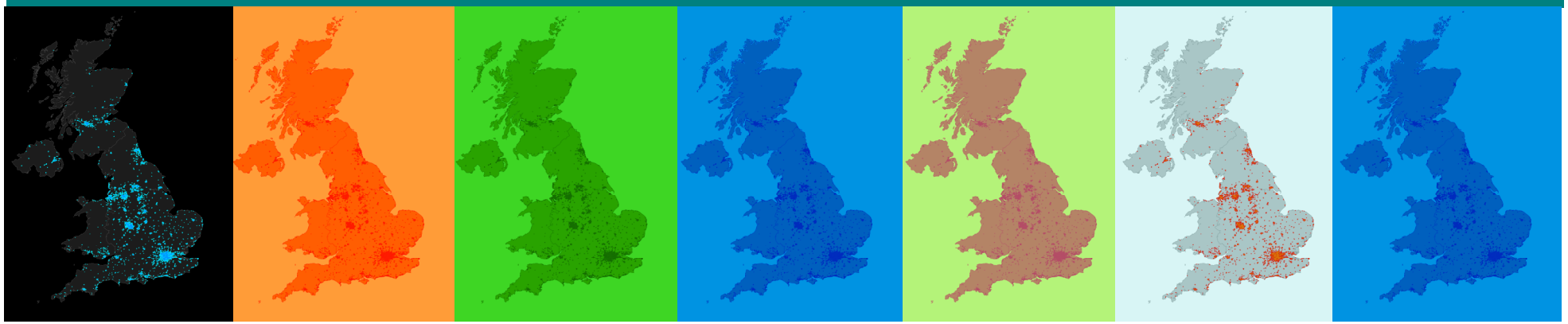
THE EVIDENCE BASE – SPATIAL STRUCTURE AND KEY DRIVERS



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JUNE 2006

UNITING BRITAIN

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Foreword

How the UK Works – A Spatial View

Why a Spatial Planning Perspective?

The Royal Town Planning Institute's *New Vision for Planning* promoted the concept of spatial planning in 2000. The enactment of the 2004 Planning and Compensation Act and Scottish planning reforms have given it a major boost. Box 1, which identifies the different levels of spatial plans that affect the UK, highlights the major gap in the hierarchy of plans at a national level.

The RTPI has long advocated that this gap must be filled if the nation is to tackle vital investment and development issues that local or regional planning cannot address. In 1999 therefore it established a Working Group to promote it.

The Need

All regions depend upon core national infrastructure networks, which involve long term national commitment to capital spending and impact on the nation's economic competitiveness. A national spatial planning framework is essential to achieve an integrated approach to the future of airports, ports, and major road and rail projects. Other essential national infrastructure networks and supplies, including those for energy, IT and water, cut across the boundaries of established administrative regions and cannot be planned on a local, or even regional, basis.

Without a national framework therefore it is considered that some of the government's key goals will not be met. These include:

- PSA2 which seeks to reduce the gap in growth rates between all the regions of the UK
- The Communities Plan which seeks to deliver four key growth areas and tackle market failure
- Implementing the findings of the Barker Report
- Tackling Climate Change
- Responding to the new European context for structural funds

The effectiveness of the planning system therefore depends on the clarity of the national policy context within which all plans, whether local or regional, must fit. The relevance of national policies depends on their sensitivity to the great spatial variation in the needs and opportunities throughout the country. However the soundness of such policies also depends on the evidence base that underpins them.

This Study

As part of its wider commitment to promoting more effective national planning the RTPI therefore commissioned the present study in 2005 in order to:

Box 1 UK Spatial Planning Levels

- ✓ Local Development Frameworks/Plans
- ✓ Regional Spatial Strategies (England)
- ✓ Strategic Development Plans (Scotland)
- ✓ Devolved Administrations:
  - ✓ Northern Ireland Regional Development Strategy. 2001
  - ✓ Wales Spatial Plan. 2004
  - ✓ National Planning Framework for Scotland. 2004
- X No Development Framework for England
- X No National Spatial Strategy for the UK
- ✓ European Spatial Development Perspective

1. explore what data sources are already available,
2. highlight any important gaps in these sources, and
3. to develop ways to map this information to depict the key aspects of life in the UK.

The study has also assembled a large number of indicators to describe the forces that drive and shape these areas. From this the authors have proposed six functional areas whose existence, let alone interests, is only partially recognised by any existing instruments of government.

Whilst there may be debate about the details of the areas identified, it cannot be doubted that large polycentric regions exist and are expanding. Such functional areas raise a host of important questions about future national priorities, in terms of

1. what is their implication for regional planning since the functional areas cut across established administrative units;
2. what are the inter-relationships between these functional regions and how should these be managed; and
3. what is the relationship between these core regions and the wider and more rural parts of the UK.

The Group intends to identify and publicise these questions in the months ahead.

One way that the working group will be compiling these questions will be by testing future development scenarios. This might, for example, involve highlighting the spatial implications of some of the Government's major strategies – its PSA 2 targets, its Sustainable Development Strategy and its Sustainable Communities Plan – in terms of their compatibility and to highlight key policy decisions or potential interventions that need to be required to pursue them. The RTPI hopes to publicise the outcomes of this work in the near future.

The RTPI does not intend to produce its own version of a national spatial planning framework nor even will it attempt to define the scope of one. For while it is keen to demonstrate the benefits of a National Spatial Planning Framework, and while it will be seeking ways to promote and demonstrate its purpose, the challenging task of putting a framework into place must rest with Government itself.

Finally, I would like to thank Professor Cecilia Wong and all her team for their excellent work and commitment to this project.

Vincent Goodstadt

The RTPI National Spatial Planning Framework Task Group

Introduction

Research Objectives

This research is a follow-up study to previous work carried out by the University of Manchester to examine whether there is a need to have a fully integrated national spatial planning framework for the UK[1]. A test case of housing and employment was used in the 2000 report to explore inter-sectoral issues and the spatial impacts brought by their close interactions. One of the strong arguments emerging is the need to provide more effective national solutions to the pervasive force of a changing spatial structure. The main purpose of this research is, therefore, to provide a better understanding of the spatial structure that underpins the development of different parts of the UK.

The spatial arrangements of human activities constitute spatial structures, which are the outcomes of both unintentional and deliberate action. These structures are relatively stable and in turn impose themselves upon the population and perpetuate further spatial change. It is, therefore, important to examine the spatial function and characteristics of different areas and how they interact with each other in our national spatial system.

Without any pre-conception of what the UK spatial structure is or should be, this study focuses on analysing the spatial connectivity and interaction of different areas, as well as the key demographic, social, economic and environmental factors that drive spatial change. The use of GIS techniques allows us to map many spatial patterns as far as possible at detailed spatial scales without being prejudiced by the boundaries of existing administrative areas. The findings of the study will help inform the Royal Town Planning Institute and its task group to further develop different policy scenarios in relation to the debate for having a UK Spatial Planning Framework.

Policy Context

Over the last few years, there has been a trend towards more strategic thinking about co-ordinating planning activities in the UK. A framework for regional planning and development in England is emerging through the publication of the White Paper on Regional Development Agencies[2] and *Planning Policy Guidance Note 11*[3]. The publication of the European Spatial Development Perspective (ESDP)[4] adds a new dimension of concern, and has stimulated thinking about the need to develop a national policy framework with a strong spatial dimension for England and the UK. In response to the call from the ESDP, Northern Ireland led the way by completing its Spatial Strategy in 2001[5]. The Wales Spatial Plan[6] and the National Planning Framework for Scotland[7] were both published in 2004.

Despite the fact that there is no National Spatial Strategy for the UK, it is clear that government policies have spatial implications. In some instances these spatial implications are made explicit, as in the case of the ODPM, DTI and Treasury sharing a Public Service Agreement target to make sustainable improvements in the economic performance of different parts of England and over the long-term reduce the persistent gap in growth rates between different regions. Reducing gaps in differential spatial economic performance is recognised as important from an 'equity' perspective, as well as from an 'efficiency' standpoint. The idea of the adoption of 'floor targets' in social inclusion and neighbourhood renewal policy aims to promote a minimum standard which under-performing areas are required to achieve, so that 'headline targets' are not achieved at the expense of increasing inter-area disparities. Mainstream government policies (e.g. supply-side measures for tackling non-employment, on defence expenditure, and investment in the science base) have implications for the spatial distribution of economic activity and opportunity.

[1] Wong, C.; Ravetz, J. and Turner, J. (2000) *The UK Spatial Planning Framework*, London: the Royal Town Planning Institute.

[2] DETR [Department of the Environment, Transport and the Regions] (1997) Building *Partnerships for Prosperity: Sustainable Growth, Competitiveness and Employment in the English Regions*, Cm 3814, London: the Stationery Office.

[3] DETR (2000) *Revision of Planning Policy Guidance Note 11 Regional Planning*, London: Department of the Environment, Transport and the Regions.

[4] European Commission (2000) *European Spatial Development Perspective*, Strasborg: European Union.

[5] Northern Ireland Office (2005) Shaping Our Future - The Regional Development Strategy for Northern Ireland 2025, Belfast: Department of Regional Development.

[6] Welsh Assembly (2004) *People, Places, Futures - The Wales Spatial Plan*, Cardiff: Welsh Assembly.

[7] Scottish Office (2004) *National Planning Framework for Scotland*, Edinburgh: Scottish Office.

National policy development and proposals can raise important regional issues. For example, the *Sustainable Communities Plan*[8] sets out proposals for four growth areas in the 'Greater South East' to provide 200,000 extra houses by 2016, and identifies nine 'Pathfinder' projects for revitalising areas of low demand housing in the Midlands and Northern regions; the Barker Review of Housing Supply[9] identifies the need for affordable housing, highlights the benefits of lower house price inflation for the economy, and shows that to achieve this would require substantial new house-building; the Lyons Review of Public Sector Relocation[10] argues that a new pattern of government service location can make significant contributions not only to national policies for reform of public services, but also to policies for reductions in economic disparities in the fortunes of regions, and to devolution.

The main concern is that administrative areas tend to be used as the spatial entities to deliver planning policy and initiatives. The boundaries of administrative areas such as regions and local authorities, however, do not define functional entities. There are also sectoral policies that focus on network planning; the most obvious example being the national transport strategy. However, these sectoral plans do not integrate with other policy sectors to examine the interactive effect on the spatial order within the nation. There are also a lack of national policies explicitly dealing with activity flows that have the greatest potential to transcend the geography and hierarchy within the national spatial system. The spatial processes of change and the socio-economic and environmental driving forces do not stop at administrative boundaries. The movement of investment, pollutants, traffic and population means that it is increasingly difficult to handle spatial planning and economic development issues within a tightly bounded local or regional planning framework.

The differential spatial contours generated by activity flows inevitably produce inter-regional issues. This creates the need for examining inter-sectoral linkages over a broader spatial framework at national or even supranational levels. At a regional level, this is perhaps most clear in the case of London, the South East and East of England regions, where three regions are influenced by the role of London as a 'World City' and where a key policy area, the Thames Gateway, straddles regional boundaries. Elsewhere, there are also important inter-linkages, as illustrated by the functional links between parts of Derbyshire (in the East Midlands) and Sheffield (in Yorkshire and the Humber), and the Milton Keynes South Midlands Growth Area which has impacts across regional boundaries. Within regions, certain sub-regions (such as Chester in the Northwest) may have stronger linkages with Wales than with other parts of the same region (such as the northern Manchester districts).

Exploring the Spatial Structures

Over the last two decades or so, a number of broad spatial trends are apparent[11]:

- an urban-rural shift in population and employment;
- a trend towards longer and more diffuse journey-to-work flows;
- a 'North-South' shift in economic activity – with persistent inter-regional disparities in economic performance and competitiveness.

While there are signs of a turn-around in fortunes in some instances (as shown by the recent reversal in London's population decline), many of these spatial trends seem well entrenched. It is, therefore, important to identify a number of key drivers that will shape life and work in the 21st century over the medium- and longer-term, as these drivers pose certain challenges for the future pattern of spatial development and for the fortunes of people and places. These drivers include[12]:

- demographic factors: age structure and population change etc.
- socio-cultural factors: level of deprivation and quality of life etc.
- knowledge economy and business competitiveness: skills, qualifications, industrial structure and research capacity

[8] ODPM (2003) *Sustainable Communities: Building for the Future*, London: Office of the Deputy Prime Minister.
[9] Barker, K. (2004) *Review of Housing Supply: Delivering Stability: Securing our Future Housing Needs*, London: HM Treasury.
[10] Lyons, M. (2004) *Well Placed to Deliver? Independent Review of Public Sector Relocation*, London: HM Treasury.

[11] Wong, C.; Ravetz, J. and Turner, J. (2000) *The UK Spatial Planning Framework*, London: the Royal Town Planning Institute.
[12] see DTI (2005) *Regional Competitiveness and State of the Regions*, London: Department; ODPM (2002) 'The development of town and city indicators database', Urban Research Summary, No. 3, London: Office of the Deputy Prime Minister; Weissbound, R. and Berry, C. (2004) *The Changing Dynamics of Urban America*, Chicago: RW Ventures and CEOs for Cities; Wong, C. (2002a) 'Developing indicators to inform local economic development in England', *Urban Studies*, 39 (10): 1833-63.

- environmental conditions: transport modes, air emissions and preservation of resources.

In order to understand how these drivers shape the spatial structures and spatial trends of the UK, the analysis focuses on the interaction and connection between places as well as the spatial outcomes caused by these drivers of change. The findings then help to identify whether any meaningful functional spatial clusters[13] exist that may have policy implications for spatial planning.

While people engage with multiple geographies, and the forces of spatial change operate at different spatial scales, this study concentrates on the macro analysis of the national spatial system. Due to the concentration of population and activities in urban areas, the analysis of the national spatial structure will inevitably be dominated by the urban spatial form. However, the urban structure is increasingly characterised by decentralisation, dispersion, and multiple employment centres. It is this broader interactive process between agglomerative and dispersive forces that makes the analysis of connections between urban and semi-rural / rural areas interesting.

There is a suggestion that the spatial forces of change interact in very complex ways and simple policy interventions are unlikely to be effective in correcting inefficiencies in spatial structures. It is the understanding of the complexities in the spatial structures that helps pose challenging questions to policymakers about rethinking the principles of spatial organisation of activities. The purpose of this exercise is not to prescribe a particular set of functional spatial boundaries, but to demonstrate the methodological analysis that could be used as a toolkit to improve our understanding of the interaction, connections and characteristics of different places. This will allow us to evaluate whether existing administrative boundaries and policy instruments provide a sensible and appropriate framework to deliver spatial strategies for future change.

[13] Functional spatial areas are coherently defined spatial entities that have similar characteristics in terms of the social and economic relationships such as patterns of journeys to work and catchment areas for shopping, social facilities and schools. The most widely used policy instrument is the definition of functional labour market areas (or travel to work areas) on the basis of the commuting patterns of workers.

Report Structure

This report consists of three main analytical sections:

Part I: Functional Spatial Connectivity

In order to understand the connectivity and spatial structure of different places in the UK, key transport infrastructure networks, commuting flows and migration patterns are analysed to illustrate the dynamics and intensity of such spatial interactions.

Part II: Key Drivers of Change

This part of the report highlights the spatial patterns of a range of demographic, socio-cultural, economic and environmental factors that underpin the processes of spatial change. This allows us to understand the impact of the key drivers on the spatial structure of the UK.

Part III: Spatial Structure of the UK

This part of the study aims to synthesise the findings of the earlier analysis and highlight the nature of the spatial structure in the UK and whether any meaningful functional spatial clusters emerge that may have policy implications for spatial planning.

The research methodology, as well as the gaps and limitations of the indicators included in the analysis are discussed in Annex 1. The definitions, data sources and health warnings for each indicator are detailed in Annex 2. In Annex 3, a more detailed explanation of the derivation of the functional spatial clusters is provided, with accompanying figures.

Part I
Functional Spatial Connectivity

The physical-spatial system of our nation is characterised by interrelated networks of nodes and flows and such connectivity has created spatial order in a functional way. In order to examine the spatial structure of the UK, the layers of infrastructural networks such as roads, railways and airport flows are mapped to illustrate how they connect the key functional nodes of our towns, cities and ports.

Places are connected primarily through the movement of individuals between locations. On a daily basis residences and workplaces are connected through the spatial process of commuting to fulfil economic production functions. Recent research, however, shows that there has been a concurrent trend of disintegration between residential and employment locations in the last few decades[14]. Commuting patterns have become very complex, including the traditional patterns of travel from suburban residential locations to work in urban centres, and also commuting between suburbs, as well as reverse commuting from urban homes to non-urban workplaces. This complexity is exacerbated by the increase in dual career households with long commuting trips from the chosen home location[15]. The logistics of transport networks and car usage have enlarged these travel-to-work patterns. Consequently, the total number of travel to work areas has reduced from the original 642 in 1971 to 334 in 1981, and to the current set of 308 in 1991[16].

Migration is the last resort used to resolve the tension between residential and work locations when the option of commuting is not viable. Inter-regional migration is widely seen as related to the business cycle. The boom and bust economic cycle in the early 1990s produced a significant downturn in the housing market and many homeowners, especially in the South East, were at risk of acquiring negative equity[17]. The rapid re-emergence of job opportunities in the South after the recession in the early 1990s has attracted a migrant workforce from the North during the mid-1990s[18]. It is this type of long-term population exchange and inter-flows that illustrates the ties between places.

The spatial structure of the UK is, examined here via a number of indicators that either illustrate the infrastructural connectivity or the dynamic population movement between different spaces. **Table 1.1** outlines the indicators included in the analysis.

Table 1.1: Indicators used to examine functional spatial connectivity

Key factors	Indicators
Infrastructure	❑ Road and rail networks ❑ Quality of inter-city rail links: time and service ❑ Major international airports: scheduled and charter flights ❑ Air transport links within the UK ❑ Major ports and tonnage of traffic
Commuting distance	❑ Short distance commuting (up to 5 km) ❑ Commuting distance of up to 10 km ❑ Long distance commuting (over 20 km) ❑ Very long distance commuting (over 60 km)
Migration flows	❑ Net migration flows ❑ Inter-urban migration: net flows ❑ Inter-urban migration: gross flows

[14] Breheny, M. (ed.) (1999) *The People: Where Will They Work?* London: Town and Country Planning Association.
[15] Green, A. E. (1997) A question of compromise? case study evidence on the location and mobility strategies of dual career households, *Regional Studies*, 31, pp 641-657.
[16] Coombes, M. (1998) *1991-based Travel-to-Work Areas*, London: Office for National Statistics.
[17] Wilcox, S. (1995) *Housing Finance Review*, York: Joseph Rowntree Foundation.
[18] Holmans, A. and Simpson, M. (1999) *Low Demand: Separating Fact from Fiction*, Coventry: Chartered Institute of Housing.

Infrastructure

Figure 1.1 shows the overall distribution of our transport infrastructure, the arterial road and rail networks connecting to the major hubs of towns and cities, international airports, and major ports.

Road and Rail Networks: Uneven Spatial Density

The spatial configuration of our land transport networks show that the distribution of the road network is closely related to the distribution of our train stations. While the coverage of major road and rail infrastructure in the UK is generally high, there is a clear spatial differentiation in the density of such networks. **Figure 1.1** shows that the land transport network density is significantly reduced when entering North Yorkshire. The network density is even lower in western Northern Ireland and the Scottish Borders; the latter area currently has a campaign to re-establish the rail link that was closed in 1969, while the former has not been as well connected since the closure of stations after nationalisation in 1948.

Quality of Rail Networks: Inter-City Links

Rail networks serve a particularly important role in connecting different cities throughout the country, enhancing the mobility of the population and of business activities. **Figure 1.2** maps the two-way links between 21 selected UK cities, including both direct and indirect connections. It is clear that London is the central hub of rail transport for all major cities in the country. The other main cities such as Birmingham, Glasgow, Manchester, Leeds, Newcastle-upon-Tyne, Nottingham and Sheffield also have a strong web of inter-city rail links. It is, however, important to note that Bristol, Cardiff, Edinburgh, and Liverpool have a lower level of inter-city connectivity in comparison with other large cities. Brighton on the south coast stands out as a place with a very high level of connectivity, though this is largely due to its frequent train connections with London. It is thus important to further differentiate the quality of the connections in terms of the level of direct links and the actual journey time incurred.

Table 1.2 shows the top ten cities with the highest level of direct rail links to other cities. As expected, London stands out as the hub with 734 direct services travelling between London and the other cities on a daily basis. Outside London, Birmingham and Manchester offer the highest level of direct service, though they are still operating at two-thirds of London's capacity. While there are 256 direct train journeys going from and to Bristol, it is interesting to note that only a short distance away in Cardiff, the number drops significantly to 91. With regard to Brighton, only 132 direct services are on offer and its strong rail links are overwhelmingly related to its connection to the London network.

Table 1.2: Direct inter-city rail links (to and from the city)

London	734
Birmingham	456
Manchester	456
Sheffield	392
Leeds	346
Newcastle-upon-Tyne	346
Bristol	256
Edinburgh	252
Liverpool	238
Glasgow	206

In order to illustrate the rail journey times for inter-city links, London and Manchester are used as examples. **Figures 1.3 and 1.4** show the differential quality of the two nodes in terms of the actual journey time incurred. While both cities have excellent rail links with other cities in the country, it is clear that London offers 1.6 times more direct links than that of Manchester. With fast speed rail links, the journey time between London and many northern cities such as York, Newcastle-upon-Tyne, Edinburgh and Glasgow are significantly compressed, thereby enhancing the mobility of the population for business and leisure trips. In spite of the fact that Manchester is in closer proximity to these northern cities, train journey times are actually very similar to those of London.

Major UK Airports

There are 29 airports targeted by the 2003 White Paper *The Future of Air Transport* for significant development. They are forecast to have a minimum of 20,000 air transport movements in 2030. In this analysis, Northern Ireland's two main airports have also been included, owing to their strategic importance and high level of air transport movement (see **Figure 1.5**).

In 1999, Heathrow Airport accounted for 37% of all passenger movement at UK airports. In total, the five major London-area airports accounted for nearly two-thirds (64%) of all passenger movements. Outside London, the largest

passenger share was at Manchester Airport, but with only 10% of all UK passenger movements. In 2004, London-area airports accounted for 60% of total passenger numbers, reflecting the growth in regional airports associated with low-budget airlines. As shown in **Figure 1.6**, the largest growth occurred at Liverpool and Prestwick airports, with passenger number increases of 158% and 207% respectively.

International Flight Capacity

As one might expect, Heathrow dominates international connectivity among UK airports, with 36% of all international passengers. Gatwick with 16%, Stansted with 11%, and Manchester with 11%, account for the bulk of the remaining international passenger share. In total, the five major London airports accounted for 67% of all international passengers at UK airports in 2004.

When scheduled international flights (**Figure 1.7**) are considered separately, the dominance of London-area airports is even more marked. In total, they accounted for over three-quarters (77%) of all international scheduled passengers in 2004, with Heathrow alone having the lion's share of 46% of the total. The largest share at a regional airport was Manchester, with less than 7% of all international scheduled passengers.

In terms of international charter passengers (**Figure 1.8**), two UK airports are clearly dominant: Gatwick and Manchester, with 27% and 25% of the UK share in 2004. The next largest in terms of passenger share are Birmingham (8%) and Glasgow (6%). In contrast to its overall dominance of UK aviation, Heathrow accounts for just 0.3% of all international charter passengers.

The contrast between **Figures 1.7 and 1.8** clearly illustrates the differential status of airports in the UK. The wider London and South East area enjoys accessibility to international, especially scheduled, flights which connect the UK with the rest of the world and serves as a hub for business travellers.

Connectivity of Air Infrastructure: Domestic and International

Domestic air traffic in the UK is dominated by three routes, all of which connect to Heathrow Airport. In 2004, the Heathrow-Edinburgh link had 1.7 million passengers, Heathrow-Glasgow had 1.5 million, and Heathrow-Manchester had 1.4 million. Other major internal linkages include Heathrow-Belfast City (0.8 million), Heathrow-Aberdeen (0.6 million) and Belfast International-Liverpool (0.6 million).

By overlaying the domestic connectivity of UK airports onto the share of international passenger numbers in **Figure 1.9**, it becomes clear that London serves as the international air travel gateway for other UK cities. If passengers flying from regional airports do not wish to fly to London for international connections, they are left with a much smaller range of flight destinations than they would otherwise be.

In terms of passenger numbers, Glasgow and Edinburgh airports are of a similar size, with 8.6 million and 8.0 million respectively in 2004. Similarly, they both exhibit a high degree of connectivity to London airports, particularly Heathrow as shown in **Figure 1.9**. The level of connectivity between the main Northern Ireland airports and the rest of the UK is very high (see **Figure 1.10**), and the strongest links are with London airports, specifically Heathrow and Gatwick, and to a lesser extent Stansted.

Given its central geographical location in the UK context, Manchester (see **Figure 1.11**) is particularly well connected to other domestic airports. It is clearly the most significant non-London airport in the UK in terms of international connectivity, particularly in relation to its large share of charter passengers. However, with a total international passenger flow of 17.6 million in 2004, it is still subordinate to Gatwick (27.4 million) and Heathrow (60.2 million) in total passenger volume.

Major Ports

In 2004 approximately £330 billion of the UK's international trade was moved through its seaports. Around 95% by volume and 75% by value of the UK's international trade is transported by sea[19]. The UK ports industry is the largest in Europe in terms of freight tonnage, handling a total of 573 million tonnes of foreign and domestic traffic in 2004. Each year around 50 million international and domestic passenger journeys are made through UK ports.

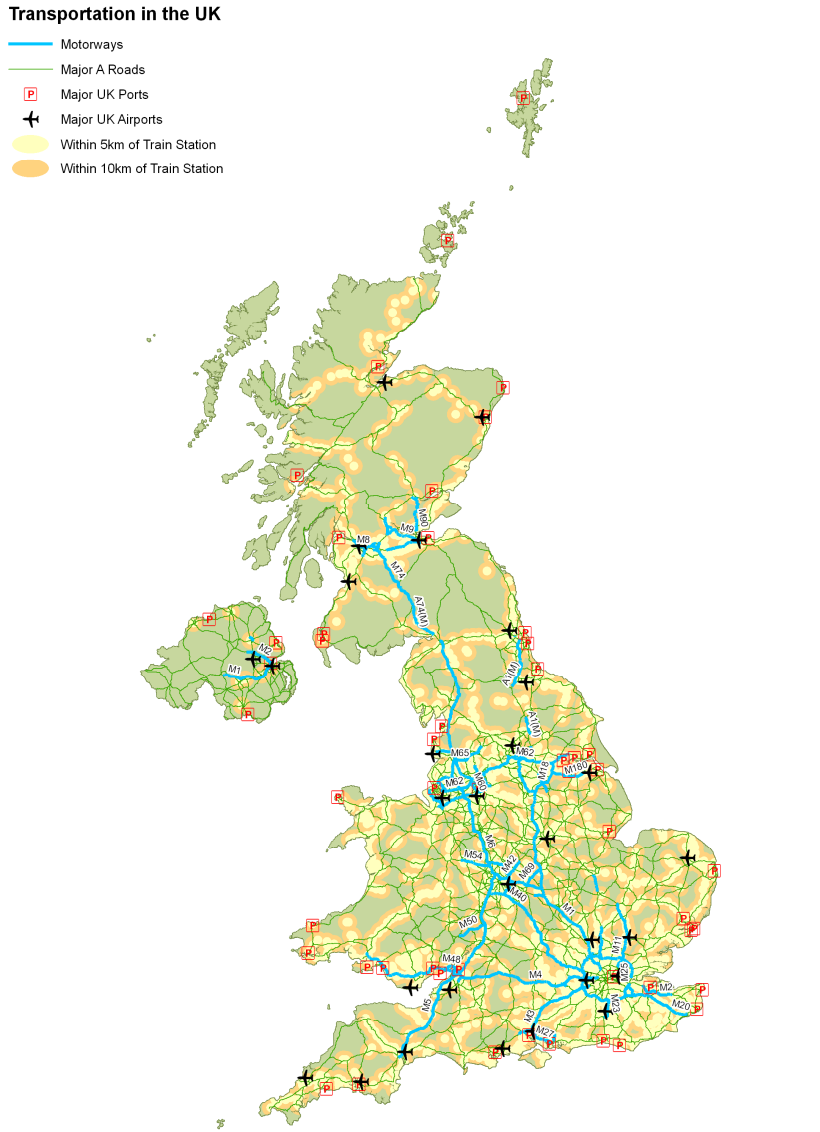
There are around 120 commercially active ports in the UK, but much of the tonnage is concentrated in the top fifteen ports as they account for almost 80% of the country's total port traffic (see **Figure1.12**). Grimsby and Immingham is the largest port in the UK, followed by Tees and Hartlepool and London, and they are the sixth, seventh and eighth largest ports in Northern Europe respectively. There is, however, a spatial concentration of the ports as nearly a third of UK tonnage and three-quarters of container units go through

[19] Department for Transport (2006) *Focus on Ports 2006*, London: Palgrave Macmillan.

South East ports, which tend to specialise in international traffic (see **Figure 1.13**).

Growth in imports has been much stronger than exports over the last two decades, reflecting the changing structure of the economy from manufacturing to service industries. Domestic traffic has declined over the same period. **Figure 1.13** shows that a number of ports specialise in handling domestic tonnage, especially the east coastal seaports in Northern Ireland, ports in Scotland and in northwest England.

