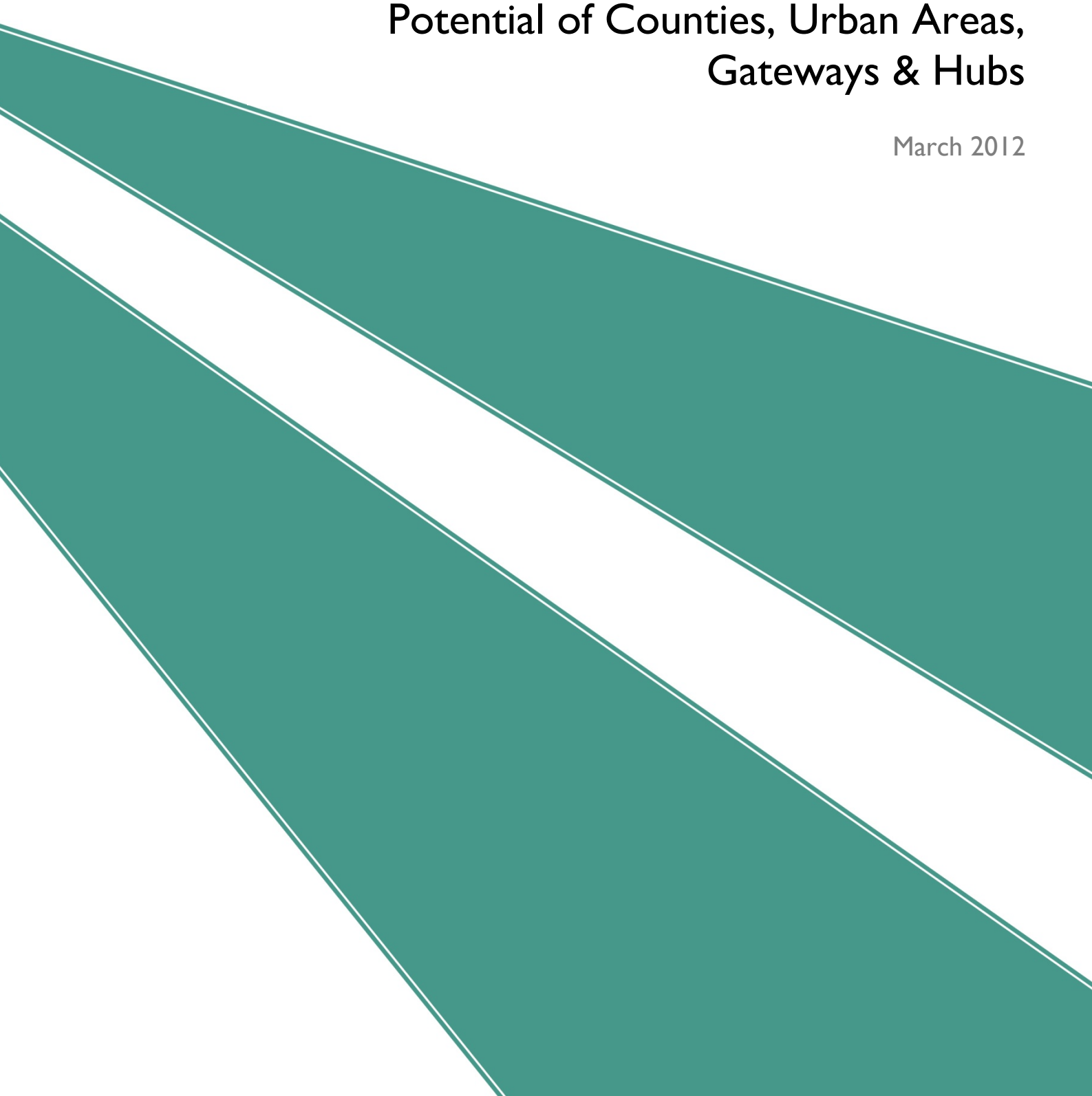
NRA
National Roads Authority
An tÚdarás um Bóithre Náisiúnta

Transport Research & Information Note

Impact of Improvements in the Road Network on the Accessibility & Economic Potential of Counties, Urban Areas, Gateways & Hubs

March 2012



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1. Introduction

General

1.1. This Report investigates the contribution that the road network makes to improving accessibility and developing the economic potential of counties, gateways and hubs throughout the island of Ireland. This analysis was made possible by the development of the NRA's National Transport Model, which provides estimates of journey times between some 870 zones throughout the country.

