The Spatial Interaction of Housing and Labour Markets: Commuting Flow Analysis of North West England

Stephen Hincks
and
Cecilia Wong

Centre for Urban Policy Studies, School of Environment and Development, University of Manchester

Abstract

The consideration of housing and labour market interaction is a relatively recent development in an academic and policy debate which has traditionally considered home and work in isolation. This paper aims to empirically examine the spatial process of housing and labour market interaction in the form of commuting at the sub-regional level via a case study of North West England. A statistical analysis and visual GIS mapping of commuting flows is adopted to explore the relationship between two sets of functional areas. This approach will generate more relevant intelligence to inform policy development compared to the previous use of modelling approaches that are crouching on a set of simplistic assumptions and with little understanding of how the two markets interact. Based on the findings on the nature of commuting and the process of housing and labour market interaction, some pointers for future research and policy implications are drawn out.

Introduction

There have been plenty of studies focusing on housing and labour market issues but there has been a distinctive lack of systematic research examining the interaction of housing and labour markets (Allen and Hamnett, 1991: 3). The reason for this research vacuum is that many complex multi-agent and multi-sector interactions have not been adequately captured by traditional modelling approaches (Wong, 2002; Wong *et al*, 2000, 2006). In particular, there is a lack of understanding of the dynamic processes involved in the interaction of different issues (Turok *et al*, 1999) and a lack of quality statistics to support the development of statistical models to explore such issues (Wong, 1998a).

Recent planning policy in Britain has been preoccupied with housing supply and the delivery of affordable homes, particularly in the South East and London; and the problem of vacant dwellings and declining neighbourhoods, notably in the northern English regions. In spite of the very different nature of housing problems in different parts of the country, there has been increasing recognition that a policy framework is needed to tackle the challenges of the changing demographic structure of the UK, the different needs of the economy and labour force, and the 'boom or abandonment' process that characterises housing markets in the UK (Mumford and Power, 2003; ODPM, 2003).

The traditional understanding of housing and labour market interaction is that rigidities in the housing market hinder the geographic mobility of labour (Barlow, 1990; Forrest and Murie, 1990). The evidence emerging from key policy documents suggests that this macroeconomic stance continues to underpin both housing and planning policies at the national level, which is reflected in the government's view that planning policies should encourage housing development in areas with good access to jobs (e.g. ODPM, 2003; Barker, 2004; Barker, 2006). However, this macroeconomic viewpoint has been challenged as partial and unhelpful in fully explaining the interaction of housing and labour markets (Jarvis, 1999; Baker and Wong, 2006). The counterargument is that the geographic mobility of labour does not simply entail the movement of individuals between two locations but is dependent on the willingness of the entire household to relocate. There has also been a shift in the labour market towards 'flexible' practices. The rapid increase in female participation rates in the labour market, part-time employment and fixed term contracts have all affected the division of labour within households. Consequently, residential location decision-making has become much more complicated. However, despite evidence showing that housing problems have to be tackled by taking into account a broad range of issues, including labour market change and access to transport, there is actually very little policy guidance on how to integrate housing policy with other strategies, sectors or services (Cole and Nevin, 2004).

Academic research in the UK has pointed to a concurrent trend of disintegration between residential and employment locations in the last few decades (Breheny, 1999). Commuting patterns have become very complex, evolving from traditional patterns of travelling from suburban residential locations to work in urban centres, to also include cross-commuting between suburbs as well as reverse commuting from urban homes to non-urban workplaces. This complexity has been exacerbated by the rapid increase in dual career households that often adopt long-distance commuting as the mechanism for balancing their chosen residential and workplace locations (Green, 1997). In addition, increased car usage has resulted in the expansion of labour market catchment areas. As the 2001 Population Census shows, more than 800,000 workers in England and Wales travel more than 48 km to work (Nielsen *et al*, 2005), which is up by a third since the 1991 Census, and the threshold of commuting has extended to a 60 km belt stretching outwards from central London to the surrounding South East (Wong *et al*, 2006). The prospect of the increasing adoption of ICT and flexible working practices means that certain types of jobs will become increasingly footloose. With less frequent commuting journeys, the process of spatial disintegration

between employment and housing is very likely to be accelerated. It is the need to understand these complex changes that supports the call made in this paper for the adoption of a more systematic examination of the nature of housing and labour market interaction and their implications for policymaking.

The paper, therefore, aims to empirically examine housing and labour market interaction in North West England and to draw out the associated policy implications. The next section outlines the wider theoretical and methodological context of housing and labour market interaction. The third section explains the research methodology and the outcome of identifying the sub-regional housing and labour markets in the North West. This is followed by an empirical analysis of the nature and characteristics of different forms of housing and labour market interaction in the region. The penultimate section draws out the key findings of the analysis and their wider policy implications for the delivery of the government's sustainable communities agenda. The paper concludes with some pointers for future research.

Contextualising Housing and Labour Market Interaction

Unlike generic commodity markets, housing and labour markets are unique. Housing units are highly durable and do not necessarily depreciate due to ageing (Quigley, 1979). The high cost of housing can also be seen as an attractive investment for asset accumulation and the heterogeneity of housing units means that even at the same market price, both suppliers and consumers can view them as significantly different. These factors point to one important feature of housing, its location, which is jointly consumed with the structural characteristics of the housing unit. Therefore, in choosing a residential location, households will attempt to address their housing aspirations and requirements in relation to family life-cycle needs, whilst attempting to take into account the positive and negative features of the local neighbourhood in order to maximise utility (Brown and Moore, 1970). Indeed, research undertaken by Rogerson *et al*. (1989) suggests that workers tend to attach great importance to their own social well-being such as safety from crime, good health provision, low environmental pollution and reasonable house prices ahead of employment prospects and commuting times.

Similarly, labour markets have their unique characteristics (Bosworth *et al*, 1996). Each worker sells his/her effort while retaining his/her inherent capital. Workers are not passive agents in the market. They have preferences for certain types of jobs, employers and places of

employment and will often make employment decisions as a household rather than on an individual basis (Jarvis, 1999). Likewise, employers also have recruitment preferences over characteristics such as age and gender. As the findings of an ESRC-funded research study (Wong, 1998b) shows, there is a clear prioritisation of traditional factors of production (e.g. physical factors, location, human resources, finance and infrastructure) over the less tangible issue of 'quality of life' when it comes to making business location decisions. Quality of life is, nevertheless, seen as either a secondary consideration or something that can be achieved through a willingness to commute.

People tend to locate in a residential area that suits the needs of some or all members of the household, while businesses tend to locate in areas that have strong potential for profits (Wong *et al*, 1999). Where tensions arise between the choice of employment and residential locations, the solution commonly involves a lengthening of the journey-to-work (Cervero, 1995; Spence and Frost, 1995). From the demand side, the key issue is whether the employment opportunities that are available match the skills of local workers or whether the jobs are outsourced to commuters from beyond the immediate housing markets (Immergluck, 1998). There is a tendency for those with professional and specialist skills to seek employment opportunities over a much wider search area than lower skilled workers (Gordon, 1999). This is coupled by a parallel trend of 'roots' effect in which households choose a fixed residential base and cope with job changes by commuting (Breheny, 1999). Research has found that residential locations close to motorways are popular for dual career households because of the benefits offered by such locations for maximising employment opportunities for both workers (Green, 1997). The mobility of the workforce has compressed the spatial distance between homes and workplaces which has created the potential for workers to substitute longer distance commuting for migration (Green *et al*, 1999).

Commuting is a demand and supply relationship expressed over geographical space. The patterns of commuting are, therefore, central to our understanding of the daily interaction of housing and labour markets as they provide a means of analysing the direction, volume and strength of movements between residential and workplace locations. Traditionally, the analysis of commuting has tended to rely on the development of econometric models to explain journey-to-work flows. The classic monocentric model, with the assumptions that all employment is concentrated in the city centre and that households will trade-off housing costs and space with transport costs and accessibility to the city centre (Alonso, 1964), has

been challenged by the emergence of poly-nodal urban systems. It has been recognised that as a result of the continuous process of urban decentralisation, the traditional relationship between suburban (residential) and city centre (employment) locations has been undermined and that alternative frameworks are needed in order to conceptualise and model the process of commuting more realistically (Van der Laan, 1998).

The monocentric model has been adapted to take decentralisation into account, in which it is assumed that commuters can travel to non-central employment locations on a radial between the city centre and their place of residence. In the deconcentrated model, commuting is still assumed to be city centre-orientated (reflecting the assumptions of the traditional monocentric model), but overall commuting distance is reduced because employment sub-centres tend to be located in close proximity to residential locations. Van der Laan *et al.*'s (1998) study in the Netherlands showed that the use of an adapted deconcentrated model slightly improved the explanation of commuting behaviour (19-59 per cent) when compared to the monocentric model which was only able to explain 4 per cent of actual commuting distance.

In response to the evolving multi-centred urban system, models of polycentric urban areas (e.g. the cross-traffic model) have emerged which assume that commuting is not centre orientated and that workers choose to travel to an employment location that is closest to their residential location. This is underpinned by the assumption that rational commuters will seek to minimise the costs associated with commuting (Hamilton, 1982). The application of the cross-traffic model with an associated 'excess commuting' measure[i] in the Netherlands resulted in a higher and more consistent level of explanation of commuting distance (40-55 per cent), but a large proportion of commuting distance remained unexplained (Van der Laan *et al*, 1998).

Since traditional modelling approaches fail to adequately explain commuting behaviour, this paper explores the value of adopting an alternative way of understanding commuting through the geo-visualisation and analysis of commuting flows. This approach consists of three key components: (1) the creation of an origin and destination matrix of actual commuting flows; (2) the simplification of commuting patterns through the Flow Standardisation Method; and (3) the mapping of the commuting flows using the Flow Data Model Tool for ArcGIS 9. The advantage of the geo-visualisation method is that it provides an analysis of 'actual' as

opposed to 'modelled' commuting behaviour, as well as facilitating the identification and interpretation of spatial patterns and relationships within complex datasets (Kwan, 2000).

Identifying Housing and Labour Markets: The Case of North West England

The spatial interaction of housing and labour markets, focusing on the process of commuting, is examined via the case study of North West England. The first task of the research was to develop a spatial component of the market where social and economic interactions of housing and jobs take place. A wide range of processes and methods have been used to delineate housing markets. However, following an in-depth review of these different processes and methods the Housing Market Area (HMA) approach, which is based on the analysis of migration patterns, was identified as being the most appropriate framework for delineating sub-regional housing markets for this study.

Housing Market Areas are functional areas within which households search for alternative accommodation without necessarily changing jobs (O'Sullivan *et al*, 2004; ODPM, 2005). Over the last decade or so research has focused on delineating and applying HMAs in Scotland which reflects the Scottish planning policy requirements that land allocation be made with reference to explicitly defined HMAs (see Jones, 2002; Jones *et al*, 2005). In contrast, research on HMAs in England has traditionally been limited, although there has been a recent surge of interest in defining sub-regional housing market areas (DTZ Pieda, 2004a; 2004b; Bibby, 2005; Coombes and Champion, 2006; Coombes *et al*, 2006) to carry out strategic housing market assessment (CLG, 2007a) following the publication of the Planning Policy Statement 3: Housing (CLG, 2007b).

A framework for HMA delineation was developed and applied in North West England by Hincks and Brown (2006) as part of a PhD study funded by the Northwest Development Agency (NWDA). For the first time, the 2001 Census of Population Special Migration Statistics (SMS) released a 100 per cent census of the origin and destination of migrants within a one-year period of the census date. The North West HMA delineation framework is informed by both economic principles and practical knowledge obtained through an iterative triangulation of information collected from estate agents [ii] and the statistical analysis of origin-destination migration data from the 2001 SMS. Since the methodology is fully explained in another article by Brown and Hincks (2008) in this journal, we only provide a

summary here. The framework identifies four main guiding principles for the delineation of HMAs:

- The HMAs should adopt a measure of supply and demand for housing, represented by the origin and destination flows of migrants;

- The delineation of the HMAs should be informed by continuous consultation with local estate agents;

- Resulting HMAs should satisfy both supply-side and demand-side self-containment criteria, with a minimum threshold of 70 per cent.

- The HMAs should have a close association in terms of size and scale to travel-to-work-areas (TTWAs).

