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# **Spatial (Im)mobility and Accessibility in Ireland: Implications for Transport Policy**

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## **Abstract**

Recent social research that links people's position in society to their ability to access employment has shown the centrality of spatial mobility in the (re-)production of patterns of (in)equality. This is particularly evident in regions where economic activity is unevenly distributed and concentrated in an urban centre and where daily travel patterns reflect a spatial segregation between places of work and residential areas. This paper presents a spatial analysis of accessibility to employment for Galway City and its environs, a predominantly rural region in the West of Ireland dominated by its urban centre. Travel-to-work data from the 2006 Census of Population of Ireland were used to present a comparison of district-specific accessibility levels across three socio-economic groups. Network analysis and Geographic Information System (GIS) visualisation tools are used to map existing socio-spatial topographies of (in)accessibility. This is done to test two contrasting sets of theoretical proposals in the social science literature regarding the relationship between spatial mobility and social status. Advocates of the first position conceptualise spatial mobility as a form of capital that helps to maintain many existing social hierarchies. This contrasts with the views of those who anticipate the dissolution of established social boundaries ('fluidification') as a result of increased spatial mobility of people, goods and ideas. It is argued that these contrasting positions are highly relevant to current transport policy debates, including discussions around the impacts of recession-related cuts in transport infrastructure investment on patterns of accessibility. In addition, they encourage reflection on the impacts of sustainable transport initiatives on different social groups that are more or less mobility-disadvantaged, a fact that has hitherto received little attention in policy research and practice.

**Key words:** accessibility, spatial mobility, social status, transport policy

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## 1. Introduction

In a world shaped by increasingly complex flows of people, goods, capital and ideas, questions abound about the consequences of spatial re-organisation for society, economy and the environment. How spatially mobile are people today both in their everyday lives and with regard to their place of residence and how does this affect their position in society? Do people move voluntarily or out of necessity and what influences their mobility patterns? What are the implications for society of an ‘immobilisation’ of large numbers of home owners due to declining property prices and negative equity? These and other questions all point to the close relationship between spatial mobility, social structures and processes and economic activity.

Rapid economic development in the Republic of Ireland (henceforth Ireland) during the so-called ‘Celtic Tiger’ era coincided with dramatic changes in land use, including a further suburbanisation of jobs in towns and cities, new suburban-style housing on the fringes of urban areas and in rural locations and a decline in services in more remote rural areas. At the same time, increased car ownership and use and significant investments in transport infrastructure, most notably roads, shifted day-to-day spatial mobility patterns towards greater car dependence. While the promotion of (auto)mobility undoubtedly brought benefits to Irish society, including enhanced access to employment and services for many people, it also produced serious problems for society and the environment. With regard to environmental degradation, the transport sector acts as a major source of greenhouse gases, accounting for more than 20% of all CO<sub>2</sub> emissions (SEI 2009). Car dependence and reduced walkability have been shown to worsen people’s health, reduce their involvement in political and community activities and limit their use of public space (Leyden, 2003; also see Sennett, 1977/1992; Putnam, 2000; Cahill 2010 for international evidence). While the recent recession triggered significant changes in daily travel patterns and modal choice, including a rise in cycling and a reduction in car-based travel to and from work, it also ‘immobilised’ many home owners in places far away from employment centres. These and related developments make Ireland a very significant place to study the relationship between spatial (im)mobilisation and socio-economic change.

While the link between people’s social status and their spatial mobility patterns has been widely recognised in the social science literature (Wickham, 2006; Canzler et al., 2008), interesting questions remain about the stability (or otherwise) of existing social hierarchies and people’s propensity to change their position within them. According to Kaufmann et al. (2004: 745), the ‘spatial distribution of goods, information and people forms dynamic interdependencies with social structures’. This implies that people’s ability to recognise and use opportunities for spatial mobility can dramatically influence both their current social status and their social mobility patterns, that is, any movement either up or down the social ladder (cf. Kaufmann, 2002; Schneider and Collet, 2010). How far people are willing and able to commute or whether or not they can move house to improve their job opportunities or advance their career thus constitutes a particular form of capital – *mobility capital* – that directly affects their social position (cf. Kaufmann et al., 2004). New opportunities for spatial mobility such as improved transport infrastructure and services, the purchase of a car, or the acquisition of a driver’s licence may thus add to people’s overall ‘capital stock’, which also includes their financial, social and cultural resources.

While advocates of this mobility-as-capital perspective emphasise the relative persistence of social hierarchies in an increasingly mobile society, others anticipate a radical restructuring of society. Prominent sociologists such as Zygmunt Bauman and John Urry anticipate the increasing ‘fluidification’ of social relations, that is, the more or less rapid dissolution of established social hierarchies and institutional structures, as global flows of people, goods and ideas multiply and intensify (Bauman 1992, 2000; Urry, 2007). The strength and weaknesses of these two contrasting positions – mobility as capital and fluidification – are discussed in more detail in Section 2.

This research argues that a person's socio-economic status (expressed through their occupation) and their location (ranging from rural periphery to urban centre) are likely to result in very different levels of accessibility to paid employment and that an in-depth analysis of accessibility can be useful in making these visible. The role of accessibility analysis in the dynamic process of integration of the land use and transport systems is widely recognised (see de la Barra, 1989; Reggiani, 1998). The benefits of adopting an accessibility-based approach have been highlighted by researchers from various disciplines for over a decade (Banister, 2002; Straatemeier, 2008). There are many definitions of the accessibility concept, as well as a great number of accessibility indicators, which are mostly derived from the seminal work of Hansen (1959). In this paper, a locational-based accessibility indicator is used to assess the relationship between spatial mobility and socio-economic status in an Irish context.

The empirical sections of this paper present an analysis for Galway City and its environs, a predominantly rural region in the West of Ireland dominated by its urban centre. Travel-to-work data from the 2006 Census of Population of Ireland were used to present a comparison of district-specific accessibility levels across three socio-economic groups. Network analysis and Geographic Information System (GIS) visualisation tools are used to map existing socio-spatial topographies of (in)accessibility in the Galway region and to empirically test the relationship between the spatial distribution of transport and employment opportunities (accessibility) and people's socio-economic status.

Findings from this research challenge common perceptions that only the most disadvantaged in society suffer from low accessibility levels and lend some support to the fluidification thesis. However, new patterns are likely to exist alongside more traditional patterns of stratification that differentiate people with high and low levels of 'mobility capital'. For example, people in remote rural areas remain disproportionately disadvantaged because of very low accessibility levels.

The study is structured as follows. Section 2 presents the theoretical background, with a detailed discussion of the two contrasting positions of mobility as capital and fluidification. This is followed by a review of the concept of accessibility and the various types of indicators suggested in the literature. An overview of the study area, its transport infrastructure endowment and commuting patterns is presented in Section 4. In Section 5, the methodological framework for the analysis is outlined, and in Section 6 the outcomes of the analysis are described and interpreted. The concluding section of this paper outlines the relevance of this debate for transport policy and practice.

## **2. Spatial Mobility as Capital? The Uneven Distribution of Mobility-Related Chances and Challenges**

The consequences of increased spatial mobility for society have been subject to intense debate among social scientists, with different perspectives emerging (cf. Rau 2010). While the 'mobilisation' of society is generally recognised as a complex and multi-faceted phenomenon, it is nevertheless possible to identify two contrasting positions that are located at opposite ends of a broad spectrum of views. As stated in the introduction, some social scientists anticipate the partial dissolution of traditional social structures and patterns of interaction ('fluidification'). This contrasts with views of society that focus on the relative persistence of many social hierarchies and structures even in the face of radical economic changes or policy intervention. We shall now discuss these two positions in more detail.

### *Fluidification and mobility*

Are we currently witnessing the dissolution of many traditional social strata, structures and institutions due to the spatial mobilisation of human social life? There is ample evidence that late modern societies are subject to continuous and rapid change or 'fluidification', a fact that has been reflected in many social scientists' theoretical and empirical work of late.

Proponents of fluidification approaches anticipate the imminent dissolution of established social hierarchies and institutional structures, as global flows of people, goods and ideas multiply and intensify (Bauman 1992, 2000; Urry, 2007). This is seen as a distinguishing feature of late modernity that separates it from previous historical eras and that can be attributed to a range of economic, socio-political and technological changes, such as the 'mobilising' effects of 'footloose' global capitalism and the rapid spread of ICT. For example, Bauman (2000) develops the concept of 'liquid modernity' to capture the increasing fluidification of social relations in the late 20<sup>th</sup> century and the 'mixed blessings of freedom' (p.18) that accompany it.

More generally, many fluidification theorists tend to embrace the idea that more static social categories such as class or ethnicity will be (partially or fully) replaced by fluid forms of social organisation and identity that both shape and reflect people's increasingly mobile lives. Importantly, they often view *mobility as an enabling force* that helps to dissolve social and spatial barriers, including those that prevent people from accessing employment. Job-related spatial mobility with regard to both residential (re)location and daily commuting is thus seen as positive development that could potentially lift many people out of poverty. Infrastructure and technology that promote corporeal and virtual mobility are seen as important tools for addressing social disadvantage.