1.2. Section 2 of the Report introduces the concept of effective density and sets out the relationship between this measure of agglomeration and productivity. The broad approach to measuring effective density in the Irish context is outlined. The detailed methodology for measuring effective density using the National Transport Model is explained in Section 3. Section provides the results of the analysis. Some implications of the analysis are discussed in Section5. Section 6 contains the conclusions of the Report.

2. Accessibility, Effective Density & Productivity

Introduction

2.1. This Section of the Report outlines the research evidence that has emerged regarding transport accessibility and the economic potential of geographic areas. The National Transport Model provides an opportunity to measure the accessibility of a given location to other geographic areas and so provide an insight into economic potential.

2.2. Interest in accessibility measures has increased because of their relevance to measuring the wider economic benefits of transport investments. One of these wider economic benefits arises from agglomeration effects. Firms that locate in dense urban areas provide spill-over benefits to other firms in their locality. The result is that firms in dense urban areas have higher productivity and lower costs than those in more rural settings, other things being equal. The scale of a firm's "locality" is in part determined by accessibility. If transport system improvements bring geographic areas closer together through accessibility enhancements, then the "effective density" of that area is raised. Thus, economic productivity gains can be realised through transport system improvements that raise effective density.

2.3. These agglomeration benefits are additional to the standard benefits associated with transport improvements – the measurement of changes in consumer's and producer's surpluses. They are thus important, as they have the potential to cause marginal transport schemes to become economic and alter the priority accorded to particular schemes, most notably in urban areas. This Section of the Report discusses the nature of these effects and outlines the potential to use the National Transport Model to assess the extent to which road network improvements in Ireland have yielded such benefits.

Agglomeration & Productivity

2.4. Urban concentrations are regarded as beneficial to economic productivity because they:

- Provide large labour markets that enable firms to more easily access the skills that they require;
- Provide large product markets that offer scope for specialisation;
- Provide large sub-supply markets that reduce input costs;
- Enhance competition between firms;
- Promote knowledge sharing or diffusion of technological practices through spill-over effects;
- Provide access to high quality public infrastructure and services through scale economies.

2.5. Knowledge spill-over effects are considered to be particularly important for service sector industries such as financial and business services. Much of the spill-over effects in the service sector are thought to be informal through the casual interaction of workers.

2.6. A feature of these benefits of agglomeration is that they are external to the firm. That is, when a firm locates in an urban area, it adds to these effects, so that it produces benefits for other firms additional to the benefits that it enjoys. This is why these agglomeration benefits are additional to the user benefits that are usually measured in the appraisal of transport projects.

2.7. There is a considerable body of empirical evidence that supports the existence of these productivity effects. The bulk of these studies relate industrial productivity to city size, as measured by population or employment. These studies have been reviewed by Graham, who summarises the responsiveness of productivity to urban size through elasticities. [1]Graham concludes that the elasticity of productivity to urban size lies between 0.01 and 0.10. This means that a doubling in city size raises productivity of firms by between 1% and 10 %.

Productivity & Effective Density

2.8. While these studies confirm the role of urban areas in promoting productivity, they suffer from an inadequate representation of urban scale and connectivity.

2.9. Urban areas are often poorly defined, with their footprint much exceeding their official boundaries. Moreover, many cities have satellite towns which add to their agglomeration impact, but are not encompassed by such studies. These drawbacks can be overcome by recognising that all areas benefit from other areas in terms of creating scale, and that this is affected by the distance between such areas. Thus, for example, the agglomeration effect of urban area of Drogheda is enhanced by its proximity to Dublin, and to a lesser extent to Belfast because of the greater distance to that conurbation.

[1] D.J.Graham. Investigating the Link between Productivity and Agglomeration for UK Industries. Imperial College London (undated)

2.10. This observation has given rise to a series of studies that related productivity of firms in urban areas to the effective density of those areas. This measures how close a given urban area is to all other areas, weighted by an indicator of economic activity in those areas. This can be characterised as follows:

$$U = \sum_{j}^{i \neq j} \left\{ {A_j}/{(d_{ij})^{\alpha}} \right\}$$

Where:

U = Effective Density

A = Measure of economic activity

d = accessibility or distance between geographic areas

α = a decay parameter; and

Subscripts $_i$ and $_j$ denote geographic areas.