The initial consultation with the estate agents resulted in the identification of 43 potential cores in the North West around which HMAs could be constructed. The derivation of the wider functional areas was based on the functional regionalisation of inter-ward migration flows using the intramax procedure (Masser and Brown, 1975; Brown and Pitfield, 1990). This initial 43-group solution was then evaluated based on the supply and demand-side migration self-containment and the continued consultation with estate agents. The validation process involved four iterations of the methodology to identify a final solution of 25 HMAs (Figure 1) that satisfied the supply and demand-side self-containment of 70 per cent and the recommendations of the estate agents. A striking feature of the regionalisation procedure was the degree to which, in many areas, the HMA geography differed from the underlying local authority administrative geography. This was particularly evident across the urban-industrial belt (Figure 2)[ii]. Similar inconsistencies between HMA and local authority geographies were also found by Jones (2002) in his study of HMAs in west central Scotland, demonstrating the inherent danger in accepting without question local authority boundaries as approximations to housing markets.

Figure 1: Housing Market Areas (HMAs) in North West England

Figure 2: 25-Group HMA Solution in the Urban-Industrial Belt Superimposed on Local
Authority District Boundaries
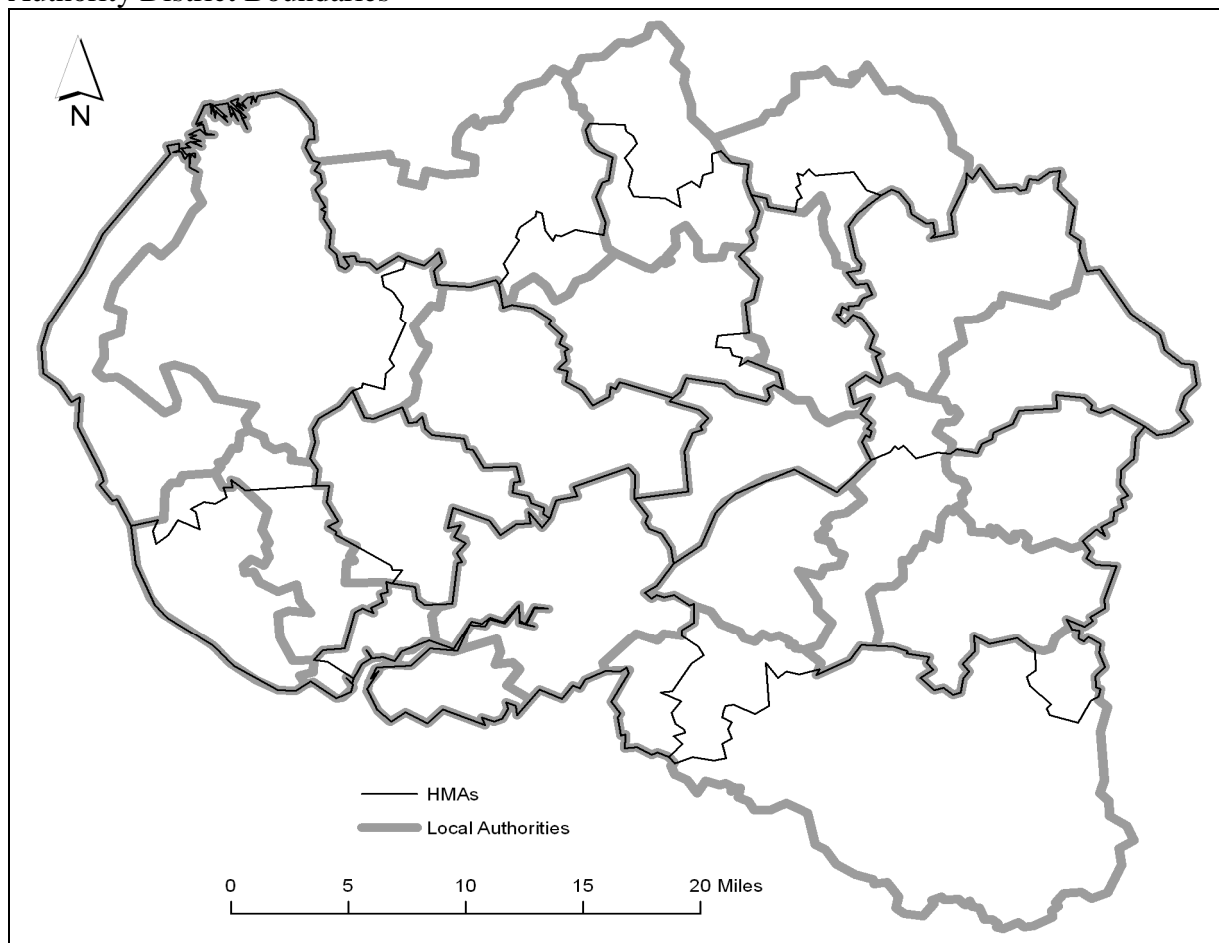
In relation to labour market delineation, travel-to-work areas (TTWAs) are the most widely
accepted and utilised functional approach. The boundaries of TTWAs are delineated using
commuting flows from the Special Workplace Statistics (SWS) from the Census of
Population. The framework is based on two key principles. The first is that a TTWA should
have a minimum residential workforce of 3,500 workers; the second is that a minimum of 75
per cent of all journey-to-work trips have both their origin and destination in the same area.
However, for larger TTWAs with a resident workforce in excess of 20,000, the self-
containment level is relaxed to 70 per cent (see Coombes and ONS, 1998).

At the time of the research in 2005 and 2006, the most recent TTWA delineation was based
on 1991 SWS data. This posed the cyclical issue of having a rather long lead-time between
the release of the raw census data and the derivation of the revised TTWAs. For example, the
1991 census-based TTWAs were not published until 1998. It is clear that the 1991-based

TTWAs are unlikely to be entirely accurate or unaffected by changes in the nature of travel-to-work patterns or by changes which have occurred in the administrative geography through ward creation and dissolution between the two censuses. In order to overcome the obsolescence issue, a validation exercise was undertaken to assess the robustness of the 1991-based TTWAs in relation to the 2001 SWS data and the revised ward boundaries from the 2001 Census. The validation exercise involved three stages.

The first stage focused on examining whether the 2001 wards provide a good fit to the 1991-based TTWA boundaries. If there were overlaps between 2001 wards and the 1991-based TTWA boundaries, the TTWA boundaries were optimised by allocating cross-cutting wards to a specific TTWA. This aimed to ensure that all the TTWAs were self-contained in terms of boundary geography. The allocation was based on the strength of commuting links (Coombes and ONS, 1998). The second stage focused on establishing the level of working population in each TTWA by summing the working population of the wards that comprise a specific TTWA. The third stage of the process involved calculating the self-containment level of each TTWA using a function developed by Coombes and ONS (1998)[iii].

The analysis revealed that all TTWAs had a resident workforce above the threshold of 3,500 workers, but seven TTWAs had a self-containment level below the minimum threshold. Since the majority of the TTWAs were found to have retained a relatively high level of self-containment, the use of the 1991-based TTWAs for this research was validated. The result of the exercise led to the inclusion of 23 TTWAs in this study (Figure 3).

Figure 3: Adjusted Travel to Work Areas in North West England (based on 1991 TTWA boundaries)
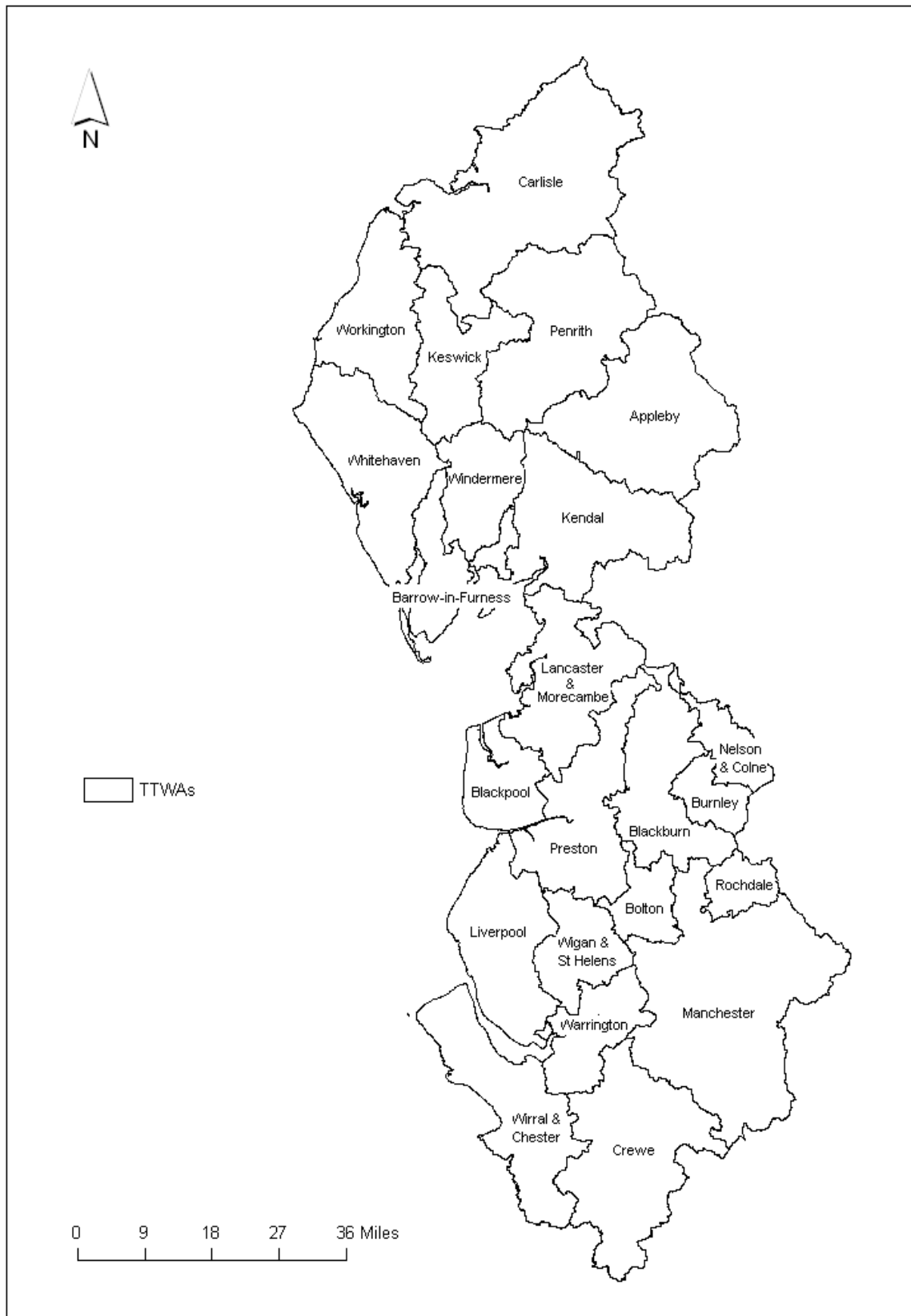
Interaction of Housing and Labour Markets: Dynamic Analysis of Commuting

The discussion here first focuses on assessing the spatial configuration of the boundaries of the HMAs and TTWAs in the North West as a means of examining the nature of their intersection. It then goes on to analyse the volume of in-commuting flows to each TTWA and the out-commuting flows from each HMA, as well as the dynamic patterns of flows between HMAs and TTWAs.

Spatial intersection of market boundaries

One of the underlying assumptions of neo-classical economic theory is that HMAs and TTWAs represent sub-regional market areas. In principle, therefore, HMAs and TTWAs should be expected to serve the same geographical area and they should share a degree of similarity in their extent and boundaries. This is consistent with the expectation that people will move home to live near their workplace and that the individual/household is only likely to move beyond their existing labour market boundary as a result of a change in job location. However, given that recent research has found that residential and workplace locations are becoming increasingly disconnected (e.g. Breheny, 1999; Wong *et al*, 2000), it is important to test whether this assumption holds true or whether the traditional neo-classical assumption fails to adequately capture the behaviour underpinning residential and workplace location decision-making.

To do this, the boundaries of the respective housing and labour market areas were mapped in order to detect the extent to which their boundaries overlapped. The analysis of the North West confirms that there is a high degree of variability between the boundaries of the HMAs and their respective/related TTWAs. While some TTWAs are served by a single HMA, in other cases, multiple HMAs are found to serve a single TTWA. It is also the case that a single HMA was found to serve multiple TTWAs. Due to the complex spatial intersections between the two markets, it is important to develop a conceptual typology to differentiate the nature of the HMA-TTWA intersection. Based on the GIS mapping exercise, two typologies were developed to describe the nature of the intersection between HMAs and TTWAs.