Recent sociological work on the fluidity of social relations tended to stress the significance of human agency in the construction of socio-economic, political and material realities (e.g. Urry, 2007, 2008). Humans are conceptualised as powerful agents of change whose individual or collective actions have the capacity to transcend barriers in society, including those that prevent those who are poor from improving their material conditions. Moreover, these studies frequently adopt a postmodern or cosmopolitan outlook that conceptualises humankind as a single community whose shared morality transcends artificially created territorial boundaries such as national borders (e.g. Beck, 2008). Spatial mobility is seen as an important step in the formation of these trans-boundary social networks. For example, recent proposals for a 'new mobilities paradigm' (Sheller and Urry 2006) in social theory and research argue that social scientists need to look beyond static units of analysis such as nation-states and focus on global flows of people, materials and knowledge.

### *Mobility as capital*

Claims that we are now witnessing the widespread 'fluidification' of social structures as a result of increased spatial mobility have been met with considerable scepticism. Critics of the fluidification thesis have emphasised the persistent influence of territorially defined social institutions, most notably the nation-state, on the regulation of diverse mobilities of people, goods and knowledge (Turner, 2007). Social research on the links between social mobility and spatial mobility also points to the relative stability of patterns of socio-spatial stratification across multiple generations and the persistent influence of class, gender and other traditional socio-demographic factors on people's spatial mobility patterns (Camarero and Oliva, 2008; Kaufmann et al., 2010; Schneider and Collet, 2010). According to Kaufmann *et al.* (2004), the distribution of 'mobility capital', that is, people's ability to recognise and avail of mobility opportunities, perpetuates structural (dis)advantages in society. Therefore, the regulation of access to 'mobility capital', like other forms of capital, is likely to cement existing patterns of inequality and exclusion rather than dissolve them.

A strong relationship exists between spatial mobility and social exclusion (McQuaid et al., 2001; Hine and Mitchell, 2003; Farrington and Farrington, 2005; Hine, 2007; Preston and Rajé, 2007; Preston, 2009; Stanley and Vella-Brodrick, 2009). Recent evidence from Ireland shows that unmet transport needs constitute a key source of socio-economic disadvantage that affects diverse social groups such as older people and young children, low-income households, single parents and people with disabilities, especially in rural areas (Fitzpatrick Associates, 2006; Millar et al., 2007). Similarly, limited accessibility to employment remains a significant problem across traditionally disadvantaged urban and rural areas (Lohan and

Wickham, 1999; O'Shea, 2009). According to O'Shea (2009: 274), transport constitutes a 'particular problem in rural areas for people who do not own a car' and who experience difficulties accessing key services and employment opportunities as a result.

Lohan and Wickham (1999) examine the impact of car systems in four European cities – Athens, Bologna, Helsinki and Dublin – on how different social groups experience accessibility (what people can reach) and mobility (how they move around) and how this affects both social cohesion *and* social inclusion. They argue that car dependency has the potential to undermine social cohesion through the encouragement of selfish and irresponsible behaviour that weakens social institutions intended to regulate and promote sociality, mutual obligation, responsibility as well as a levels of social control. 'The "great car society" promulgated by Mrs. Thatcher [*former U.K. Prime Minister*] is an oxymoron. Where everyone uses a car, then social cohesion is undermined' (Lohan and Wickham, 1999: 4). While this suggests that '[t]he *right to mobility* [...] ties in directly with the question of *citizenship*' (Camarero and Oliva 2008, emphasis in original), it also draws attention to possible connections between (forced and voluntary) *immobility*, social justice and quality of life.

There is growing evidence for the coexistence of old and new patterns of mobility-related disadvantage. Camarero and Oliva's (2008) work demonstrates how traditional structural constraints on people's mobility exist alongside new forms of mobility-related disadvantage. They argue that increased mobility is a core aspect of modernity that produces 'new forms of exclusion and social risk and creates a new environment that forces the different social groups to draw up private and unequal strategies' (p.345). For example, newly emerging *burdens of excessive spatial mobility* can reduce the quality of life of groups with high and low levels of social, political and economic capital. In Ireland, increasing 'time poverty' due to long-distance commuting affects people with varying levels of economic and social capital.<sup>1</sup> At the same time, the disproportionate number of serious accidents and fatalities on rural roads illustrates the uneven distribution of mobility risks that reflects traditional socio-spatial cleavages in society (Carroll, 2010; cf. Cahill, 2010).

Overall, current social-scientific debates on the social causes and consequences of spatial mobility show that many traditional social structures that have the potential to both physically and socially 'immobilise' people continue to exist alongside more fluid social arrangements that emerge from the increasing spatial 'mobilisation' of late modern societies. The availability of capital, including mobility capital, remains an important predictor of people's current and future position in society. As shown in this section, critical views of the pressures arising from the need to move around to be able to avail of economic opportunities contrast with more optimistic perspectives on increased spatial mobility that (over)emphasise its benefits. The following section will link these debates to more concrete challenges to do with transportation, access to employment and social disadvantage. Subsequently, we will compare travel and accessibility data from Galway City and County across different socio-economic groups to test some of the assumptions outlined in Sections 2 and 3.

### **3. Making the Connection: Transportation, Social Exclusion and Accessibility**

In a globalising world that promises social and economic rewards to those on the move, immobility can act as a major disadvantage for those who are either unwilling or unable to move. Importantly, experiences of immobility often reflect a complex interplay between individual characteristics (e.g. inability to drive a car, unwillingness to move) and wider structural conditions (e.g. lack of transport infrastructure, restrictions in international labour mobility). For example, Kaufmann et al.'s (2010) concept of motility combines individual and

<sup>1</sup> This is reflected in a series of newspaper articles in 2003 and 2010 by *Irish Times* journalists Kathy Sheridan and Frank McDonald. These articles covered the live experiences of commuters in the Leinster area, the eastern province of the Republic of Ireland that includes the capital city Dublin, over a period of seven years.

structural factors in three key areas: availability of opportunities for movement, people's mobility skills and the actual appropriation of opportunities for movement. They observe that '[i]ndividuals can be endowed with motility in varying ways' and that a focus on motility can help uncover both old and new patterns of social inequality (Kaufmann et al., 2010: 97).

Undoubtedly, (lack of) access to paid employment constitutes a key structural factor that influences the (re)production of socio-spatial disadvantage. The concept of *accessibility*, that is, the availability of opportunities for face-to-face social interaction and economic activity has gained currency in this context (Preston and Rajé, 2007). Accessibility measures for particular socio-economic groups can yield interesting insights into the context and distribution of mobility-related disadvantages (cf. Geurs and van Wee, 2004; Handy and Niemeier, 1997). According to Handy and Niemeier (1997), accessibility is influenced by a number of elements: the spatial distribution of opportunities at the destination, their magnitude, quality and character, and the characteristics of the transport system related to the ease of reaching a particular destination.

Kaufmann et al. (2010) deploy a two-pronged approach to accessibility that recognises the influence of both individual and structural factors on people's mobility patterns, most notably with regard to daily travel. They combine measures of *contextual accessibility* (proximity to key mobility infrastructure) and *individual accessibility* (car ownership, internet access) with indicators of *mobility competency* (e.g. foreign language skills) and *willingness to move*. While Kaufmann et al.'s concept of accessibility is very promising because of its emphasis on both material *and* social aspects at different scales of social organisation (e.g. individuals, families and households, national, supranational) it requires substantial amounts of data that may not be readily available.

The importance of accessibility has been discussed in recent studies with regards to the widely used valuation of travel time savings (see discussion in Metz, 2008; Schwanen, 2008; Givoni, 2008). Empirical evidence from travel time surveys suggests that in broad terms, average travel time holds constant across populations over time (Metz, 2008). Dependence on motorised mobility for commuting has translated into additional accessibility to a wider range of employment opportunities as people use new road transport infrastructure to allow alternative more distant destinations to be reached through faster travel, which has become environmentally unsustainable (Metz, 2010). Recent research has addressed issues of distance and speed and time in the context of sustainable mobility (Banister, 2011). Planning practices that encourage residential and employment suburbanisation have only reinforced the need to travel longer distances for the same journey purpose. Growing incomes and higher car ownership rates have underpinned these land use patterns that require increasing travel distance to work and speed in order to gain (and enhance) access to employment.

There are numerous contributions regarding the measurement of accessibility in the literature. Many studies offer a comprehensive review of the concept of accessibility and the different measuring approaches and methodologies (see for example, Handy and Niemeier, 1997; Geurs and Ritsema van Eck, 2003; Halden, 2002; Geurs and van Wee, 2004; Martin and Reggiani, 2007; Willigers et al., 2007). Most authors agree that the definition and specific formulation of accessibility indicators greatly depends on the objectives of the particular study for which the accessibility measure is intended for (Borzacchiello et al., 2010).