Figure 1.1



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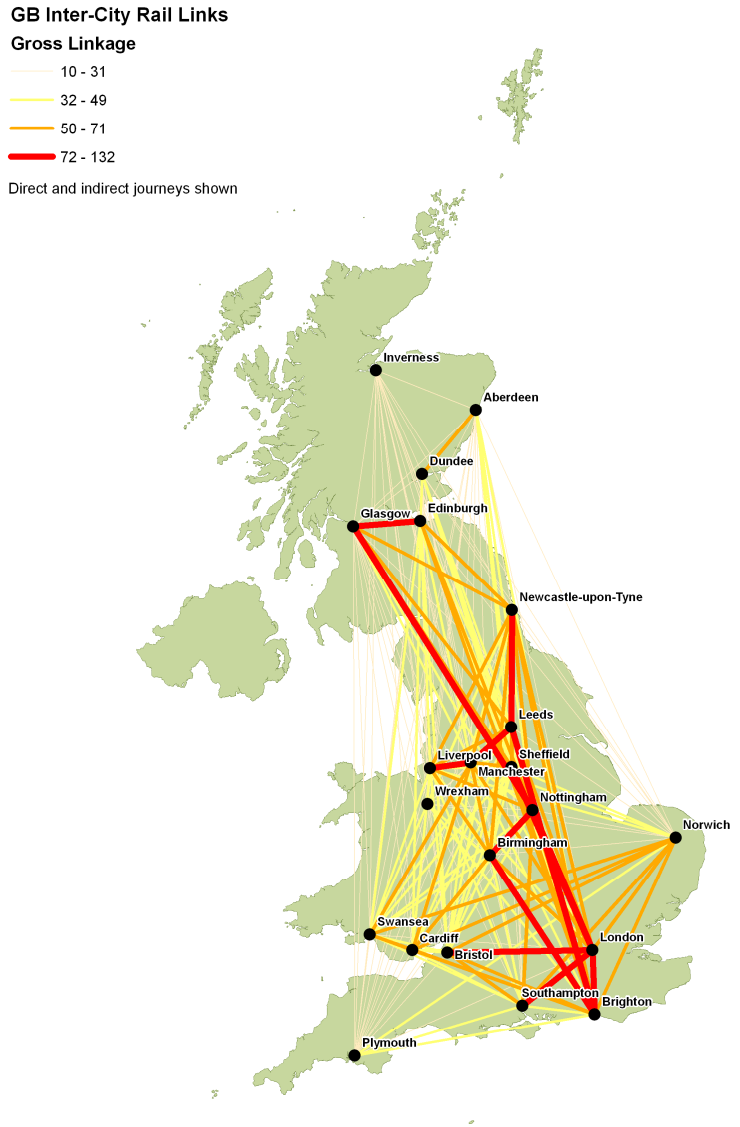

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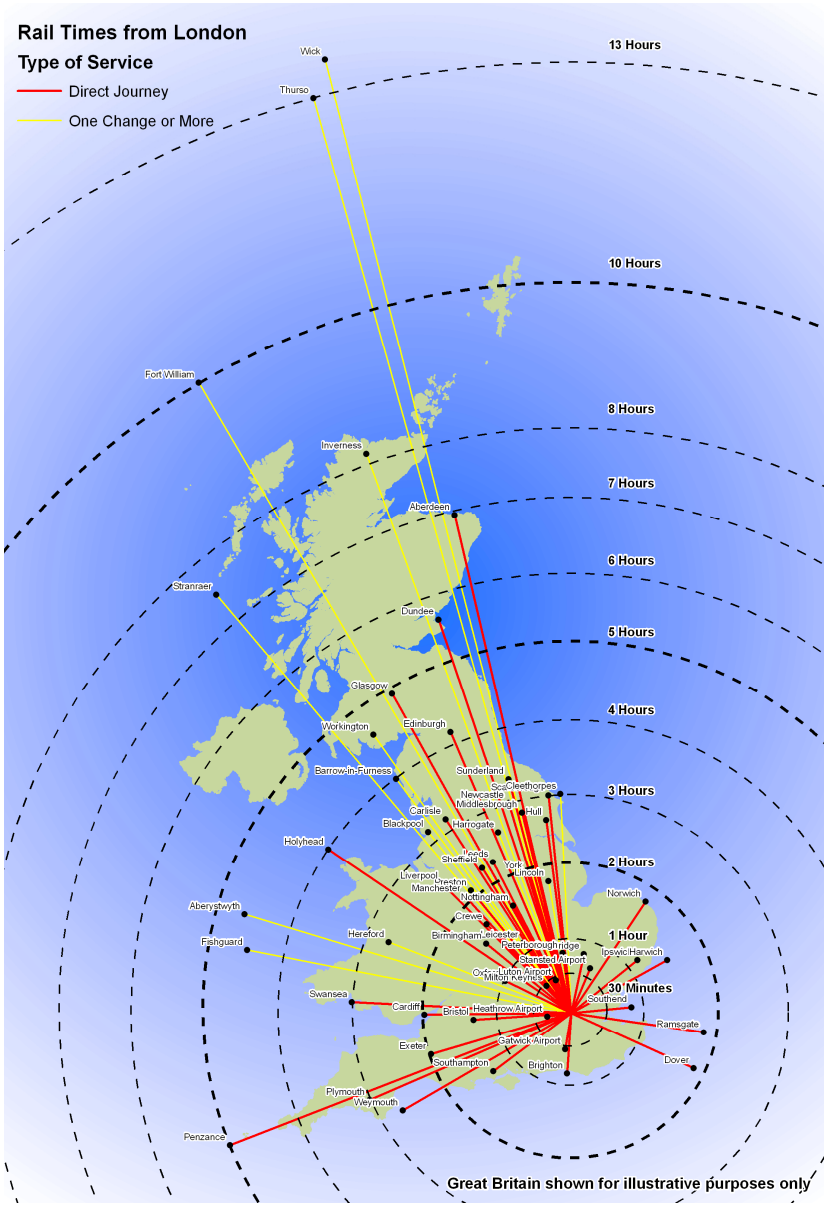

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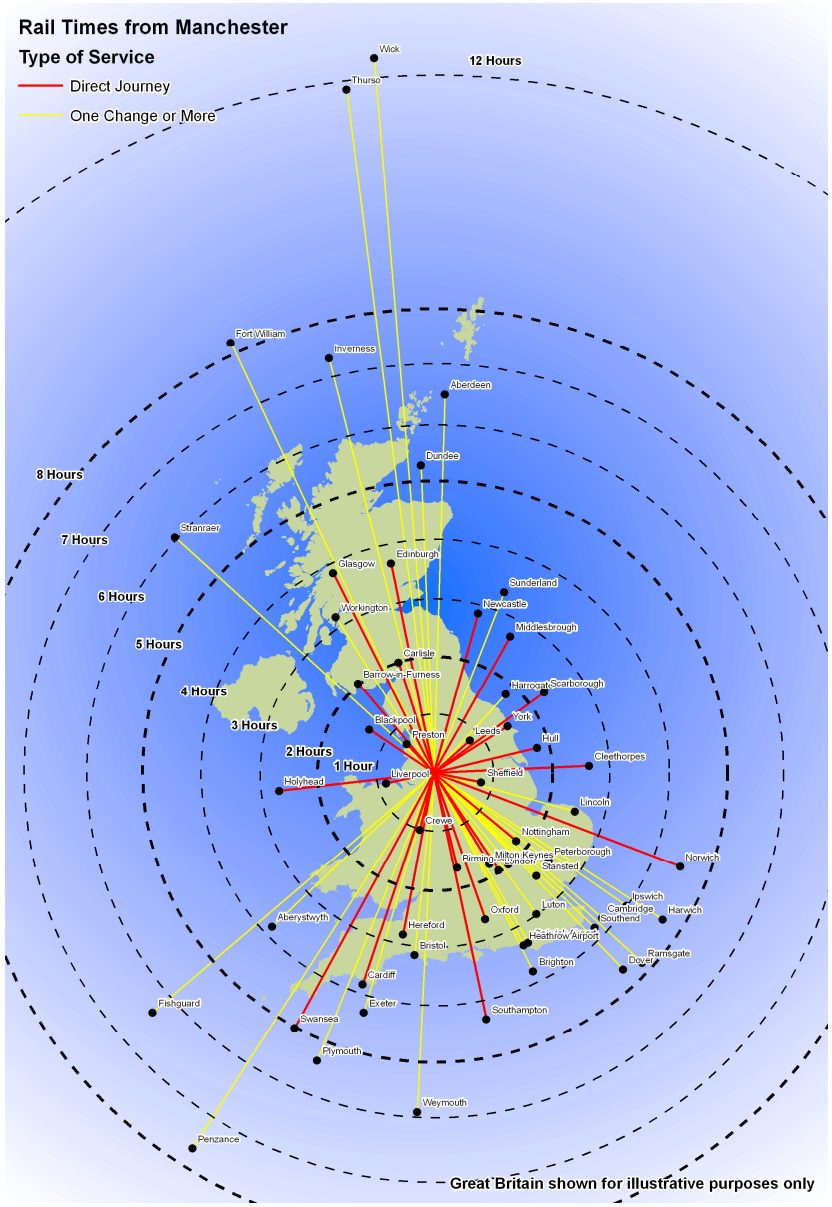

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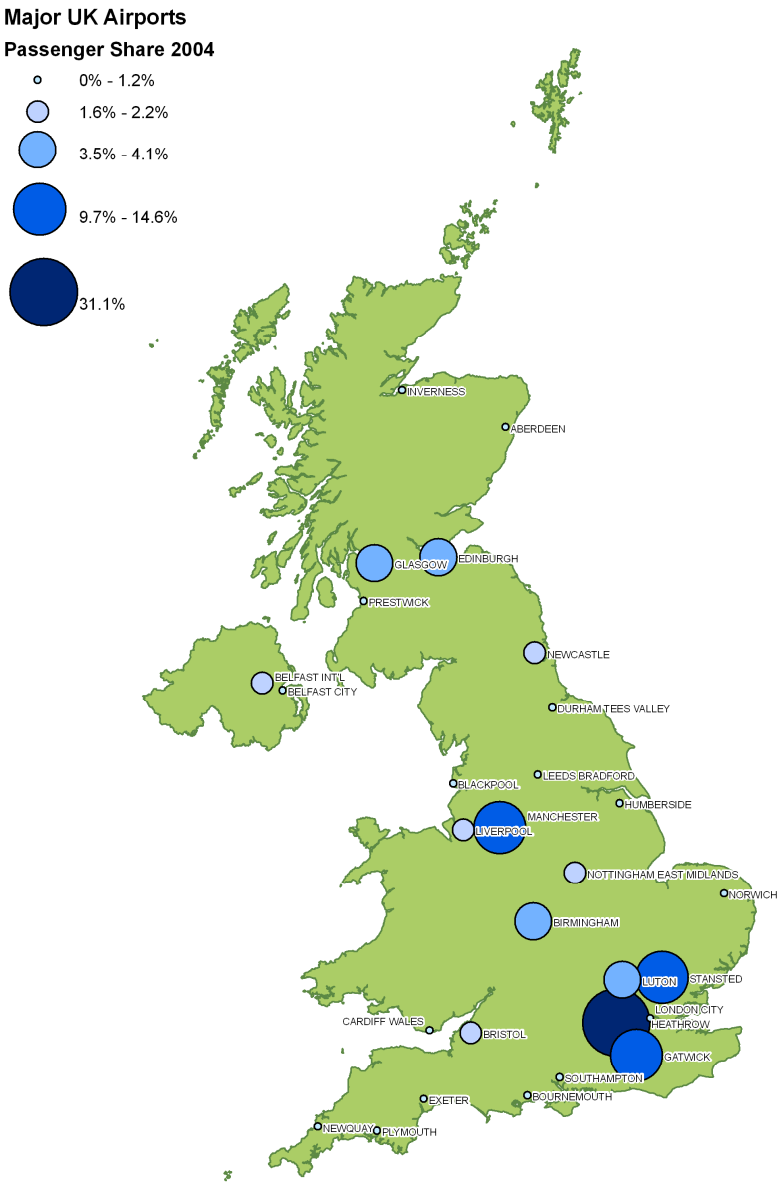

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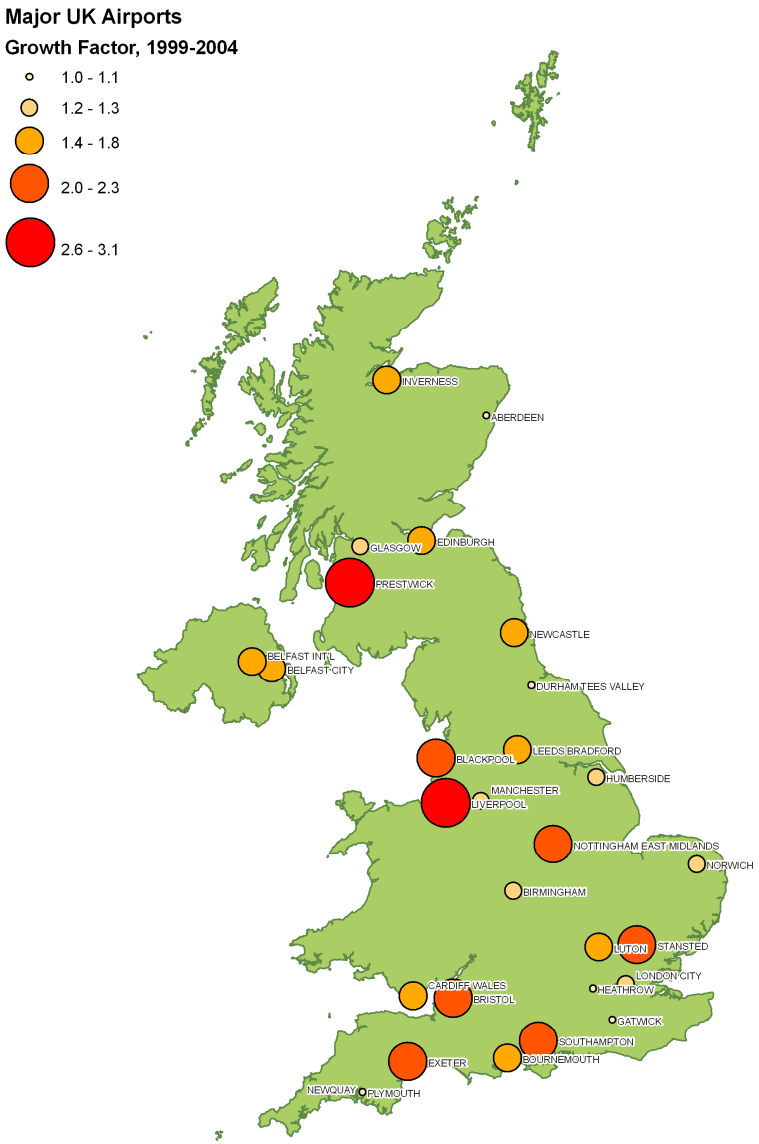

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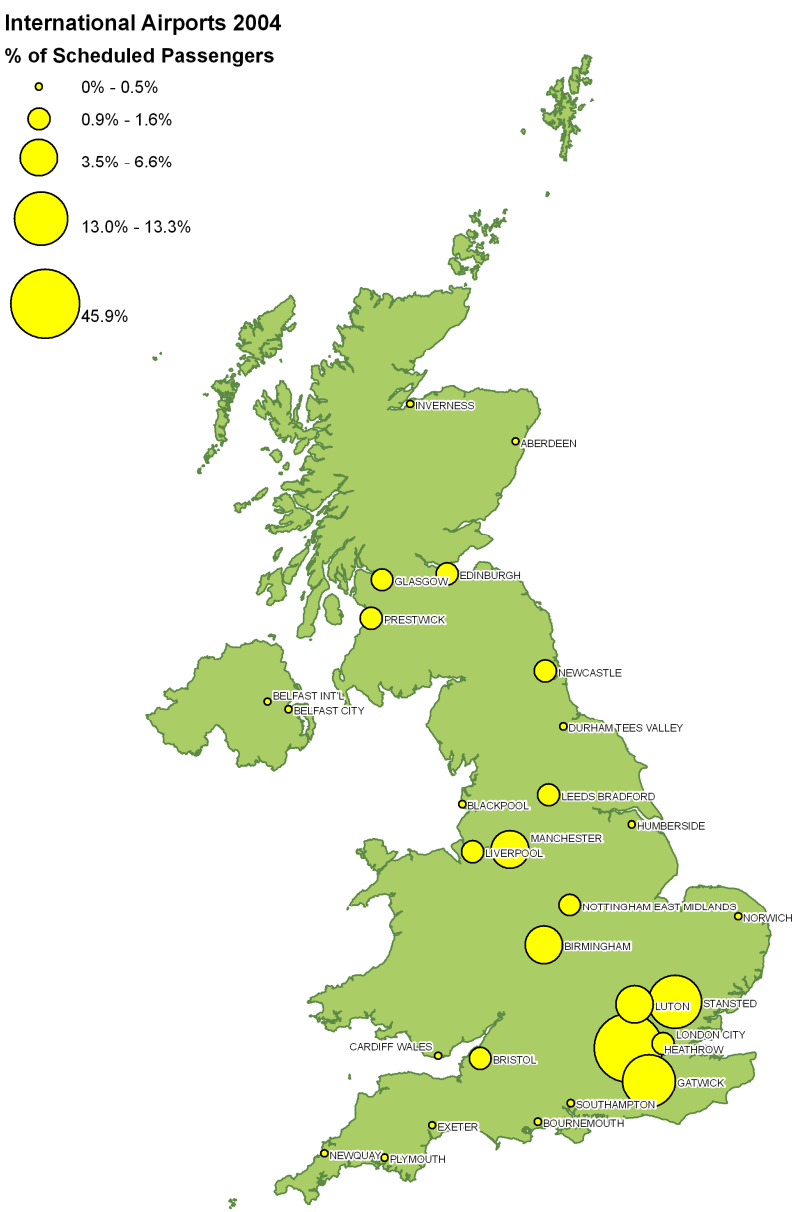

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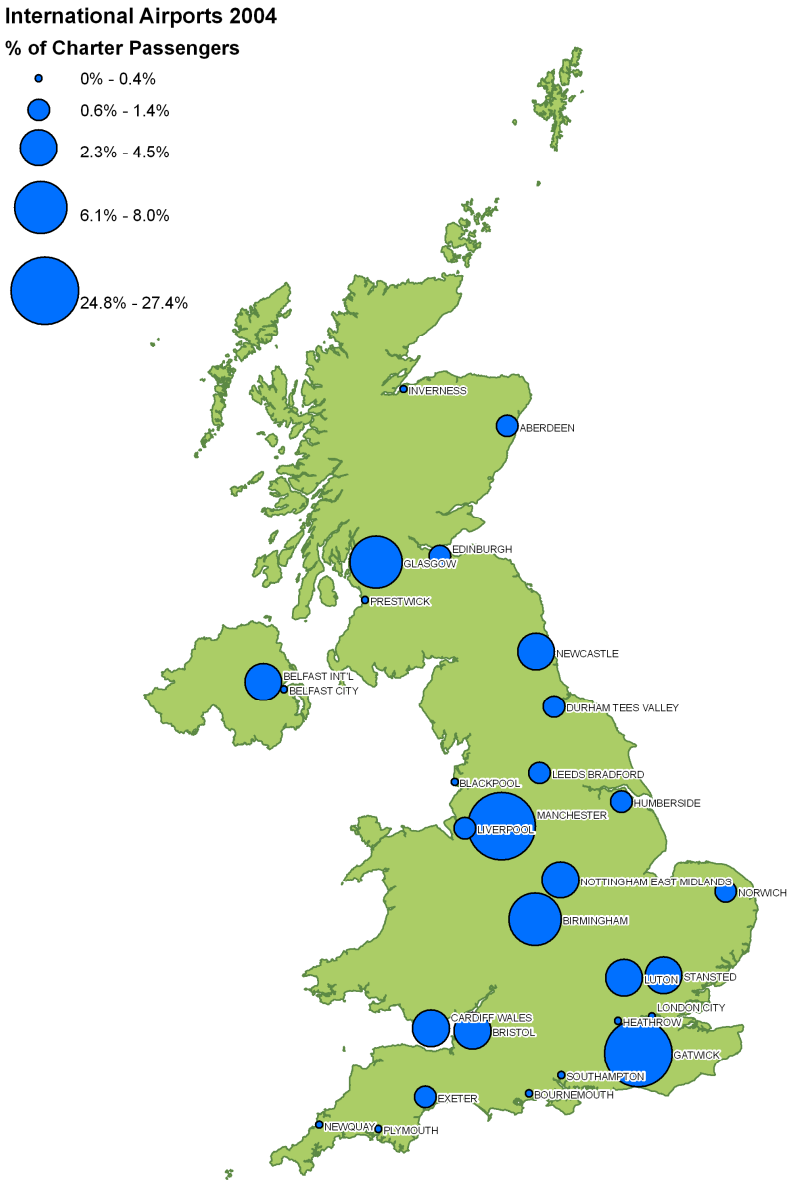

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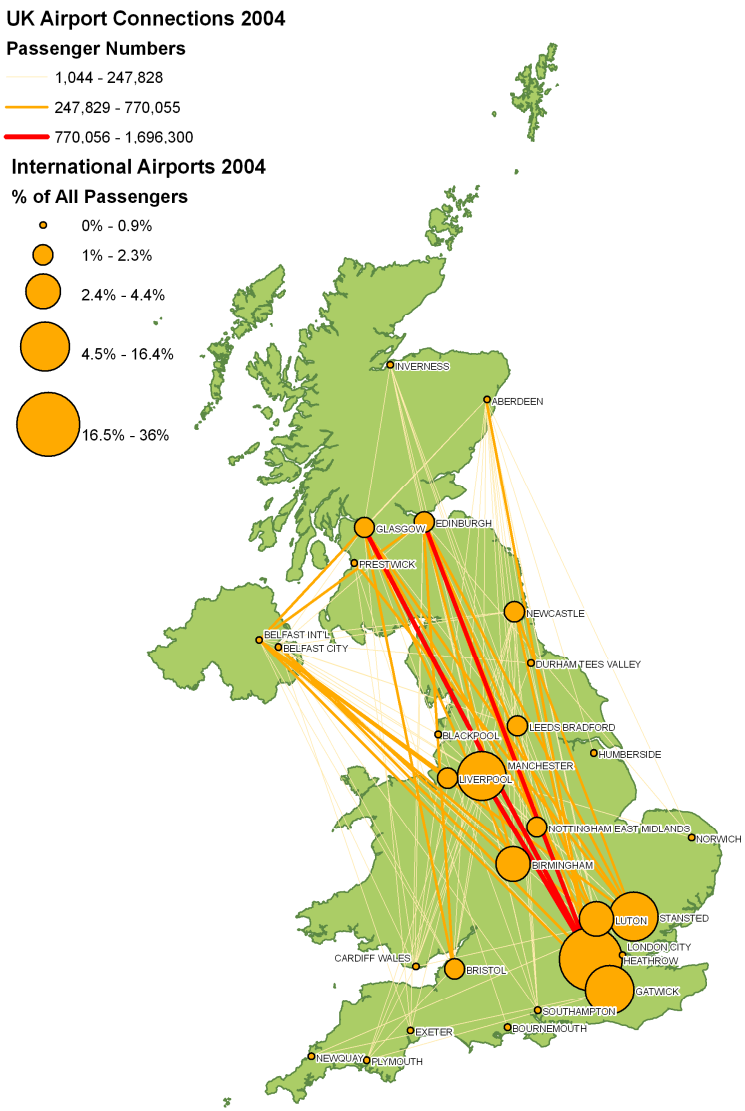

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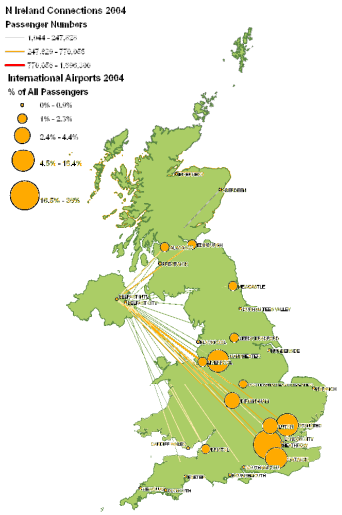

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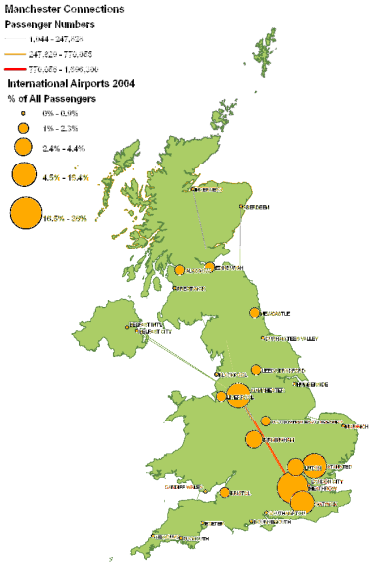
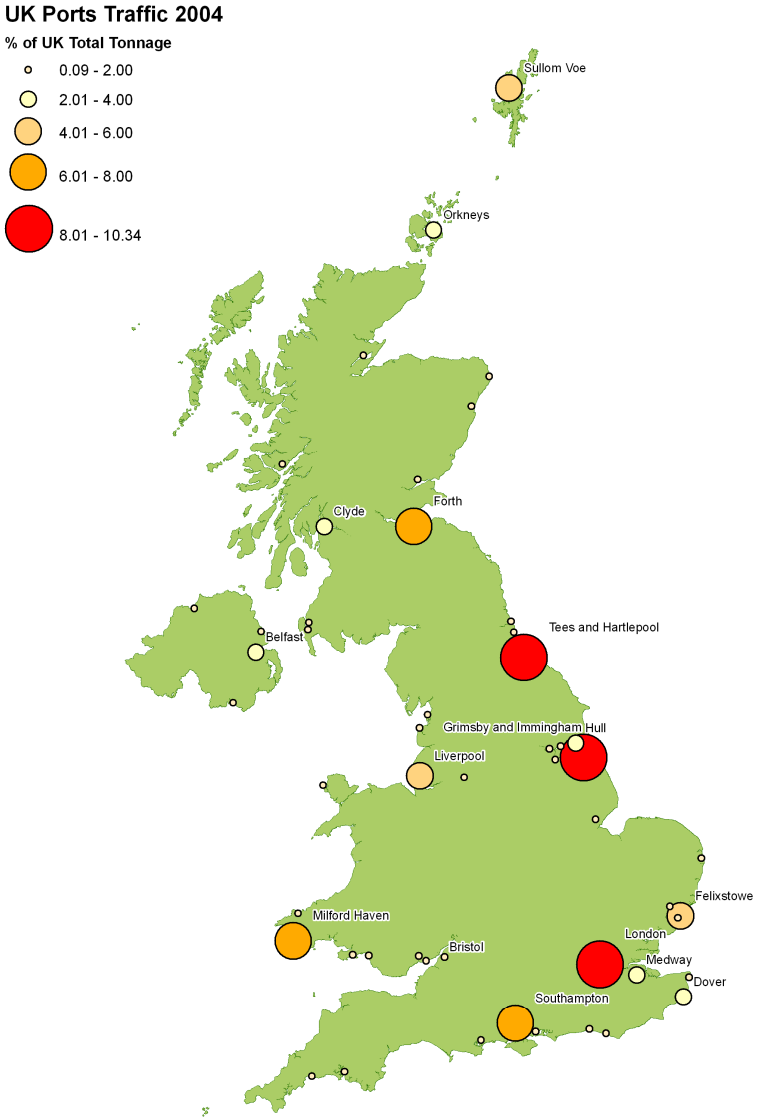


Figure 1.12



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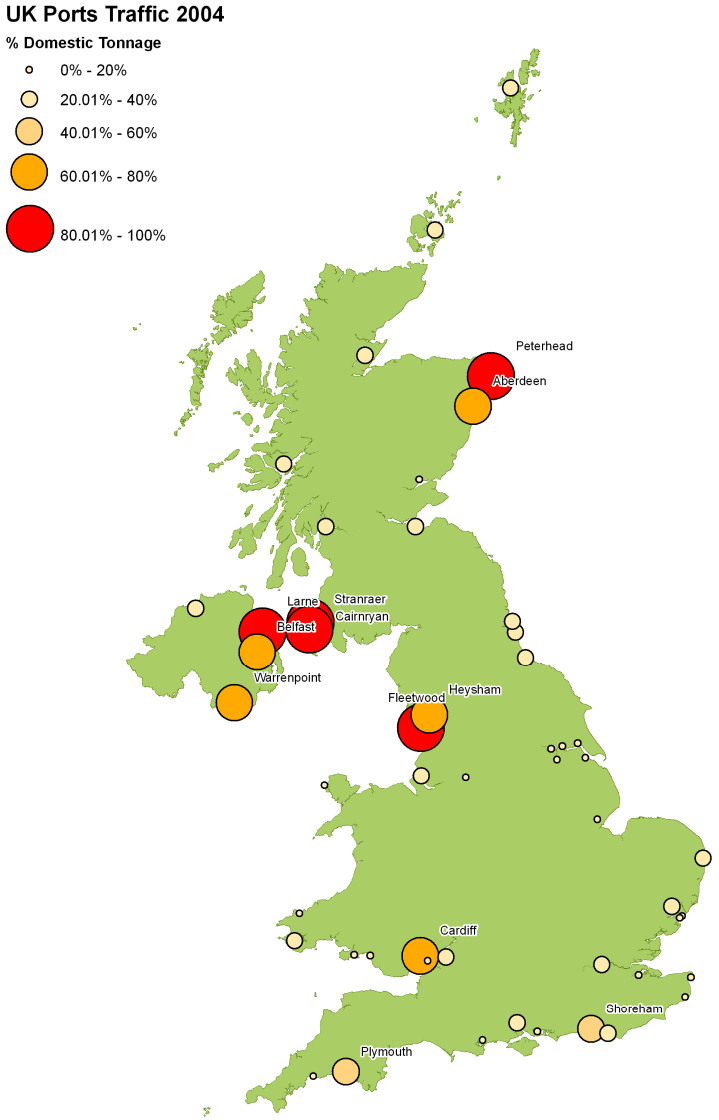

Commuting Distance

According to the 2004 National Travel Survey[20] data, the average commuting distance in Great Britain was about 13.7 km (a 13% increase from the 1992/94 figure), and the average time taken was about 26 minutes. The high level of car ownership throughout the UK has encouraged commuting by motor vehicles. Indeed, the mobility of the workforce has compressed the spatial distance between homes and workplaces, and has the potential to substitute longer distance commuting for migration.