The HMA typology (see Table 1 and Figure 4) offers a supply-side classification of the relationship between different HMAs and individual TTWAs. The TTWA typology (see Table 2 and Figure 4), on the other hand, analyses different sources of employment opportunities for residents living in each HMA and so provides a demand-side classification

of the relationship between the HMAs and TTWAs. The classification distinguishes primary and secondary markets based on a 50 per cent 'geographical intersection' of market areas. In other words, on the supply-side, when half a HMA covers a TTWA, the HMA is considered a primary source of labour for that particular TTWA (and below 50 per cent the HMA is considered a secondary source). On the demand-side, when half a TTWA covers a HMA, the TTWA is considered a primary labour market for the HMA (and below 50 per cent the HMA is deemed to be a secondary labour market)[iv].

In the North West, only 6 of the 23 TTWAs (Appleby, Blackpool, Kendal, Penrith, Whitehaven, and Windermere) are served by a single dominant HMA. These TTWAs tend to be concentrated in the rural heart of Cumbria where the HMA boundaries of Eden, South Lakeland, and Whitehaven have extended beyond the boundary of their associated TTWA. The exception to this is the urban-focused Blackpool HMA which extends beyond the boundary of the Blackpool TTWA into the Lancaster & Morecambe TTWA. The analysis also reveals that it is common for a TTWA to be served by two primary HMAs (e.g. Blackburn, Liverpool, and Wirral & Chester TTWAs). Interestingly, the Keswick TTWA attracts its workforce from three primary HMAs, which reflects the fact that this labour market area is not embedded within a single housing market but is positioned across the boundaries of the Whitehaven, Workington, and Eden HMAs.

The intersection of the housing and labour markets becomes more complex when a TTWA cuts across primary and secondary HMAs. Indeed, 7 TTWAs (Bolton, Burnley, Crewe, Nelson & Colne, Rochdale, and Workington) draw their labour supply from one primary and one secondary HMA. In addition, 3 TTWAs (Barrow-in-Furness, Carlisle, and Lancaster & Morecambe) are served by a primary and two secondary HMAs. To add to the complexity, the labour catchment of the Preston TTWA includes the Preston HMA and three other secondary HMAs; while the Wigan & St. Helens TTWA intersects with two primary HMAs and one secondary HMA. Finally, the most complex spatial intersection is found in the relationship between the Manchester TTWA and the surrounding HMAs. The Manchester TTWA is served by three primary HMAs and four other secondary HMAs. This reflects the sheer size of the Manchester labour market catchment area, as well as the diverse spatial structure of sub-regional housing markets serving the Manchester TTWA.

Table 1: Spatial Intersections of HMAs and TTWAs: HMA-based Classification

Category	Description
Single Primary HMA	**Single HMA serves a single TTWA (6 cases)** *Appleby TTWA* – Eden PHMA; *Blackpool TTWA* – Blackpool PHMA; *Kendal TTWA* – South Lakeland PHMA; *Penrith TTWA* – Eden PHMA; *Whitehaven TTWA* – Whitehaven PHMA; *Windermere TTWA* – South Lakeland PHMA
Dual Primary HMAs	**Two HMAs serve a single TTWA (3)** *Blackburn TTWA* – Blackburn PHMA + Rossendale PHMA; *Liverpool TTWA* – Liverpool PHMA + Sefton & W Lancashire PHMA; *Wirral & Chester TTWA* – Wirral PHMA + Chester PHMA
Multiple Primary HMAs	**More than two HMAs serve a single TTWA (1)** *Keswick TTWA* – Whitehaven PHMA + Workington PHMA + Eden PHMA
Single Primary HMA with a Single Secondary HMA	**Single primary HMA and a secondary HMA serves a single TTWA (7)** *Bolton TTWA* – Bolton PHMA + Bury & Salford SHMA; *Burnley TTWA* – Burnley & Nelson & Colne PHMA + Blackburn SHMA; *Crewe TTWA* – Crewe & Nantwich PHMA + Chester SHMA; *Nelson & Colne TTWA* - Burnley & Nelson & Colne PHMA + Blackburn SHMA; *Rochdale TTWA* – Rochdale & Oldham PHMA + Rossendale SHMA; *Workington TTWA* – Workington PHMA + Whitehaven SHMA; *Warrington TTWA* – Warrington PHMA + Chester SHMA
Single Primary HMA with Dual Secondary HMAs	**Single primary HMA and two secondary HMAs serve a single TTWA (3)** *Barrow-in-Furness TTWA* - Barrow-in-Furness & Ulverston PHMA + Whitehaven SHMA + South Lakeland SHMA; *Carlisle TTWA* – Carlisle PHMA + Whitehaven SHMA + Eden SHMA; *Lancaster & Morecambe TTWA* - Lancaster & Morecambe PHMA + South Lakeland SHMA + Blackpool SHMA
Single Primary HMA with Multiple Secondary HMAs	**Single primary HMA with more than two secondary HMAs serve a single TTWA (1)** *Preston TTWA* – Preston PHMA + Sefton & W Lancashire SHMA + Bolton SHMA + Blackburn SHMA
Dual Primary HMAs with Single Secondary HMA	**Two primary HMAs and one secondary HMA serve a single TTWA (1)** *Wigan & St Helens TTWA* – Wigan PHMA + St Helens PHMA + Sefton & W Lancashire SHMA
Multiple Primary HMAs with Multiple Secondary HMAs	**More than two primary HMAs and two secondary HMAs serve a single TTWA (1)** *Manchester TTWA* – Manchester PHMA + Bury & Salford PHMA + Macclesfield PHMA + Rochdale & Oldham SHMA + Warrington SHMA + Crewe & Nantwich SHMA + Wigan SHMA

Note: PHMA is a primary housing market area and SHMA is a secondary housing market area
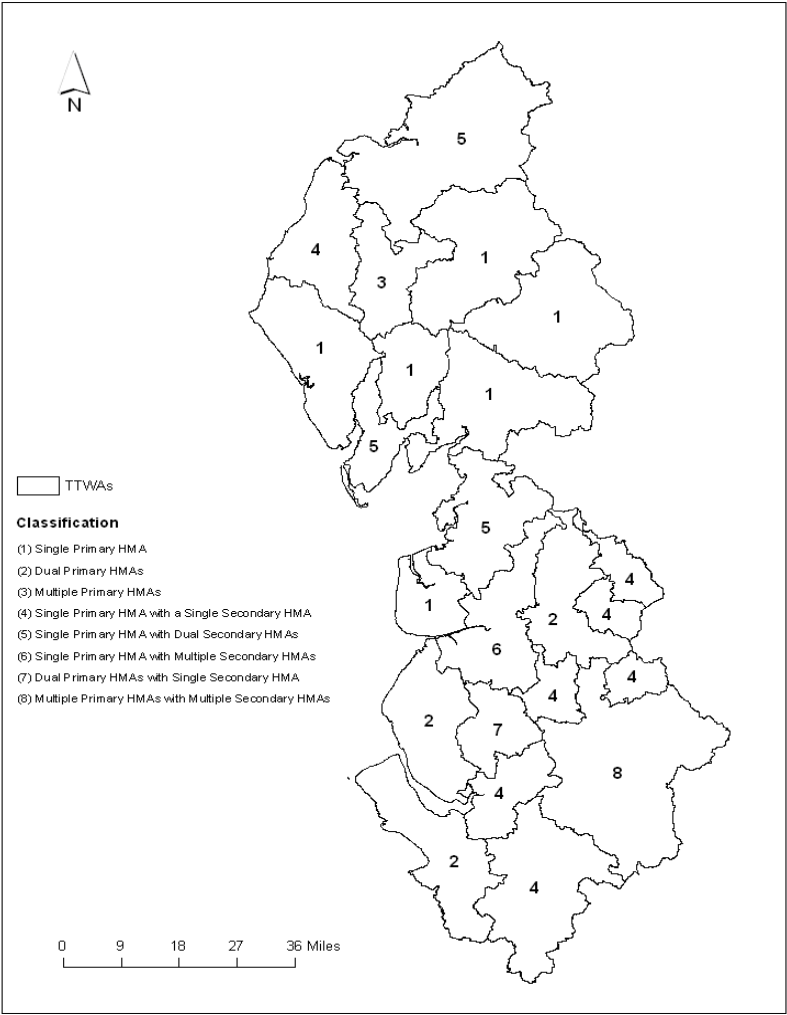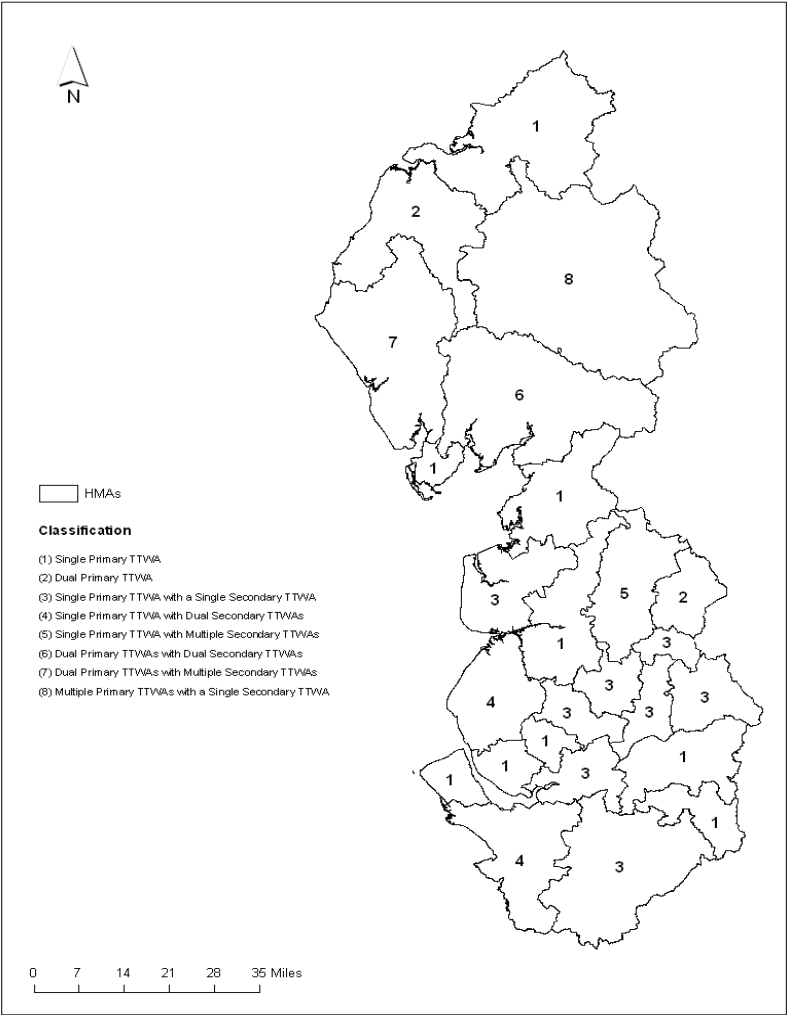
Table 2: Spatial Intersections of TTWAs and HMAs: TTWA-based Classification