Three basic perspectives have been identified by Geurs and Ritsema van Eck (2003) on the measurement of accessibility: (1) infrastructure-based measures, (2) activity-based measures and (3) utility-based measures. Infrastructure-based measures describe the level of service in the transport infrastructure, such as the level of congestion or average travel speed along the road network. The advantage of these measures is that they are easily interpreted by researchers and policy-makers, but they present significant theoretical limitations because of their lack of reference to the land use. The land use component is introduced in activity-based measures, which describe the level of accessibility to spatially distributed activities such as the number of jobs or the provision of health care centres. These measures have been sub-

divided into (a) location-based accessibility measures and (b) person-based or time-space accessibility measures (Geurs and van Wee, 2004). The latter type of accessibility measure focuses on the micro (individual) level and it has been used in time geography (see for example, Weber 2003). Finally, utility-based measures are based on random utility theory and focus on the economic benefits or consumer surplus from access to spatially distributed activities (see Martinez 1995; Martinez and Araya 2000). Existing accessibility measures involve at least one of the first two perspectives, while features regarding time or individual components are present in a smaller number of studies. Several formulations of accessibility may lead to different results for the same transport network and land use context (Reggiani et al., 2007; Barzacchiello et al. 2010).

From the broad range of accessibility indicators outlined above, a modified version of the traditional gravity-based measure – also known as economic potential - is used in this study. This model has been widely used in accessibility studies and it can be interpreted as the volume of economic activity to which an area has access to, after the cost/time of covering the distance to that activity has been accounted for (Dundon-Smith and Gibb, 1994). The specific formulation of this model is presented in detail in Section 5.

#### 4. The study area

The empirical part of this study focuses on travel-to-work patterns and accessibility levels across three different socio-economic groups in the Galway region in the West of Ireland. The region is characterised by a main urban centre – Galway City – and its rural hinterland, County Galway. Galway City and County have a combined population of 231,670 individuals according to the 2006 Census of Population of Ireland (CSO, 2006). Population densities vary from 26 inhabitants/km<sup>2</sup> in remote rural areas to just below 1,500 inhabitants/km<sup>2</sup> in Galway City, the latter of which accounts for 30% of the population of the Galway region.

[Figure 1]

There are at least three reasons why the Galway region represents an ideal case for examining the relationship between spatial mobility and socio-economic status in Ireland. First, Galway is one of the gateways identified in the National Spatial Strategy 2002-2020 (Government of Ireland 2002), the main planning policy document in Ireland that addresses issues of decentralisation and balanced regional development, amongst other things. This makes the Galway region a policy-relevant case for assessing national socio-spatial patterns of accessibility. Secondly, Galway lends itself to an investigation of accessibility patterns because of its wide and varied range of sub-regions. While Galway City has experienced considerable growth in its suburban hinterland, the region still features a very distinctive landscape that ranges from urban and peri-urban areas<sup>[2]</sup> to remote rural places<sup>[3]</sup> (see Figure 1). Third, the regional impact of Galway City as a centre of employment is significant, with over 55% of the total employment located in the city<sup>[4]</sup>. However, the city's direct influence remains largely limited to its immediate environs. This clearly contrasts with Ireland's capital city Dublin which economically, socially and politically dominates many neighbouring regions and whose influence extends as far as the Midlands.

<sup>2</sup> Peri-urban areas are settlements with fewer than 1,500 inhabitants that are subject to very high levels of urban generated adjustment, including increased levels of commuting to a large town or city nearby.

<sup>3</sup> This contrasts with other regions in the country, such as the Eastern region, where there is a heavy influence of Dublin City as the main employment centre. While the regional impact of Galway City is significant, its influence remains largely limited to its immediate environs.

<sup>4</sup> Place of Work Sample of Anonymised Records (POWCAR) (CSO, 2006).



Separation between employment and residential areas continues to be a key feature of the Galway region, with an increasing number of people living in rural areas but working in Galway City. This has contributed to changes in travel behaviour, including a rapid increase in car dependency over the last fifteen years which is accentuated by some deficiencies in the provision of public transport. Throughout Galway City bus operators provide reasonably good coverage, but with inadequate frequency, lack of supporting traffic management measures, and some timetabling issues, the services are not being used as much as they might otherwise be (MVA Consultancy, 2010).

Table 1 illustrates these patterns of car dependency in the Galway region. It compares origin-destination commuting patterns in the region for the 2002 and the 2006 Census of Population of Ireland. Inward commuting into Galway City represents the largest proportion of all commuting trips. Table 1 shows an overall increase in the number of trips into Galway City that originate outside the city. This increase is more pronounced for residential locations that are 10 kilometres or more away from the city. In contrast, intra-city commuting reduced by 2.7% in the same period.

Table 1 also shows an increase in the number of outward commuting trips to locations less than 10 kilometres away from the city. The level of commuting to and from small towns and rural areas is still significant but decreases in the period 2002-2006. Overall, these travel-to-work patterns have contributed to high levels of car use that contribute to widespread congestion around important transport nodes. The limited provision of public transport, a road transport network that largely radiates into the North and East of Galway City and the topography of the region have further exacerbated congestion along the main commuting routes.

[Table 1]

Table 2 provides aggregate figures of modal choice for 2002 and 2006 in Galway City and County. The private car is the main mode of travel to work in the region. Slower, more sustainable modes such as walking and cycling rank second. The overall trend shown in Table 2 suggests that while the level of car use has remained fairly constant in the period 2002-2006, public transport use has decreased considerably in Galway City and remains very low outside the city. This trend has been accompanied by increases in walking and cycling in the city.

[Table 2]

In the Galway Public Transport Feasibility Study (MVA Consultancy, 2010), the city's main employment centres are found around a large industrial park in a sub-urban district to the East of Galway City and in the Central Business District (CBD). The most significant individual travel to work movements are both from the West to the East of the city and within Eastern districts. Figure 2 shows the residential location patterns for the three socio-economic groups considered in the analysis<sup>5</sup>: (1) employers, managers, higher and lower professionals, (2) non-manual workers and (3) manual, semi-skilled and unskilled workers. The maps follow the classification scheme for professional and educational status used by the Irish Central Statistics Office (CSO). In general, all three socio-economic groups show the highest

<sup>5</sup> The standard deviation classification method is used to facilitate comparisons across socio-economic groups.

concentration in Galway City and medium and small towns across the region, with a significant proportion of the population in Western residential areas, located at a considerable distance from the main employment centres. Figure 2 shows that the socio-economic group of *employers, managers, higher and lower professionals* favour residential locations in suburban and peri-urban areas. In contrast, the residential locations of *non-manual workers* are more concentrated around Galway City. The spatial distribution of the residential locations of *manual, semi-skilled and unskilled workers* extends further into rural areas, in particular towards the West of the region. Overall, all three maps suggest a connection between people's socio-economic status and their choice of residential location, albeit in ways that differ from commonly held views of the poor inner city, wealthy suburbia and poor rural areas. These residential patterns in turn affect people's travel patterns and contribute to a specific distribution of mobility burdens that cut across traditional socio-economic boundaries.

[Figure 2]

## **5. Accessibility to employment and the spatial distribution of population by socio-economic group**

In this paper, gravity-based measures of accessibility are used to compute accessibility scores at the electoral district level. These measures are based on a model of social behaviour which predicts that the interaction between residential and employment locations decline with increasing travel distance, time or cost. Gravity-based measures of accessibility thus weight opportunities by travel impedance, which means that accessibility decreases as the travel time or distance to the opportunity increases.

The type of mathematical function used to represent the spatial separation between origins and destinations, also known as the travel impedance function, plays a crucial role in computing these accessibility measures. Some studies have used exponential functions (Wilson, 1971) or Gaussian functions (Ingram, 1971). The negative exponential function is most closely associated with travel behaviour theory and has been widely used in international transport studies Handy and Niemeier (1997).

Theoretical limitations of the gravity model for accessibility relate to the exclusion of competition effects regarding access to employment (Geurs and van Wee, 2004). Shen (1998) suggests that the traditional gravity-based accessibility measure is only useful when either one of the following conditions is satisfied: (1) the demand for available opportunities is uniformly distributed across space and (2) the available opportunities have no limitation in capacity. As regards to employment opportunities, neither the first nor the second condition holds. Employment is characterised by its non-random spatial distribution and jobs are limited to one worker accessing them, which represents a clear limitation in capacity.

Shen (1998) thus proposes a modified version of the traditional gravity-based accessibility measure to account for both the uneven spatial distribution of jobs and the effect of competition for jobs at each location. The advantage of Shen's (1998) proposal is that it considers not only the number of available employment opportunities at the destination, but also the number of job seekers by occupation type or *demand potential*. This represents an extension of Kaufmann et al.'s (2010) definition of accessibility by including people's skills needed to access employment opportunities. This reveals interesting connections between Shen's economic model of accessibility and Kaufmann et al.'s sociological approach.