Sustainable Commuting: Urban and Remote Rural Areas

Recent research shows that the largest volume of commuting flows are short journeys of less than 5 km[21] (see **Figure 1.14**), and about 70% of journeys to work in England and Wales in 2001 were under 10 km[22] (see **Figure 1.15**), which is similar to that of 1991. As expected, urban areas and especially their inner cores tend to have higher shares of short distance commuting of under 5 km. This is probably related to the fact that there are more job opportunities in the local area. When extending the commuting journeys up to 10 km in **Figure 1.15**, the spatial patterns provide a clear reflection of the spatial structure of all main metropolitan areas in the country. In spite of the fact that people working from home are not included in this analysis, it is interesting to find that some remote rural areas also show a relatively large share of up to 10 km commuting journeys. This is probably a reflection of the self-containment threshold of remote rural communities.

Urban Commuter Belts

When examining the pattern of long distance commuting in **Figure 1.16**, the wider commuting-belt around major UK cities can easily be identified. The most noticeable pattern is the large commuting zone surrounding the London urban area. With 20-58% of commuters from the surrounding South East travelling more than 20 km to work on a daily basis. Long distance commuting tends to be found in shire areas that neighbour large urban centres, which is particularly true in the less urbanised North East and Scotland. However, the apparently large share of long distance commuters in Scotland has to be interpreted with reference to the fact that the total number of commuters involved is not very large, since the population density is rather low in most areas.

Super-London Functional Labour Market – the 'London Eye'

Figure 1.17 examines the pattern of very long-distance commuting of over 60 km. The unique spatial pattern emerging from the South East is very noticeable, as there is a clear commuter ring embracing the London urban area in a shape that resembles a symmetrical eye. At the outer rim of the eye, up to 10-20% of the commuters are travelling over 60 km to work. This form of extreme commuting does not seem to be taking place in other major urban areas in the UK, though a much smaller scale of extreme commuting is also found in Northern Ireland around the Belfast urban area.

In order to examine the 'London eye' effect further, **Figure 1.18** maps the average commuting distance by ward. Those areas that have shown a significant share of commuters doing extremely long journeys to work are also areas with a very long average commuting distance that ranges from 22 to 68 km. These spatial patterns echo the findings of another research study[22] which found that there has been a recent rise in very long commutes. According to 2001 Census data, more than 800,000 workers in England and Wales now travel more than 48 km to work, up by a third since the 1991 Census. Most of these long-distance commuters lived around London and in the South East.

Both **Figures 1.17 and 1.18** confirm that there is a super-London functional labour market area with a 60 km radius stretching out from central London. Recent research studies[23] on commuting patterns in the South East suggest that there is a tendency for those with professional and specialist skills to seek appropriate employment opportunities over a much wider search area rather than the nearest alternatives. This is coupled by a parallel trend of a 'roots' effect where households increasingly choose a fixed residential base and cope with workplace location changes by commuting. Residence close to motorway corridors is popular for dual career households and the M40 is a well-known example.

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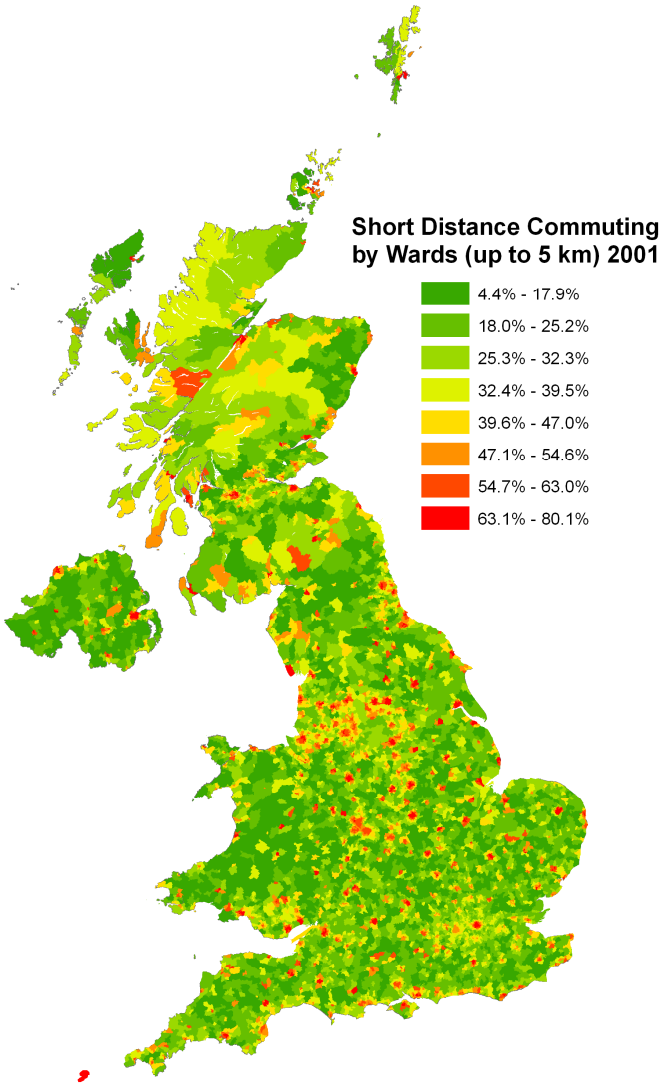
[20] Department of Transport (2005) *Transport Statistics Bulletin – National Travel Survey: 2004*, London: DOT.

[21] Frost, M. and Spence, N. (1993) 'Global city characteristics and central London's employment', *Urban Studies* 30(3): 547-58.

[22] Nielsen, T.S.; Hovgesen, H. H. and Lassen, C. (2005) 'Exploratory mapping of commuter flows in England and Wales', *RGS-IBG Annual International Conference 2005*, London.

[23] see Gordon, I. (1999) 'London and the South East', in Breheny, M. ed 1999 *The People: Where Will They Work?* London: Town and Country Planning Association, pp 169-186; Breheny, M. (ed.) (1999) *The People: Where Will They Work?* London: Town and Country Planning Association; Green, A. E.; Hogarth, T. and Shackleton, R. E. (1999) *Long Distance Living: Dual Location Households*, Bristol: Policy Press.

Figure 1.14



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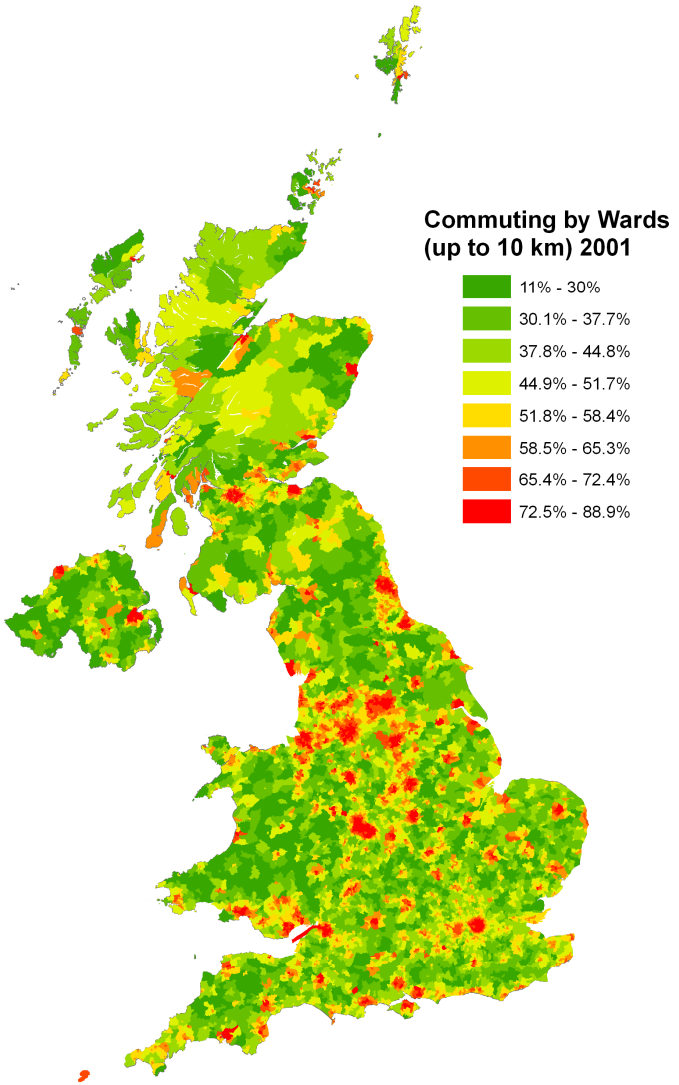

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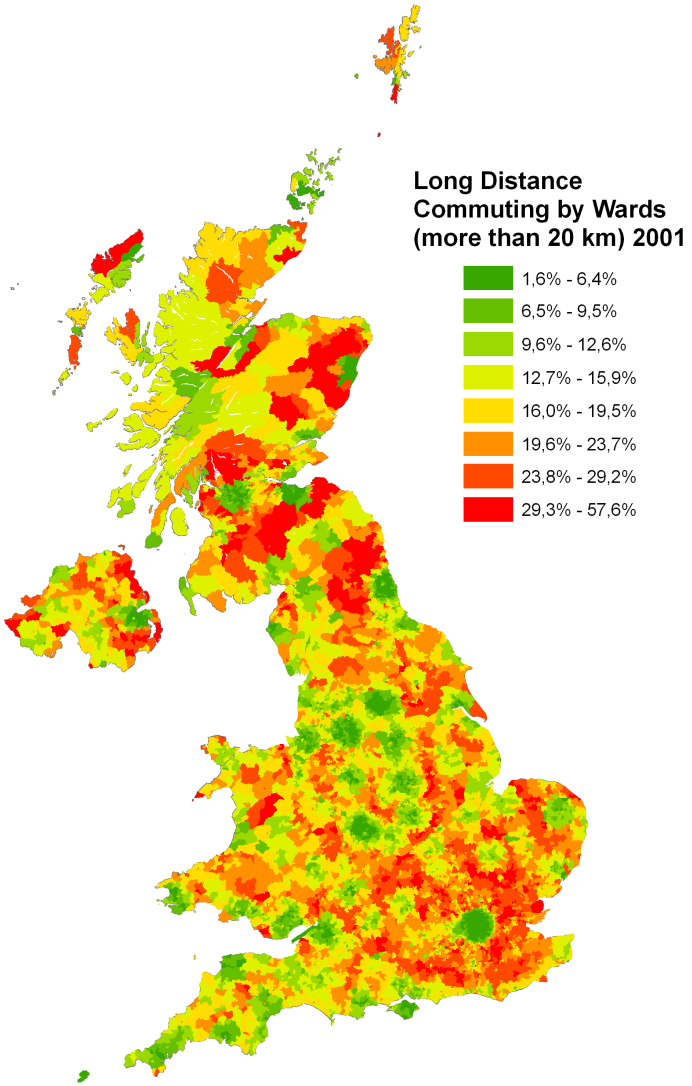

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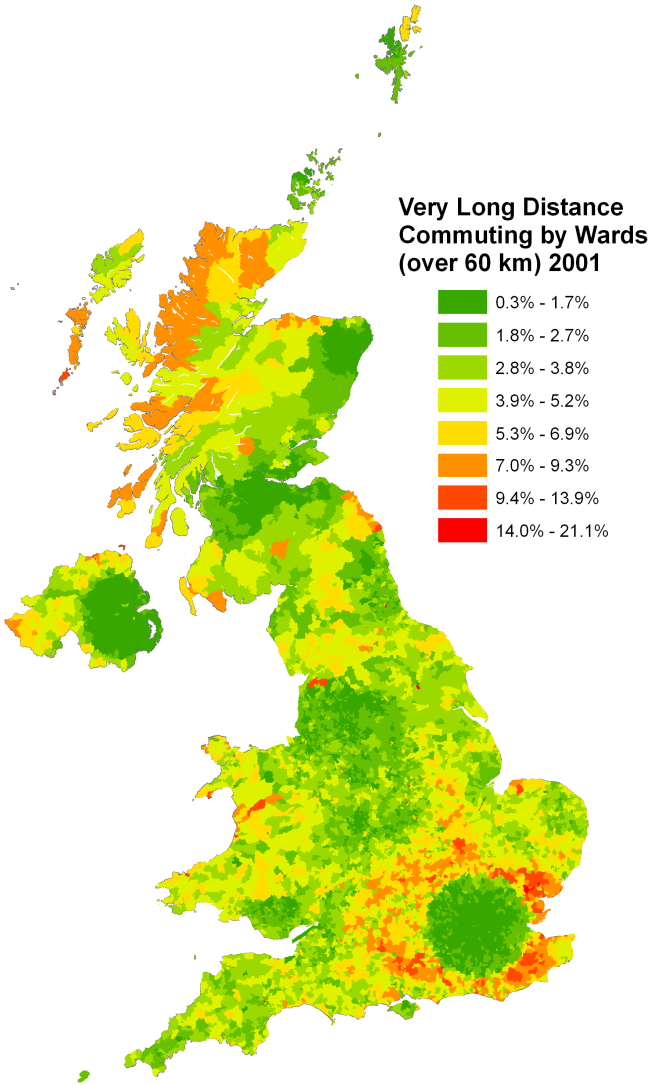

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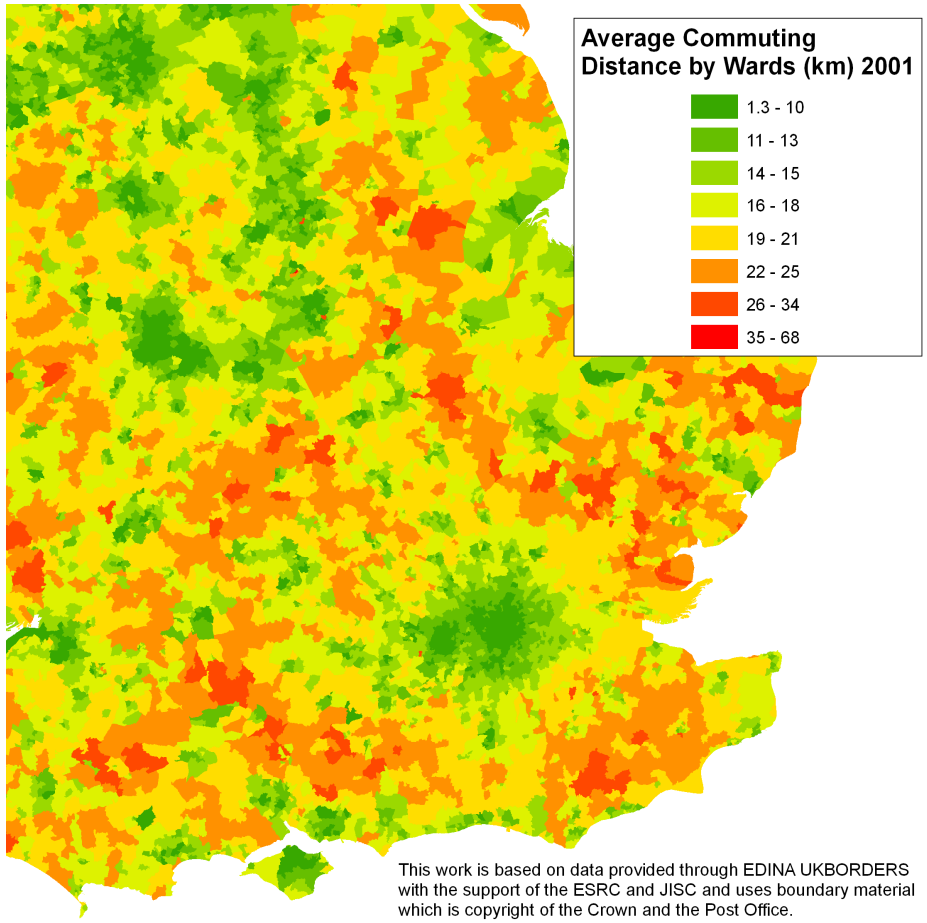


Migration Flows

The North-South Drift

The major migration flows within the UK in many ways reflect the long-established pattern of population drift from north to south. The broad spatial pattern of net flows in 1991 (see **Figure 1.19**) bears much similarity to that of 2001 (see **Figure 1.20**). For example, in 2001 the North East had an outflow of 2,537 and an inflow from just 345. In contrast, the South East had an outflow of 22,908 and an inflow of 28,760, which resulted in an overall increase of 5,852. It is however interesting to note that while London was a net loser to other regions in 1991, its fortunes turned around by 2001. The net flow between the North East and London in 2000/2001 was 909, while from the North West the figure was 1,919. There was, nevertheless, no net inflow to London from the South West or the East Midlands during this period.

The South-East Triangle

There exists a strong pattern of inter-regional migration between London, the South East, the East of England and the East Midlands (see **Figure 1.22**) with London as a loser of population. In 2000/2001, 52,315 people moved out from London to the South East and the East of England. Elsewhere, there was a net outflow from London to Northern Ireland, and also from the South East to Wales and Scotland, though in absolute terms these were relatively small. When compared with the situation in 1990/91 (see **Figure 1.21**), it is clear that the trend of London losing population to the South East and the East England has been long-standing. However, in 2000/2001, there were more net outflows from London directly to the South West, from the South East to the South West, and from the East of England and the South East to the West Midlands.

London Gravity

When examining the migration flows between the main urban areas in 2000/2001, it is clear that the net movement in the UK favours the London conurbation (see **Figure 1.23** and **Table 1.3**); not surprising when we consider its large population share and the job opportunities available there. In terms of migration towards London, the strongest net flows are from Birmingham, Nottingham, Manchester, and Liverpool (see **Figure 1.24**); and the weakest are from Belfast, Cardiff, and Edinburgh. When examining net flows of more than 100 between the major urban areas of the UK, the dominance of London over the other English regional cities becomes clear. Also, the lack of significant connections at this level between Belfast and elsewhere is notable.

Other than gaining population from elsewhere in the UK, London as a world city is also a magnet for international migrants. As shown in **Figure 1.25**, there has been an increasing number of international migrants moving to the London region since the early 1990s. This inflow is much larger than the total number relocating elsewhere in the UK. According to the 2001 International Passenger Survey, 104,400 international migrants moved to London, but only 67,500 went to other regions in the UK. The latest migration statistics[24] show that London had an inflow of 574,200 and a net gain of 270,100 international migrants during the period between 2001 and 2003.

Table 1.3: Inter-urban migration in the UK, 1991 and 2001

	2001			1991
URBAN AREA	INFLOW	OUTFLOW	NET	NET
London	33208	27853	5355	-416
Manchester	15975	16349	-374	455
Liverpool	7191	9299	-2108	-563
Sheffield	9113	9887	-774	218
Newcastle	5840	6473	-633	-173
Birmingham	11755	13210	-1455	-428
Leeds	15918	15007	911	106
Bristol	5615	5436	179	422
Nottingham	5483	5347	136	-139
Cardiff	3556	4018	-462	127
Glasgow	5133	6185	-1052	-55
Edinburgh	6390	6057	333	446
Belfast	995	1051	-56	0

The Northern England Nexus

While Manchester and Leeds are both losing population to London, they have significant inflows from other urban areas in northern England. This is partly due to their success in reconfiguring their economic structure in recent years to provide more employment opportunities, and their geographical proximity to other major northern cities. From the patterns shown in **Figure 1.26**, it is

[24] ONS (2005) *International Migration: Migrants Entering or Leaving the UK and England and Wales, 2003*, London: HMSO.

possible to identify a 'northern nexus' in England that contains Liverpool, Manchester, Leeds, and Sheffield in the first tier; and Birmingham, Nottingham, and Newcastle-upon-Tyne in the second tier. The dynamics of population movement among these urban areas suggest that there is a polycentric spatial configuration of development in northern England.

Spatial Connections

In order to gain a full understanding of the spatial connections between places, gross (two-way flows) rather than net population movements between the main urban areas are mapped in **Figures 1.27 and 1.28**. The message emerging from these figures further reinforces the analysis above. In relation to the spatial structure of migration in the UK, there is a strong weighting towards London, particularly from other English regional cities. In spite of being overshadowed by the influence of London, there are strong migration networks among urban areas in northern England. A strong triangular nexus of Liverpool-Manchester-Leeds-Sheffield can be identified, and this nexus is then further extended to include Birmingham, Nottingham, and Newcastle-upon-Tyne to form a polycentric spatial structure. In Scotland, much of the inter-flows are found between the Glasgow and Edinburgh conurbations.

Figure 1.19

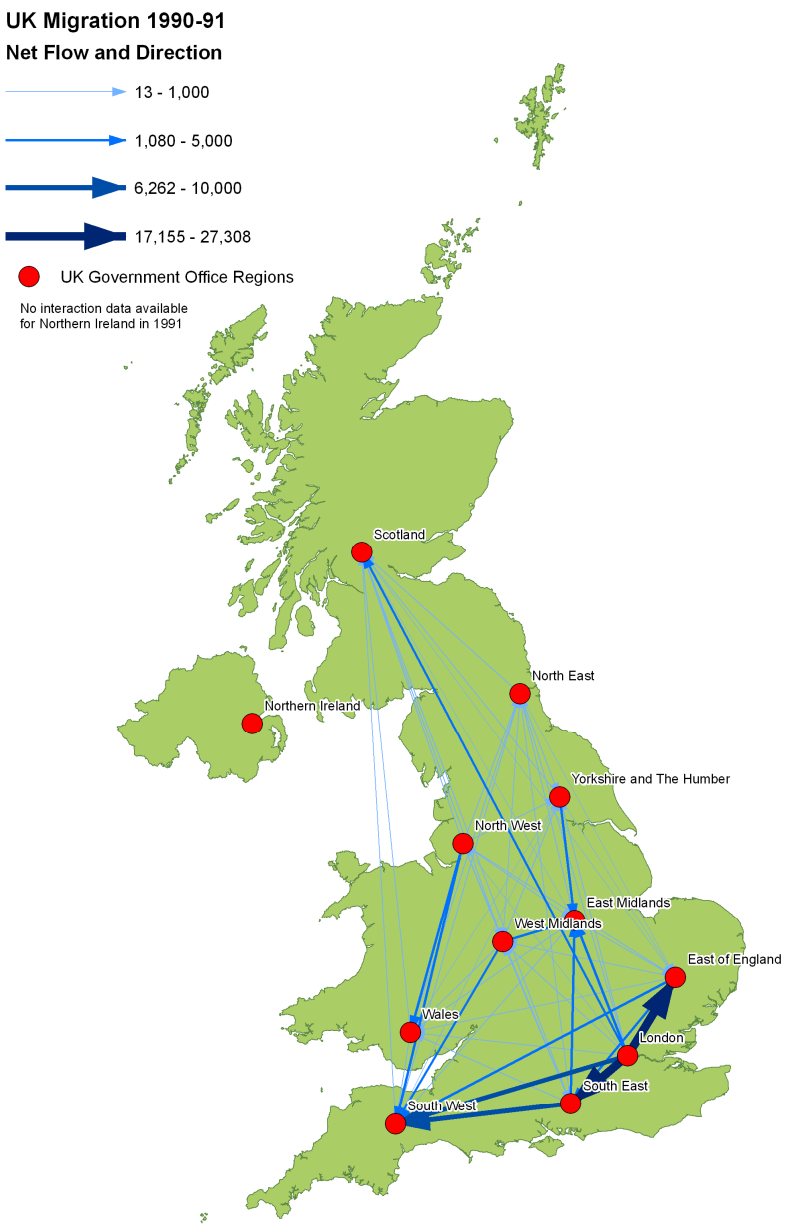
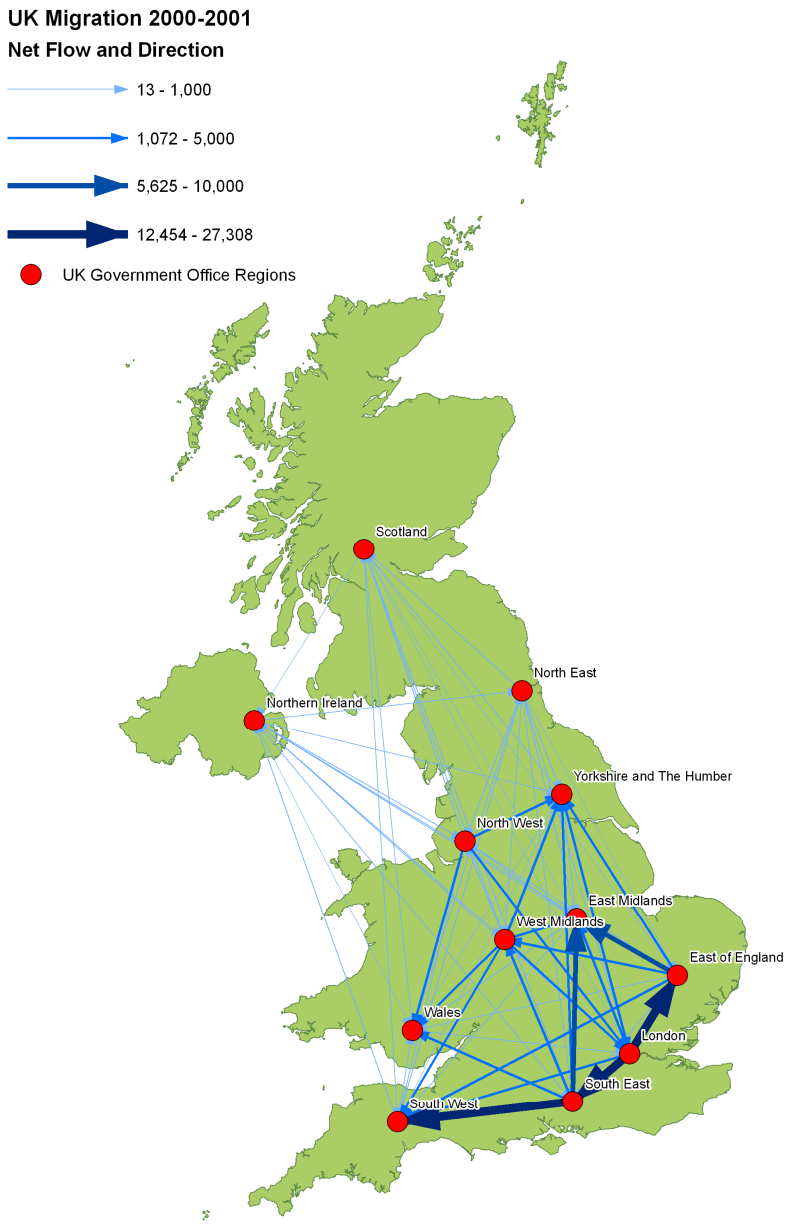


Figure 1.20



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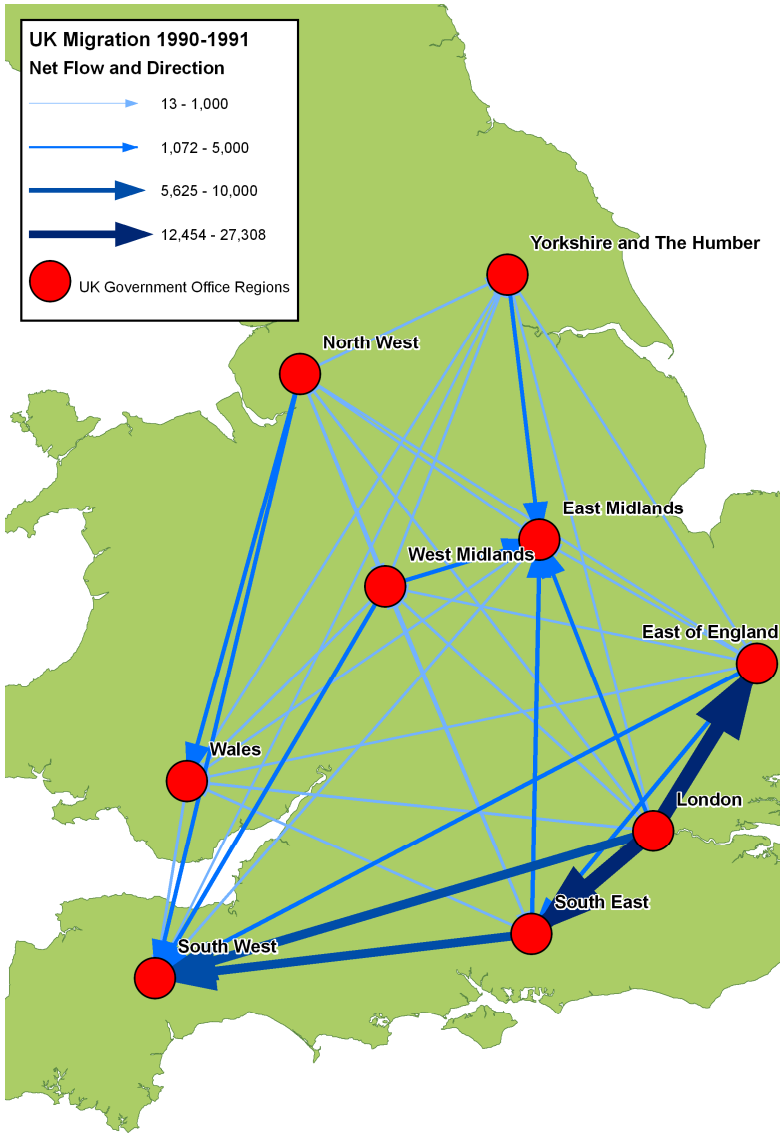