Category	Description
Single Primary TTWA	**Single TTWA served by a single HMA (9 cases)** *Barrow-in-Furness & Ulverston HMA* – Barrow-in-Furness PTTWA; *Carlisle HMA* – Carlisle PTTWA; *Lancaster & Morecambe HMA* – Lancaster & Morecambe PTTWA; *Liverpool HMA* – Liverpool PTTWA; *Macclesfield HMA* – Manchester PTTWA; *Manchester HMA* – Manchester PTTWA; *Preston HMA* – Preston PTTWA; *St Helens HMA* – Wigan & St Helens PTTWA; *Wirral HMA* – Wirral & Chester PTTWA
Dual Primary TTWA	**Two TTWAs served by a single HMA (2)** *Burnley & Nelson & Colne HMA* – Burnley PTTWA + Nelson & Colne PTTWA; *Workington HMA* – Workington PTTWA + Keswick PTTWA
Single Primary TTWA with a Single Secondary TTWA	**Single primary TTWA and a secondary TTWA served by a single HMA (8)** *Blackpool HMA* – Blackpool PTTWA + Lancaster & Morecambe STTWA; *Bolton HMA* – Bolton PTTWA + Preston STTWA; *Bury & Salford HMA* – Manchester PTTWA + Bolton STTWA; *Crewe & Nantwich HMA* – Crewe PTTWA + Manchester STTWA; *Rochdale & Oldham HMA* – Rochdale PTTWA + Manchester STTWA; *Rossendale HMA* – Blackburn PTTWA + Rochdale & Oldham STTWA; *Warrington HMA* – Warrington PTTWA + Manchester STTWA; *Wigan HMA* – Wigan & St Helens PTTWA + Manchester STTWA
Single Primary TTWA with Dual Secondary TTWAs	**Single primary TTWA and two secondary TTWAs served by a single HMA (2)** *Chester HMA* – Wirral and Chester PTTWA + Crewe STTWA + Warrington STTWA; *Sefton & West Lancashire HMA* – Liverpool PTTWA + Preston STTWA + Wigan & St Helens STTWA.
Single Primary TTWA with Multiple Secondary TTWAs	**Single primary TTWA and more than two secondary TTWAs served by a single HMA (1)** *Blackburn HMA* – Blackburn PTTWA + Burney STTWA + Nelson & Colne STTWA + Preston STTWA
Dual Primary TTWAs with Dual Secondary TTWAs	**Two primary TTWAs and two secondary TTWAs served by a single HMA (1)** *South Lakeland HMA* – Kendal PTTWA + Windermere PTTWA + Barrow-in-Furness STTWA + Lancaster & Morecambe STTWA
Dual Primary TTWAs with Multiple Secondary TTWAs	**Two primary TTWAs and more than two secondary TTWAs served by a single HMA (1)** *Whitehaven HMA* – Whitehaven PTTWA + Keswick PTTWA + Workington STTWA + Barrow-in-Furness STTWA + Carlisle STTWA
Multiple Primary TTWAs with a Single Secondary TTWA	**More than two primary TTWAs and a single secondary TTWA served by a single HMA (1)** *Eden HMA* – Appleby PTTWA + Penrith PTTWA + Keswick PTTWA + Carlisle STTWA

Note: PTTWA is a primary Travel-to-Work Area and STTWA is a secondary Travel-to-Work Area

Figure 4: Spatial Intersection of North West HMAs and TTWAs. Left: HMA-based Classification; Right: TTWA-based Classification

Left map legend:

HMAs

Classification

(1) Single Primary TTWA
(2) Dual Primary TTWA
(3) Single Primary TTWA with a Single Secondary TTWA
(4) Single Primary TTWA with Dual Secondary TTWAs
(5) Single Primary TTWA with Multiple Secondary TTWAs
(6) Dual Primary TTWAs with Dual Secondary TTWAs
(7) Dual Primary TTWAs with Multiple Secondary TTWAs
(8) Multiple Primary TTWAs with a Single Secondary TTWA

0   7   14   21   28   35 Miles

Right map legend:

TTWAs

Classification

(1) Single Primary HMA
(2) Dual Primary HMAs
(3) Multiple Primary HMAs
(4) Single Primary HMA with a Single Secondary HMA
(5) Single Primary HMA with Dual Secondary HMAs
(6) Single Primary HMA with Multiple Secondary HMAs
(7) Dual Primary HMAs with Single Secondary HMA
(8) Multiple Primary HMAs with Multiple Secondary HMAs

0   9   18   27   36 Miles

It is also possible to examine the complex intersection of the two markets from the demand side of the labour market (TTWA-based). The TTWA typology reveals that a labour market does not necessarily tap into its labour supply from a particular housing market area. Only 9 HMAs in the region (Barrow-in-Furness & Ulverston, Carlisle, Lancaster & Morecambe, Preston, Liverpool, St. Helens, Macclesfield, Manchester, and Wirral) serve as a primary catchment for one dominant TTWA. The other HMAs tend to supply workers to a range of different labour market areas. The most common pattern, however, is for one HMA to serve a primary TTWA but in doing so the HMA also acts as the secondary HMA for another TTWA. In total 9 HMAs fall into this category and they include Blackpool, Rossendale, Wirral, Bolton, and Bury & Salford, as well as Warrington, Rochdale & Oldham, Wigan, and Crewe which serve as the secondary HMAs of the Manchester labour market area. A number of other complex intersections can be identified from the typology. The Chester HMA and the Sefton & West Lancashire HMA both serve one primary TTWA and act as the secondary HMA for two other TTWAs; the Workington and Burnley & Nelson & Colne HMAs serve as the primary HMAs for two TTWAs; the Eden HMA serves three primary TTWAs and a secondary TTWA; and the South Lakeland and Whitehaven HMAs serve as primary HMAs for two TTWAs and as secondary HMAs for two other TTWAs.

From a neo-classical perspective the ideal situation is that where a single HMA serves a single TTWA, then the TTWA should attract the majority of its workforce from the HMA serving that area. The analysis in the North West shows that there is not a single case where there is one TTWA intersecting solely with one HMA. The closest example is the case of Blackpool where a single HMA primarily serves a single TTWA of similar size. With the majority of HMAs intersecting two or more TTWAs, there is a higher likelihood of more complex outward commuting. Likewise, where there are dual and multiple HMAs serving a single TTWA, the TTWA will attract significant inflows of commuters from a range of HMAs. While the intersection is indicative of potential travel-to-work relationships, commuting flows need to be analysed and mapped to provide firm evidence of the actual spatial interaction of housing and labour markets. This exercise is the focus of the next section.

Spatial patterns of commuting flows

The attention here turns to examining the patterns of actual commuting flows to measure the volume and intensity of spatial interaction between housing and labour markets in the North West. The analysis involves a number of key methodological steps:

(1) Examining the volume of in- and out-flows:

This was achieved by aggregating ward level flow data from the 2001 Census of Population SWS (Table W201) to a 25 by 23 origin (HMA) and destination (TTWA) matrix. The analysis of flow volume provides an indication of the general pattern of commuting in the region, and the relative importance of particular HMAs and TTWAs in relation to the concentration of labour supply (outgoing commuting) and demand (incoming commuting). The degree of concentration of incoming and outgoing commuting is measured by the Gini coefficient[v]. Where the Gini coefficient is equal to 0, each of the HMAs would have an equal share of outgoing commuting and each of the TTWAs an equal share of incoming commuting; and where the coefficient is 1, outgoing commuting would be dominated by a single HMA, and incoming commuting would be concentrated in a single TTWA.

(2) Standardisation of commuting flows:

In order to simplify the complexity of origin and destination matrices, the flow standardisation method was developed for this research. This method provides an alternative way of categorising flows based on statistical significance rather than relying on arbitrary cut-off thresholds. The flow standardisation method involves the following steps:

- Commuting inflows to a particular TTWA are first converted into standardised-scores (z-scores). The conversion is undertaken individually for each destination TTWA, essentially a column at a time for each column in the matrix.

- The inflows of exceptional magnitudes, based on the z-score value of over 1.65 ($p < 0.05$) for a one-tailed test, are then identified for each destination. These represent the salient flows (i.e. the dominant first order flows) to each destination.

- The dominant flows are then removed from the matrix and the mean of the remaining non-salient flows for each destination is calculated. The flows above the non-salient mean value (using the same z-score values calculated as above) are taken to represent the second order flows for each destination TTWA, and those below the mean value represent the third order flows.

- Having identified the first, second, and third order flows for each of the TTWAs, the absolute inflow value in the original matrix is expressed as a proportion of total incoming commuters to each TTWA to aid interpretation.

According to the 2001 Census of Population, the average number of *outgoing commuters* in the North West is 112,282 workers per HMA and 12 out of the 25 HMAs have a higher than regional average level of outgoing commuting (see Table 3). An important issue that needs to be explored is the distribution of outgoing commuting (labour supply) across the HMAs to determine whether the outflows are concentrated in a few dominant HMAs or whether outgoing commuting is more evenly dispersed. The Gini coefficient of 0.38 suggests that there is some degree of concentration of outgoing commuting in the North West. Indeed, 50 per cent of all outgoing commuting in the region originates from just 7 HMAs which tend to serve the urban-industrial belt. The Manchester HMA alone accounts for over 15 per cent of all outgoing commuting in the region. In contrast, the smaller urban and more rural HMAs, with a lower level of labour supply, tend to have much lower levels of outgoing commuting. For instance, the Eden and Rossendale HMAs account for less than 1 per cent of total outgoing commuting flows, whilst the HMAs of Lancaster & Morecambe, Carlisle, South Lakeland, Workington, Barrow-in-Furness & Ulverston, and Whitehaven each account for less than 2 per cent of the total.

Table 3 also shows the demand for labour represented in the form of *incoming commuting* to TTWAs. The average number of incoming commuters in the region is 121,912 workers per TTWA. The analysis reveals that 8 of the 23 North West TTWAs have above regional average level of inflows. The Gini coefficient of 0.59 for incoming commuting flows suggests that there is a relatively high degree of concentration of in-flows in a few labour market areas. As shown in Table 3, the metropolitan TTWAs account for the highest levels of incoming commuting. This is particularly evident in the case of the Manchester TTWA, the dominant regional labour market, which accounts for nearly one-third of all regional inflows. In terms of the proportion of inflows, the Manchester TTWA is followed by the Liverpool TTWA and together the two labour markets account for 45 per cent of all incoming commuting in the region.

Table 3: Sub-Regional Inflows and Outflows of Commuters. Left: Outgoing Commuting from HMAs; Right: Incoming Commuting to TTWAs

HMA	Total Outgoing Commuters (% of regional total)	TTWA	Total Incoming Commuters (% of regional total)
Manchester	15.43	Manchester	31.86
Rochdale & Oldham	7.25	Liverpool	13.61
Sefton & West Lancashire	6.85	Wirral & Chester	6.48
Bury & Salford	6.32	Preston	5.83
Liverpool	6.26	Warrington	5.62
Preston	5.55	Wigan & St Helens	5.61
Warrington	4.94	Blackpool	4.51
Wigan	4.91	Blackburn	4.48
Blackpool	4.77	Bolton	4.04
Crewe & Nantwich	4.64	Crewe	3.56
Wirral	4.29	Rochdale	2.20
Bolton	4.00	Lancaster & Morecambe	2.09
Blackburn	3.78	Carlisle	1.90
Chester	3.23	Burnley	1.46
Burnley & Nelson & Colne	2.56	Barrow-in-Furness	1.27
St Helens	2.36	Nelson & Colne	1.09
Macclesfield	2.27	Whitehaven	1.07
Lancaster & Morecambe	1.89	Workington	0.99
Carlisle	1.60	Kendal	0.94
South Lakeland	1.39	Penrith	0.60
Workington	1.34	Windermere	0.40
Barrow-in-Furness & Ulverston	1.24	Appleby	0.20
Whitehaven	1.15	Keswick	0.18
Rossendale	0.99		
Eden	0.91		
Total	**2,807,051 (100.00)**		**2,803,979 (100.00)**

After the two largest metropolitan labour markets, those TTWAs with inflows above the regional average tend to serve the urban-industrial belt which is a key location for economic activities and varied employment opportunities (NWDA, 2006). However, the contrast between the metropolitan and larger urban HMAs, on the one hand, and the smaller urban and more rural HMAs on the other, is also apparent in relation to the inflows to TTWAs. The Workington, Kendal, Penrith, Windermere, Appleby, and Keswick TTWAs all account for less than 1 per cent of total incoming commuting in the region. The analysis also found low levels of in-commuting flows into the TTWAs of Carlisle, Burnley, Barrow-in-Furness, Nelson & Colne, and Whitehaven, each of which account for less than 2 per cent of total regional inflows. This is likely to reflect the fact that there are less employment opportunities in the smaller urban and rural labour market areas and a smaller working population in their surrounding HMAs.

While the aggregated commuting flows provide a starting point, further analysis of the commuting flows is needed in order to understand the complex nature of the interaction of the two markets. The 25 by 23 origin-destination matrix shows that 82 per cent of the commuting flows (334 of the 405 [vi]) have less than 3,640 commuters. This contrasts significantly with the 3 per cent of flows (15) that have more than 59,000 commuters. This demonstrates the diversity of commuting in the region in which there is a high number of comparatively low magnitude flows and a low number of dominant flows that contain significant concentrations of commuters. In order to compare the magnitude of the interaction of the HMAs and TTWAs, the absolute flows were subjected to the flow standardisation method outlined above. These flows were then mapped to provide a geo-visualisation of the aggregate patterns of spatial interaction between the sub-regional housing and labour markets in the region. The analysis here focuses on the first and second order flows as together they account for 94 per cent of the total commuting flows in the region.