Accessibility is computed following Shen's (1998) formulation below:

$$A_i = \frac{\sum_j E_j f(c_{ij})}{D_j}$$

$$D_j = \sum_k \alpha_k P_k f(c_{kj}) \quad (1)$$

where:

$A_i$  is the accessibility index for people living in location  $i$  (origin);

$E_j$  is the number of employment opportunities in destination  $j$ ;

$P_k$  is the number of job seekers living in zone  $k$ ;

$\alpha_k$  is the proportion of households at location  $k$  that have access to one or more cars;

$f(c_{kj})$  is the impedance function measuring the spatial separation between  $k$  and  $j$ . The functional form is equal to  $\exp(-\beta T_{ij})$  where  $exp$  is the base of the natural logarithms and  $\beta$  is the impedance parameter. This parameter is empirically calibrated through simple regression analysis to maximize the fit between predictions of the gravity model and the actual observed cost of travel,  $T_{ij}$ [6]. Travel times in minutes from zone  $i$  to zone  $j$  are used as the cost of travel.

For an urban or regional system with  $N$  locations,  $i = 1, 2, \dots, N$ ,  $j = 1, 2, \dots, N$  and  $k = 1, 2, \dots, N$ .

Geographical Information Systems (GIS) visualisation tools and network analysis were used to compute accessibility measures and identify residential location clusters by socio-economic group. First, the ESRI's ArcGIS Network Analyst extension was deployed to generate an origin-destination matrix based on congestion-adjusted travel times from each origin to each destination in the study area. Given the predominance of car-based travel and data limitations in terms of public transport use in rural areas, the focus of the analysis is on car travel times. These are obtained for each section of the road network and adjusted by congestion along the main commuting roads into Galway City and along urban roads within the perimeter of Galway City. This is then used for the computation of the gravity-based accessibility index.

All empirical results presented in section six below draw on data from the 2006 Census of Population of Ireland. Data analysis encompassed two separate stages. First, an index of accessibility to employment was computed for the study region. Following Shen's (1998) formulation, the accessibility index took into account the supply and demand of job opportunities at each location, the travel time from each residential location to each employment centre, car availability at the household level and traffic congestion experienced in the journey to work. Secondly, the analysis focused on clusters of population by socio-economic group across the study area. For this purpose, observed population figures were standardised, using the population of Ireland as a baseline. These standardised measures were subsequently used to identify electoral districts (EDs) with a relatively higher share of population from a particular socio-economic category than would otherwise be expected given the national distribution. The analysis relied on the Irish Central Statistics Office's (CSO) classification of socio-economic groups which incorporates education levels and employment status of individuals aged 15 years or over who are at work. Own account

<sup>6</sup> Due to the lack of reliable data on the impedance parameter for job accessibility, this parameter was estimated as the natural log of a number of friction factors as the dependent variable and travel time cohorts as the independent variables (see Grengs, 2009; Levinson, 1998 for more details).

workers, farmers and agricultural workers were excluded from the analysis because of their low levels of commuting. The resulting visual representations illustrate the connection between the uneven distribution of accessibility to employment and the emergence of novel patterns of socio-spatial disadvantage.

## 6. Results and findings

The results presented in this section compare the level of accessibility in the study region with the spatial distribution of residential locations by socio-economic group. Figure 3 shows the accessibility scores for the Galway region[7].

[Figure 3]

As expected, the city of Galway and its suburban hinterland display the highest levels of accessibility to employment, which conforms to the traditional monocentric city model. However, disparities in terms of accessibility are found between the east and the west of the region. While average levels of accessibility are found in electoral areas to the east of Galway City, even at considerable distances from urban centres, districts to the west of the city present comparatively poorer job accessibility levels. This may be explained by the relatively weaker provision of road transport infrastructure in this part of the region, which can be partially explained by the topography of the electoral districts within this area. In addition, high levels of accessibility are found in suburban and peri-urban areas to the north of Galway City and along two main national roads. This contrasts with low levels of accessibility in peripheral areas to the north and northeast of County Galway, as well as to the southeast of the region.

Following from this general accessibility analysis, Figures 4-6 show the spatial distribution of the standardised population across three different socio-economic groups: (1) employers, managers, high and low professionals, (2) non-manual workers and (3) manual, semi-skilled and unskilled workers. This was done to identify possible connections between people's educational and professional status, their choice of residential location and their exposure to mobility opportunities and risks arising from the existing road transport network structure. Electoral districts with standardised rates above 100 indicate that the proportional representation of a particular socio-economic group is higher than expected, given the socio-spatial distribution of the population at the national level.

Figure 4 shows that group 1 tends to choose residential locations at a relatively short distance from Galway City. Residential location patterns reflect a preference for sub-urban and peri-urban areas around the city of Galway and along the coast line, in residential areas with high amenity value. In most cases, these electoral districts also suffer from low levels of accessibility to employment. This is further explored in Figure 5, where a comparison between job accessibility measures for this socio-economic group and the average accessibility level across all three groups is carried out. The curve for the general population (continuous dark line) indicates that about 50% of all workers are subject to an accessibility index of 0.6, while for employers, managers and high and low professionals, the same percentage only experience an accessibility index of 0.48. The curve for this group – group 1 – lies to the left of the curve for the general population, which implies that this section of the

<sup>7</sup> Figure 3 illustrates the spatial structure of the road network in the region, focusing exclusively on primary roads. However, the subsequent road network analysis to compute travel times relied on data for the entire road network, including secondary and regional roads. Congestion-adjusted peak travel times were used to compute the origin-destination matrix that serves as the basis for the gravity-based accessibility index described in Section 5.

working population is worse off in terms of accessibility to employment than the average worker in the region. This result challenges common perceptions that only the most disadvantaged groups in society experience low accessibility levels and supports existing studies that demonstrate how both high and low income socio-economic groups in Ireland face the challenges associated with reduced mobility and car-dependency, albeit in different ways and equipped with different coping mechanisms (Wickham, 2006). Similar arguments have connected transport-related social exclusion with socio-economic status, income levels and land use planning and development in previous studies (see Preston and Rajé, 2007 for a UK-based analysis; Banister, 2011).

[Figure 4]

[Figure 5]

Standardised population rates for group 2 – non-manual workers – are mapped in Figure 6. Overall, this group is characterised by a strong preference for urban locations and by a concentration in small urban areas in East Galway and rural areas in the western parts of the region where a strong tourism sector is present. Given its urban base, this socio-economic group enjoys higher levels of accessibility to employment than the other two socio-economic groups included in the analysis. This is shown in Figure 7 where job accessibility levels with respect to the cumulative share of population for group 2 are compared with the average. The curve for this social group lies considerably to the right of the curve for the general population, which means that group 2 enjoys a significant advantage in job accessibility compared to the average.

[Figure 6]

[Figure 7]

Finally, Figure 8 shows a distinctive pattern of residential location for manual, semi-skilled and unskilled workers (group 3). A large proportion of these workers live in urban electoral districts to the east of Galway City. From a land use point of view, these urban districts have a balanced mix of residential and industrial areas, with a large number of business and industrial parks. Group 3 also features prominently in poor rural areas in the eastern part of the region and remote rural areas in the West, in particular in the Irish-speaking electoral districts. Figure 9 shows that group 3 is worse off in terms of accessibility to employment than the average. Again, the curve for this group lies to the left of the curve for the average population.

[Figure 8]

[Figure 9]

The results presented in this section show how the lack of integration in practice between land use and transport policy in Ireland has contributed to an uneven distribution of employment opportunities and transport infrastructure, which influences accessibility levels and mobility opportunities and burdens experienced by all three socio-economic groups. Observable differences in relative accessibility across all three socio-economic groups suggest a combination of new and existing structural constraints and point towards a non-linear relationship between socio-economic status and spatial mobility. However, the results from the analysis of the spatial distribution of the standardised population by socio-economic group

should be interpreted with caution. Due to data limitations, the spatial distribution of workplaces by socio-economic group is not included in the analysis. This implies that the residential location patterns illustrated in Figures 4, 6 and 8 can also reflect residential location decisions based on the location of employment opportunities for each of the three socio-economic groups considered. Further research should attempt to clarify this.

## **7. Conclusions and Discussion**

The conceptualisation of spatial mobility as a form of capital that shapes and reflects peoples' socio-economic status as well as wider social hierarchies offers a useful starting point for social research on accessibility. Alternative proposals in the mobilities literature that anticipate the partial dissolution or 'fluidification' of traditional social hierarchies due to increased levels of spatial mobility appear to complement rather than contradict these mobility-as-capital approaches. A comparison of accessibility levels across different socio-economic groups presented in this paper confirms their complementarity. On the one hand, accessibility scores for the Galway region, with its dominant urban centre and large rural hinterland, reveal that there is no direct link between social status and (in)accessibility. As we were able to show, people's occupation (which is assumed to be a very good indicator of their socio-economic status) acts as poor predictor of their experiences of (in)accessibility. Group 1 (employers, managers, higher and lower professionals) and group 3 (manual, semi-skilled and unskilled workers) are positioned at different ends of the socio-economic spectrum but experience similar low levels of accessibility and significant mobility burdens. This contrasts with group 2 (non-manual workers) whose members experience higher levels of accessibility and potentially less pressure to be spatially mobile. Overall, these findings challenge widely held views that only the most disadvantaged groups in society face low accessibility and lend support to arguments that both high and low income socio-economic groups in Ireland face mobility-related challenges, including car dependency. Recent sociological work that predicts an increasingly unequal distribution of key resources between the mobile and the immobile, including access to employment opportunities and use of time, demonstrates the relevance of these findings.