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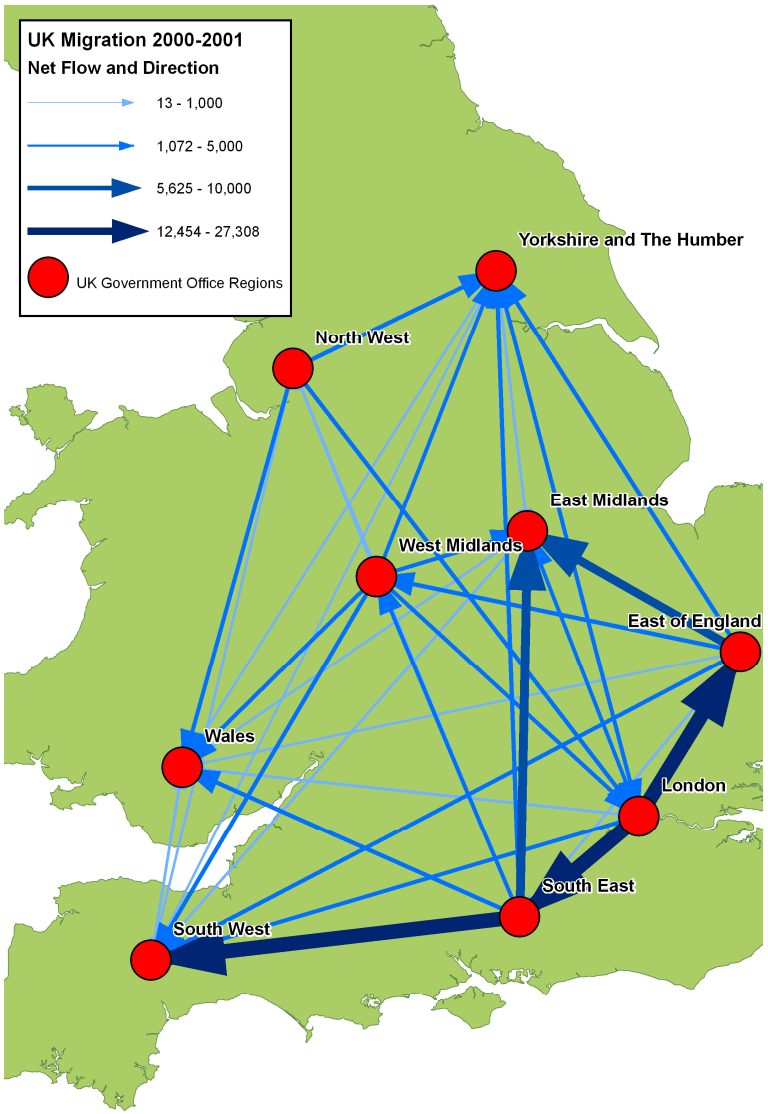

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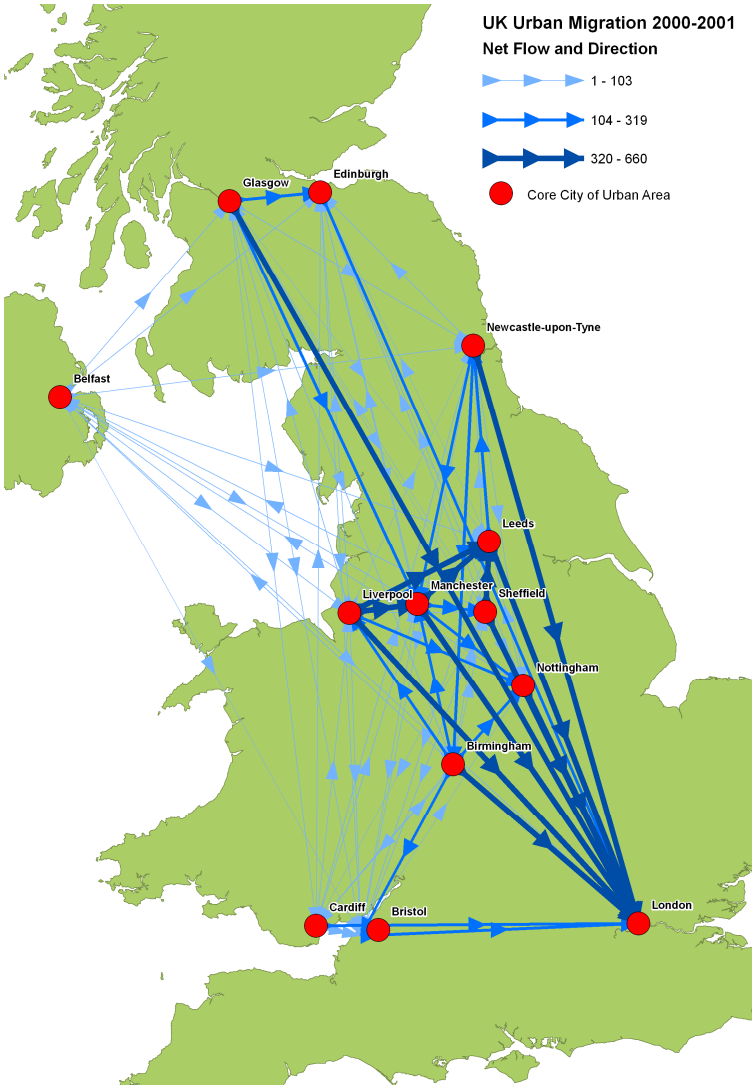

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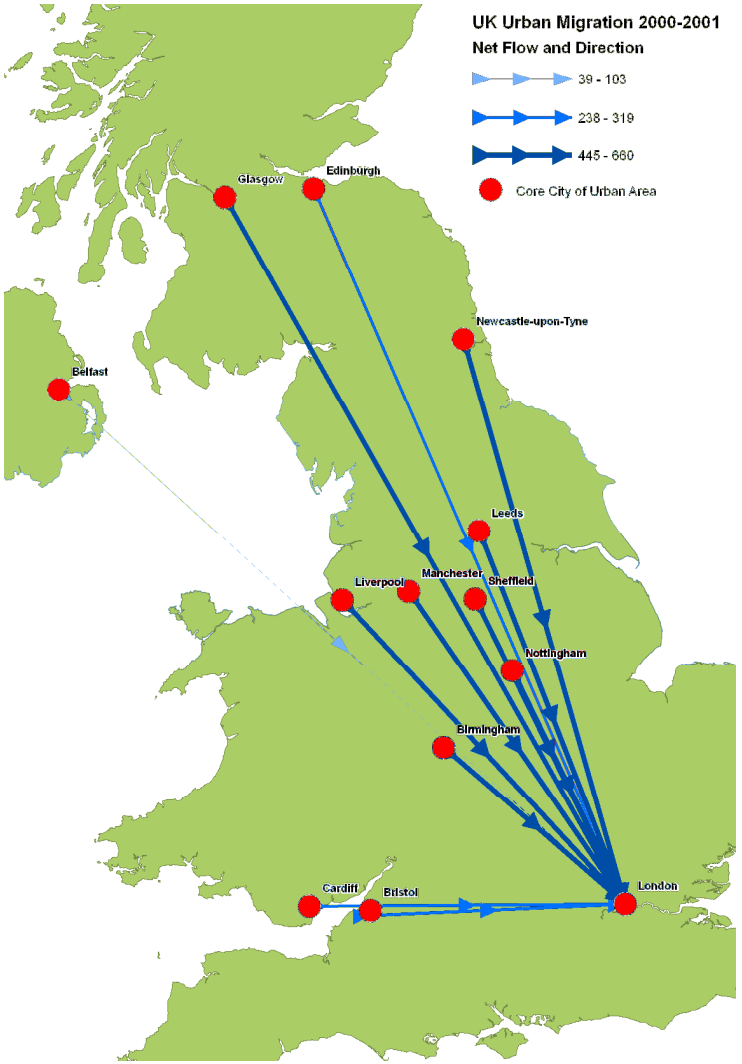

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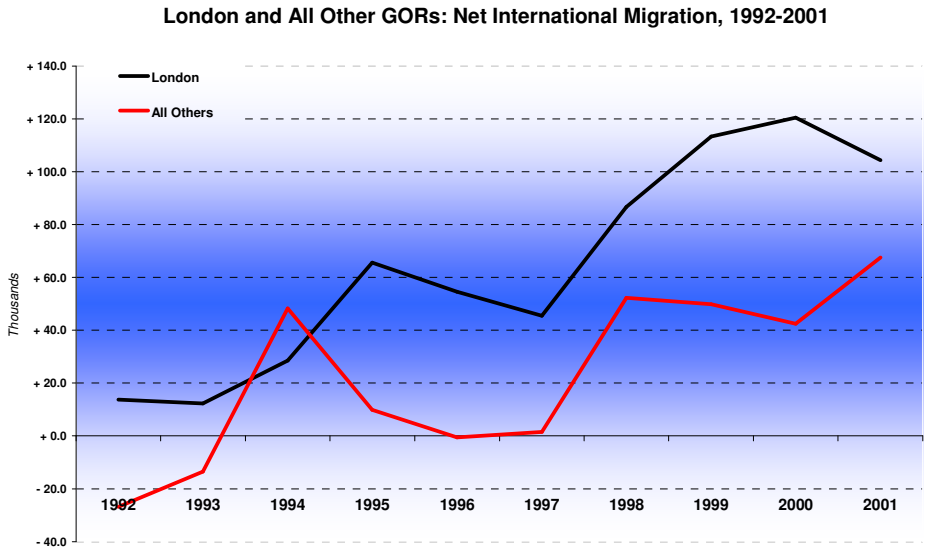


Figure 1.26

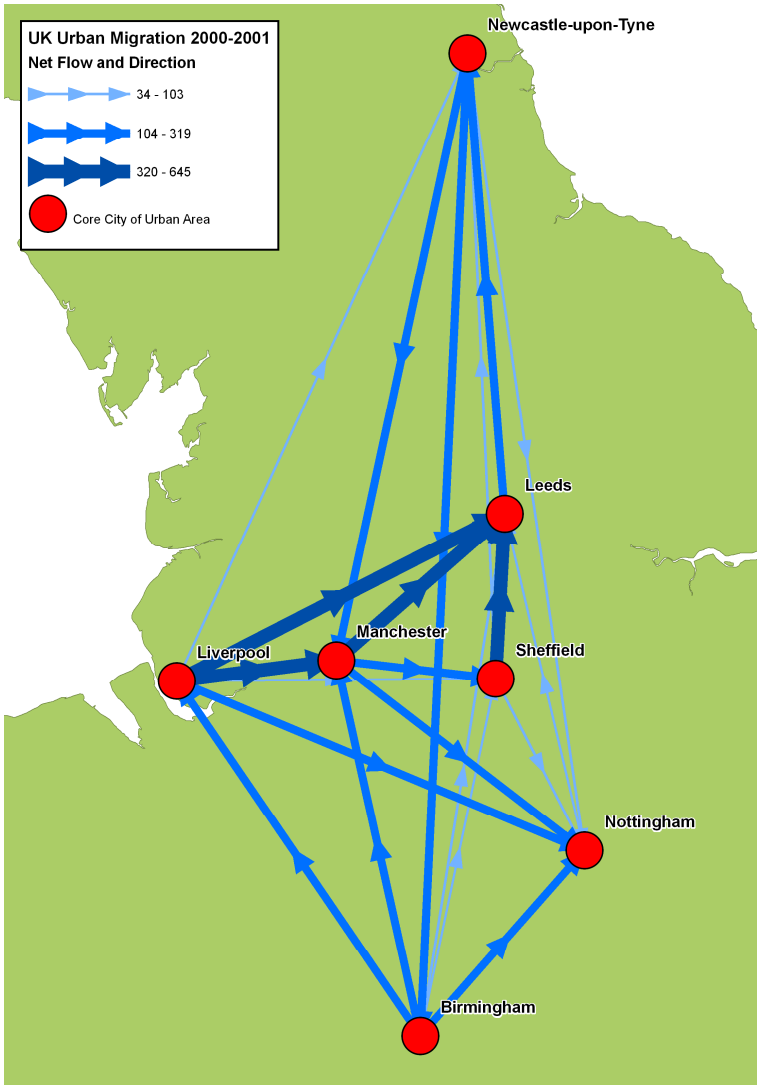


Figure 1.27

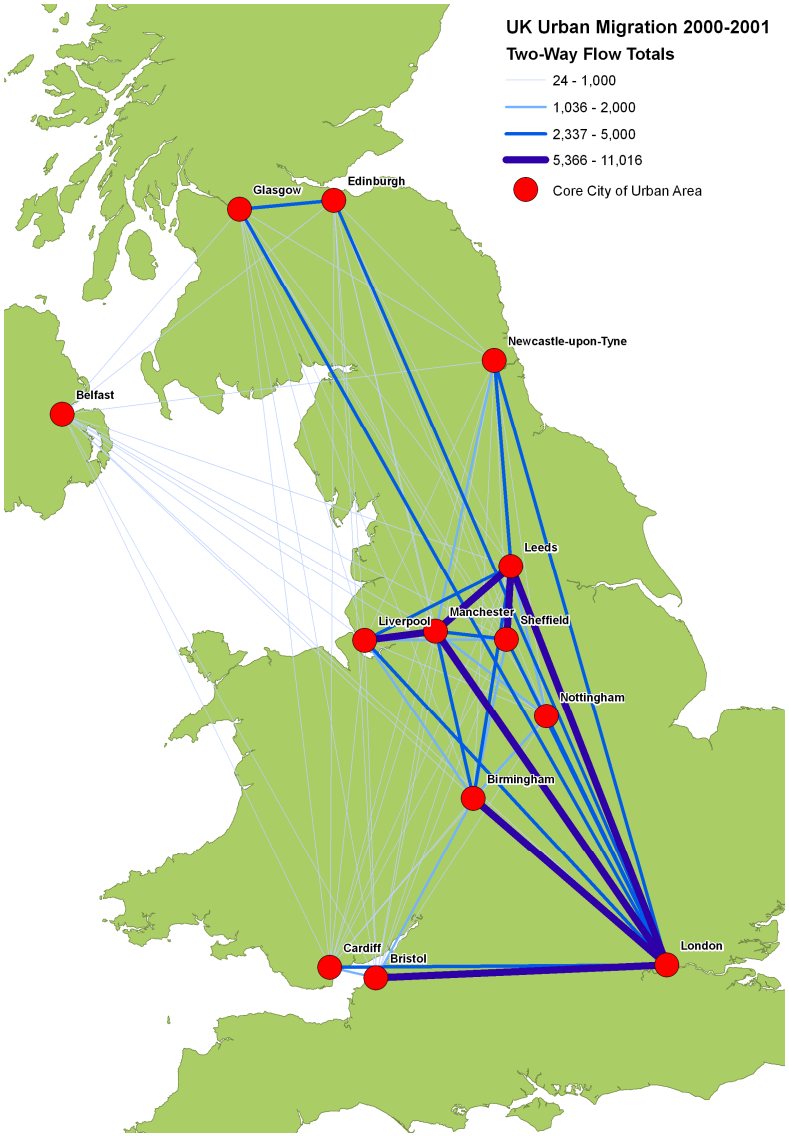
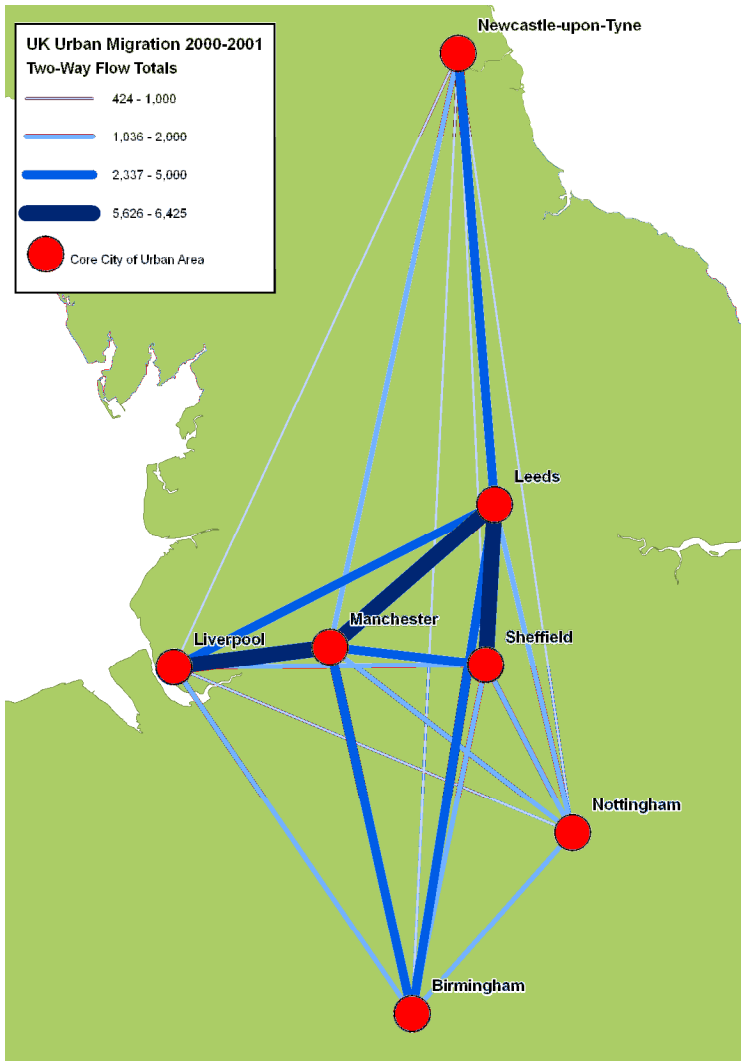


Figure 1.28



Part II
Key Drivers of Change

Urban and regional change is a continuous process of spatial transformation, which includes economic, social, physical and demographic dimensions. Global financial flows and the use of telecommunications technologies have altered the international economic development landscape in which cities compete. At the same time, long-standing economic decline and social problems in urban areas have triggered labour market restructuring and other socio-cultural adjustments. The negative outcomes of urban growth have led to a large-scale urban exodus where people seek their rural idyll and a better quality of living in smaller settlements. These changes transcend neatly defined administrative boundaries. The outcomes of the process of change have been mixed and are contingent upon the endowment and exploitation of assets and resources of urban areas and their wider functional hinterlands.

This part of the report highlights the spatial outcomes brought about by a range of demographic, socio-cultural, economic and environmental factors that underpin processes of spatial change. Greater understanding of impacts brought by these driving forces on the urban-region spatial structure of the UK will help inform the delivery of planning policy. **Table 2.1** outlines the key indicators included in the analysis.

Table 2.1: Indicators measuring key drivers of change

Key drivers	Indicators
Demographic trends	❑ Population Change 1981-2001 ❑ Working Age Population 2001 ❑ Retired Age Population 2001 ❑ Male and Female Life Expectancy
Socio-cultural trends	❑ Deprivation Indices, 2004 and 2005 ❑ Annual Personal Income ❑ Average House Prices
Knowledge economy and business competitiveness	❑ Employment Rate: % Working Age Population at Work ❑ Supply-Side Over-Qualification Index: the ratio of professional and managerial jobs to persons with degree and above qualifications ❑ % High Tech and Knowledge Industry Employment ❑ Research Capacity of Higher Education Institutes: Research Assessment Exercise
Environmental trends	❑ % Public Transport Commuters with Car Access ❑ Air Pollution: Sulphur Dioxide, Nitrogen Oxide, Carbon Dioxide and Particulate Matter ❑ Household Waste Recycling Rates

Demographic Trends

According to the Office for National Statistics[25], the total population of the UK grew from 50.2 million in 1951 to 58.5 million in 2001, a 17% increase. During the last five decades, the trajectory of growth has been rather different. During the 1950s and 1960s, the population growth of 5.6 million could be attributed mostly to natural change. Population levels in the 1970s, however, remained more or less static due to declining birth rates. The trend of population growth returned again in the 1980s and 1990s and the 2.4 million increase was largely due to natural change, though migration has been the main contributory factor since the late 1990s.

As well as increasing in size, there have been marked changes in the composition of the UK population. The 2001 census shows that for the first time there are more people over 60 than there are children. This ageing of the population is probably a reflection of people living longer lives. According to official census figures, there were only 0.2 million (0.4%) very elderly people (aged 85 and over) in 1951, compared to the latest figure of over 1.1 million (1.9%) in 2001.

Population Growth Areas: Southern English Regions

Due to the missing million and the change of enumeration methodology, 1991 Census data is less reliable for trend analysis. It is more meaningful to look at the longer-term trends between 1981 and 2001 when examining the spatial process of change. The population in the UK grew by 4.3 million (7.8%) between 1981 and 2001. As shown in **Figure 2.1**, most areas in the UK have witnessed an increase in total population during this period of time, though at differential growth rates. Areas experiencing the highest growth rates are found in the South East (with Milton Keynes topping the table at 69.7%), the South West, part of the East of England region, and the East Midlands. Significant population growth is also found in north east Scotland (related to the oil industry), Wales and Northern Ireland.

At the opposite end of the spectrum, it is interesting to note that areas experiencing a loss in population are the main cities and declining industrial urban areas of northern England: notably the M62 corridor across the Merseyside and Greater Manchester conurbations, and Tyne and Wear. The Clyde Valley in Scotland, the Welsh Valleys, and Belfast also suffered from population loss.

The situation in London is more favourable, in comparison with the continuing decline in other major metropolitan areas and cities. **Figure 2.1** shows that only a few inner-London boroughs have experienced population loss and a few have actually gained a significant number of people. It is fair to say that there is a divide between the southern English regions and the rest of the country in terms of population growth rates between 1981 and 2001.

Working Age and Retired Population

Figure 2.2 shows that 38.3 million (65.2%) of the UK population were aged 16-64 in 2001. However, when extending the working age to include those at 16-74, there were 42.5 million people (72.3%).

The spatial distribution of the working age population is further mapped on **Figure 2.3**. It is interesting to note that the UK districts have a high level of working age population of above 70%. Lower percentages of working age population are found in rural and coastal locations in mid-Wales, large part of the South West, most of Northern Ireland, and the south coast of England. This is partly related to the remote nature of these locations, but also their desirability as retirement resorts for pensioners.

In 2001, there were 5.8 million retired people in the UK, which constituted nearly one-tenth (9.8%) of the total population. When examining the distribution of the retired population, it is clear that they tend to cluster around coastal towns, especially in southern England (see **Figure 2.4**). It is interesting to note that this contrasts from the rest of the South East and London which have a smaller percentage of retired persons.

Unequal Levels of Life Expectancy

The ageing of the UK population is partly related to longer life expectancy. Better health levels in the population may be attributable to improvement in the quality of our living environment and better medical services. In 2004 the life expectancy at birth of females was 80.4 years compared with 75.7 years for males. However, people in different parts of the nation have a significantly different expectation of their length of life, with a differential range of 11.5 years for males and 9.4 years for females. **Figures 2.5 and 2.6** highlight the fact that residents in southern England, on the whole, have longer lives. At the opposite end of the spectrum, Scotland, Wales, Northern Ireland, and urban areas in northern England all have a shorter life expectancy for both males and females.

[25] ONS webpage: www.statistics.gov.uk/census2001/demographic_uk.asp

Figure 2.1

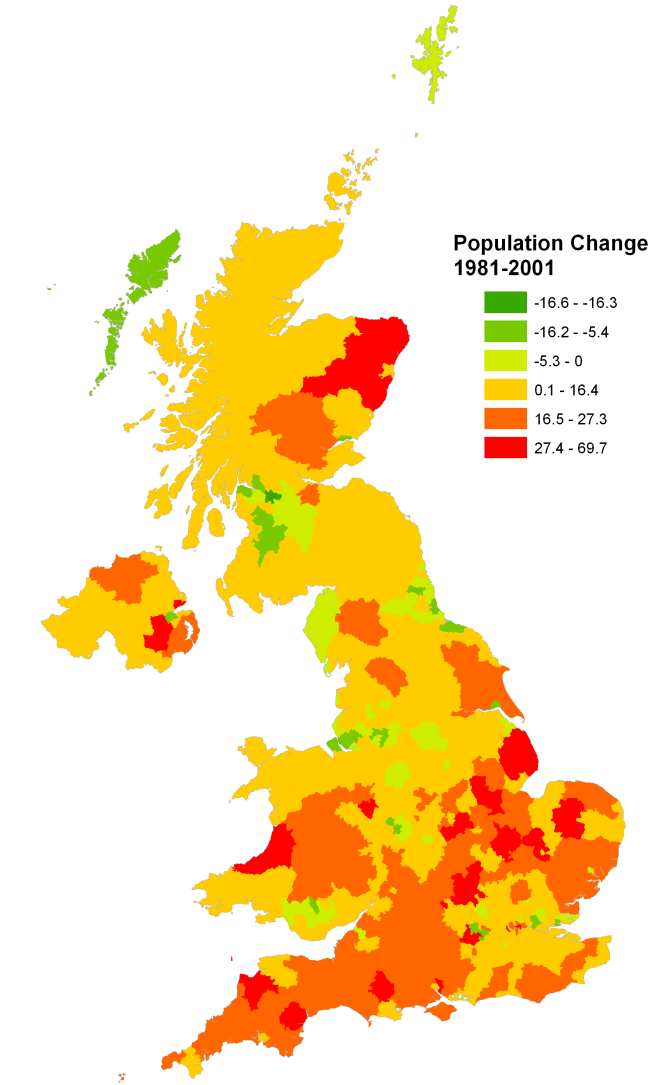
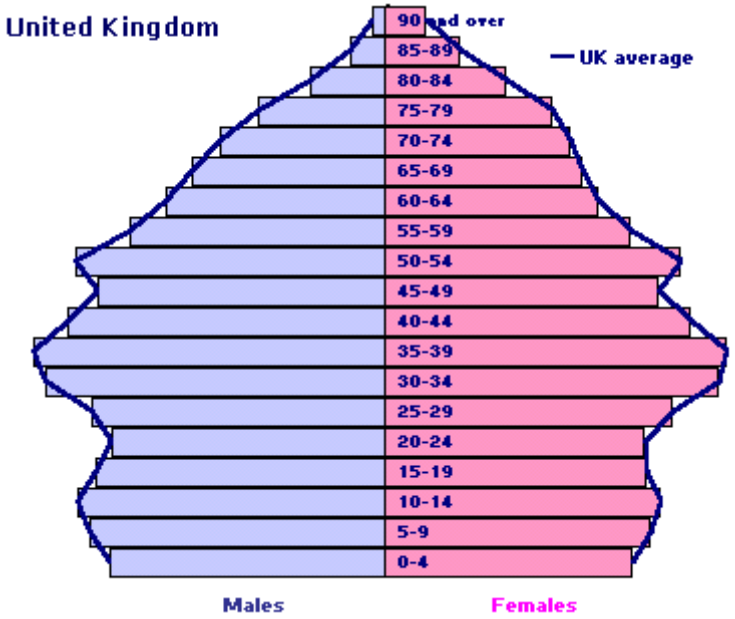


Figure 2.2

Age-Sex Pyramid, 2001 Census



source: ONS web site
(www.statistics.gov.uk/census2001/pop2001/print_v/united_kingdom_print.asp)