A striking feature of the analysis is that the dominant flows into each of the TTWAs tend to originate from spatially coincident HMAs. This is particularly apparent in areas where the HMA and TTWA boundaries are comparable. To a certain extent, this is expected because of the constraint built into the TTWA framework that requires a high level of commuting self-containment for an area to be accepted as a TTWA (see Coombes and ONS, 1998). However, the outcome of this is the forging of dominant commuting links between geographically coincident housing and labour markets. Based on the cut-off threshold set out in the

methodology, 25 flows are classified as *first order flows*. These dominant flows account for over two-thirds (68 per cent) of all commuting in the region, and on average, 71 per cent of incoming commuting into the destination TTWA. This suggests that the majority of workers will commute to a limited number of local labour markets (see Lowe, 1998) and supports the assumption that workers will attempt to balance residential and workplace locations to minimise commuting costs (Kain, 1962).

As expected, the largest dominant flows (one-fifth of total commuting in the region) are found to connect the HMAs and TTWAs of Manchester and the two respective markets in Liverpool. The high level of commuting between these housing and labour markets is characteristic of the generally high levels of commuting across the urban-industrial belt (Figure 5). Indeed, the dominant flows connecting the TTWAs of Manchester, Bolton, Liverpool, Warrington, and Wigan & St Helens with the HMAs serving the same area account for over a third of all commuting in the region. Besides the urban-industrial belt, the interactions of the housing and labour markets of other major urban centres (Figure 5) are also characterised by relatively large first order flows. High magnitude first order flows (one-fifth of total commuting in the region) are also found between the labour markets and their spatially coincident housing markets in Preston, Wirral & Chester, Lancaster & Morecambe, Blackpool, and Blackburn. This echoes the findings of Rain (1999) and Johannsen *et al*. (2005) who suggest that large and medium-sized urban areas act as 'magnets' for commuters and despite losing substantial numbers of jobs through economic restructuring (Bailey and Turok, 2000), these areas continue to function as critical employment centres (NWDA, 2006). The analysis of the dominant flows reveals that the north of the region, unlike its southern counterpart, is characterised by high levels of self-containment as high magnitude flows connect geographically coincident housing and labour markets. Indeed, for TTWAs in the north of the region, four-fifths of incoming commuters originate in geographically coincident HMAs.

Figure 5: First Order Commuting Flows between HMAs and TTWAs of the Urban-Industrial Belt and Other Large Urban Centres
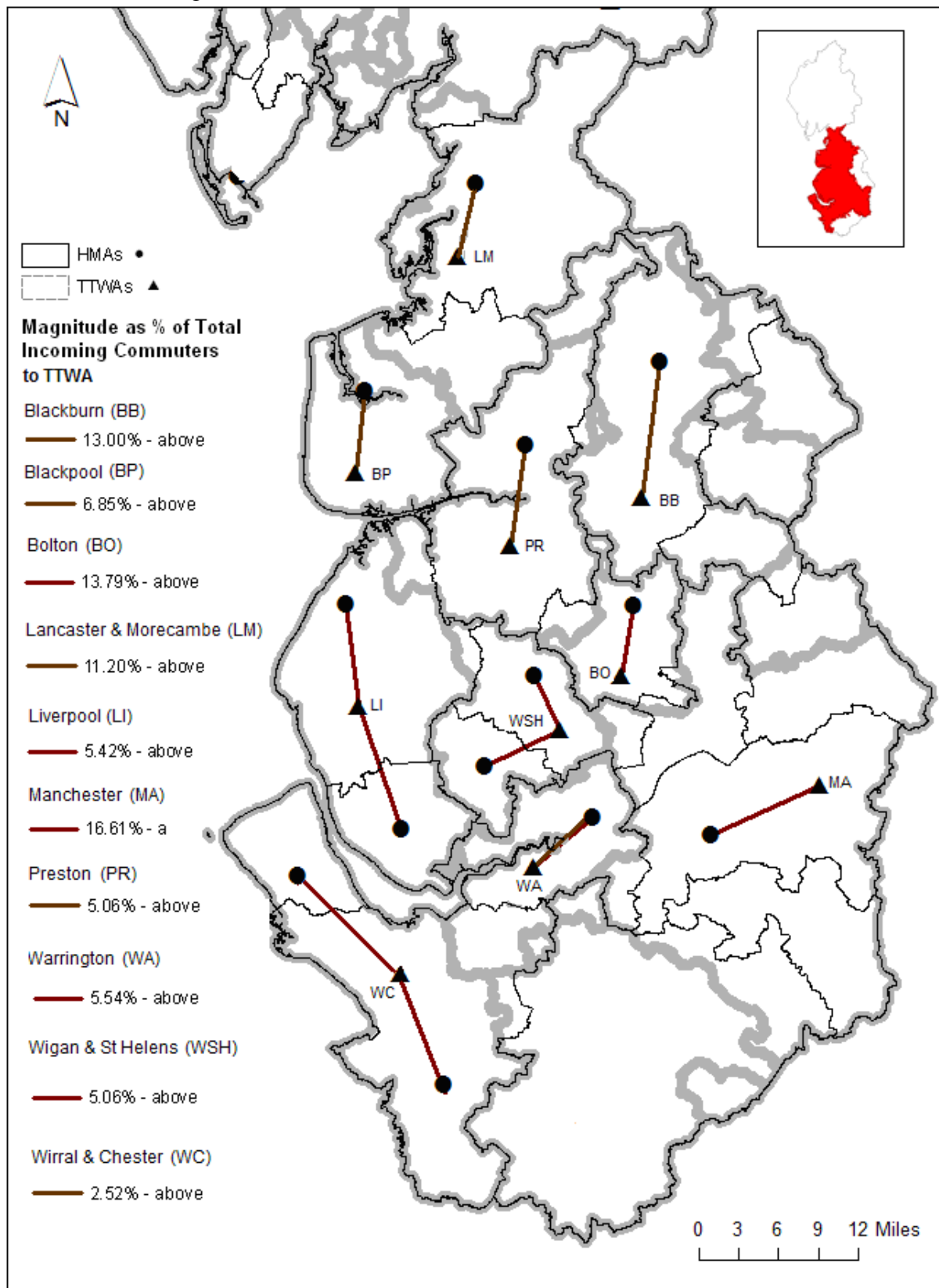
The *second order flows* tend to be of significantly lower magnitude when compared to the first order flows. This is reflected in the fact that a much smaller proportion of commuters (26 per cent of total regional commuters) are concentrated in the second order flows. The average size of the second order flows is about 3 per cent of the inflows to the destination TTWA. On the whole, there are relatively strong interactions between the housing and labour markets located in the same sub-regional area. This is reflected in the fact that of all second order flows in the urban-industrial belt, over two-thirds originate in housing markets located in the belt (that is 11 per cent of total second order flows in the region). Similarly, three-quarters of all second order commuters to Lancashire labour markets originate from housing markets in Lancashire, whilst nine-tenths of second order incoming commuters to TTWAs in Cumbria live in HMAs in Cumbria. However, the picture is rather different in Cheshire. Only one-third of second order incoming commuters to TTWAs in Cheshire actually live in HMAs serving Cheshire labour markets.

It is, however, more interesting to examine cross-commuting patterns between the different sub-regions. The analysis of the second order flows highlights that HMAs in Cheshire function as important pools of labour for TTWAs in the urban-industrial belt. These flows account for nearly three-quarters of all secondary commuting between the urban-industrial belt, Cheshire and Lancashire. However, the outflow of workers who live in the industrial belt to work in Cheshire labour markets is negligible –accounting for 8.3 per cent of all incoming flows to Cheshire TTWAs. However, the direction of secondary flow interaction between the urban-industrial belt and Lancashire is rather different to that found between Cheshire and the urban-industrial belt. Indeed, 14 per cent of secondary commuting into the Lancashire TTWAs originates from housing markets in the urban-industrial belt; but only 5.3 per cent of secondary commuting flows move from HMAs in Lancashire into the labour markets in the industrial belt.

The analysis of second order commuting indicates that there is a degree of balance cross-commuting taking place between the housing and labour markets of the urban-industrial belt and Lancashire. However, this contrasts significantly to the interaction between the urban-industrial belt and Cheshire in which labour markets serving the urban-industrial belt attract significant proportions of workers from Cheshire HMAs. This shows the importance of Cheshire as a hinterland for the two metropolitan areas, and the practice whereby workers locate in a desirable residential location for quality of life benefits and take up jobs located in

the older industrial areas. Another key finding is that the urban-industrial belt appears to act as a buffer between the housing and labour market areas of Lancashire and Cheshire. The analysis reveals that there is no interaction between the shire sub-regions (Cheshire and Lancashire) in terms of second order commuting flows. Furthermore, apart from the second order flows between the Sefton & West Lancashire HMA and the Preston and Blackpool TTWAs, there is no interaction between the HMAs in Merseyside and the TTWAs in Lancashire, or vice versa. The final key finding is that, with the exception of connections between the Lancaster & Morecambe HMA and the Kendal and Windermere TTWAs and between the South Lakeland HMA and Lancaster & Morecambe TTWA, there are no established connections between the north and south of the region. In combining the analyses of both the first and second order flows, the findings demonstrate that the northern and southern parts of the region are two highly self-contained areas in terms of the daily interaction of housing and labour markets. The second order interactions for the respective sub-regions are illustrated in Figures 6 to 9.

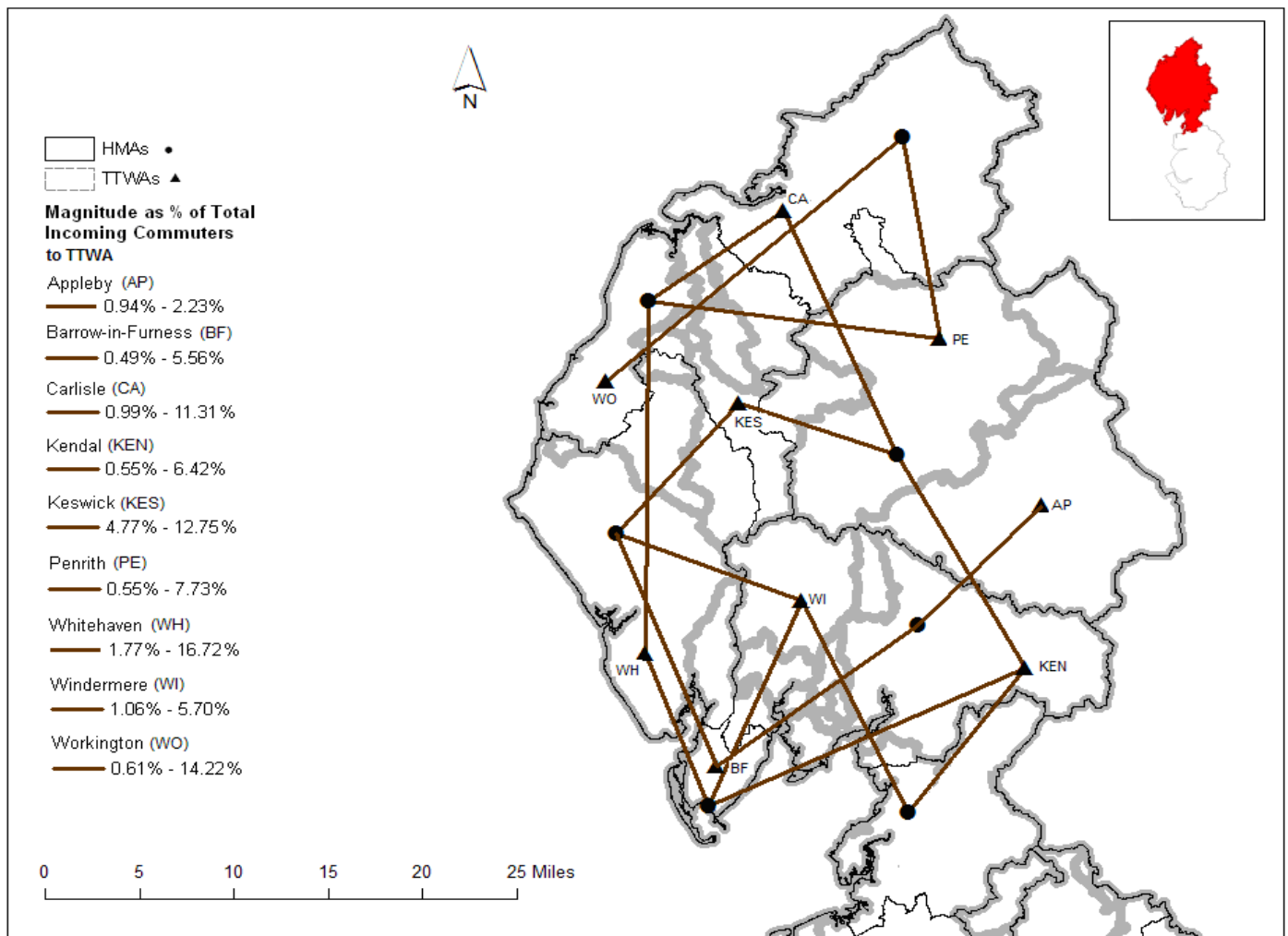Figure 6: Second Order Commuting Flows into the TTWAs of Cumbria