On the other hand, it is clear from the data presented in this paper that the ability of people in the Galway region to reach their place of work is determined by their choice of residential location. First and foremost, we can conclude that rural-urban cleavages with regard to accessibility persist in the Galway region, even though their exact boundaries appear to have changed significantly over the past decades (cf. Commins and Nolan 2010 for a discussion of national patterns). Interestingly, opportunities to live in close proximity to work do not necessarily depend on a person's financial capital, which explains the relative advantage of group 2 (non-manual workers). For example, property near employment centres on the Eastern side of Galway City can be less expensive than housing in other areas of the city without much employment. A person's ability to buy an expensive house in a sought-after residential area thus may or may not result in greater job accessibility. The aforementioned absence of a clear link between occupational status and accessibility in the Galway region illustrates this. Moreover, there are obvious implications for a person's impact on the environment which require further research.

Access to various forms of capital, including mobility capital, nevertheless remains important with regard to mobility choices and opportunities. The growing cost of motoring has been seen as a major source of disadvantage, especially in the current recession. It is likely that the three socio-economic groups compared in this paper draw on different strategies for coping with mobility burdens, such as time loss and cost of motoring (cf. Lohan and Wickham, 1999; Wickham, 2006). This points towards a close connection between mobility capital and economic capital. Overall, it is evident from our research work that more traditional patterns of disadvantage related to unmet transport needs now exist alongside new forms of social

differentiation associated with the recent spatial ‘mobilisation’ and acceleration of social life in Ireland. This is highly relevant to current policy debates that link car dependency and excessive spatial mobility to time poverty, reduced quality of life and a decline in citizen engagement and social capital.

Accessibility levels do not depend solely on the choices that individual members of society make but also reflect wider social, economic and political factors such as the state of the housing market, previous transport policy and land use decisions or prevailing cultural norms regarding home ownership (vis-à-vis renting). While the beginnings of many modern trends in transport and land use patterns in Ireland, such as the popularity of one-off rural housing and significant gaps in public transport services, can be traced back to political decisions and ideological struggles in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, they have been utterly transformed during the last two decades. Changes in the economic and social makeup of Irish society since the mid-1990s and corresponding developments in transport infrastructure and policy transformed opened up opportunities for spatial mobility for many citizens while (further) immobilising others at the same time. The onset of the recession in 2008 and its economic and political fallout changed Ireland’s policy landscape practically overnight. The discontinuation after five years of *Transport 21*, a ten-year transport investment programme with a budget of almost euro 35 billion that was introduced by the Ahern Government in 2005, demonstrates the serious implications of the deterioration in public finances for transport policy.

Recent trends in transport and land use planning have revolved around the need to reconcile a regionally balanced distribution of jobs with aspirations for ‘smart’ transport systems that promise greater sustainability. *Smarter Travel: A Sustainable Transport Future* (Department of Transport, 2009) provides a new transport policy framework for Ireland until 2020 that promotes low-carbon transport choices such as walking and cycling. *Smarter Travel* also advocates changes in land use patterns to address growing rural-urban imbalances in transport infrastructure provision and access to employment and services. The need to concentrate population and employment growth in compact urban and rural areas forms one of its central themes. In addition, the policy document advocates the co-location of employment and residential centres and the aligning of employment policy with transport planning.

While the recent shift towards ‘smart’ low-cost or revenue-neutral transport solutions is first and foremost a response to Ireland’s precarious financial situation that made high-cost investment programmes such as Transport 21 unviable, it also recognises the need to reconcile economic and environmental sustainability goals. However, *Smarter Travel* offers few concrete suggestions with regard to accessibility. Low accessibility to jobs and services and unsustainable mobility patterns such as time-consuming long-distance commutes by car continue to affect diverse groups in Irish society with different levels of economic, social and mobility capital. The design and implementation of socially and ecologically responsible transport and land use measures that improve accessibility to employment across different social groups thus remain an important policy goal in the Irish context.

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**Table 1. Commuting trips by origin and destination in 2002 and 2006 (shares)**

<i>Origin</i>	<i>Destination</i>								
	<i>City</i>			<i>County &lt;10 km from Galway City</i>			<i>County &gt;10 km from Galway City</i>		
	2002	2006	% <i>Change</i>	2002	2006	% <i>Change</i>	2002	2006	% <i>Change</i>
<i>City</i>	0.34	0.31	-2.74	0.02	0.03	+1.23	0.02	0.02	-0.20
<i>County &lt;10 km from Galway City</i>	0.12	0.12	+0.32	0.04	0.05	+1.05	0.02	0.02	-0.23
<i>County &gt;10 km from Galway City</i>	0.13	0.13	+0.50	0.03	0.04	+0.59	0.27	0.26	-0.52

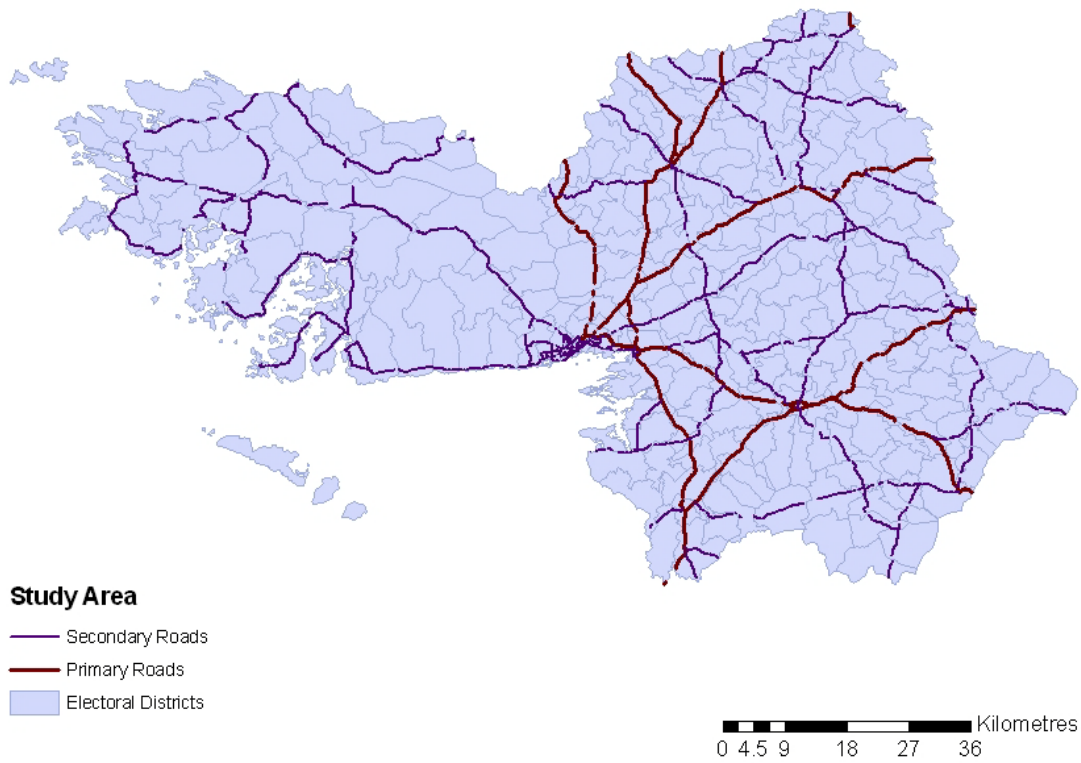
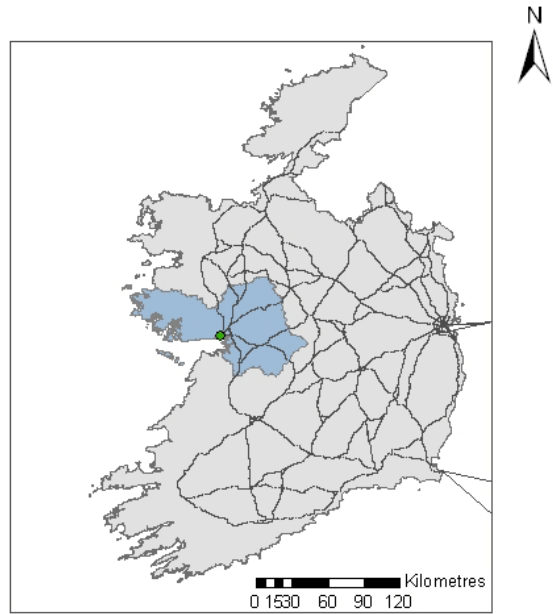
*Data sources:* Authors' calculations based on Irish Central Statistics Office data; 2002 and 2006 Census of Population of Ireland.