Figure 2.3

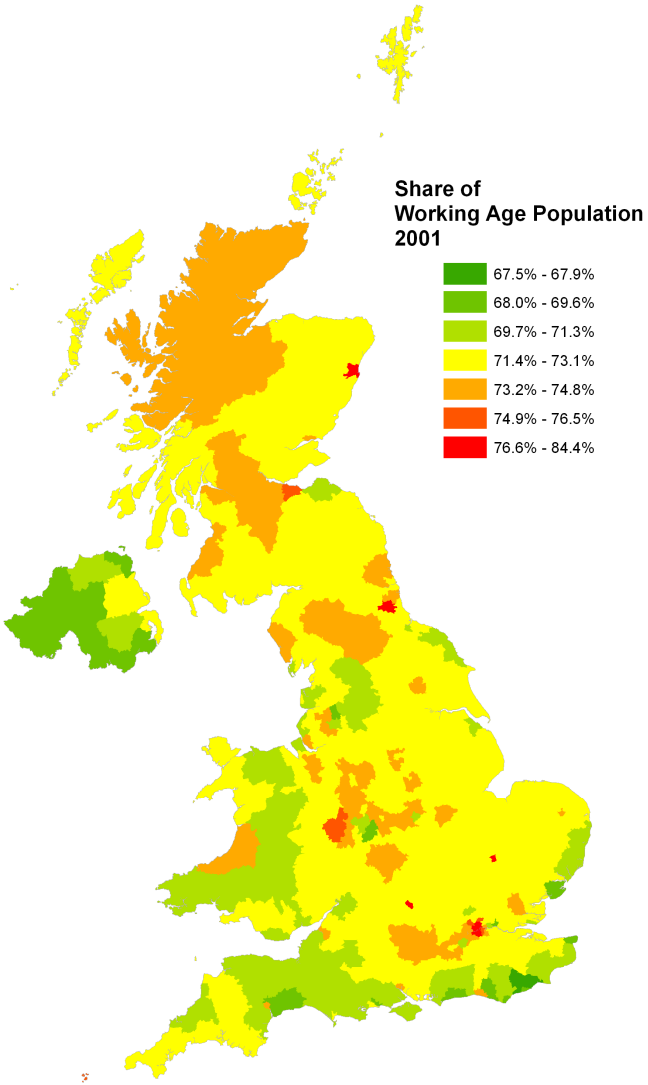


Figure 2.4

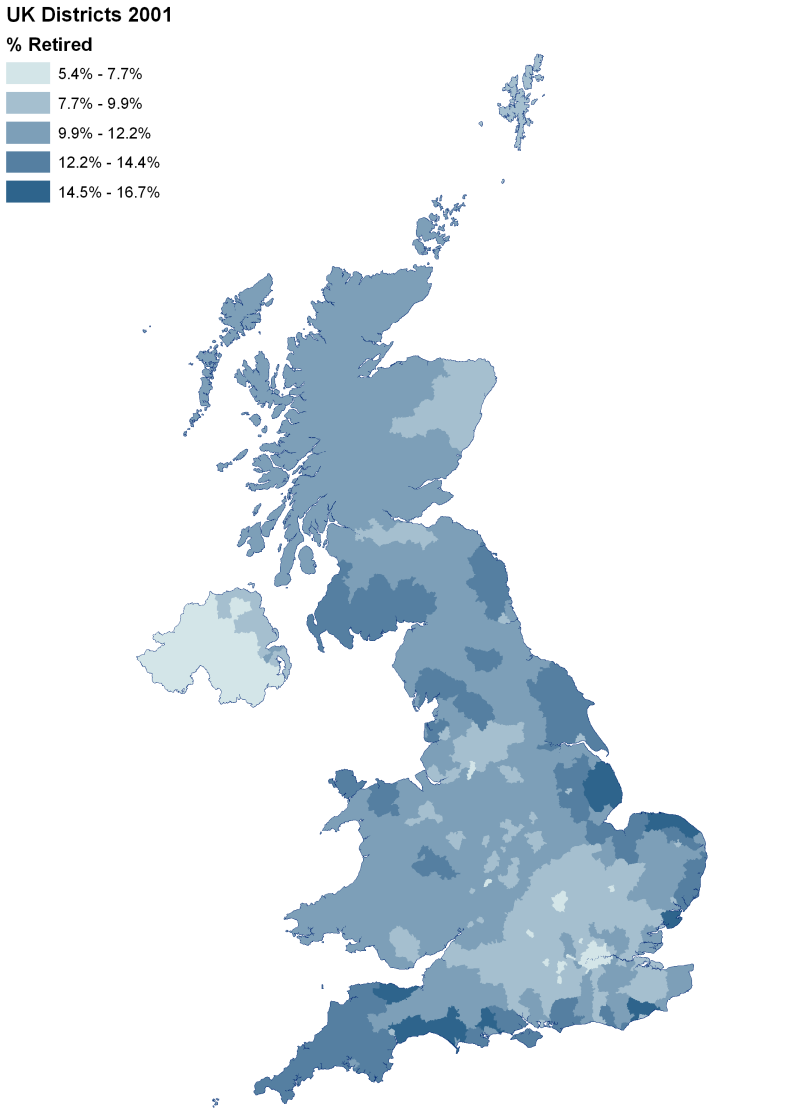


Figure 2.5

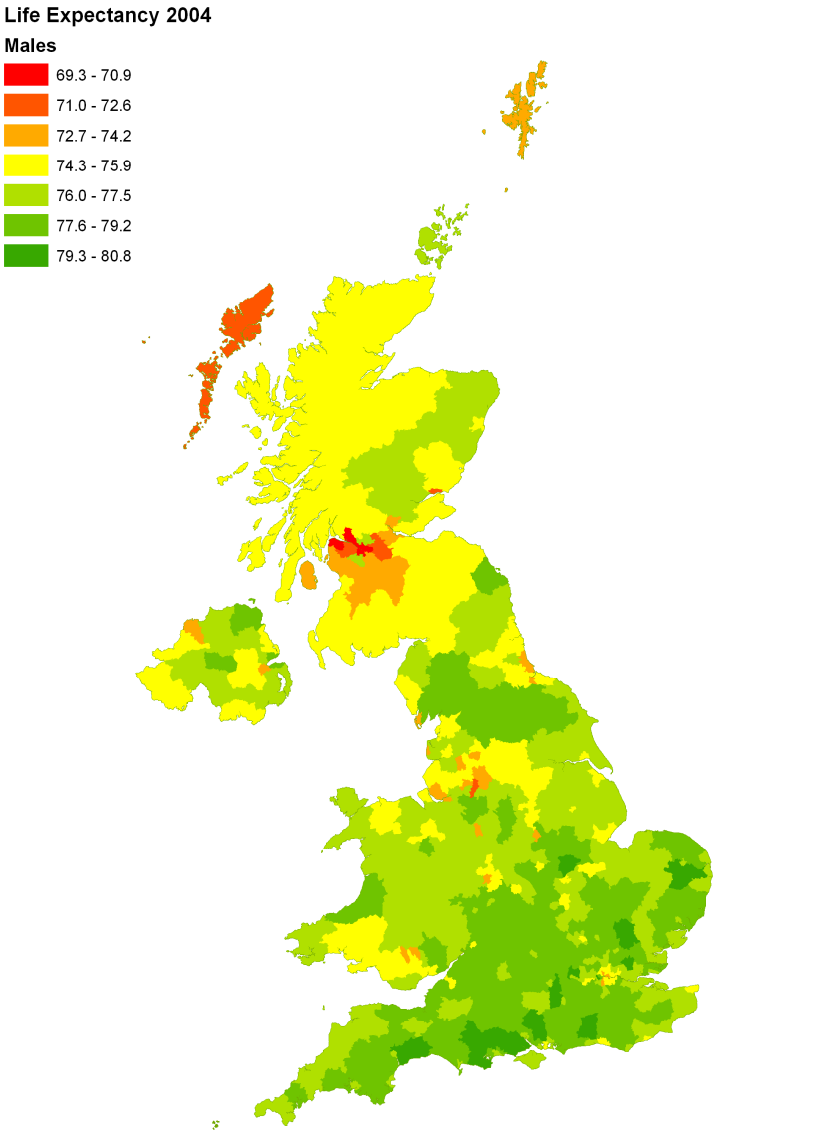
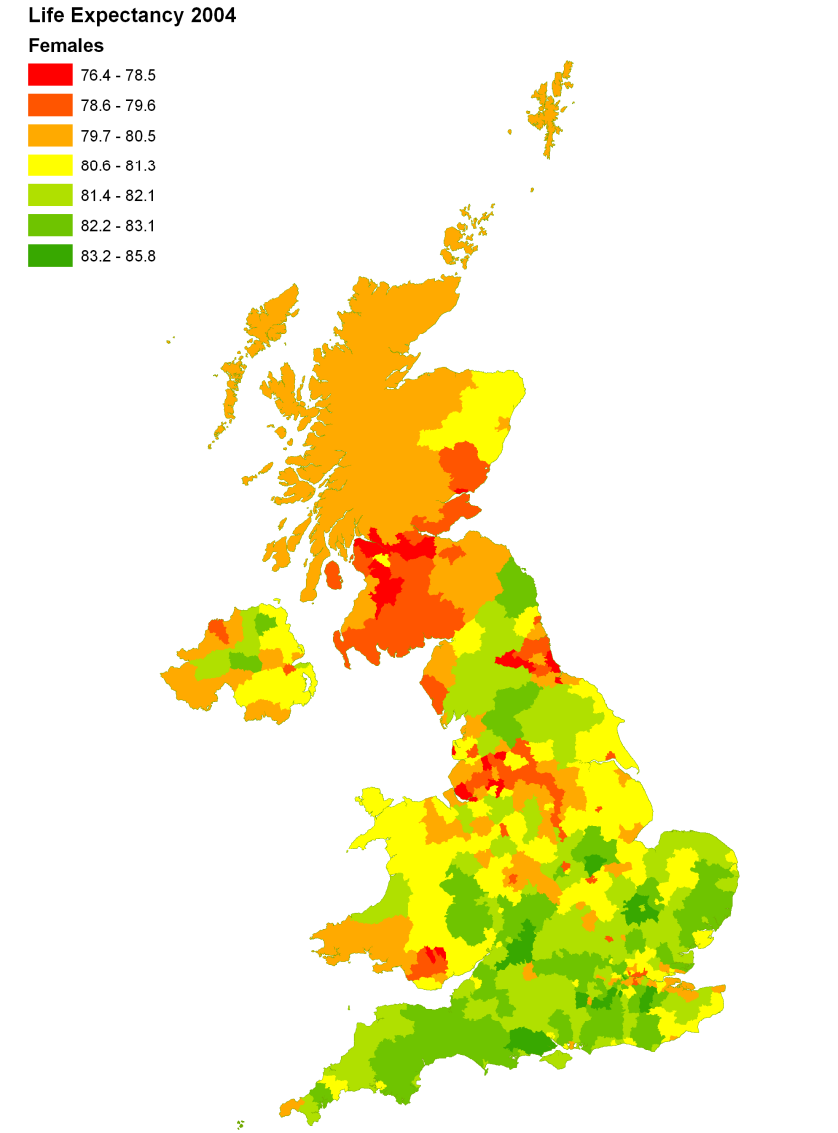


Figure 2.6



Socio-Cultural Trends

The need to tackle social deprivation and exclusion and the supply of quality homes have been at the forefront of the policy agenda in recent years. The UK is a nation of home owners, with the average level of home ownership now reaching 70%. Previous research suggests[26] that workers tend to attach great importance to their own social well being in relation to safety from crime, good health provision and reasonable house prices. These often have priority ahead of employment prospects and commuting times. Hence, the social concerns of the population can significantly influence the spatial dynamics through their choice of residential locations, which may then trigger the process of commuting or longer-term migration.

Multiple Deprivation and the Urban Footprint

Figure 2.7 maps the landscape of multiple deprivation in the UK, which is measured by the respective official index of the four constituent countries (each version is a slight variant of the others). One striking feature of the spatial pattern of deprivation is its resemblance to the urban footprint in **Figure 2.8**, though severe deprivation is variable in the inner-London boroughs along the Thames and includes some pockets of rural areas. The spatial distribution highlights the fact that the South East, South West, East of England, as well as rural areas are least affected by the problem of chronic deprivation.

When examining the indicators in relation to urban size, the large conurbations stand out as the most deprived urban areas as one third of their population lives in the most deprived wards. It is also important to note that there are significant intra-regional variations in the spatial distribution of deprivation. For example, urban areas in the North West had the widest range of deprivation values. Even in the more affluent East of England region, significant deprivation is found in the east coast at Great Yarmouth, Lowestoft and King's Lynn.

Differential Earning Power: the London/South East Powerhouse

Based on the Annual Survey of Hours and Earnings, the average gross annual pay in the UK was about £23K. **Figure 2.9** shows the spatial distribution of annual personal income. Since the data is survey-based, there is missing data for some areas. It is clear from the map that there are significant spatial variations in terms of the average earning power, ranging from over £35K in Richmond upon Thames and Elmbridge to under £17K in Strabane and North Devon.

Areas with the highest level of average earnings are found in London and the wider South East Region. It is remarkable to see the gradient of earnings gradually reduce when moving away from central London. The spatial pattern of earnings bears a strong resemblance to the pattern of very long distance commuting in **Figure 1.17**. Again, we can see the 'London Eye' effect here. Other areas with high earnings tend to scatter around the nation and cluster in small pockets. For instance, the oil industry in Scotland has boosted the average earning level in the north east around Aberdeen. At the opposite end of the ladder, areas with lowest earnings tend to be found in remote rural areas, especially in Wales, Scotland, Northern Ireland, and industrial and former mining areas in northern England.

Soaring House Prices: Super-London Effect

The publication of *Sustainable Communities* by the ODPM highlights several sets of housing issues across different parts of England. While northern regions are suffering from the problem of low demand and abandonment, the South East and London have overheated housing markets and a shortage of affordable housing for first time buyers and key public sector workers. It is, however, important to point out that hot spots can be found in northern England, as shown in **Figure 2.10**. Recent house price figures suggest that the average price level is now above the £200K mark. Average house prices in local authority districts range widely from around £70K in Burnley to over £800K in Kensington and Chelsea.

The spatial distribution of house prices across different parts of the UK (see **Figure 2.10**) suggests that there is a broad divide in the dynamics of regional housing markets. London, the South East, and parts of the South West and East of England enjoy very buoyant housing markets that command the highest level of house prices. The highest houses price are found in central London where properties on average fetch over half a million pounds. The steepness of the house price gradient then gradually reduces as the distance from central London increases. Again, the patterns mirror those of the very long distance commuting (**Figure 1.17**) and the gross annual income (**Figure 2.9**). This indicates that there is continuous interaction between the labour market and the housing market in the London and South East region. House price inflation seems to ripple outwards to the South West as there is a trend

[26] Rogerson, R., Findlay, A., Morris, A. and Coombes, M. (1989) 'Indicators of quality of life: some methodological issues', *Environment and Planning A* 21: 1655-66.

of second home buying from affluent home owners in London and the South East for their weekend and holiday retreats.

In contrast to the Super-London effect, other large cities do not seem to be able to trigger such centripetal effects. However, higher house prices are found in the commuter belts on the urban fringes and accessible rural locations close to major metropolitan areas. House prices, on the whole, are lower in Scotland, Wales, and Northern Ireland.

Figure 2.7

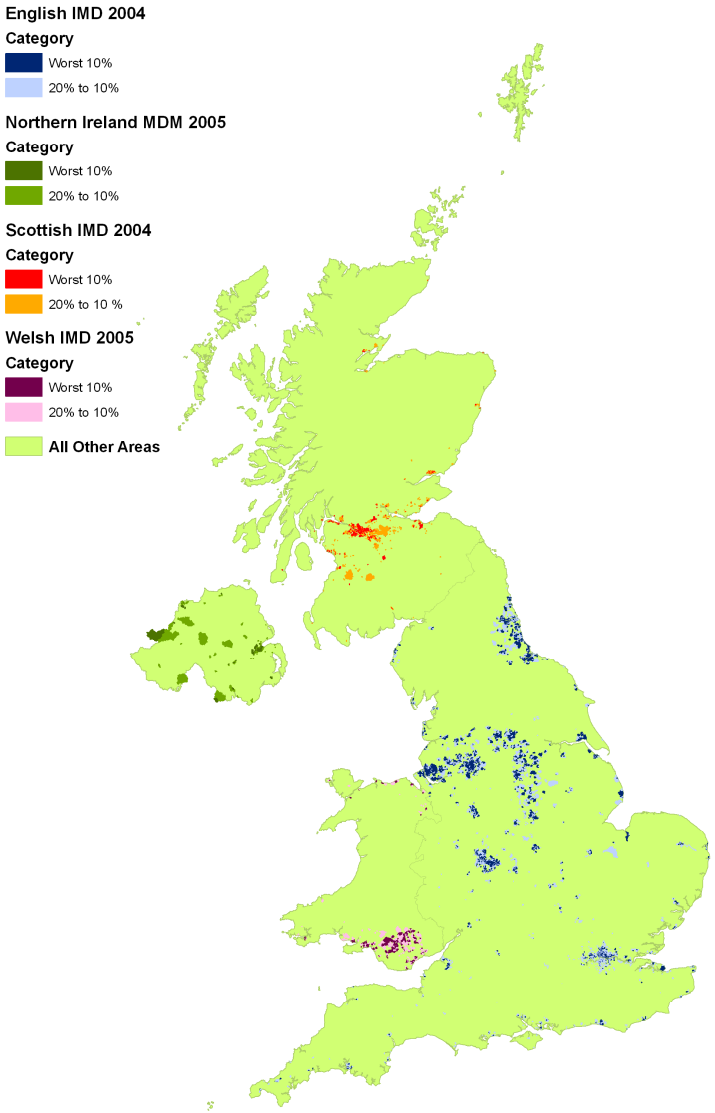


Figure 2.8

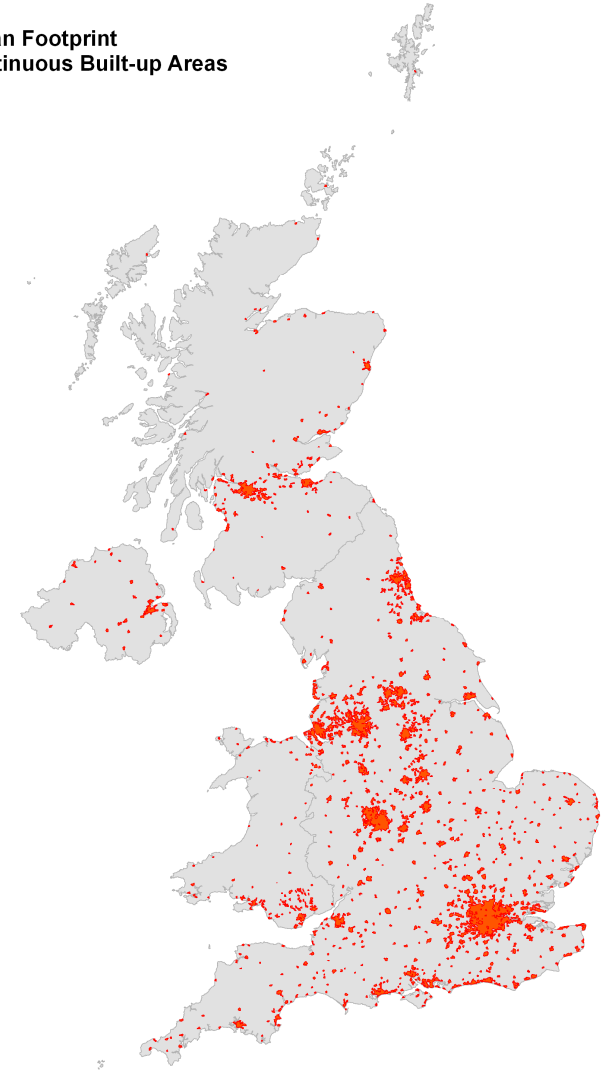


Figure 2.9

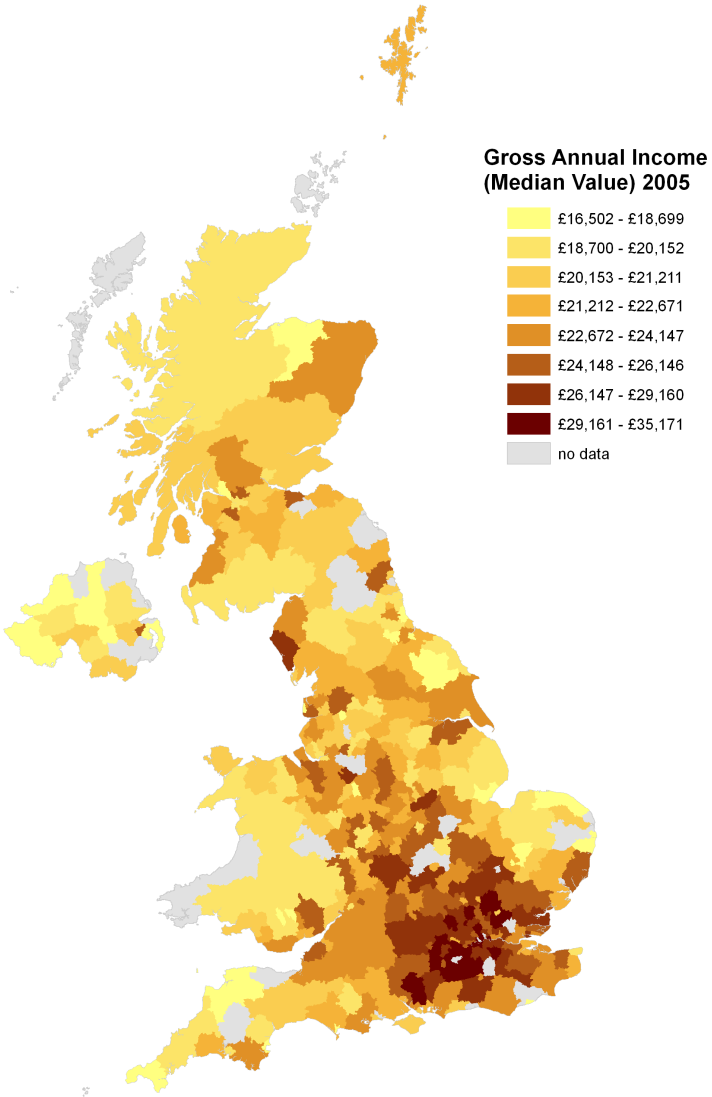
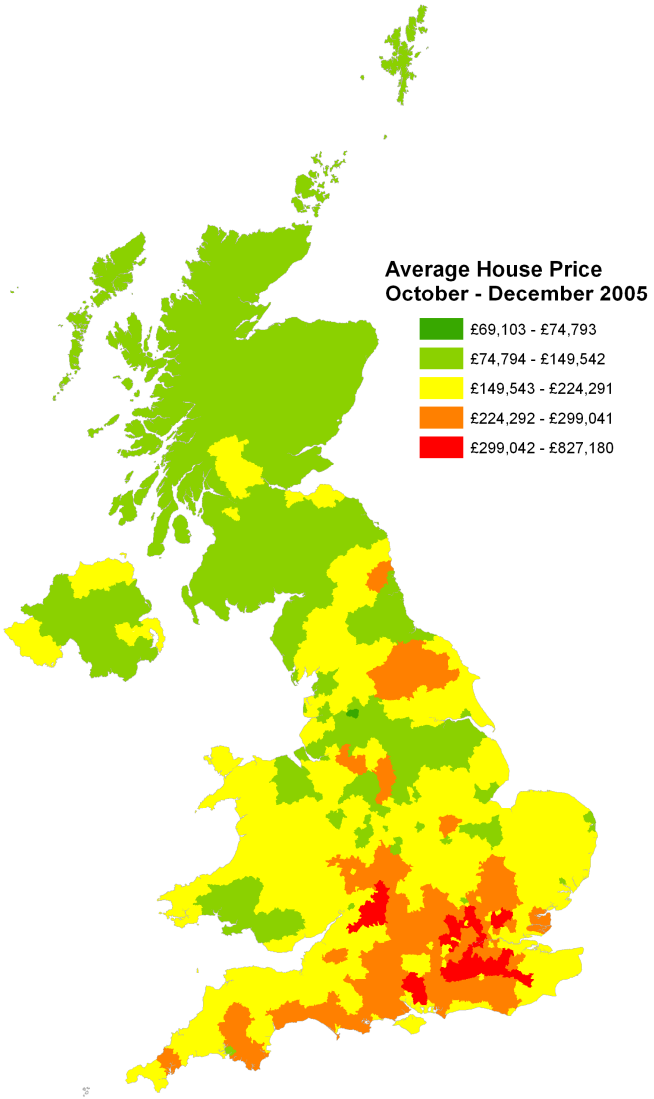


Figure 2.10



Knowledge Economy and Business Competitiveness

The economic competitiveness of places has to be related to their capacity to accumulate capital for investment. Past research shows that London, together with the surrounding South East, has the largest number of the nation's commercial and industrial company headquarters[27] and has overwhelming control of the UK's financial system. Despite the existence of a number of provincial financial centres such as Leeds, Manchester, Edinburgh, Glasgow, Birmingham and Bristol, London's dominant position is not remotely challenged. This is because the provincial growth tends to be branch offices and routine functions[28]. Due to the lack of detailed spatial data on the financial system and investment flows, the analysis here is not able to map such dynamics. It is, nevertheless, important to examine other important factors that contribute to the development of a knowledge-based economy and to business competitiveness.

Buoyant Labour Market: Southern English Regions

Significant variations in employment rates for people of working age are found in **Figure 2.11**, ranging from 88.5% to 54.1%. It is important to note that to some extent spatial variations in the employment rate for people of working age may reflect variations in the age structure of the working age population, since employment rates are proportionately lower than average at each end of the working age spectrum than in the middle.

Amongst English regions, the North East displays the lowest employment rate for people of working age (68%), which is followed by the North West and London (both around 71%). Low employment rates are notable in Northern Ireland, Wales and urban Scotland. Conversely, the highest employment rates for people of working age are found in the South East, the South West, and the East of England (77%-80%). Hence, the position of London (mainly inner-London) contrasts with that of other southern regions, especially when many areas in the South East have an employment rate of over 85%.

The observed pattern shows that the lowest employment rates (under 65%) are found in the inner-London urban area and many northern metropolitan areas such as Manchester, Middlesbrough, Liverpool, and Nottingham. On the whole, it is clear that the level of employment is much higher in the southern English regions in comparison to the rest of the UK, especially when taking into account of its economically active population size.

Mismatch between Jobs and Skills

High skill levels are increasingly seen as a major factor that contributes to economic competitiveness. The concern for our labour market is less about the quantity of labour supply, and more about matching the right type of skills to meet with the requirement of the jobs. The Supply-Side Over-Qualification Index is used to measure the supply and demand of the high skilled end of the labour market. It is a ratio of the total number of professional and managerial jobs (as a proxy for jobs requiring high skills) to the population with degree and above qualifications (as a proxy measure for labour skills available). When the index value is 1, there is a good match of the supply and demand of high skilled labour; when the value is less than 1, there is an over-supply of the qualified workforce; and when the index has a value of over 1, it indicates a shortage of skilled workforce to meet the needs of the job market.

The pattern emerging from **Figure 2.12** shows that in most areas of the UK, there are a larger number of graduates compared to the number of professional and managerial jobs in the locality. These areas include inner-London, the urban areas of some northern cities, the North East, Wales, Scotland, Northern Ireland, and pockets of the South West. This is partly related to the sluggish economy in some of the urban areas, or related to the remote and peripheral location of some areas. There is a healthy balance of labour skills in most parts of the Midlands, the Eastern Region, and the South East. Nevertheless, the areas that suffer most from skill shortage are mostly in some parts of the Eastern Region, which may be related to the fact that it is the fastest growing region of the nation. From a macro-economic point of view, the over and under-supply of skilled workforce in the UK indicates that the national economy is not operating at the optimum to maximise the productivity of its workforce.

[27] see Goddard, J. B. (1992) 'Structural economic change and the region', paper presented to the Annual Conference of the Regional Studies Association, London; Martin, R. and Minns, R. (1995) 'Undermining the financial basis of regions: the spatial structure and implications of the UK pension fund system', *Regional Studies* 29 (2): 125-44.

[28] see Gentle, C. and Marshall, J.N. (1992) 'The deregulation of the financial services industry and the polarisation of regional economic prosperity' *Regional Studies* 26: 581-85; Marshall, J.N.; Gentle, C.J.S.; Raybould, S. and Coombes, M. (1992) 'Regulatory change, corporate restructuring and spatial development of the British financial sector', *Regional Studies* 26: 453-68.

High-Tech and Knowledge Industries

The largest proportions of total employees are accounted for by high technology and knowledge intensive industries in London and the other southern English regions (i.e. the South East, the East of England and the South West) than in the remaining regions. The southern regions all have more than half of their employees in this sector. Nearly two-thirds of employees in Borehamwood, Cambridge, Haywards Heath, Fleet and Oxford are employed in these sectors. At the other end of the spectrum, less than half of the employees in the East Midlands, Yorkshire and the Humber, Wales, and Scotland have jobs in high technology and knowledge intensive industries.

Figures 2.13 and 2.14 provide more detailed mapping of the level of knowledge and high-tech employment by local authority across Great Britain (data is not available for Northern Ireland). The level of presence of knowledge industries tends to be higher around the main urban areas and with significantly higher levels of concentration in the South East. With regard to high-tech industry, it is very clear that employment opportunities tend to concentrate in the southern English regions. However, there are small high-tech clusters scattered around the country such as those in south and north Wales, as well as in central Scotland.

More fine-grained analysis of the local contribution to total national employment in these two industries is shown in **Figure 2.15**. The relative employment distribution largely reflects the urban footprint, though some urban areas, such as Tyne and Wear, are clearly under performing. It is also clear that there is a large cluster of high-tech and knowledge intensive industries around London and the wider South East. Outside London, the largest clusters are found in Leeds, Birmingham, and Manchester.

Research Capacity of Higher Education Institutes (HEIs)

The research capacity of higher education institutes is widely regarded as a key factor for gaining competitive advantage. Research capacity here is calculated on the basis of their graded performance in the 2001 Research Assessment Exercise and the number of research active staff involved.

The spatial patterns of research capacity shown in **Figure 2.16** closely mirror the distribution of the high-tech and knowledge intensive industries in **Figure 2.15 -** being highest in the larger urban areas, especially in the large cities and London. A few urban locations seem to largely function as student areas, where over half of the population were higher and further education students in 2000/2001, for example, Hatfield (64%) and Canterbury (50%).