Figure 7: Second Order Commuting Flows into the TTWAs of Lancashire
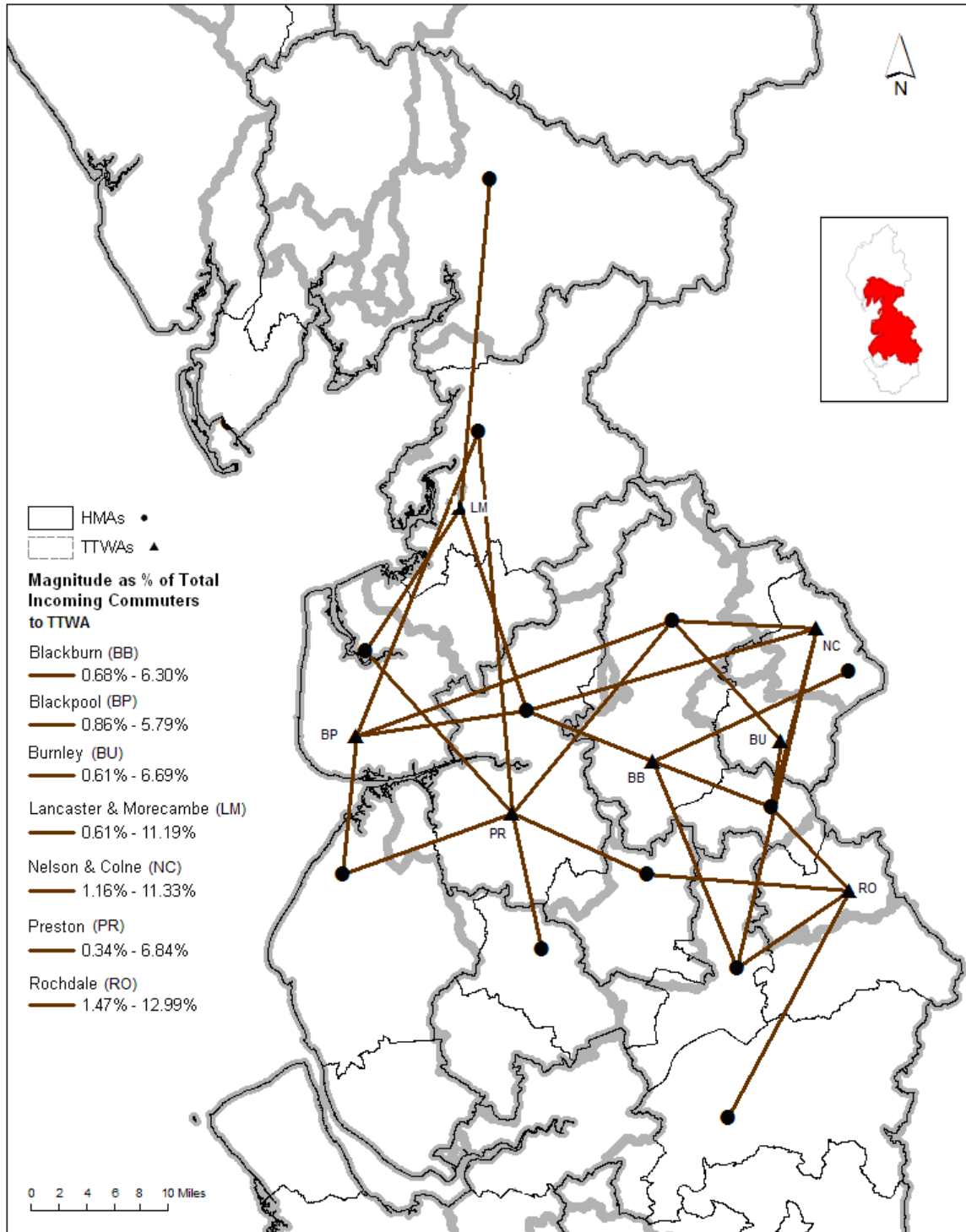
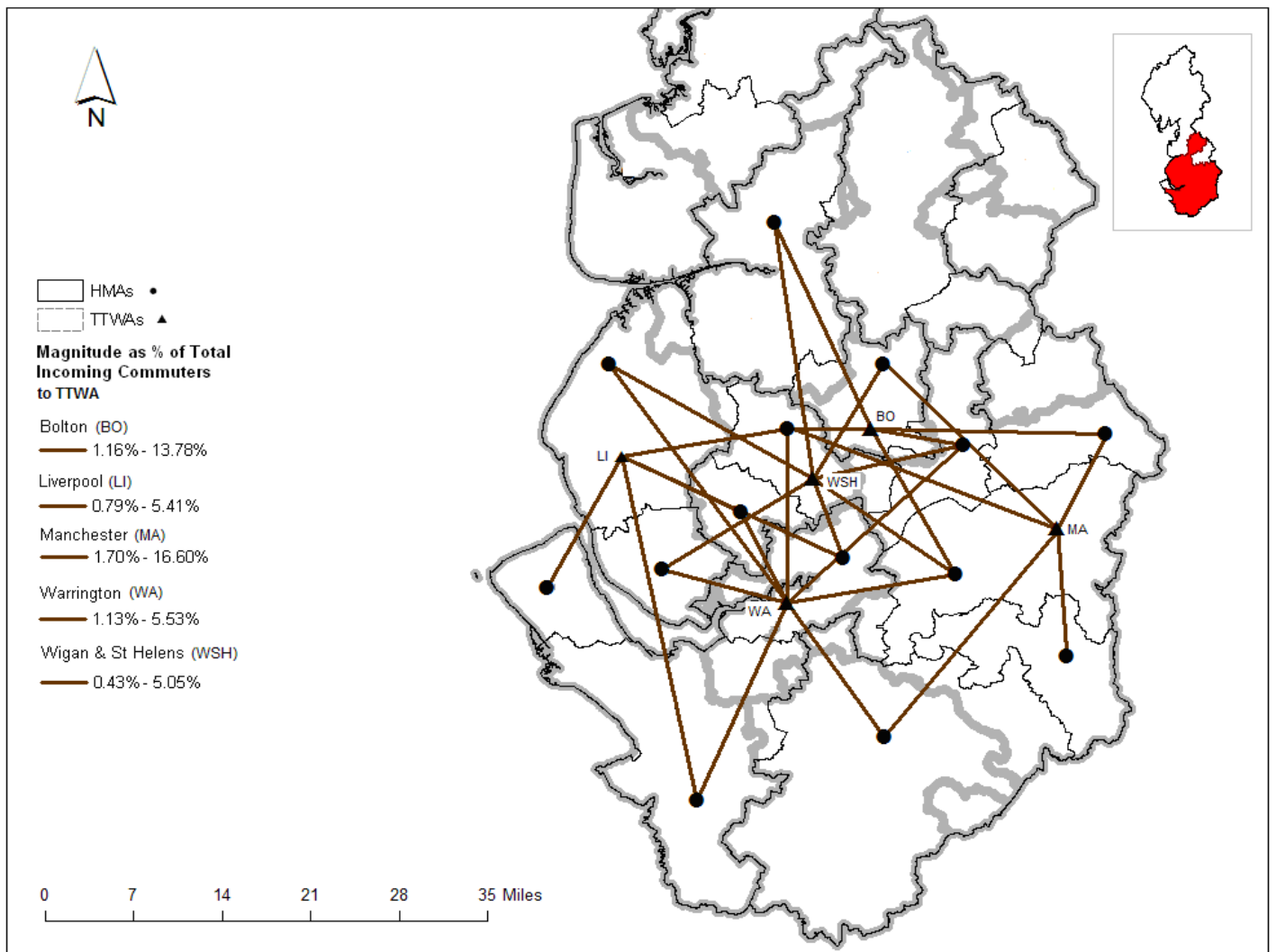Figure 8: Second Order Commuting Flows into the TTWAs of the Urban-Industrial Belt
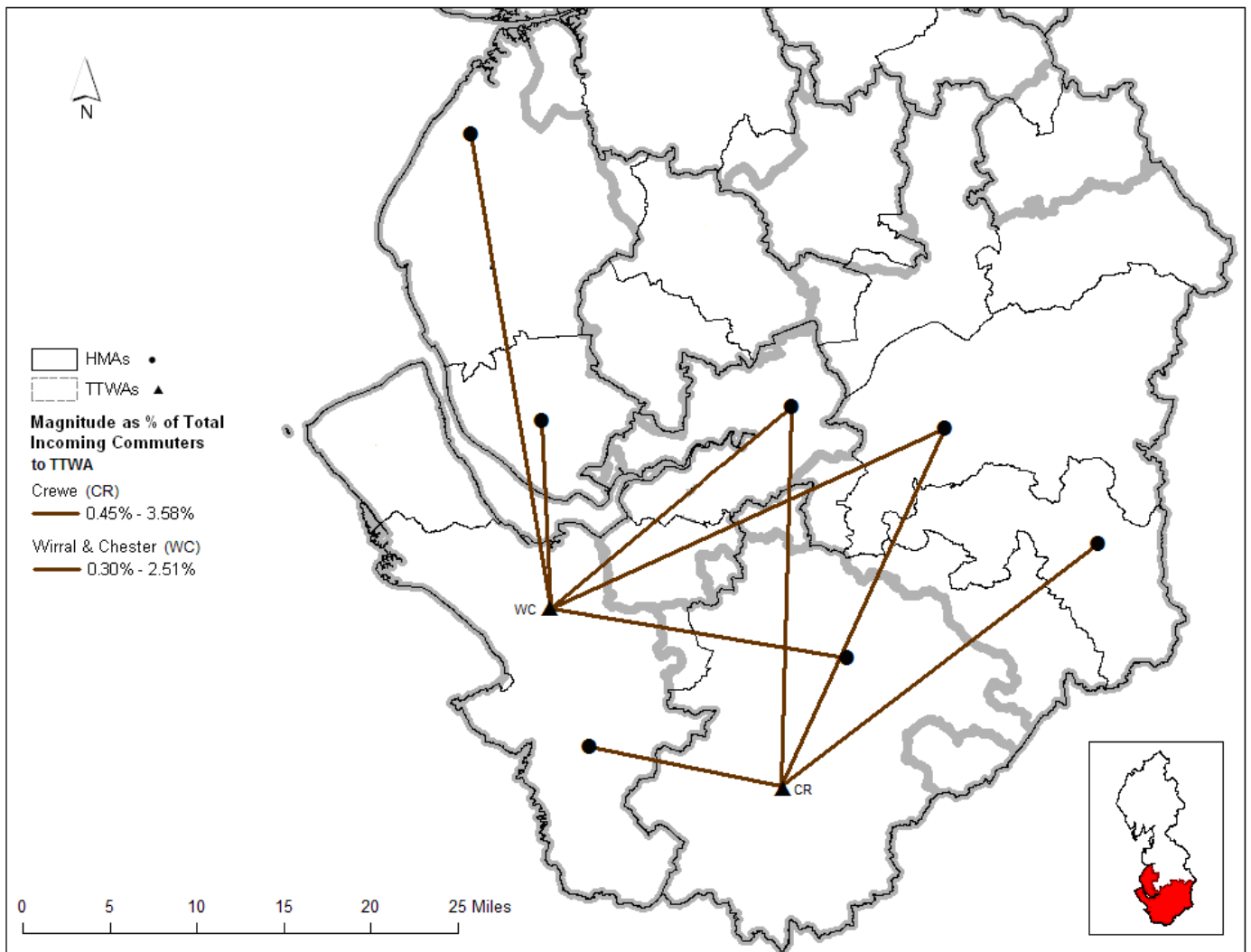
Figure 9: Second Order Commuting Flows into the TTWAs of Cheshire

Key Findings and Policy Implications

Through a case study of North West England, this paper applies a geo-visualisation methodology to examine the interaction of sub-regional housing and labour markets. The flow standardisation method has proven to be a robust approach for classifying different types of flow interactions without resorting to the use of arbitrary cut-off thresholds. Besides this methodological development, the empirical findings have enhanced our understanding of the dynamic spatial patterns of commuting and have shed light on key policy debates underpinning the development of sustainable communities.