**Table 2. Travel mode choice shares in 2002 and 2006 for journey to work**

	<i>Walk/Cycle</i>		<i>Public Transport</i>		<i>Private Car</i>	
	2002	2006	2002	2006	2002	2006
<i>Galway City</i>	0.23	0.27	0.11	0.07	0.66	0.66
<i>Galway County</i>	0.08	0.08	0.03	0.02	0.89	0.90

*Data sources:* Authors' calculations based on Irish Central Statistics Office data; 2002 and 2006 Census of Population of Ireland.

# Study Area Galway City and County

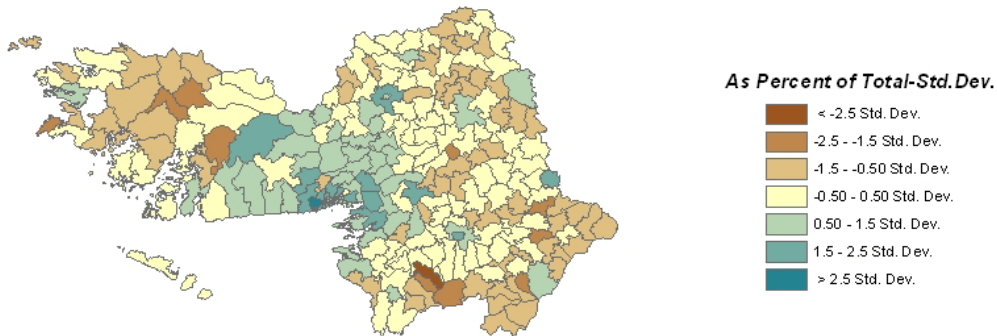


**Figure 1.** The study region and its main urban centre, Galway City  
*Data Sources:* Digital boundaries provided by Ordnance Survey Ireland

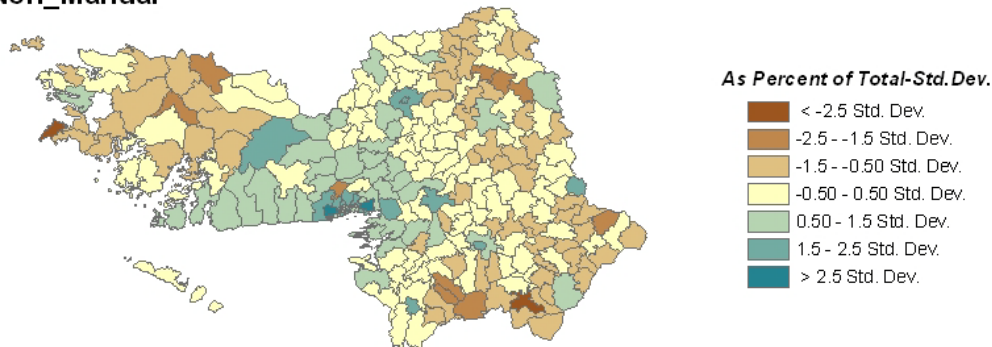


## Population by Socio-Economic Group

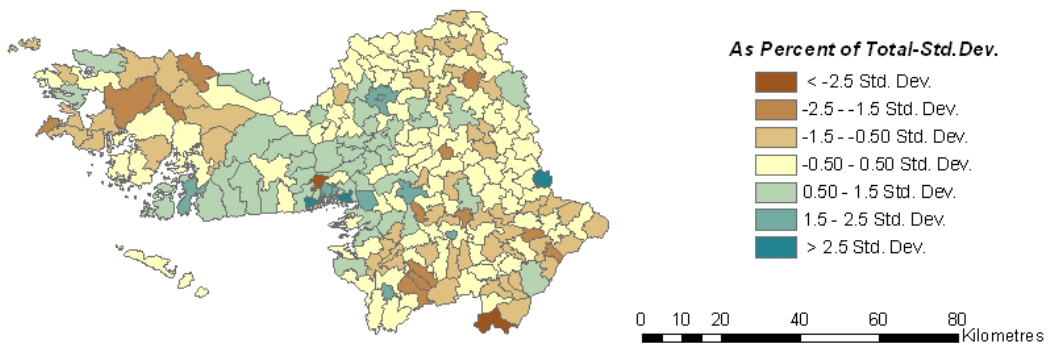
### Employers, Managers, Higher and Lower Professionals