Levels of research capacity across the UK are rather polarised. As shown in **Figure 2.16**, London dominates research capacity across the UK. The University of London's constituent colleges and institutes alone account for 15% of the national research capacity. The University of London, together with Oxford University (4.2%) and Cambridge University (3.8%) forms a golden research triangle in the South East that accounts for nearly a quarter of the UK's total research capacity. Their counterpart in northern England, though at a less impressive scale (just under 10% of total research capacity), is the triangle built around the M62 corridor with the Universities of Liverpool (1.7%), Manchester (3.4%), Leeds (2.4%) and Sheffield (2.0%). Another research cluster is found around the universities in the Midlands, and the Scottish corridor from Glasgow to Edinburgh. The distribution of HEI research capacity in Scotland, Wales, and Northern Ireland very much follows the distribution of their urban areas.

Figure 2.11

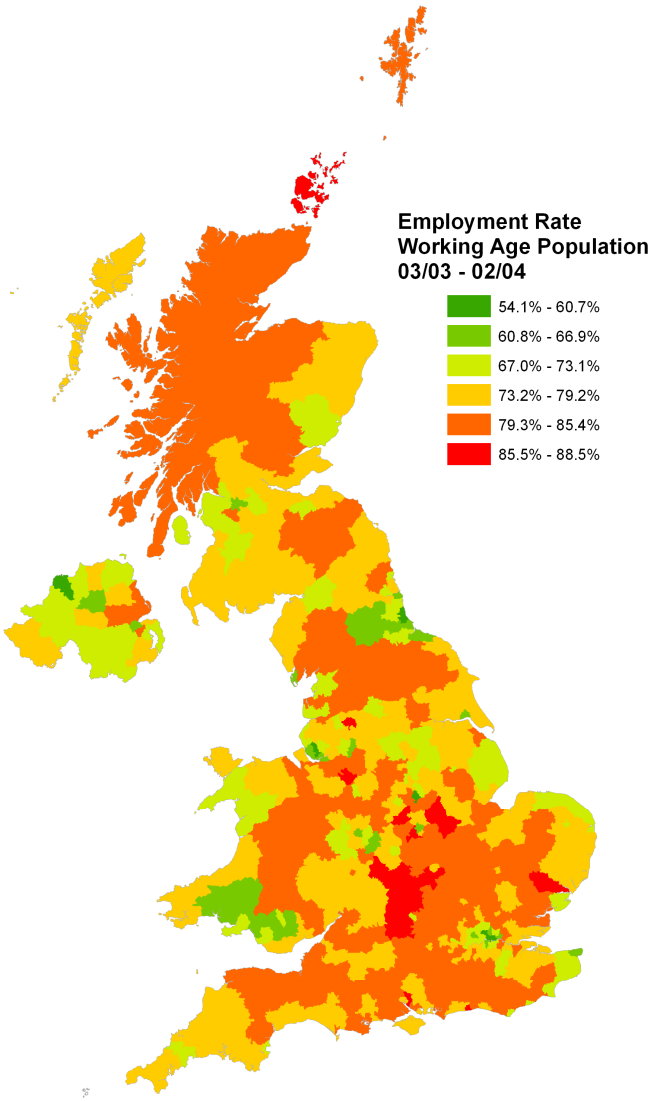


Figure 2.12

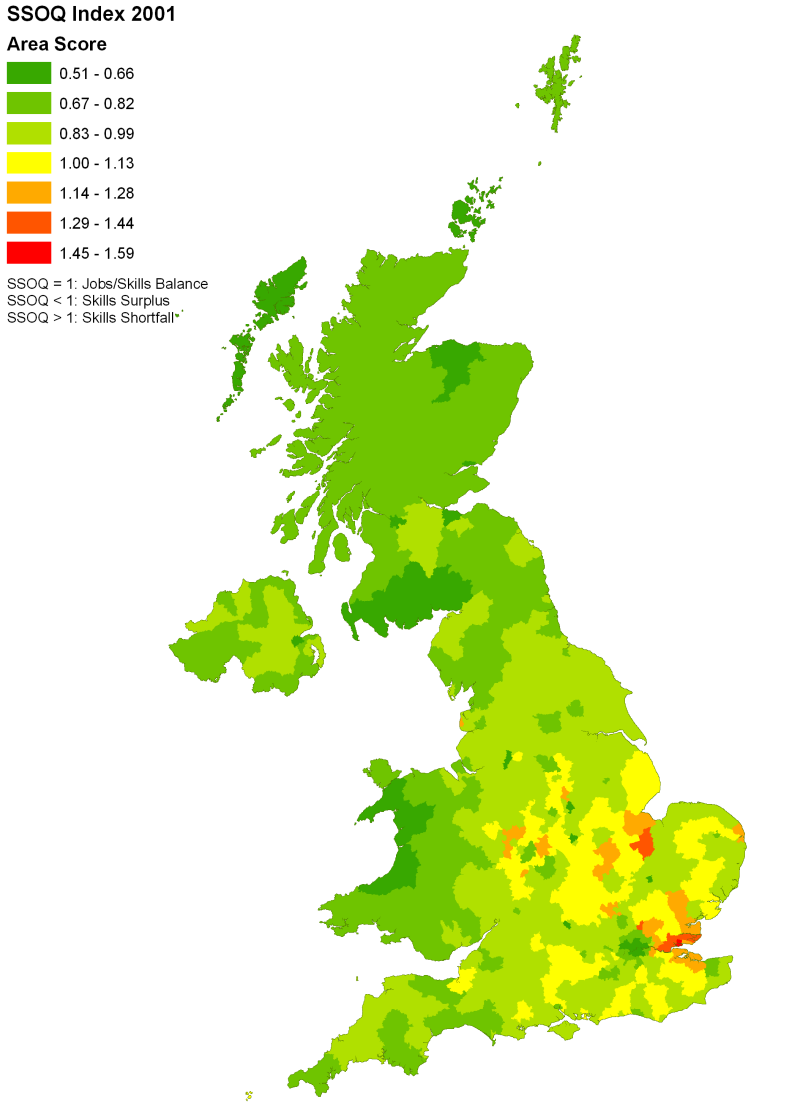


Figure 2.13

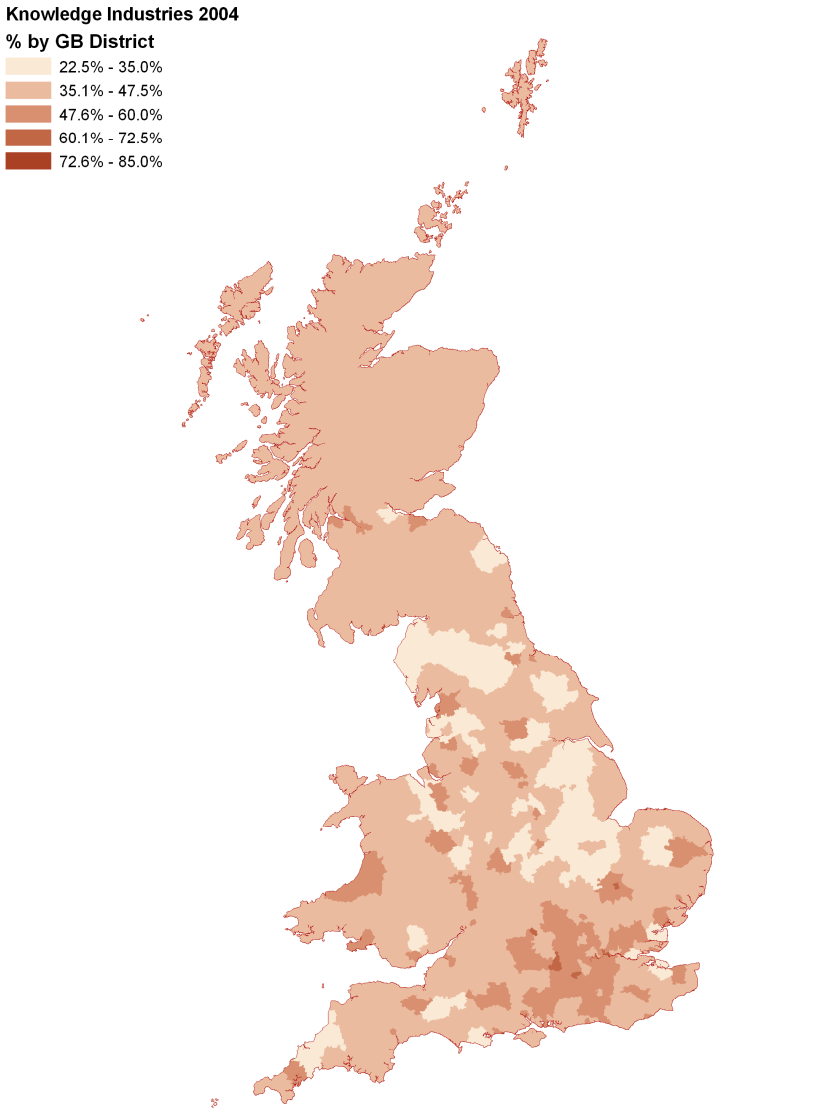


Figure 2.14

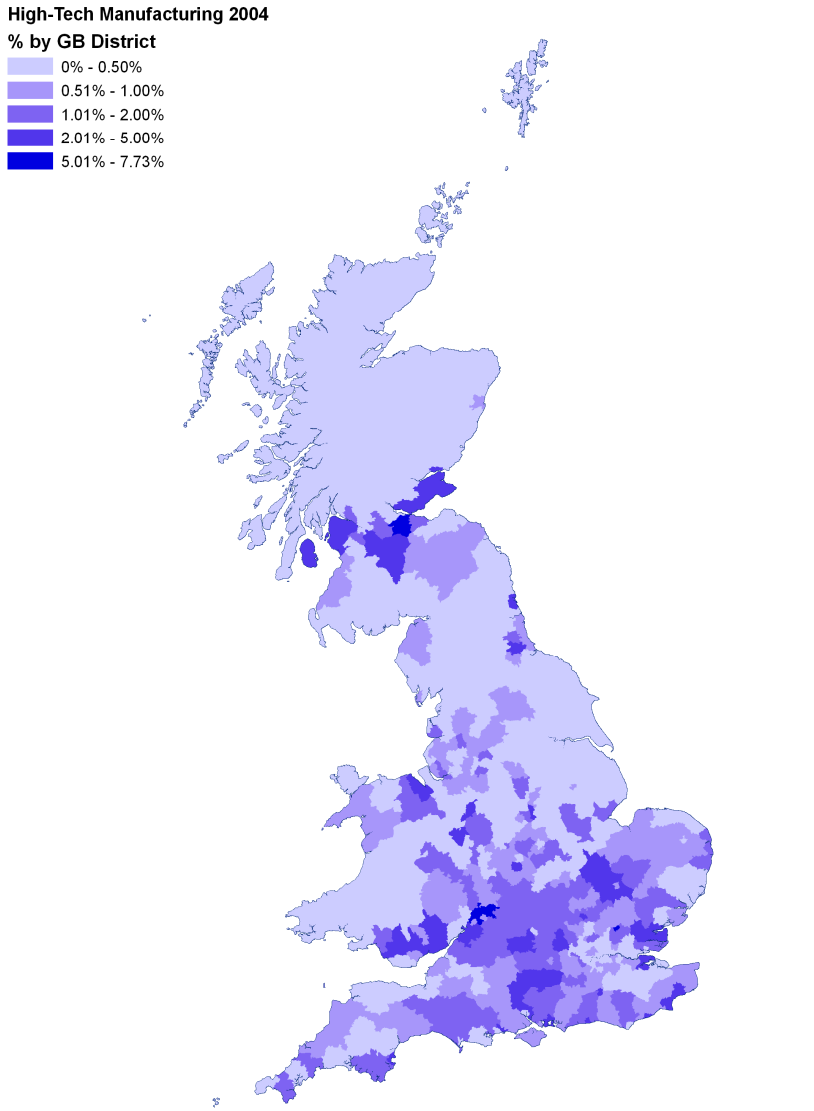


Figure 2.15

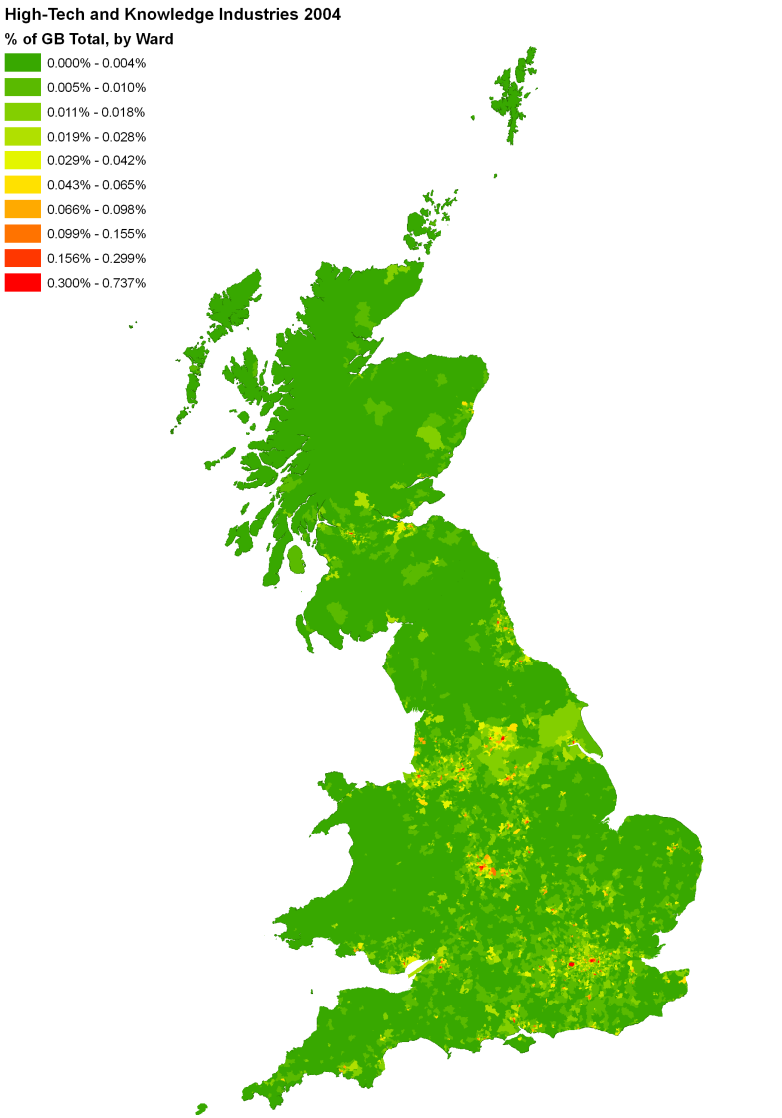
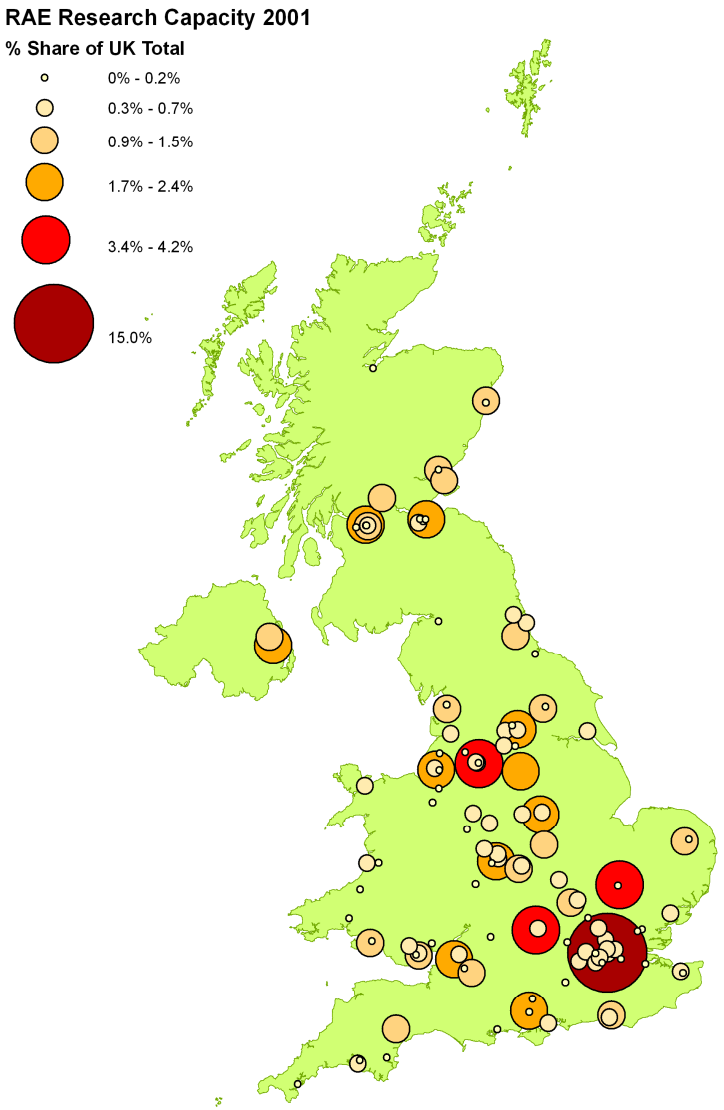


Figure 2.16



Environmental Trends

There is an increasing recognition of the importance of the natural environment and the ecological footprint in providing a more sustainable and friendly living environment to attract the workforce, and investment. Quality of life[29] is very much seen as one of the key factors that contribute to the competitiveness of places.

Sustainable Commuting Modes

With respect to the mode of commuting, large volumes of travel to work journeys in the UK are carried out by the unsustainable mode of private cars. Less than one-third of work journeys in the UK were made by public transport, cycling or on foot according to the 2001 Census. It is interesting to note whether people opt to use a more sustainable transport mode if they have access to the use of a private car or van.

Figure 2.17 maps the percentage of commuters who had access to private cars but opted to use public transport to work. It is interesting to find that outside London, nowhere else had a value of over 24% in 2001. This suggests that if any one has access to a car outside the London area, there is a 76% chance that they will drive to work. It is important to note that the Glasgow and Strathclyde area had the next highest level of public transport users. This is probably due to the high quality underground network in the area (figures for Scotland also include travel to place of study).

The map shows that urban areas, on the whole, are more sustainable than other parts of the country. However, the most interesting patterns are found in the London conurbation, once again, the London/South East area stands out from the rest as it has the largest share of commuters who voluntarily use public transport to work. This is probably related to the fact that public transport is the only viable option when there is serious traffic congestion in inner-London, and when the commuting distance is too long for driving.

[29] see Wong, C. (2001) 'The relationship between quality of life and local economic development: an empirical study of local authority areas in England', *Cities* 18: 25-32; Wong, C. (2002a) 'Developing indicators to inform local economic development in England', *Urban Studies* 39 (10): 1833-63; Rogerson, R. (1999) 'Quality of life and city competitiveness', *Urban Studies* 36 (5-6): 969-85.

Air Emissions

Based on the National Atmospheric Emissions Inventory data, the emission levels of sulphur dioxide, carbon dioxide, nitrogen oxides and particulate matter are mapped on **Figures 2.18 to 2.21**. Different forms of pollution tend to be worse in larger urban areas. Air pollution does not otherwise vary all that strongly across the urban hierarchy, with the exception of London where it is noticeably worse. This is largely a function of population density.

The presence of sulphur dioxide (see **Figure 2.18**), a chemical present in emissions from combustion of fossil fuels that enters the atmosphere and returns to earth with precipitation as acid rain, tends to concentrate in the main urban areas and the main road networks. However, high levels of emission are also found in areas with power stations.

Carbon dioxide is the main greenhouse gas created by combustion, and the presence of nitrogen dioxide is seen as an important cause in the creation of smog. Both are emitted primarily from human activity such as burning of fossil fuels to generate electricity, and vehicles. Hence, it is not a surprise to find that the patterns of their emission in **Figures 2.19 and 2.20** resemble the urban footprint and spread along the main road networks. Areas that have lower levels of these air pollutions are found in North Yorkshire, mid Wales, and the Scottish Highland where there are lower density of road networks.

Figure 2.21 shows the presence of particulate matter that consists of tiny solid or liquid particles of soot, dust, smoke, fumes, and aerosols. Again, the pattern very much reflects the distribution of the urban footprint and much lower levels are found in North Yorkshire, Northumberland, mid Wales, and the Scottish Borders and Highlands.

Reducing Resource Consumption

The recycling rate for the UK does not compare favourably with other countries in the European Union. On average, less than 20% of the household waste was recycled in 2004. **Figure 2.22** shows that not many areas in the UK managed to recycle over a third of their household waste and there are significant variations in the level of domestic waste being recycled, ranging from 46% in Lichfield to under 4% in Liverpool. In general, the urban areas around the M62 corridor had a poor record of recycling household waste. Elsewhere, the Scottish Borders and Highlands, Yorkshire and the Humber, and the North East also held the poorest record in 2004. In very general terms, the southern English regions, Wales, Northern Ireland, and central Scotland had a better recycling rate than the rest.

Figure 2.17

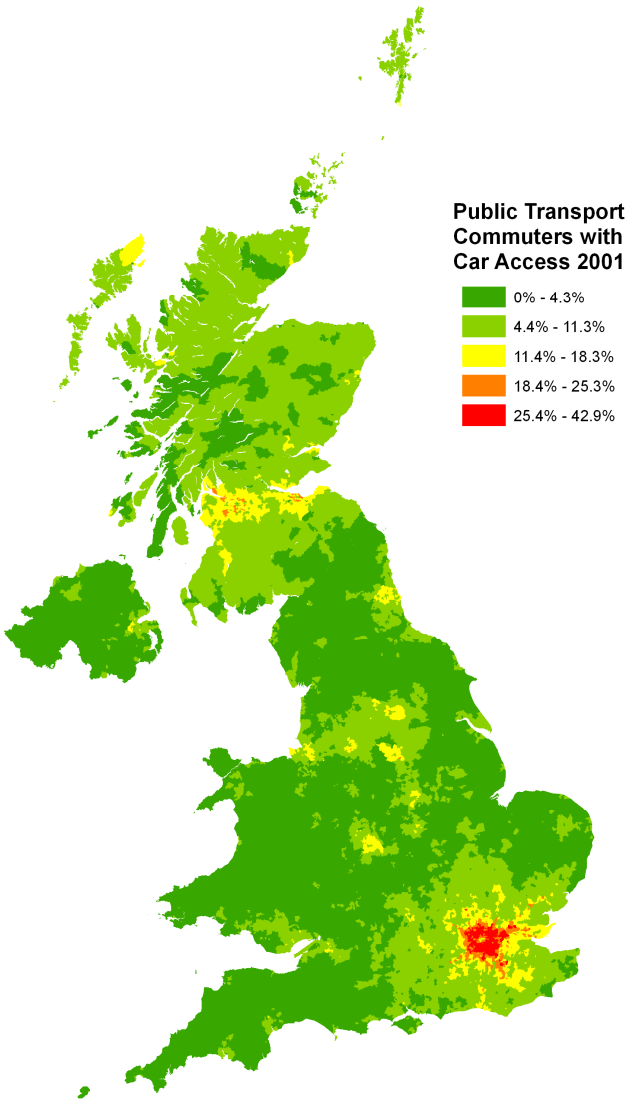
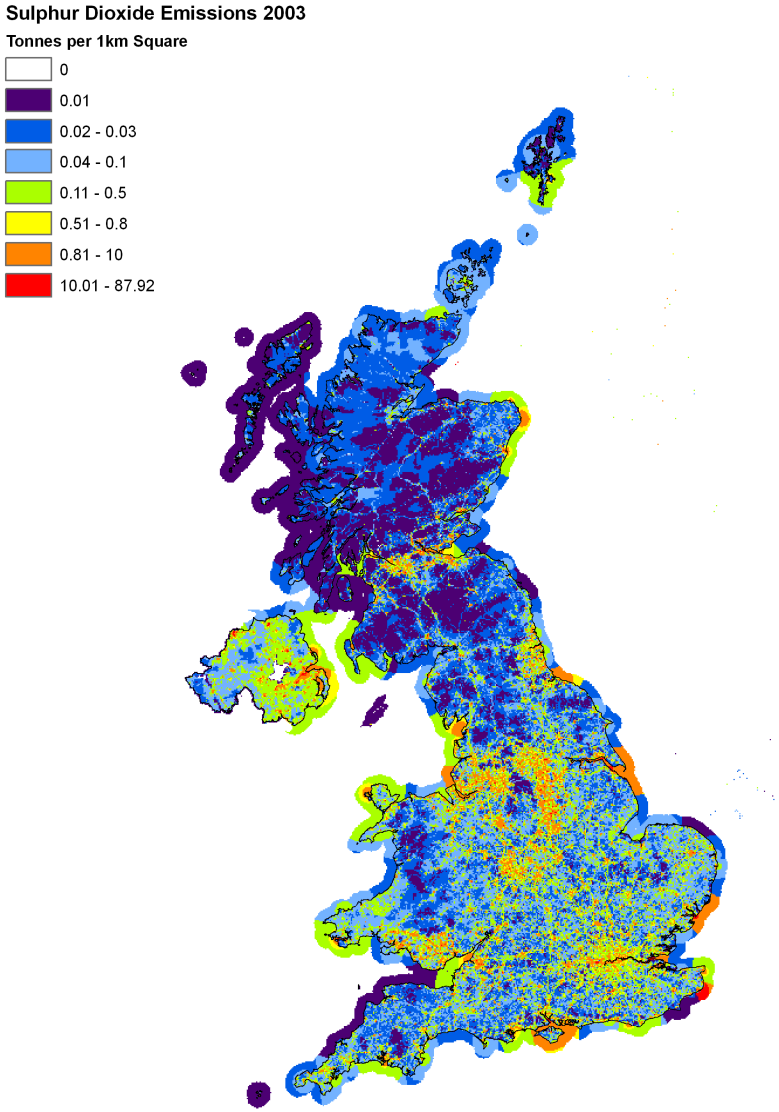
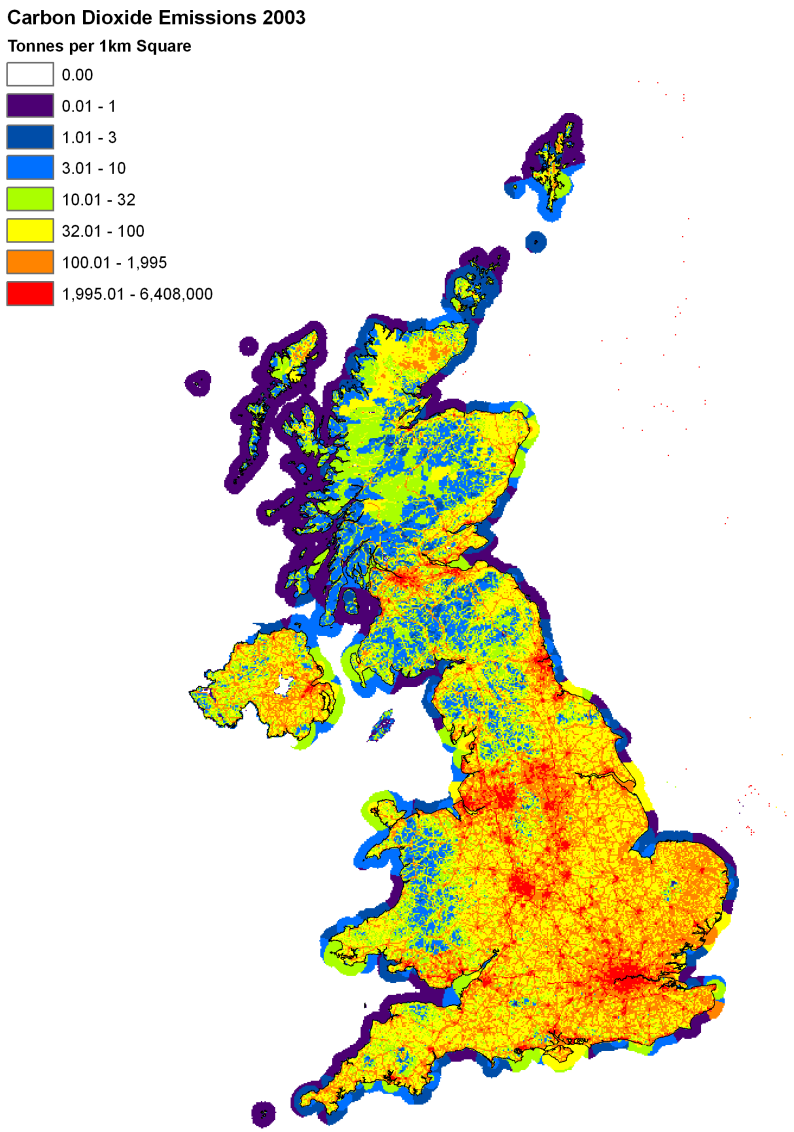