Of all outgoing commuting in the region, half originates from 7 HMAs. Meanwhile, half of all incoming commuting is concentrated in just 3 TTWAs. The disproportionate concentration of incoming and outgoing commuting in the region is explained by the fact that

the majority of residential and workplace locations are found in the main urban areas. The analysis of actual commuting flows reveals that the region is characterised by high magnitude first order commuting between geographically coincident housing and labour markets. The 2001 Census of Population reveals that the majority of commuting journeys in the North West are between 2 and 20 km which lends support to the assumption that TTWAs tend to attract the majority of their workers from nearby HMAs.

Second order flows are smaller in magnitude than the first order flows. In contrast to the first order flows, the second order flows tend to connect more distant housing and labour markets located in the same geographical sub-region. The analysis of secondary commuting found that cross-commuting between different sub-regions is a key feature underpinning the spatial structure of the home-work link in the North West. The Cheshire housing markets function as major labour supply pools for the labour markets in the urban-industrial belt. However, reverse commuting from the housing markets in the urban-industrial belt to the labour markets in Cheshire is negligible. In contrast, there is a degree of balance cross-commuting taking place between the urban-industrial belt and Lancashire. However, the analysis demonstrates that there are no secondary flows connecting the housing and labour markets of Cheshire and Lancashire. One of the key findings is that the northern and southern parts of the region are highly self-contained areas, illustrated by the limited secondary links between the two.

These spatial interaction patterns are clearly reflected in the commuting distance data recorded in the 2001 Census of Population. Areas in the urban-industrial belt, Cheshire and south Lancashire tend to have above average longer distance commuting of over 30 km. Likewise, the housing and labour market areas in Cumbria, in particular, are well represented in the longer distance commuting bands in the 2001 Census. This is related to a number of possible factors. There is relatively high cross-commuting between the HMAs and TTWAs in the urban-industrial belt, owing much to the well developed motorway and rail networks connecting this part of the region. In addition, the Cheshire housing markets provide substantial numbers of commuters to the labour markets in the urban-industrial belt, which results in longer distance outgoing commuting from HMAs in Cheshire. There are also relatively high levels of secondary commuting between the HMAs in the urban-industrial belt and the TTWAs in Lancashire. Finally, the housing and labour markets in the shire sub-regions of Cheshire, Lancashire and Cumbria tend to be large, containing at their centre an

urban area surrounded by a relatively large rural fringe (Coombes *et al*, 1979). This has been found to result in longer distance commuting from rural and suburban residential areas to urban workplace locations (Moss *et al*, 2004). The diverse commuting patterns and the distance that workers are prepared to travel is likely to reflect improved access to private transport. Over two-thirds (67 per cent) of commuters in the North West rely on the use of cars to travel to work. In contrast, in 2001 the figure for England and Wales was lower at 62 per cent. Car-borne commuting is particularly dominant in Lancashire and Cheshire and this is serving to contribute to diverse commuting patterns and longer journeys. As Wong and Madden (2000) argue, the rise of dual earner households seeking a better quality of life in more affluent residential locations in Cheshire and Lancashire has served to exacerbate the trend of cross-commuting and extended commuting journeys.

The interaction of housing and labour markets has acquired a relatively narrow and fragmented focus within national and regional policy agendas in the UK. The lack of housing supply is seen as the main factor impeding labour mobility. Recent UK government sponsored research argues that constraints imposed on spatial labour mobility can be removed by improving the functioning of housing markets (Barker, 2004). The key messages emerging from the sustainable communities plan (ODPM, 2003), *Planning Policy Statement 3 (Housing)* (CLG, 2006), and the urban renaissance agenda echo this macroeconomic viewpoint. However, such a perspective fails to adequately capture the complexities that shape the interactions of the two arenas at the regional and sub-regional levels. A number of important implications for policy have emerged during the course of this research.

The research demonstrates the value in developing a national HMA framework to complement the already established TTWA framework. Whilst TTWAs have long been accepted as official labour market areas in the UK, local authority and TTWA boundaries have traditionally been adopted as approximations to sub-regional housing markets. However, as Jones (2002) rightly argues, such boundaries have little functional meaning within the housing system. The value of the methodological approach developed in this research is that the derived HMA framework is consistent with the requirements set out in the recently published government guidance (CLG, 2007a) for local authorities on how to carry out housing market assessments. If such a method was consistently applied through a national HMA delineation exercise, housing market statistics, such as house price change, and housing supply, demand and need could then be collected and reported on a more meaningful

and coherent basis than is currently the case. Likewise, population and household projections are currently compiled at regional and local authority levels. However, the development of a national HMA framework would provide an opportunity to also publish the projections at sub-regional level in the form of functional HMAs.

The success of the UK government's housing market renewal areas is dependent on the ability of policymakers to generate job growth locally because many areas that suffer from housing decline are also areas with major economic and unemployment problems (Bramley and Pawson, 2002). The positive message emerging from the analysis is that the dominant commuting flows are concentrated on spatially coincident housing and labour markets, particularly around the two metropolitan areas of Manchester and Liverpool. This suggests that at the sub-regional level (at least in the North West), there continues to be a high degree of home to work trip self-containment. As such, the sub-regional level would provide policymakers with a practical spatial scale for managing housing and labour market interaction in a car dependent society. However, the analysis also demonstrates that there is no guarantee that if jobs are generated they will be suitable to the skills of the local workers or that the jobs will be taken up by local workers (Immergluck, 1998; Shuttleworth *et al*, 2000). This is clearly illustrated by the diverse nature of the second order commuting flows. This also opens up the controversial debate around which spatial scale is the most appropriate to undertake strategic planning of housing and employment land provision. While sub-regions are increasingly recognised as important spatial units to plan for housing provision as stated in *PPS 3* (CLG, 2006), there is little guidance on what constitutes a sensible sub-regional unit. Furthermore, the commuting analysis shows that there is a lack of movement between the northern and the southern parts of the North West. Major commuting flows are taking place within the urban-industrial belt and are very much associated with the metropolitan areas along the M62 corridor. This raises the question as to whether it would be beneficial to develop a spatial strategy to enhance the north-south connection in the region (which is not considered in the submitted Regional Spatial Strategy) as a way of fostering sustainable economic growth (e.g. along the corridor of the west coast railway mainline), rather than simply focusing on the traditional east-west development axis along the M62 corridor (e.g. ODPM, 2004)

Although the absolute number of cross-commuting flows is small in comparison to the dominant flows, it is the more diverse and complex long distance commuting flows that

require monitoring. A key assumption driving the urban renaissance agenda is the belief that decentralisation has fuelled longer commuting journeys, as a result of workers travelling longer distances to urban workplaces. However, since population and jobs have decentralised, many of the work trips are now between non-urban residential and workplace locations as shown in the second order commuting flows in this study. The analysis of commuting distance reveals that commuting tends to be shorter in urban areas in relation to both the home and work-end of the trip, whilst commuting to non-urban locations tends to be longer distances. The urban renaissance agenda is unlikely to be fully effective at tackling decentralisation and commuting because it overlooks the interaction of non-urban residential and workplace locations.

In summary, the analysis of commuting between different areas in the North West reveals that the spatial interaction of home and jobs is far more complex than the access-space model suggests. Commuting patterns have diversified and the length of the commute has increased, with the majority of workers travelling to workplaces outside the CBD. Recent government policies, notably the urban renaissance agenda and sustainable communities plan, are not effective in addressing these very complex spatial interaction processes or in dealing with the mismatch between the supply and demand for housing and labour. As the workforce becomes increasingly professionalised, the complexity of the commuting process is likely to increase. In conjunction with this, a general increase in car-borne mobility has allowed people to take up jobs over much wider areas. Government policy promotes the idea that a balance of housing and jobs in the same locality will lead to better self-containment and lower commuting levels (ODPM, 2003). However, this appears to be rather unrealistic given that unless the settlement is very large such as the metropolitan areas of Manchester and Liverpool, journey-to-work self-containment is likely to be difficult to achieve (Breheny *et al*, 1998). The discussion here clearly points to the fact that the fragmentation of housing and labour market issues in national and regional policy frameworks has to be addressed in order to achieve the objectives of developing sustainable communities.

Conclusion

This study has empirically enhanced our conceptual understanding of the process of housing and labour market interaction and the analysis has helped to stimulate debate over the delivery of strategic planning issues. Through the course of the research a number of

potential avenues for future study have also emerged. We would like to conclude by drawing out some key pointers for future methodological and research development.

While the Census of Population is a comprehensive data source, it does not allow us to explore the factors that underpin commuting behaviour or the decisions governing the choice of residential and workplace locations. These behavioural issues can only be examined by collecting primary survey data. This would have been particularly advantageous for understanding the processes involved in balancing residential and workplace locations by different household members, the dynamics involved in household location strategies and location considerations of businesses. Furthermore, the 2001-based TTWAs were not available when the research began in 2004. A set of procedures were adopted to validate the 1991-based TTWAs, which provides a methodology to address the cyclical time lag issue between the collection of census data and the derivation of the official TTWAs.

Further work is needed to develop and optimise the HMA framework. It would certainly be beneficial to explore the effects of adopting a non-seed approach [viii] to allow the natural evolution of HMAs (Coombes and Champion, 2006). This would be particularly useful in polycentric areas where there are likely to be strong interdependencies between different urban nodes (Van der Laan and Schalke, 2001). There is also the need to explore the effect of adopting alternative self-containment thresholds on the delineation of HMAs. In addition, consideration needs to be given to the potential for incorporating a self-containment trade-off into the HMA procedure to reflect urban and rural contrasts, similar to the trade-off adopted in the TTWA framework. There is also scope to extend the HMA approach by using disaggregated inter-ward migration data to allow the delineation of HMAs for specific population sub-groups based on socio-economic and demographic characteristics. Similar arguments have also been raised with regard to TTWA delineation (Green *et al*, 1986; Coombes *et al*, 1988; Casado-Diaz, 2000).

Finally, an obvious direction for future research is to extend the analysis by taking into account other processes that shape the relationship between housing and labour markets. Such analyses might include exploring the impacts of migration, trade-flows, business mobility, or service provision on housing and labour markets, and the way that they interact. Indeed, Wong *et al*. (2006) highlight the need to develop our understanding of the spatial movements and connections between different places to inform spatial planning policy.

However, the paucity of dynamic data means that the analysis of such issues is restricted and will continue to be so until comprehensive datasets are complied and released at finer spatial scales. In addition, our understanding of housing and labour market interaction would benefit from shifting the analysis from the sub-regional level to finer spatial scales, particularly to the urban level. Whilst previous urban-based research has tended to explore the process of commuting to the city centre from surrounding areas, the analysis of housing and labour market interaction could explore the interaction between different housing submarkets and workplace sub-centres at the urban level.

References

Allen, J. and Hamnett, C. (1991) 'Introduction', in Allen, J. and Hamnett, C. (eds) *Housing and Labour Markets: Building the Connections*. London, Unwin, 3-15.

Alonso, W. (1964) *Location and Land Use*. Massachusetts, Harvard University Press.

Bailey, N. and Turok, I. (2000) 'Adjustment to Job Loss in Britain's Major Cities' *Regional Studies*, 34 (7), 631-653.

Baker, M. and Wong, C. (2006) 'Indicators and Strategy Monitoring: The Case of the English Regions' *Environment and Planning B*, 33 (5), 661-83.

Barker, K. (2004) *Review of Housing Supply*. London, HMSO.

Barker, K. (2006) *Review of Land Use Planning*. London, HMSO

Barlow, J. (1990) 'Housing Market Constraints on Labour Mobility: Some Comments on Owen and Green' *Geoforum*, 21 (1), 85-96.

Bibby, P. (2005) *West Midlands Regional Housing Strategy 2005: Defining Housing Market Areas*. Sheffield, Department of Town and Regional Planning, University of Sheffield.

Bosworth, D.L., Dawkins, P.J. and Stromback, T. (1996) *Economics of the Labour Market*. Essex, Longman.

Bramley, G. and Pawson, H. (2002) 'Low Demand for Housing: Incidence, Causes and UK National Policy Implications' *Urban Studies*, 39 (3), 393-422.

Breheny, M. (1999) 'Introduction', in Breheny, M. (ed) *The People: Where Will They Work?* London, TCPA, 1-8.

Breheny, M., Foot, D. and Archer, S. (1998) 'Work Trip Self-Containment and Sustainable Settlements' Paper Presented at the 94th Meeting of the Association of American Geographers, Boston, August.