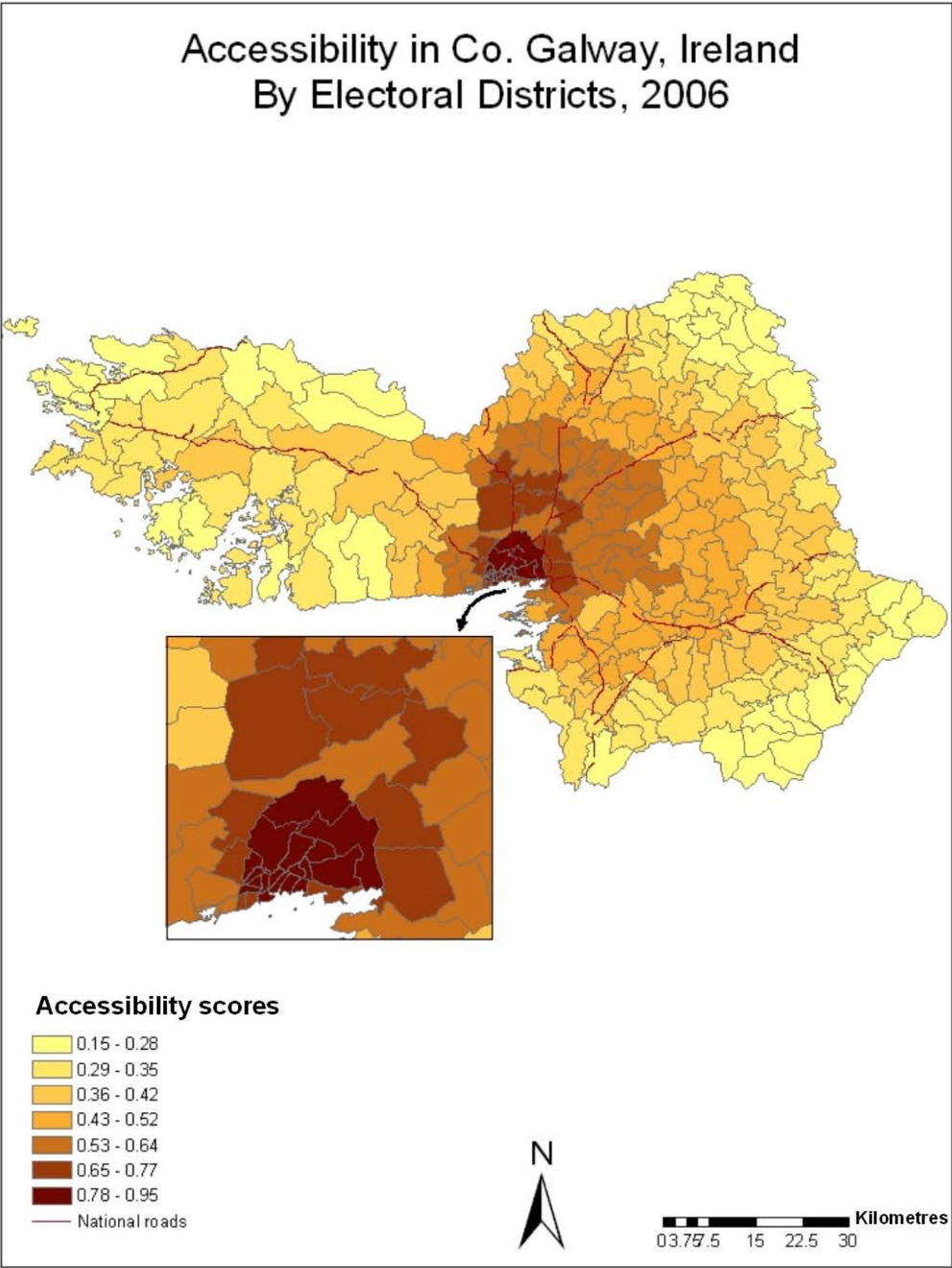
### Non\_Manual



### Manual, Semi-Skilled and Unskilled



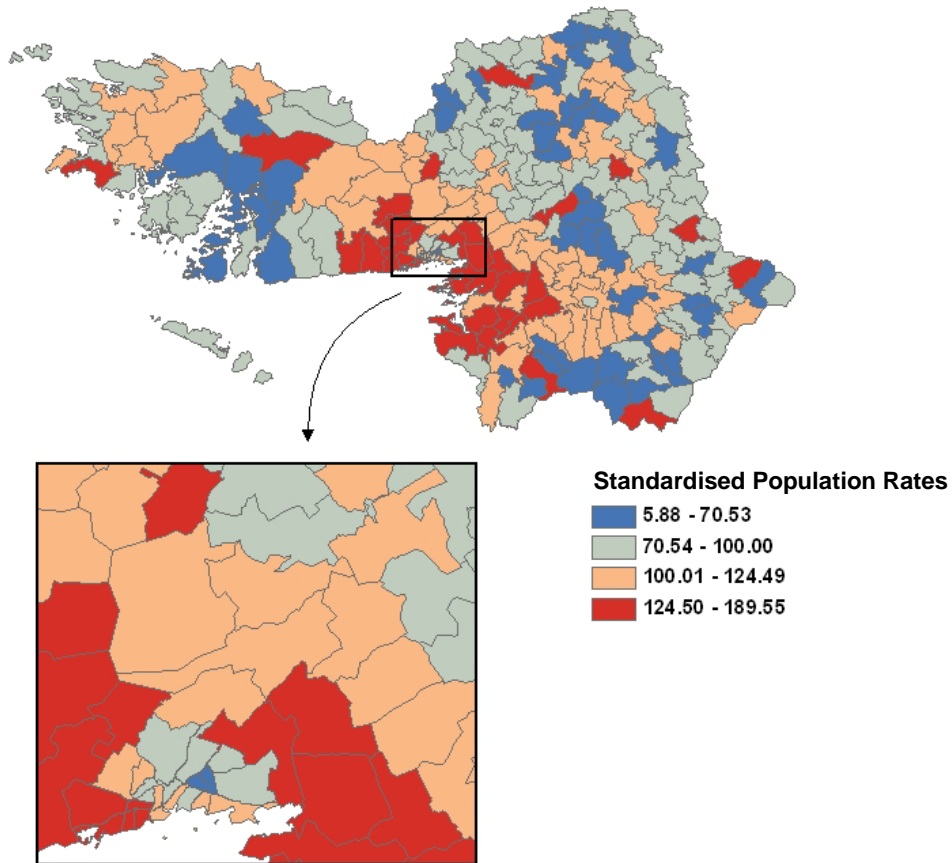
**Figure 2.** Spatial distribution of individuals by socio-economic group of reference in the study region (% of total population).  
*Data sources:* Small Area Population Statistics (SAPS) based on 2006 Census of Population of Ireland. Digital boundaries provided by Ordnance Survey Ireland.



**Figure 3.** Accessibility scores for Galway region (city and county)  
*Data sources:* Authors' calculations based on 2006 Census of Population of Ireland data.  
 Digital boundaries provided by Ordnance Survey Ireland.



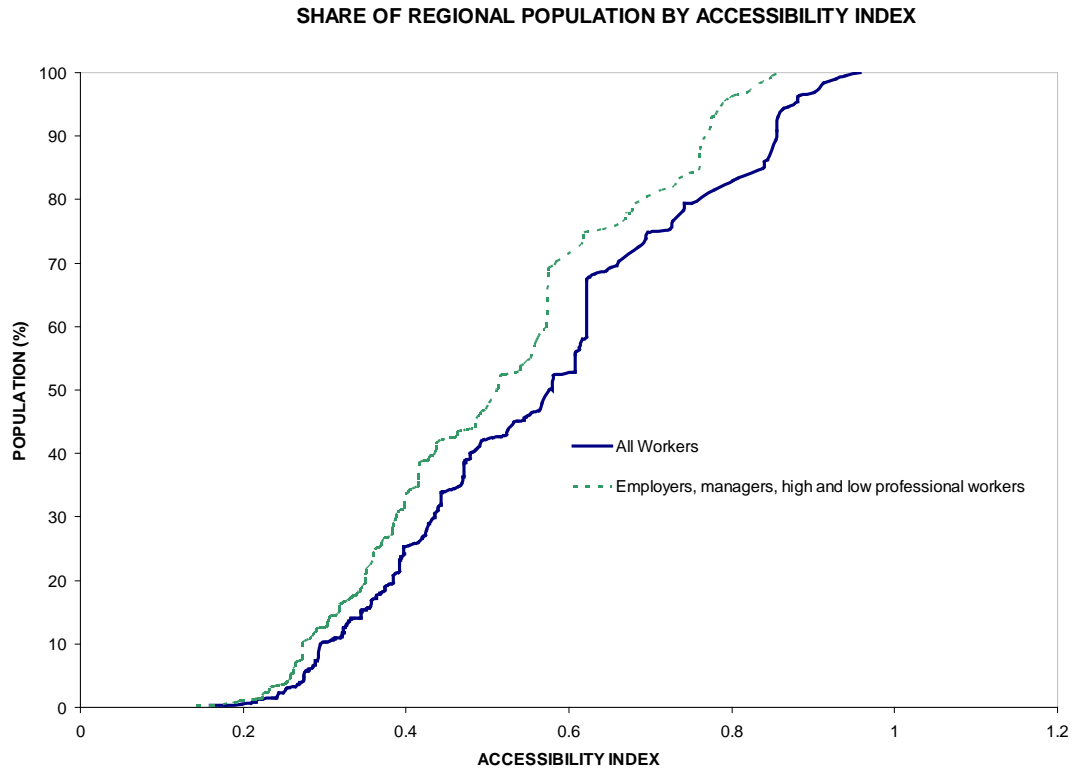
## Standardised Population Rates by Socio-Economic Group



**Figure 4.** Standardised population rates for employers, manager and high and low professionals

*Data sources:* Authors' calculations based on 2006 Census of Population of Ireland data. Digital boundaries provided by Ordnance Survey Ireland.