Figure 2.18



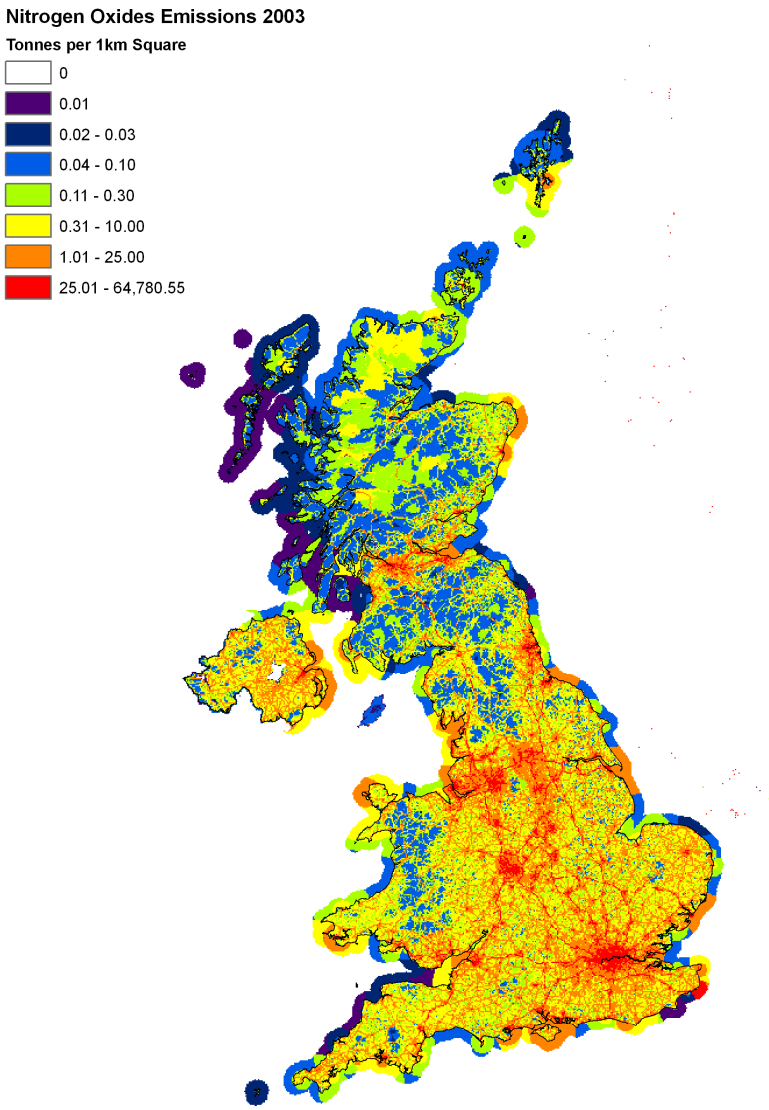
Source: National Atmostpheric Emissions Inventory, 2006

Figure 2.19



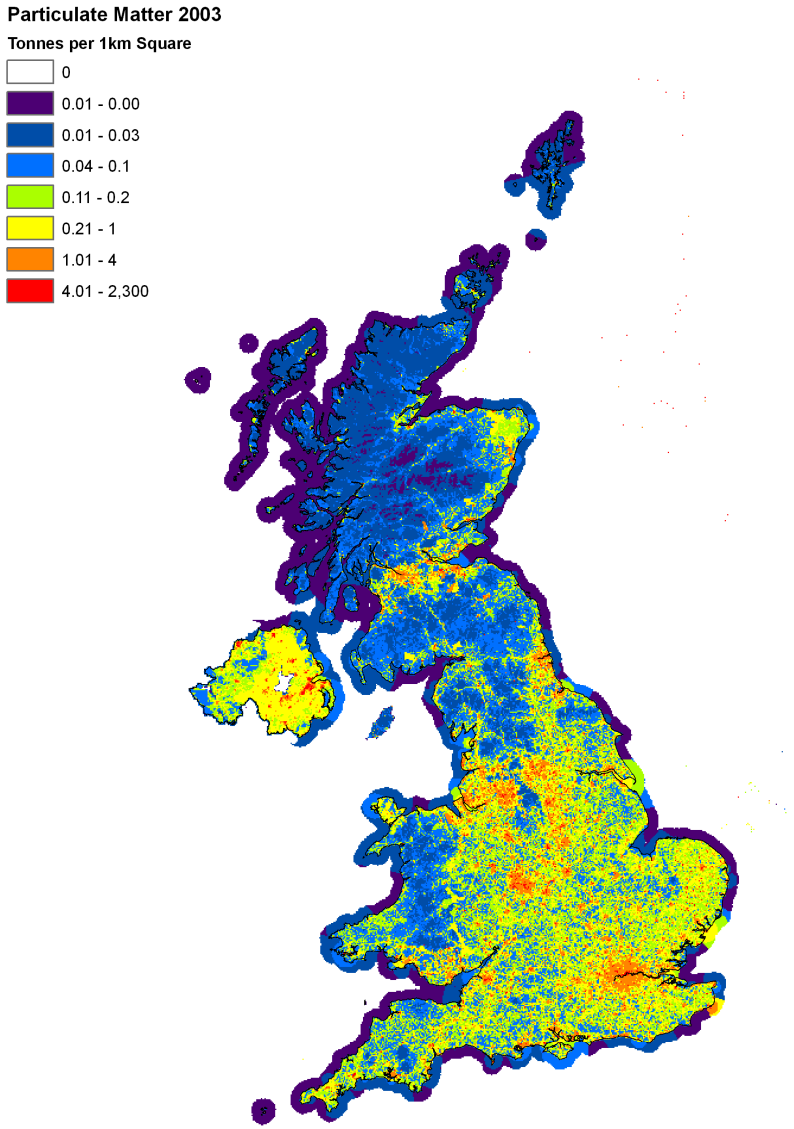
Source: National Atmostpheric Emissions Inventory, 2006

Figure 2.20



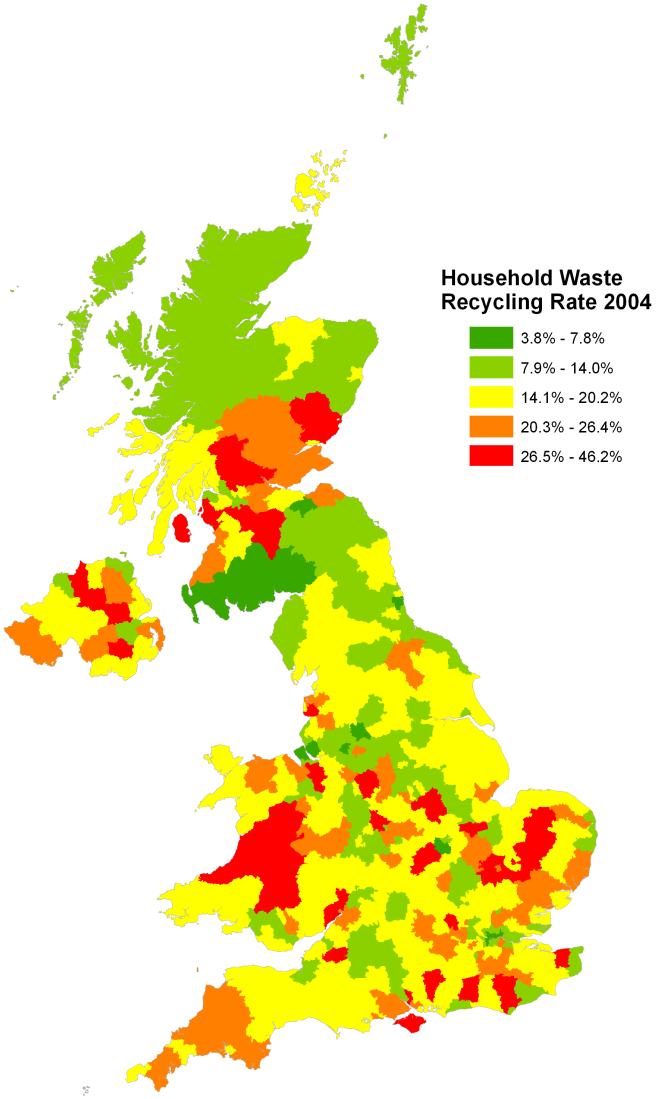
Source: National Atmostpheric Emissions Inventory, 2006

Figure 2.21



Source: National Atmostpheric Emissions Inventory, 2006

Figure 2.22



Part III
Spatial Structure of the UK

Based on the analysis of the two sections above, some recurrent spatial patterns emerge. These broad spatial patterns help us to have a better understanding of the complexity of the urban-regional spatial system of the UK and how different spaces are or are not functionally connected. The discussion in this final section focuses on the main features of the spatial structure and the emerging functional clusters of the UK.

Before examining the functional connection of different spaces, it is important to highlight the two characteristics that feature strongly throughout the analysis:

- The dominance of the urban footprint in determining different levels of activities, as well as its relationship with the neighbouring areas.

- The affluence and buoyancy of the Southern English regions demarcates the spatial dynamics of this broad area from the rest of the UK. This Severn and Wash divide has been recognised by academics since the 1950s. It is interesting that this spatial inertia has not been shifted in over half a century.

These broad spatial features provide a backdrop for examining the more detailed functional connection between different spaces and six functional clusters are identified from the analysis. **Table 3.1** identifies the major towns and cities included in each of these clusters.

- The London Supernova
- The Central Constellation
- The Tyne-Tees Cluster
- The Central Belt of Scotland
- The Belfast Cluster
- The South Wales and Bristol Channel Cluster

The boundaries of the spatial clusters outlined above were *conceptually*, rather than statistically, derived from a synthesis of all the foregoing research. The idea is to diagrammatically outline these clusters as a starting point to stimulate debate over the functional connection of different places, rather than rigidly defining a fixed set of boundaries. It is meant to be analytical rather than prescriptive.

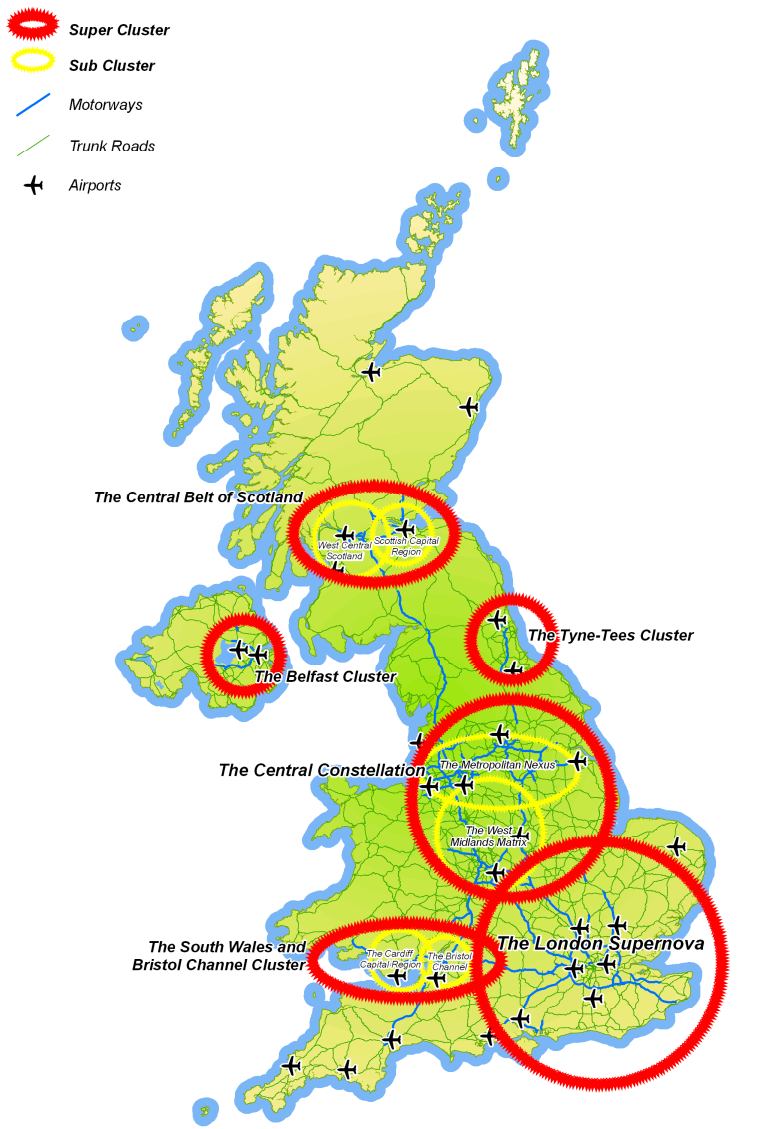
The construction of the cluster focuses on the crucial areas of economic activity, that is, the labour market areas (defined by inter-ward commuting distance), the housing market areas (defined by inter-district migration flows), the presence of knowledge industries, land-based transport connectivity; as well as deprivation patterns. Within these clusters, interaction tends to be significantly higher than with outside areas, both in terms of commuting and migration flows. The derivation of the functional clusters is closely related to the functional regionalisation methodology used to devise local labour market areas.

In three of the functional clusters, two sub-clusters are identified, based on a further analysis of patterns within the larger conceptual areas. For example, the larger area may form the basis for a single labour market in relation to long-distance commuting flows, but may constitute more than one housing market area. Where there are overlaps between conceptual clusters, this is intended to indicate a greater degree of interaction between separate clusters.

The definition of functional clusters is not a homogeneous conceptual process and is subject to various definitions and interpretations by different analysts (for more detailed explanation, see Annex 3). The fluidity of the boundaries of the functional areas asserts the crucial importance of interaction. The nature and intensity of interactions depend on what socio-economic activities are involved in the functional process. In this sense, the dynamic interaction between different activities over different spatial areas makes it difficult to delimit any functional areas within a tightly bounded, single-minded physical framework.

Table 3.1: UK functional spatial clusters: major towns and cities	
Cluster	**Selected Major Towns and Cities**
The London Supernova	London, Brighton, Cambridge, Colchester, Ipswich, Luton, Milton Keynes, Oxford, Portsmouth, Reading, Southampton, Southend
The Central Constellation	Birmingham, Bradford, Coventry, Derby, Doncaster, Hull, Leeds, Leicester, Liverpool, Manchester, Nottingham, Rotherham, Sheffield, Stoke-on-Trent, Warrington, Wolverhampton
The Central Belt of Scotland	Glasgow, Edinburgh, Coatbridge, Dunfermline, East Kilbride, Falkirk, Hamilton, Livingston, Motherwell, Paisley
The Tyne-Tees Cluster	Newcastle-upon-Tyne, Sunderland, Middlesbrough, Darlington, Durham, Gateshead, Hartlepool, Redcar, Stockton-on-Tees
The Belfast Cluster	Belfast, Antrim, Ballymena, Bangor, Carrickfergus, Castlereagh, Larne, Lisburn, Newtownabbey, Newtownards, Portadown
The South Wales and Bristol Channel Cluster	Bristol, Cardiff, Barry, Bath, Bridgend, Chepstow, Cwmbran, Keynsham, Llanelli, Neath, Newport, Swansea, Weston-Super-Mare

Figure 3.1 Transport Infrastructure and Functional Spatial Clusters



The London Supernova

London stands out as a world city with its unique gravitational power absorbing the surrounding area in the South East to become the economic powerhouse of the UK. The spatial structure of the Greater London area forms a polycentric configuration, with the dominant city of London spreading out to absorb its suburbs and incorporate its commuting hinterland, thereby forming a significant magnet for activity. The commuting zone resembles a symmetrical eye with a 60 km inner radius from Central London.

London as a city specialises in international traffic links, both through providing international scheduled flights via Heathrow Airport and handling international trade through its ports. It also dominates the domestic traffic links through its domestic airport connections and high quality, fast speed rail links with other cities in the UK. When combined with the capacity in its wider South East hinterland, this transport hub provides 75% of the nation's international scheduled flights and handles 75% of container units. London also controls the country's political and financial system and serves as the knowledge centre with a large amount of research capacity, especially when combining its impact with the capacity in the wider hinterland.

The magnet of international movement has resulted in significant international migration flows to London, as well as gaining population from other provincial cities in northern England. Hence, London has experienced population growth. This also partly explains the continuous supply of high skilled, highly qualified workforce to meet with the labour market demand, though in some areas of the wider hinterland, there is still problem of skill shortage.

The economic success of this functional area means that the workforce has the highest level of average earnings. However, house prices are rocketing in London and affecting its neighbouring area which has triggered very long distance commuting and migration to the surrounding South East, the East of England, part of the East Midlands, and the South West. It is, however, important to note that the public transport network has served the commuters well, which is reflected by the fact that it has the highest level of public transport commuters.

London itself, however, suffers from the socio-environmental problems that other global cities have. In the inner urban area of the city, there are still some pockets of areas suffering from multiple deprivation, with the shortest life expectancy and low levels of employment rate. More importantly, high population and traffic density means that it has suffered from the highest level of air pollution. Some inner-London areas also have the worst record of recycling domestic waste. These negative conditions again encourage the population to move out to the wider South East or even further away to seek better quality of living. For example, the retired population tends to cluster around the coastal resorts along the south coast.

The Central Constellation

The dominance of the super-London/South East functional area has overshadowed the development of the rest of the UK. Through the analysis it is interesting to note that the spatial interaction between provincial cities in northern England has led to an emerging 'polynucleated metropolitan region'[30] which transcends the traditional regional boundaries. We have called this the 'Central Constellation', which reflects the central location of this cluster within the UK spatial context. This polynucleated spatial structure means that these cities are independent centres of similar size, but through transport links and continuous urban growth, there is a possibility for them growing into a polynucleated megalopolis.

This conceptual region resembles a galaxy of the northern cities, within which we can further define two inter-related functional areas (see **Figure 3.1**):

- The Metropolitan Nexus: it includes the provincial cities of Liverpool, Manchester, Leeds, and Sheffield and their surrounding areas.

- The West Midlands Matrix: it consists of Birmingham, Nottingham and other urban townships in the Midlands.

The Metropolitan Nexus operates along the M62 corridor and the Transpennine rail link. This cluster of cities has good inter-city rail links and motorway networks, four major airports including the largest international airport outside London in Manchester, the largest international sea port at Grimsby and Immingham, a strong cluster of higher education institutes with the largest research capacity outside the South East, and pockets of areas with strong high-tech and knowledge-based industrial employment. In spite of all these positive points, they are all subordinate to the London Supernova.

[30] see Champion, A.G. (2001) 'A changing demographic regime and evolving polycentric urban regions: consequences for the size, composition and distribution of city populations', *Urban Studies* 38 (4): 657-77; Dieleman, F. M. and Faludi, A. (1992) 'Polynucleated metropolitan regions in Northwest Europe', *European Planning Studies* 6: 365-77.

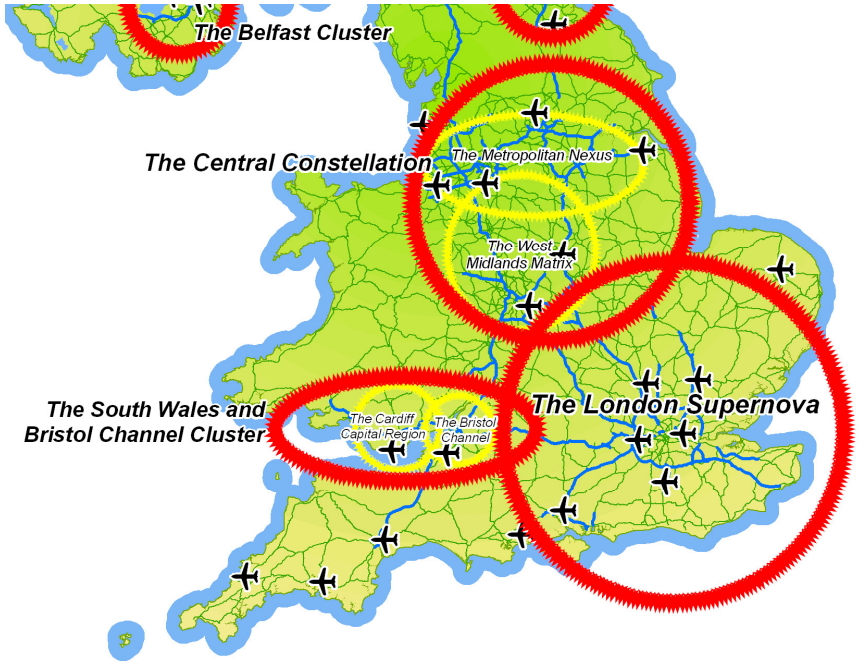
On the less positive front, there are more graduates in these cities than the number of high skilled jobs available in the market. They have suffered from the problems of industrial decline over the last century and continuous population loss. These urban areas have the highest levels of social deprivation, high levels of air pollution and low levels of life expectancy. While there is a large proportion of population at working age, the irony is that these areas also have lower levels of employment rate.

Unlike the more polynucleated Metropolitan Nexus, the West Midlands Matrix is centred on a single city region (Birmingham) that defines much of the functionality within this sub-cluster. This area also has significant interaction with the Metropolitan Nexus through its high density rail links and motorway networks, as well as inter-urban migration flows. This area has two medium size airports that serve mainly domestic and international charter flights. This spatial cluster does not only enjoy spatial proximity to the London Supernova, but also has an above average employment rate, a strong research capacity from a number of HEIs, and a cluster of high-tech and knowledge-based industries in the Birmingham area.

The presence of a dominant urban centre in this spatial cluster means that for most socio-economic drivers, there are differences between the West Midlands urban area around the city of Birmingham and the East Midlands area. For instance, there have been mixed fortunes in population growth in this spatial cluster between 1981 and 2001 – with population growth in the East Midlands area and population loss around the West Midlands urban area. Birmingham as a city had net population loss to other cities such as London, Manchester, Liverpool and Nottingham. On the contrary, Nottingham gained population from Liverpool and Manchester, but had a net loss to London. Likewise, higher levels of social deprivation, average earnings and house prices are found in the West Midlands urban area.

The analysis here suggests that the Central Constellation offers both opportunities and challenges. In spite of their close proximity and significant spatial connections through population movements and transport links, they are operating under different administrative frameworks and institutional structures as they transcend the boundaries of four separate regions. Hence, it is not surprising to find that they often compete with each other to gain international and domestic investment and public sector resources. In order to exploit their development potential and create another strong magnet of economic growth, the joint capacity and inter-connections of this functional spatial region has to be strategically developed and managed.

Figure 3.2 Inset of Functional Spatial Clusters



The Tyne-Tees Cluster

The Tyne-Tees Cluster includes the urban areas of Teesside and Tyne and Wear and their wider hinterlands. As shown by the spatial analysis in this report, this area is rather tightly defined spatially as it is separated both geographically and functionally from its closest neighbouring cluster. In a physical sense, it is buffered by the North York Moors National park to the South, the Yorkshire Dales National Park to the South West, and

Northumberland National Park to the North and West. In terms of functional connections, most travel to work journeys are less than 10 km. This area is connected with other places through its two medium-sized regional airports for domestic and international charter flights, the Tees and Hartlepool port for international trade links, and daily movements via its road and rail networks.

Despite its inclusion in the recently outlined Northern Way growth strategy, the Tyne and Wear area is a separately identifiable spatial cluster on its own that operates somewhat independently from the rest of England's urban North. This is partly due to the physical distance and the fact that it has a lower density road network. Although the Transpennine rail link connects the towns and cities in this spatial area with other northern cities, the journey time is rather long. The only exception is the high speed east coast rail link between Newcastle-upon-Tyne and London, within a journey time of around 3 hours.

The Tyne-Tees Cluster has continued to suffer from population loss (a decrease of 5% between 1981 and 2001), and it tends to lose population to larger cities like London, Manchester, Birmingham, but with a small gain from Leeds, Sheffield and Liverpool. Its demographic structure shows that it has a relatively small proportion of working age population, but a larger share of the retired. The area has suffered from deprived social conditions as most of its urban areas fall within the top 20-25% most deprived in England and its population has a much lower life expectancy than the average. The lower average earnings of the area are also balanced out by the lowest average house prices. This area also has the lowest employment rate and underperforms in terms of high-tech and knowledge based industrial employment. Its research capacity is also relatively small in comparison with other spatial clusters. Similar to other urban areas, this area has a high level of air pollution. It also has a poor track record of domestic waste recycling.

The Central Belt of Scotland

Clearly identifiable within the Central Belt are two separate and unequal functional entities. The area of West Central Scotland centred on Glasgow is the largest and most populous urban region of Scotland and is home to two airports, as well as a significant amount of high-tech manufacturing. The Scottish Capital Region, centred on Edinburgh, is the historic seat of Scottish governance and provides a counterbalance to Glasgow's role as a post-industrial heartland. The Central Belt of Scotland has long been an area of considerable socio-economic productivity, though split between the major Scottish cities of Glasgow and Edinburgh. The tensions between these areas and have sometimes led to divergent strategic development trajectories.

The identification of the entire Central Belt of Scotland as a functional entity in itself is backed up throughout this research by the level of functional connectivity in terms of commuting potential, actual commuting, and migration patterns. In terms of transport infrastructure, they are connected by Scotland's busiest road, the M8 motorway. The area is well served by three international airports, one of which (Prestwick) has undergone massive growth over the last five years in particular. Owing to their strategic location on the east and west coast rail lines, Edinburgh and Glasgow enjoy relatively fast journey times between London at just over 4 and just less than 5 hours respectively.

In terms of domestic connectivity, Edinburgh and Glasgow have the largest air links with London but also enjoy significant connections to Belfast and Bristol in particular. In relation to maritime transport, the Central Belt is home to one of the UK's busiest ports, on the Firth of Forth, handling over 6% of total tonnage in 2004. When inter-urban migration is taken into account, there are clear differences between the core city regions of Glasgow and Edinburgh. The latter shows a net gain from other UK city regions, while the former witnessed a net loss between 2000 and 2001.

Some areas of Scotland have suffered significant population loss over the last 25 years; particularly in the west of the Central Belt cluster. This pattern of population change is mirrored nationally with patterns of residential migration favouring suburban rather than core urban locations. Of particular concern, however, is the particularly low life expectancy for males and females in the Central Belt. The region around Edinburgh displays figures around the UK average, but for the city of Glasgow the life expectancy for males in 2004 was just 69.3 years, compared to 80.8 for Kensington and Chelsea. These results are perhaps not surprising when the pattern of the Scottish Index of Multiple Deprivation from 2004 is taken into account. The majority of the most deprived areas are located in the inner core of Glasgow, although there are smaller clusters of deprivation evident in the city of Edinburgh and other Central Belt towns.

Owing primarily to the presence of the 'Silicon Glen' area of west central Scotland, the Central Belt cluster displays a high percentage of high tech manufacturing employment. The presence of major UK research universities also favourably enhances the cluster's presence of knowledge-based employees.

The pattern of air pollutant emissions in the Central Belt cluster mirrors that of elsewhere in the UK, in that the urban footprint and major road network can be easily picked out. Given that this area is particularly highly urbanised and has a dense road network, the Central Belt cluster has higher than average levels of emissions.

The Belfast Cluster

The cluster focuses around the Belfast city region which is Northern Ireland's equivalent to London in terms of its significance for long distance commuters in the province. In the wider UK context, its connections with other places in England and Scotland via its two main airports are very important. It is, however, interesting to note that the level of air traffic between Belfast and London is not that different from the level between Belfast and North West England (especially Liverpool), given the dominance of London as a world city. There are two sea ports in the Belfast cluster, which mainly concentrate on handling domestic tonnage.

While Belfast city itself has significantly lost population over the last two decades, its wider hinterland especially areas towards the south has gained population. On the whole, it has a rather young population structure and the population has similar life expectancy to the UK average. Within the Belfast cluster, deprivation tends to concentrate in inner urban areas. The average earnings and house prices are similar to the UK average. It is interesting to note, however, that there are differential employment rates in the area, with a higher rate in the northern part of the cluster. There are two major universities in the Belfast Cluster that provide research capacity for the area. The cluster, in general terms, does not suffer from major air pollution problems, though higher levels of air pollution are found in the inner urban area.

The South Wales and Bristol Channel Cluster

The towns and cities of South Wales and the Bristol Channel area form the sixth major spatial cluster in the UK. In spite of their physical proximity, Bristol and Cardiff city region are functionally quite separate, each with their own commuter belt. Both Bristol and Cardiff have their own airports mainly for international charter flights, though Bristol has a medium size airport while Cardiff Wales International Airport is rather small in scale.

The impact of London as a major destination for long-distance commuting does not reach out towards either Bristol or Cardiff. This is despite the fact that Bristol has very frequent rail connections with London. It is interesting to note that while there are over 250 direct inter-city trains travelling from and to Bristol, Cardiff only has 91. This suggests that Cardiff's rail connections with other main cities are heavily relied upon the Bristol service.

In terms of population movements, despite the fact that the South West gained population from the South East and London, Bristol urban area lost population to London though with an overall gain from other urban areas. This means that Bristol had an overall population growth between 1981 and 2001. Meanwhile, Cardiff city had a net loss of population to London and a small net gain from other major cities, which resulted in an overall net loss of population. During the last two decades, the city of Cardiff has gained population but there has been continuous population decline in the Welsh Valleys.

Similar to many other cities, Bristol city-region also has some areas ranking highly in the Index of Multiple Deprivation, yet not to the same extent as some other large urban areas. In the South Wales context, significant deprivation problems are found concentrated in inner city Cardiff and the Valleys. In terms of economic competitiveness, the Bristol area has a higher than average employment rate and a larger number of high tech and knowledge intensive employment. This area has a strong research capacity considering the population size of its urban areas. The wider Cardiff city-region, on the other hand, has a lower employment rate mainly due to the situation in the Valleys, but the area as a whole has attracted a large number of high tech and knowledge-based employment. It has a number of research institutes, though they are not performing in a significant way independently.

The level of air pollutant emissions in both areas shows no significant difference from many other parts of urban England. The life expectancy in both areas is similar to the UK average, with lower expectancy in the city of Bristol and the Welsh Valleys.

The identification of the South Wales and Bristol Channel Cluster as a single functional area is perhaps counter-intuitive in some respects. However, in spite of their distinctive functional commuting belts, there is still significant commuting between the core cities of Cardiff and Bristol. When compared to the level of flows between Manchester and Leeds, for example, Cardiff and Bristol show a relatively high degree of linkage. For example, gross commuting between Manchester and Leeds in 2001 was 859, whilst the comparable figure for Cardiff and Bristol was 1,271, including a commuting

flow of 957 from Cardiff to Bristol. In addition, there is also strong connection through migration of population and rail traffic.