Brown, L.A. and Moore, E.G. (1970) 'The intra-urban migration process: a perspective' *Geografiska Annaler*, 52B, 1-13.

Brown, P.J.B. and Pitfield, D.E. (1990) 'An Intramax Derivation of Commodity Market Areas from Freight Flow Data' *Transportation Planning and Technology*, 15, 59-81.

Brown, P.J.B. and Hincks, S. (2008) 'A Framework for Housing Market Area Delineation: Principles and Application' *Urban Studies*, 45 (11), 2225-2247.

Casado-Diaz, J.M. (2000) 'Local labour market areas in Spain: a case study', *Regional Studies*, 34, 843-856.

Cervero, R. (1995) 'Changing Live-Work Spatial Relationships: Implications for Metropolitan Structure and Mobility', in Brotchie, J., Batty, M, Blakely, E., Hall, P. and Newton, P. (eds) *Cities in Competition*, Melbourne, Longman, 330-347.

CLG [Department for Communities and Local Government] (2007a) *Strategic Housing Market Assessments Practice Guide*, Department for Communities and Local Government, London.

CLG [Department for Communities and Local Government] (2007b) *Planning Policy Statement 3: Housing*, Department for Communities and Local Government, London.

Cole, I. and Nevin, B. (2004) *The road to renewal: The early development of the housing market renewal pathfinder programme in England.* York, JRF.

Coombes, M., Green, A.E. and Owen, D.W. (1988) 'Substantive issues in the definition of 'localities': evidence from sub-group local labour market areas in the West Midlands', *Regional Studies*, 22, 308-318.

Coombes, M. and Office for National Statistics (ONS) (1998) *1991-Based Travel-to-Work Areas*. London, ONS.

Coombes, M. and Champion, T. (2006) 'Migration and the division of England into local Housing Market Areas' *Paper presented at the 36th Annual Conference of the British and Irish Section of the Regional Science Association International*, Jersey, August.

Coombes, M., Raybould, S., Wymer, C. (2006) *Housing Market Areas across the North East Region*. Draft Final Report. Newcastle University, CURS, Newcastle.

Communities and Local Government (CLG) (2006) *Planning Policy Statement 3 (Housing)*. London, CLG.

DTZ Pieda (2004a) *Analysis of Sub-Regional Housing Markets in the South West*. Reading, DTZ Pieda.

Forest, R. and Murie, A. (1990) *Moving the Labour Market*. Aldershot, Avebury.

Gordon, I. (1999) 'London and the South East', in Breheny, M. (ed) *The People: Where Will They Work?* London, TCPA, 169-186.

Green, A.E. (1997) 'A Question of Compromise? Case study evidence on the location and mobility strategies of dual career households' *Regional Studies*, 31, 643-659.

Green, A.E., Coombes, M. and Owen, D.W. (1986) 'Gender-Specific Local Labour Market Areas in England and Wales' *Geoforum*, 17 (3), 339-351.

Green, A.E., Hogarth, T. and Shackleton, R.E. (1999) 'Longer Distance Commuting as a Substitute for Migration in Britain: A Review of Trends Issues and Implications' *International Journal of Population Geography*, 5, 49-67.

Hamilton, B.W. (1982) 'Wasteful Commuting' *The Journal of Political Economy*, 90, 1035-1053.

Hincks, S. and Brown, P.J.B. (2006) 'The identification of housing market areas in North West England' *Paper presented at the 36th Annual Conference of the British and Irish Section of the Regional Science Association International*, Jersey, August.

Horner, M. (2004) 'Spatial Dimensions of Urban Commuting: A Review of major Issues and Their Implications for Future Geographic Research' *The Professional Geographer*, 56 (2), 160-174.

Immergluck, D. (1998) 'Job Proximity and the Urban Employment Problem: Do Suitable Nearby Jobs Improve Neighbourhood Employment Rates?', 35 (1), 7-23.

Jarvis, H. (1999) 'Housing Mobility as a Function of Household Structure: Towards a Deeper Explanation of Housing-related Disadvantage' *Housing Studies*, 14 (4), pp. 491-505.

Johannsen, H.H.W., Nielsen, T.S. and Hovgesen, H.H. (2005) 'Polarisation tendencies in the spatial regional fabric in Denmark – Challenges on the road towards more balanced regional spatial and economic development' *Paper Presented at the AESOP Conference*, Vienna, July.

Jones, C. (2002) 'The definition of housing market areas and strategic planning' *Urban Studies*, 39, 549-564.

Kain, J.F. (1962) 'The Journey-to-Work as a Determinant of Residential Location' *Papers and Proceedings of the Regional Science Association*, 9, 137-160.

Kwan, M.P. (2000) 'Interactive geovisualisation of activity-travel patterns using three-dimensional geographic information systems: a methodological exploration with a large dataset' *Transportation Research Part C*, 8, 185-203.

Lowe, J.C. (1998) 'Patterns of Spatial Dispersion in Metropolitan Commuting' *Urban Geography*, 19 (3), 232-253.

Masser, I. and Brown, P.J.B. (1975) 'Hierarchal Aggregation Procedures for Interaction Data' *Environment and Planning A*, 7, 509-523.

Mumford, K. and Power, A. (2003) *Boom and Abandonment: Resolving housing conflicts in cities*. Coventry, CIH.

Nevin, B., Lee, P., Goodson, L., Murie, A. and Phillimore, J. (2001) *Changing Housing Markets and Urban Regeneration in the M62 Corridor*. Birmingham, University of Birmingham.

Nielsen, T.S., Hovgesen, H.H. and Lassen, C. (2005) Exploratory Mapping of Commuting Flows in England and Wales. *Paper Presented at the RGS-IBG Annual International Conference*, London.

North West Regional Development Agency (NWDA) (2006) *Regional Economic Strategy – 2006*. Warrington, NWDA.

O'Sullivan, T. Young, G., Maclennan, D., Gibb, K., McClaren, J., Britain, A., Dowie, A. and Thornton, C. (2004) *Local Housing System Analysis Good Practice Guide*. Edinburgh, Communities Scotland.

Office of the Deputy Prime Minister (ODPM) (2003) *Sustainable Communities; Building for the future*. London, ODPM.

ODPM (2004) *Making it Happen: Creating Sustainable Communities in the North West*. London, ODPM.

ODPM (2005) *Factsheet 3 : Planning - Draft Planning Policy Statement 3 : Housing*. London: ODPM.

Owen, D.W. and Green, A.E. (1989) 'Spatial aspects of labour mobility in the 1980s' *Geoforum*, 20, 107-126.

Palm, R. (1978) 'Spatial Segmentation of the Urban Housing Market' *Economic Geography*, 54, 210-221.

Quigley, J.M. (1979) 'What have we learned about urban housing markets?', in Mieszkowski, P. and Straszheim, M. (eds) *Current Issues in Urban Economics*. Baltimore, Johns Hopkins Press, 391-429.

Rain, D. (1999) 'Commuting directionality: a functional measure for metropolitan and non-metropolitan area standards' *Urban Geography*, 20, 749-767.

Rogerson, R., Morris, A.S., Findlay, A.M., Henderson, J. and Paddison, R. (1989) *Britain's Intermediate City: A Comparative Study of Quality of Life*. Glasgow, Department of Geography, University of Glasgow.

Shuttleworth, I., Power, J. and McKinstry, D. (2000) 'Examining 1991 travel-to-work patterns in the Belfast Urban Area as a context for urban employment policy' *Applied Geography*, 20, 177-202.

Spence, N. and Frost, M. (1995) 'Work Travel Responses to Changing Workplaces and Changing Residencies', in Brotchie, J., Batty, M, Blakely, E., Hall, P. and Newton, P. (eds) *Cities in Competition*, Melbourne, Longman, 359-381.

Turok, I., Kearns, A., and Goodlad, R. (1999) 'Social exclusion: in what sense a planning problem?' *Town Planning Review*, 70, 363-384.

Van der Laan, L. (1998) 'Changing Urban Systems: An Empirical Analysis at Two Spatial Levels' *Regional Studies*, 32 (3), 235-247.

Van der Laan, L., Vogelzang, J. and Schalke, R. (1998) 'Commuting in Multi-Nodal Urban Systems: An Empirical Comparison of Three Alternative Models' *Tijdschrift voor Economische en Sociale Geografie*, 89 (4), 384-400.

Van der Laan, L. and Schalke, R. (2001) 'Reality versus Policy: the Delineation and Testing of Local Labour Market and Spatial Policy Areas' *European Planning Studies*, 9 (2), 201-221.

Wong, C. (1998a) 'Old wine in a new bottle? Planning methods and techniques in the 1990s' *Planning Practice and Research*, 13, 221-236.

Wong, C. (1998b) 'Determining Factors for Local Economic Development: The Perception of Practitioners in the North West and Eastern Regions of the UK' *Regional Studies*, 32 (8), 707-720.

Wong, C. (2002) 'Is There a Need for a Fully Integrated Spatial Planning Framework for the United Kingdom?' *Planning Theory and Practice*, 3 (3), 277-300.

Wong, C., Baker, M. and Gallent, N. (1999) 'The North West', in Breheny, M. (eds) *The People: Where Will They Work?* London, TCPA, 119-144.

Wong, C., Ravetz, J. and Turner, J. (2000) *The UK Spatial Planning Framework*. London, The Royal Town Planning Institute.

Wong, C., Schulze Baing, A. and Rae, A. (2006) Uniting Britain: the evidence base – spatial structure and key drivers. London, RTPI.

Notes

[i] Excess commuting is an efficiency measure of urban travel where the observed level of commuting in a city is compared to an estimated theoretical minimum commute. The observed level captures people's choice in relation to journey to work, whilst the theoretical minimum commute is a hypothetical calculation of the journey to work pattern where all commuters choose workplaces that minimise the region wide commuting cost (HORNER, 2004, 165).

[ii] Estate agent knowledge was used in the delineation of HMAs based on the assumption that, in their catchment area, estate agents have specialist knowledge of housing market operation and are aware of the typical patterns of prospective-mover search behaviour (Palm, 1978). Initially, a number of settlements in the region were identified that were broadly consistent with those covered by TTWAs, reflecting the assumption that the HMAs and TTWAs should be geographically comparable (Jones, 2002). In these settlements, the branches of national estate agents were contacted to enable the compilation of a list of settlements, judged to constitute local markets that could be drawn upon in guiding the delineation of HMAs. In areas where national estate agent coverage was low, local estate agents were used, and this proved necessary in parts of Cheshire and Cumbria. The consultation was then extended, beyond the initial core settlements, to identify further settlements that might constitute the cores of additional HMAs. In total, 43 potential core HMA settlements were identified through estate agent consultation. Brown and Hincks (2008) offer a more detailed account of this process.

[ii] Strictly speaking, the urban-industrial belt is not an official sub-region description. However, it provides a useful generic spatial reference to the economic activities taking place in the metropolitan areas stretching from Merseyside to Greater Manchester along the M62 motorway, and was used in this way in the M62 Corridor Study of housing needs (Nevin *et al*, 2001)

[iii] The function applied is as follows:

$$\min \left\{ \frac{Fa,a}{Ra} ; \frac{Fa,a}{Wa} ; 0.75 \right\} x$$

Where:
Fa,a is the number of people who both live and work in the area concerned.
Ra is the number of workers living in the area concerned (demand side)
Wa is the number of people who work in the area concerned (supply side)

[iv] This can be readily achieved using the intersect tool in ArcGIS.

[v] The Gini coefficient is used to measure the degree of concentration (inequality) of a variable in a distribution of its elements. It compares the Lorenz curve of a ranked empirical distribution with the line of perfect equality. This line assumes that each element has the same contribution to the total summation of the values of a variable. The Gini coefficient ranges between 0, where there is no concentration (perfect equality), and 1 where there is total concentration (perfect inequality).

[vi] In total, 405 flows had 10 or more recorded commuters between the HMAs and TTWAs in the North West.

[viii] Within the 43 potential core HMA settlements, the most densely populated ward was identified as constituting the core of the potential HMA and seeded or 'flagged' in the intramax algorithm using a binary programming code (1=core and non-core= 0). The intramax procedure was then applied in such a way that each of the resulting groups could contain only a single core ward around which non-core wards were grouped to form the HMAs (see Brown and Hincks, 2008). However, a non-seeded approach would mean that no core base unit (e.g. ward) is identified in the intramax algorithm meaning that the HMAs are allowed to evolve based solely on the strength of the migration flows (e.g. Coombes and Champion, 2006).