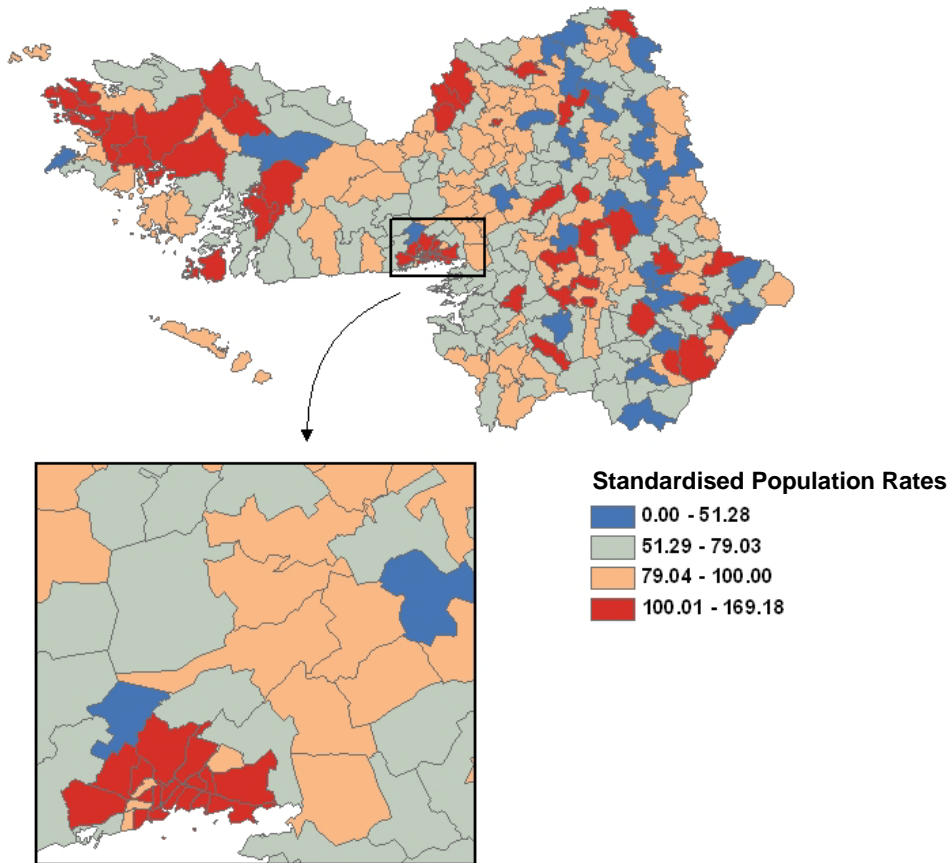




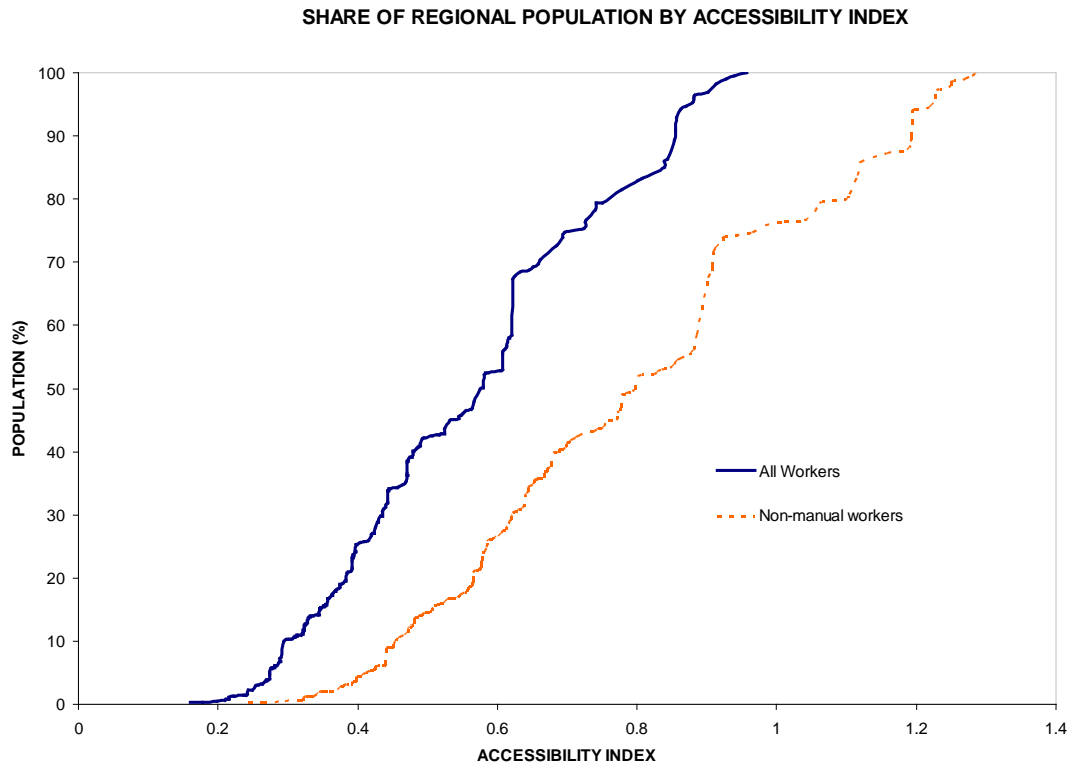
**Figure 5.** Cumulative share of regional population by accessibility index for all workers compared with employers, managers, high and low professionals



## Standardised Population Rates by Socio-Economic Group



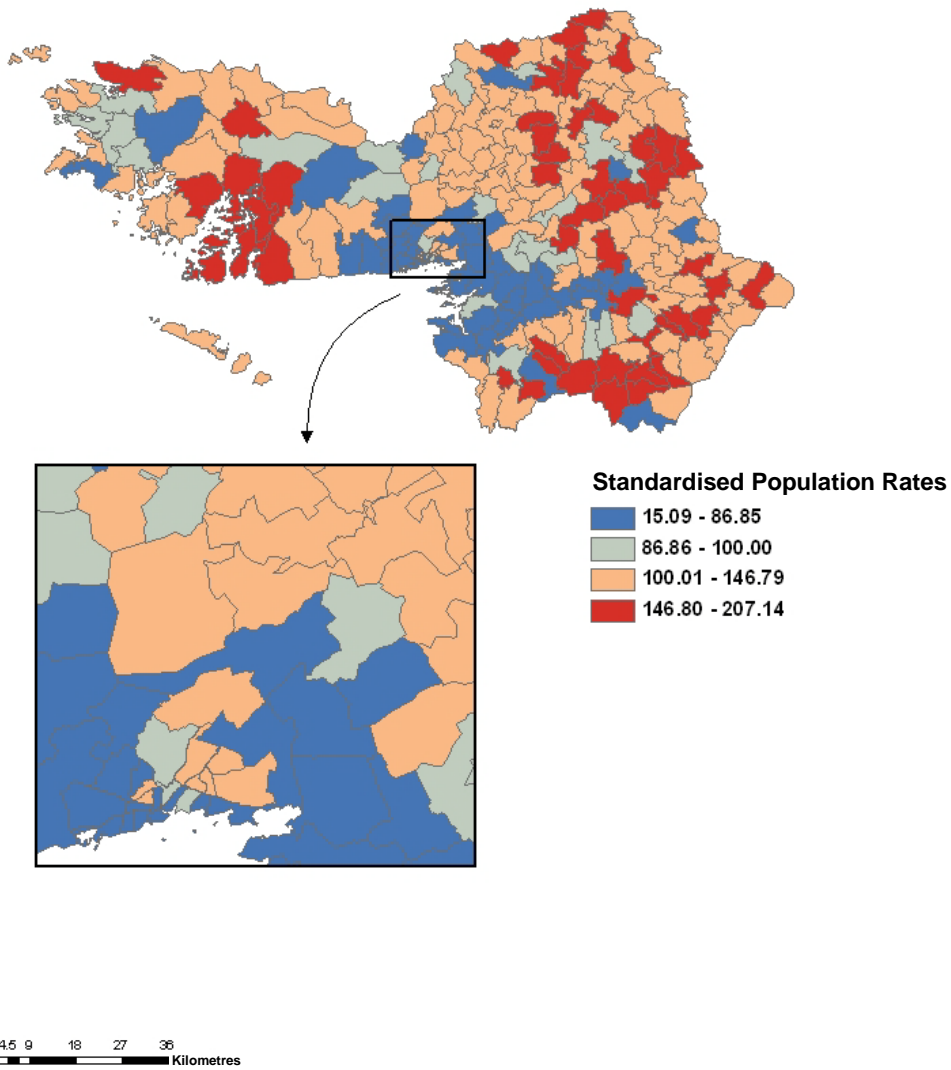
**Figure 6.** Standardised population rates for non-manual workers  
*Data sources:* Authors' calculations based on 2006 Census of Population of Ireland data.  
Digital boundaries provided by Ordnance Survey Ireland.



**Figure 7.** Cumulative share of regional population by accessibility index for all workers compared with non-manual workers



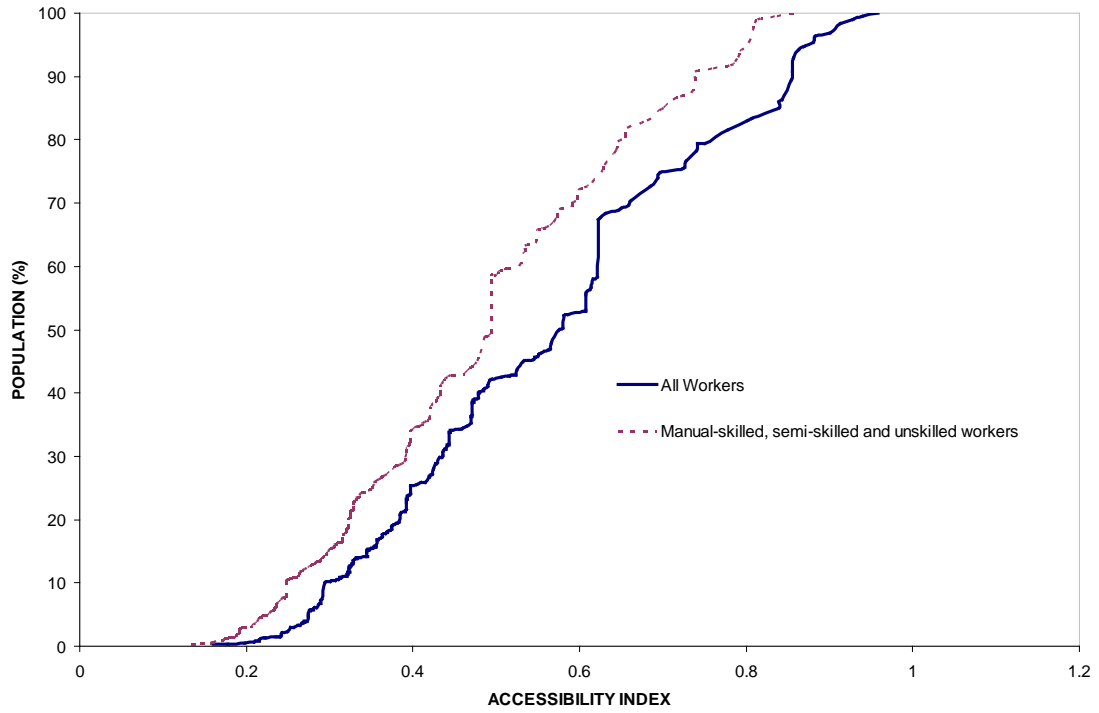
## Standardised Population Rates by Socio-Economic Group



**Figure 8.** Standardised population rates for manual, semi-skilled and unskilled workers

*Data sources:* Authors' calculations based on 2006 Census of Population of Ireland data. Digital boundaries provided by Ordnance Survey Ireland.

### SHARE OF REGIONAL POPULATION BY ACCESSIBILITY INDEX



**Figure 9.** Cumulative share of regional population by accessibility index for all workers compared with manual, semi-skilled and unskilled workers