The discussion above suggest that there is a relatively high degree of connectivity between the two city-regions and, therefore, justifies the identification of a single area, albeit one that operates two sub-clusters simultaneously.

Conclusion

This research has analysed and interpreted the spatial patterns of functional connectivity and interaction between different places in the UK, and the spatial outcomes created by key drivers of change. It is interesting that the spatial patterns emerging from different indicators tend to repeat themselves. This suggests that the spatial processes of change and the resultant spatial structures are interacting and reinforcing the long-standing spatial trends identified. More importantly, notwithstanding the fact that there are data gaps in the analysis, the recurring spatial patterns give confidence to the rigour of the analysis.

Another important aspect of this study is that it did not set off to base itself on any particular set of spatial units or administrative boundaries to examine the spatial structure. The analysis was based on data that are available at the finest spatial scale and provide full coverage of the UK. This allowed us to remove the artificial constraints imposed by administrative boundaries and use a fresh approach to explore spatial connectivity and the resultant spatial patterns. This means that even though we did not conduct a major statistical exercise to derive the boundaries of the six spatial clusters, their conceptual delineation is robust.

Several spatial patterns emerged from the series of maps highlighting concentration and dispersal of different socio-economic activities. The purpose of this study is to enhance our understanding as well as to stimulate further discussion about the functional connections between places, and the macro-spatial hierarchical system of the nation. As emphasised before, the analysis does not aim to lead to any prescriptive policy formulation; it does however show that the exploration of spatial functional connections is critical to the derivation of spatial policy. The analysis here demonstrates the methodological toolkit that could be used to enhance such an understanding.

The research intended to cover a wider range of indicators to provide a more rounded exploration of the spatial structure and functional connections of different areas. Due to the difficulty of gathering consistent data for the entire UK, some very useful indicators have been omitted from the analysis. These include:

- Financial information and investment flows
- Trade flow and linkages
- Data on high-tech and knowledge industries for Northern Ireland
- Rateable value of commercial floorspace
- Domestic burglary rates
- Qualifications of school leavers
- Travel to shop journeys
- Vacant and derelict land
- Re-use of previously developed land
- Water catchment areas

When these datasets become available at more fine-grained spatial scales with full coverage for the UK, it would be useful to further examine the spatial structures to complete the jigsaw of analysis.

Following the findings from this research, the next logical step is to use the identified spatial clusters as the springboard to test different policy scenarios by projecting their likely impacts on the national spatial hierarchy and the interaction and connection between different places, both urban and rural. The comparative analysis of the ‘what if’ scenarios under different policy directions will help stimulate debate over the relevance of having a spatial planning framework for the UK.

Annex 1
Research Methodology

The methodological steps involved in the study are:

(1) To understand the functional spatial structure of the UK through the use of a number of indicators to demonstrate distribution of key infrastructure and its spatial connectivity, and the dynamic movements of residents and workers.

(2) To map the trends and patterns of key drivers of socio-economic and environmental change by using a small bundle of indicators to develop a portrait of each driver.

(3) To compare and interpret the spatial patterns emerging from the different components in order to understand the relationship between the spatial structure and the key drivers of change, and to evaluate whether existing administrative boundaries provide an appropriate spatial framework to deliver spatial strategies for future change.

Since the idea of this study is to produce some conceptual maps to manifest the underlying functional spatial structure of the UK to allow further analysis, indicators are mapped with data at the finest spatial scale available. For datasets that are available at more refined grid reference or postcode spatial units, GIS was used to integrate these data into a coherent dataset. In addition, due to the changing definitions used in different censuses and different datasets (e.g. change in local government boundaries), significant GIS data-processing work has been required to bring all data into a consistent and coherent format for analysis.

It is also important to note that Scotland and Northern Ireland have different data collection practices from England and Wales, so there have been difficulties encountered in compiling data with consistent definitions and spatial scales, as well as lack of complete spatial coverage of the UK. This means that the indicators included in this study have been constrained by the availability of reliable and consistent datasets across different parts of the UK.

Annex 2
Data Sources and Health Warnings

Figure	Indicator	Data Source	Definition and Health Warnings
1.1	Roads	EDINA/UKBorders	Major 'A' Roads and Motorways are shown. Size and type of 'A' road differs considerably across the UK, but those shown are principal routes in their respective areas.
	Airports	Author/CAA UK Airport Statistics	Not all UK airports shown, only current major airports or those targeted for significant development in the 2003 White Paper *The Future of Air Transport*.
	Ports	Author/DTI	All ports for which data is collected are shown here.
	Trains	EDINA/UKBorders	Five and ten kilometre buffers were generated around train station locations. This indicates proximity to a rail station and *potential* train travel, rather than *actual* connectivity.
	UK Outline	ESRI	Generalised boundary of the UK.
1.2	Inter-City Trains	National Rail Enquiries	Map shows largest one-way connection, in number of possible train journeys, between selected UK cities between the hours of 0600 and 1800 on weekdays. Data extracted on 14th February 2006. Cities included in analysis: *Aberdeen, Birmingham, Brighton, Bristol, Cardiff, Dundee, Edinburgh, Glasgow, Inverness, Leeds, Liverpool, London, Manchester, Newcastle, Norwich, Nottingham, Plymouth, Sheffield, Southampton, Swansea, Wrexham.* The cities chosen for this analysis include the major urban areas identified in the definitions section below, and a selection of other strategically important towns and cities dispersed across Great Britain.
	UK Outline	ESRI	Generalised boundary of the UK.
1.3	Rail Times from London	National Rail Enquiries	Given scale of cartogram, some minor inaccuracies may exist in the exact positioning of cities close to point of origin. Journey times are for direct trains leaving at or before 0800 Monday to Friday.
	UK Outline	ESRI	Generalised boundary of the UK, shown for illustrative purposes only in order to provide geographical context for direction.
1.4	Rail Times from Manchester	National Rail Enquiries	Given scale of cartogram, some minor inaccuracies may exist in the exact positioning of cities close to point of origin. Journey times are for direct trains leaving at or before 0800 Monday to Friday.
	UK Outline	ESRI	Generalised boundary of the UK, shown for illustrative purposes only in order to provide geographical context for direction.
1.5-1.8	UK Airport Passengers	Author/CAA UK Airport Statistics	Not all UK airports shown, only current major airports or those targeted for significant development in the 2003 White Paper *The Future of Air Transport*.
	UK Outline	ESRI	Generalised boundary of the UK.
1.9-1.11	UK Airport Connectivity	Author/CAA UK Airport Statistics	Only those airports with a passenger linkage of 1000 or more are shown on these maps.
	UK Outline	ESRI	Generalised boundary of the UK.

1.12-1.13	UK Ports	DfT Maritime Statistics 2004	Major ports are those handling more than 1 million tonnes annually. Of the 51 shown, only Newhaven, Swansea, Boston, Peterhead, Great Yarmouth and Fishguard are below this level.
	UK Outline	ESRI	Generalised boundary of the UK.
1.14-1.17	Commuting Distance by Wards (up to 5 km) 2001	Census 2001	- The distance travelled is a calculation of the straight line between the postcode of place of residence and postcode of workplace. - Figures for place of residence were used, taken from tables S120, UV36, UV117 - In Scotland the figures also include travel to work of study and are therefore not directly comparable with the rest of the UK.
1.18	Average Commuting Distance by Wards (km) 2001	Census 2001	Taken from Table KS015 Travel to Work
1.19-1.22	UK GOR Migration in 2000-01 and 1990-91	Census Interaction Data Service	Government Office Region Migration data for 1991 is not available for Northern Ireland. For representation purposes, geographic centroids of regions are used, rather than specific cities. Flow lines constructed via an implementation of the Flow Data Model Tool (FDMT) for ArcGIS 9.0.
	UK Outline	ESRI	Generalised boundary of the UK.
1.23-1.28	UK Inter-Urban Migration in 2000-01	Census Interaction Data Service	Inter-urban migration uses core cities of urban regions, rather than individual local authority boundaries. The data used follows 'CIDS interaction data district' boundaries, which are identical to local authority boundaries, except in the case of Northern Ireland. See Definitions section below for full list of urban areas used for this section. For representation purposes, geographic centroids of core cities are used, rather than specific cities. Flow lines constructed via an implementation of the Flow Data Model Tool (FDMT) for ArcGIS 9.0.
	UK Outline	ESRI	Generalised boundary of the UK.
1.25	International Migration	Census 2001	Data for international migration to UK Government Office Regions is derived in part from the International Passenger Survey. More information on this source can be found at: http://www.statistics.gov.uk/ssd/surveys/international_passenger_survey.asp.
2.1	Population Change 1981-2001	Census 1981, 2001	- Population 2001: Table KS001 – usual resident population, all people Population 1981: - Table SAS81 – all present and absent residents, Manually adjusted to 2001 district boundaries using population data for 1981 enumeration districts Important: in 2001 students were counted at their place of study
2.2	UK Population Pyramid 2001	Census 2001	Source: www.statistics.gov.uk/census/2001/pop2001/print_v/united_kingdom_print.asp .
2.3	Share of Working Age Population 2001	Census 2001	Calculated based on table KS002 Age Structure

2.4	Retired Population of the UK	Census 2001, Key Statistics	The retired population data refers to economically inactive persons who are classified as retired, and not simply the population aged over 60 (female) or 65 (male).
	UK Districts	ESRI	Generalised district boundaries in the UK.
2.5-2.6	Life Expectancy	ONS	All figures were calculated by ONS with the exception of results for Scotland for 2002-2004. These were calculated by the General Register Office for Scotland (GRO-S) and published in a report on 6th October 2005.
	UK Districts	EDINA/Ordnance Survey	Generalised district boundaries in the UK.
2.7	UK Deprivation	Various	The different indices for the UK use slightly differing methodologies, so are not directly comparable between the constituent nations of the UK. However, there is a high degree of correlation between the indices in general and they provide an accurate representation of the geography of deprivation in the UK in general.
	English IMD	ODPM	The English Indices of Deprivation 2004 (Revised) were used here, at the lowest geographical resolution (Super Output Area, Lower Level). Only those areas in the most deprived 20% of the index are shown. The data is available from the ODPM, at: http://www.odpm.gov.uk/index.asp?id=1128445. Boundary
	SOA	EDINA/Ordnance Survey	Lower level super output areas were used to map the English Indices of Deprivation 2004.
	Scottish IMD	Scottish Executive	The Scottish Index of Multiple Deprivation 2004 was used here, at the Data Zone level. Only those areas in the most deprived 20% of the index are shown. The data is available from the Scottish Executive, at: http://www.scotland.gov.uk/stats/simd2004/.
	Data Zones	Scottish Executive	Data zones were used to map the Scottish Index of Multiple Deprivation 2004.
	Welsh IMD	Statistics for Wales	The Welsh Index of Multiple Deprivation 2005 was used here, at the lowest geographical resolution (Super Output Area, Lower Level). Only those areas in the most deprived 20% of the index are shown. The data is available from the ODPM, at: http://www.wales.gov.uk/keypubstatisticsforwales/wimd2005.htm.
	SOA	EDINA/Ordnance Survey	Lower level Super Output Areas were used to map the Welsh Index of Multiple Deprivation 2005.
	Northern Ireland MDM	NINIS	The Northern Ireland Multiple Deprivation Measure 2005 was used here, at the lowest geographical resolution (Super Output Area, Lower Level). Only those areas in the most deprived 20% of the index are shown. The data is available from the ODPM, at: http://www.ninis.nisra.gov.uk/.
	SOA	EDINA/Ordnance Survey	Lower level Super Output Areas were used to map the Northern Ireland Multiple Deprivation Measure 2005.
2.8	Urban Footprint - Continuous Built-up Areas	EDINA/Ordnance Survey	This dataset has been derived from the publicly available Vector Map 0 (VMAP 0) data, extracted from the NIMA Geospatial Engine (http://geoengine.nima.mil and http://www.nima.mil) and made available on UK Borders.
2.9	Gross Annual Income (Median Value) 2005	ASHE	Annual Survey of Hours and Earnings (ASHE), figures for full time workers
2.10	Average House	Land Registry	- Land Registry of England and Wales

	Price October-December 2005		- Registers of Scotland Executive Agency. All figures are simple averages based on all residential properties between £20,000 and £1,000,000 recorded in the four quarters of each year. - University of Ulster in partnership with Bank of Ireland. As data is collected for regions this was applied to district geography.
2.11	Employment Rate Working Age Population 03/03-02/04	NOMIS/DETI	- England, Wales, Scotland: Labour Force Survey – Four Quarter Averages - Northern Ireland Labour Force Survey 2003, District Council Labour Market Structure 2003, Department of Enterprise, Trade and Investment
2.12	SSOQ Index	Census 2001	The supply-side over qualification index is a ratio measure, comparing the number of people with degree or above qualifications, with those in higher-level managerial and professional employment. Where the SSOQ index is equal to 1.0, there are an equal number of high-level jobs to qualifications. Where the score is less than 1.0, there are more highly-qualified persons than high-level jobs. Where the score is more than 1.0, there are more high-level jobs than highly-qualified persons.
	UK Districts	ESRI	Generalised district boundaries in the UK.
2.13	Knowledge Industries 2004	Nomis, Annual Business Inquiry	This map shows the percentage of persons in each district working in 'Knowledge Industries' in 2004, categorised using SIC92 codes, as follows: **61** - Water transport **62** - Air transport **64** - Post and telecommunications **65** - Financial intermediation, etc **66** - Insurance and pension funding, etc **67** - Act auxiliary financial intermediation **70** - Real estate activities **71** - Renting machinery/equipment, etc **72** - Computing and related activities **73** - Research and development **74** - Other business activities **80** - Education **85** - Health and social work **92** - Recreational, cultural and sporting Data were not available for Northern Ireland in 2004.
	GB Districts	EDINA/Ordnance Survey	Generalised ward boundaries in the UK.
2.14	High-Tech Manufacturing	Nomis, Annual Business Inquiry	This map shows the percentage of persons in each district working in 'High-Tech Manufacturing' in 2004, categorised using SIC92 codes, as follows: **30 -** Manuf office machinery and computers **32** - Manuf radio, TV/communications equipment **33** - Manuf medical, precision instruments, etc

			Data were not available for Northern Ireland in 2004.
	GB Districts	EDINA/Ordnance Survey	Generalised ward boundaries in the UK.
2.15	High-Tech and Knowledge Industries	Nomis, Annual Business Inquiry	This map shows the percentage of persons in each district working in 'High-Tech Manufacturing', 'Medium-High-Tech Manufacturing' and Knowledge Intensive Sectors in 2004, categorised using SIC92 codes, as follows: **24** - Manuf chemicals and chemical products **29** - Manuf machinery and equipment nec **30** - Manuf office machinery and computers **31** - Manuf electrical machinery/apparatus nec **32** - Manuf radio, TV/communications equipment **33** - Manuf medical, precision instruments, etc **34** - Manuf motor vehicles, trailers, etc **35** - Manuf other transport equipment **61** - Water transport **62** - Air transport **64** - Post and telecommunications **65** - Financial intermediation, etc **66** - Insurance and pension funding, etc **67** - Act auxiliary financial intermediation **70** - Real estate activities **71** - Renting machinery/equipment, etc **72** - Computing and related activities **73** - Research and development **74** - Other business activities **80** - Education **85** - Health and social work **92** - Recreational, cultural and sporting Data were not available for Northern Ireland in 2004.
	GB Wards	EDINA/Ordnance Survey	Generalised ward boundaries in the UK.
2.16	RAE Research Capacity 2001	HERO	This figure relates to research grade and capacity (research active staff) of the higher education sector in the 2001 Research Assessment Exercise. The figures for the University of Manchester and UMIST, and for the separate colleges and institutions of the University of London have been combined here, hence the larger appearance of these on the map, compared to the individual institution scores.

	UK Universities	Manually Digitised	The locations of some universities have been off-set slightly in order to enhance display capability. For some institutions that have multiple campuses (e.g. The University of Ulster, UHI Millennium Institute), a single campus point was chosen for display purposes. For The Open University, the data is displayed in the location of Milton Keynes.
2.17	Public Transport Commuters with Car Access 2001	Census 2001	- Table KS015 Travel to Work, Share of public transport users with access to a car in the same household for wards. - In Scotland figures include travel to place of study
2.18-2.21	UK Emissions Data	NAEI	This data was sourced from the National Atmospheric Emissions Inventory, in e00 format and mapped in ArcGIS 9.0. The NAEI is funded by Defra, The National Assembly for Wales, The Scottish Executive and The Department of Environment, Northern Ireland. The NAEI compiles estimates of emissions to the atmosphere from UK sources such as cars, trucks, power stations and industrial plant. These emissions are estimated to help to find ways of reducing the impact of human activities on the environment and our health. For more information on this source, see: http://www.naei.org.uk/. The mapping extends to the extent of the UK coastline and also includes data on emissions relating to North Sea Oil and Gas production.
2.22	Household Waste Recycling Rate 2004	Local Authority Audits	- National Assembly for Wales Performance Indicators - Audit Commission – Local Authority Performance Indicators - Scotland Audit, Waste Management - Full 2004/2005 household recycling rates for NI http://www.letsrecycle.com/materials/composting/news.jsp?story=5014
3.1	Transport Infrastructure and Functional Spatial Clusters	EDINA/Ordnance Survey/Manually Digitised	Areas identified through a synthesis of previous figures and data analysis. Symbolic names assigned based on functional spatial activity.
3.2	Inset of 3.1	EDINA/Ordnance Survey/Manually Digitised	Areas identified through a synthesis of previous figures and data analysis. Symbolic names assigned based on functional spatial activity.

Definitions

Classification for Analysis of Major City Migration Flows

England – 74 Areas

London-Inner (14)
- Camden
- City of London
- Hackney
- Hammersmith and Fulham
- Haringey
- Islington
- Kensington and Chelsea
- Lambeth
- Lewisham
- Newham
- Southwark
- Tower Hamlets
- Wandsworth
- Westminster

London-Outer (19)
- Barking and Dagenham
- Barnet
- Bexley
- Brent
- Bromley
- Croydon
- Ealing
- Enfield
- Greenwich
- Harrow
- Havering
- Hillingdon
- Hounslow
- Kingston upon Thames
- Merton
- Redbridge
- Richmond upon Thames
- Sutton
- Waltham Forest

Bristol-South Gloucestershire (2)
- City of Bristol
- South Gloucestershire

Leeds-West Yorkshire (5)
- Bradford
- Calderdale
- Leeds
- Kirklees
- Wakefield

Liverpool-Merseyside (5)
- Knowsley
- Liverpool
- Sefton
- St. Helens
- Wirral

Greater Manchester (10)
- Bolton
- Bury
- Manchester
- Oldham
- Rochdale
- Salford
- Stockport
- Tameside
- Trafford
- Wigan

Nottingham (3)
- Broxtowe
- Gedling
- Nottingham

Birmingham-West Midlands (7)
- Birmingham
- Coventry
- Dudley
- Sandwell
- Solihull
- Walsall
- Wolverhampton

Newcastle-Tyne and Wear (5)
- Gateshead
- Newcastle-upon-Tyne
- North Tyneside
- South Tyneside
- Sunderland

Sheffield-South Yorkshire (4)
- Barnsley
- Doncaster
- Rotherham
- Sheffield

Northern Ireland – 4 Areas

Belfast (4)
- Belfast East
- Belfast North
- Belfast South
- Belfast West

Scotland – 9 Areas

Glasgow (6)
- Glasgow City
- Renfrewshire
- East Renfrewshire
- East Dunbartonshire
- West Dunbartonshire
- North Lanarkshire

Edinburgh (3)
- City of Edinburgh
- Midlothian
- West Lothian

*South Lanarkshire is omitted from the Glasgow urban area owing to its large geographical extent and the inability to disaggregate some places (e.g. East Kilbride, Hamilton) from the entire area.

Wales – 3 Areas

Cardiff (3)
- Cardiff
- Vale of Glamorgan
- Newport

Annex 3
Identifying Functional Spatial Clusters

The identification of functional spatial clusters in Figure 3.1 is not intended to be a discriminatory exercise. Rather, it is an explicit recognition of the fact that the UK can be sub-divided into loosely defined spatial clusters on the basis of two inter-related components:

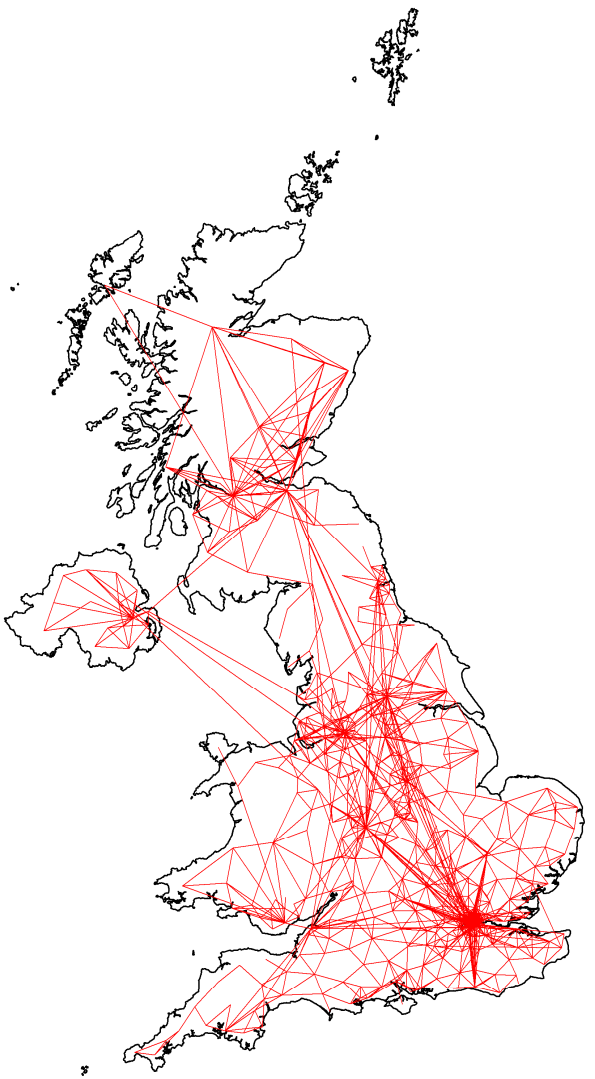
1. Spatial Form: e.g. the geography of the urban footprint, the distribution and density of transport infrastructures;
2. Spatial Flows: e.g. the level of commuting, migration or other moves between different areas.

The operative term in the identification of these areas is 'cluster'. Therefore, many rural areas and some relatively large urban areas (e.g. Plymouth, Aberdeen) are not identified as being within these functional areas since they form relatively isolated clusters in their own right, outside the geographical extent of the largest spatial clusters. If functional spatial clusters were to be identified at a lower geographical scale (e.g. regional or sub-regional) then areas that are not currently within the major clusters would certainly be included. However, the current work focuses on the identification of spatial structures at a *United Kingdom* level, hence the apparent discrimination between certain places.

As stated in the main body of the report, the clusters are intended to be *conceptual* rather than *concrete* and the exact positioning of boundaries is of course open to debate. Nonetheless, the derivation of these clusters is based to a large degree on a synthesis of the data used in the compilation of this report. This data, either static (e.g. demographic variables) or dynamic (e.g. migration statistics) has been interpreted at a United Kingdom level in order to pick out the largest functional clusters that can easily be identified. Put simply, these conceptual clusters have a consistent and defensible statistical heritage.

In order to demonstrate how these areas were constructed, visualising district level migration data is particularly insightful. In Figure A3.1 the level of migration between local authority districts in the UK is set at 250 or more (gross flows, 2000-2001). At this level of interaction, the United Kingdom looks like an inter-connected web of flows but the core areas identified previously are beginning to emerge.

Figure A3.1 – Inter-District Flows: 250 or More, 2000-2001



The threshold at which areas become separated is in many ways related to the original population base. Since this analysis is concerned with absolute flows and the absolute level of connectivity between places (i.e. the actual level of connection between places) rather than relative connections, different connection strengths have been tested.

In Figure A3.2 the level of connectivity between local authority districts has been increased to 500. These areas are much more clearly separated than the in Figure A3.1 and demonstrate the separation between clusters identified in Figure 3.1. In particular, the disconnection between The London Supernova cluster and The Central Constellation, and The London Supernova and The South Wales and Bristol Channel Cluster is particularly evident here. In addition, The Metropolitan Nexus sub-cluster also exhibits a high-degree of inter-connectivity.

In Figure A3.3, the level of connectivity between local authority districts is increased to 750. At this level of interaction, the United Kingdom is much more disintegrated and local clusters are much more clearly identifiable. At this level of interaction, these areas are analogous more to local housing market areas (using absolute flows) than they are to the overall functional clusters in Figure 3.1, but it is useful to highlight the level at which interactions begin to diminish.

Finally, Figure A3.4 shows the level of interactions at 500 or more, overlaid onto the urban footprint. This layering of different datasets, both dynamic and static, illustrates the relationship between spatial form and spatial flows at the level of the United Kingdom. Clearly, areas outside the major functional spatial clusters are important and need to be considered in a spatial planning framework, but it is obvious from this analysis that the spatial structure of the United Kingdom us highly correlated with its urban form and inter-urban connectivity in particular.

Figure A3.2 – Inter-District Flows: 500 or More, 2000-2001

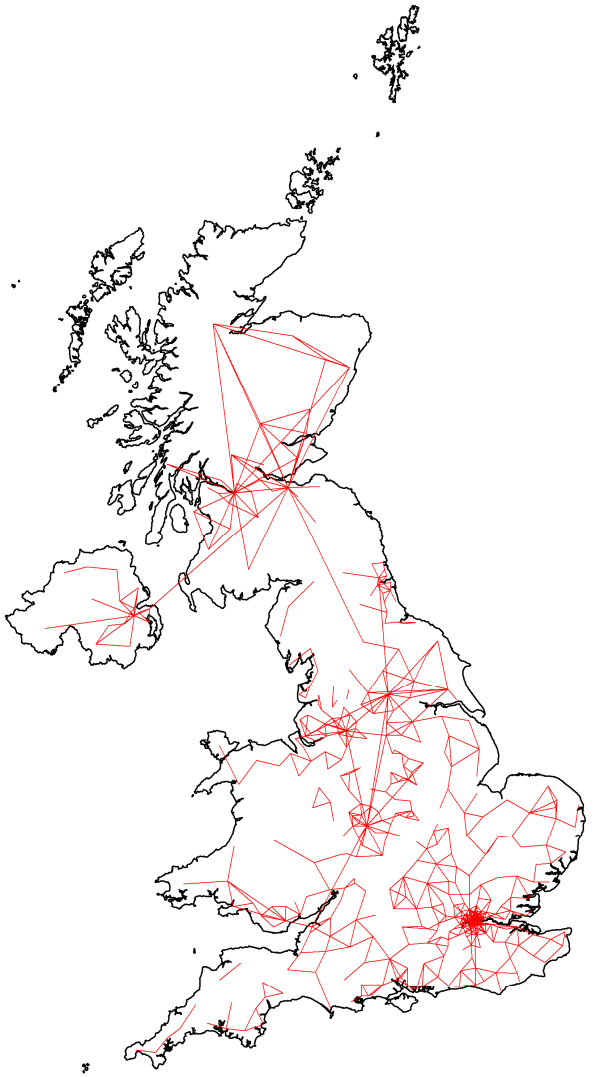


Figure A3.3 – Inter-District Flows: 750 or More, 2000-2001

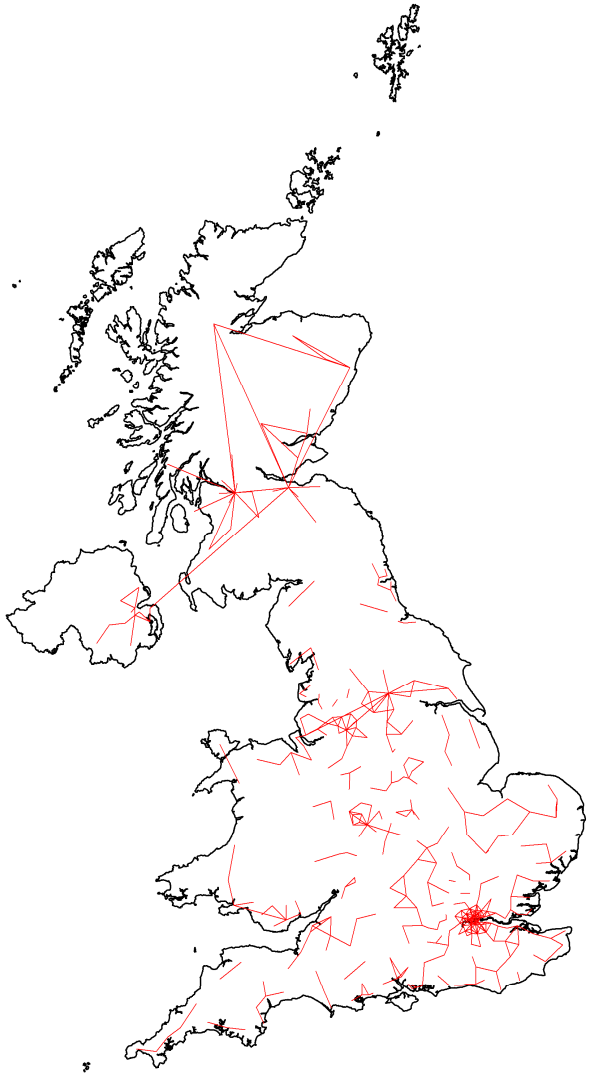


Figure A3.4 – Flows Over 500 and Urban Footprint