2.11. The advantage of using effective density as a measure is that the agglomeration effect of a given settlement can encompass its interaction with and accessibility to a large number of other areas.

Measuring Effective Density

2.12. Operationalising a measure of effective density requires calculation of a number of parameter values.

Measure of Economic Activity

2.13. The benefits of agglomeration outlined in Section 2.2 are based largely on a firm's proximity to workers, consumers or other firms. Any of these factors could be used as a measure of economic activity. In practice, these measures are closely related geographically to one another, so that the choice between may not affect the measure of effective density. In general, there has been a tendency to use employment (jobs in the area) or population as the measure of economic activity. Intuitively, the employment factor has the greater appeal as it encompasses both firm to firm and firm to worker interactions.

Accessibility or Distance

2.14. Most of the early studies that employed the concept of effective density used straight-line distance between areas as the measure the accessibility of one area to another. This was often dictated by the fact that better measures of accessibility, such as travel time or generalised cost of travel, were not available. A small number of studies have benefited from the availability of a transport model capable of predicting travel times between geographic areas. Using this latter approach has the benefit of including the effect of congestion on transport networks in the analysis. This is important as urban areas often become congested and the consequent reduction in accessibility and effective density reduces the benefits of agglomeration.

Decay Parameter

2.15. The decay parameter encompasses the degree to which the contribution of other geographic areas to the effective density of given zone declines with distance of journey time. Once the decay parameter is above zero, more distant zones are weighted less. If the decay parameter equals unity, then the contribution of an external geographic area is proportionate to the measure of accessibility or distance. This is an empirical matter and α can be determined through the econometric measurement of production functions which employ effective density as an explanatory variable.

Recent Empirical Studies Using Effective Density

2.16. Graham (op.cit) estimated productivity with respect to effective density for the UK, employing both distance and generalised costs as accessibility factors. The measure of economic activity was employment levels and the analysis was conducted at the level of the ward. The decay parameter was set at unity. Based on these assumptions, and employing distance as the accessibility factor, Graham estimated agglomeration elasticity for the manufacturing sector at 0.077. That for the service sector was much higher at 0.197, with an average across sectors of 0.125. The latter figure can be interpreted as indicating that doubling of effective density increases productivity by 12.5% overall. When the generalised cost measure is used, the elasticities increase by approximately one-third. These results indicate that impact of agglomeration on productivity is substantial, with a doubling of effective density leading to a 27% increase in service sector productivity, for example (using the generalised cost measure).

2.17. A further study for New Zealand yielded somewhat lower elasticities of 0.069 overall. [2] However, the analysis showed that the relative elasticities for different industrial sectors followed the trends evident in UK data: service sectors such as finance and insurance recorded higher elasticities (0.087), with agriculture much lower at 0.032. The New Zealand analysis was based on a travel time measure of accessibility, employment as a measure of economic activity and a decay parameter of unity.

2.18. A more recent report for the UK (Graham et al (2009)), produced significantly lower estimates for the UK of 0.043 for the economy as a whole, with a higher value for business services. [3]

2.19. Taking the latest UK result and that for New Zealand, an overall elasticity of 0.05 would seem to be a reasonable basis on which to estimate the effects of effective density in an Irish context. This implies that a doubling of effective density raises productivity by 5%. While effects on this scale may not seem large, it is worth pointing out that this increase in productivity is a sustained one, so that transport

[2] D.C.Mare and D.J. Graham. Agglomeration Elasticities in New Zealand.

[3] D.J Graham et al. Transport Investment and the Distance Decay of Agglomeration Benefits. January 2009.

improvements would provide such increases in productivity on an annual basis for a considerable period of time.

Using the National Transport Model

2.20. The National Transport Model predicts zone to zone journey times for some 874 zones on the island of Ireland. Economic activity measures such as population and jobs are also available within the Model. This facilitates the calculation of effective density for any of the zones on the island.

2.21. In undertaking this analysis, the effective density formula of Section 2.3 was altered. This was in recognition of the fact that that formula measured the effective density arising from the proximity of the individual zone to external zones, but did not take account of internal effective density. That is when zones are relatively large, the density within the zone may be as important and the zone's accessibility to other dense zones.

2.22. The inclusion of this effect was accomplished through the following formula:

$$U = \sum_{j}^{i \neq j} \left\{ {}^{A_j}\!/_{(d_{ij})^{\alpha}} \right\} + {}^{A_i}\!/_{d_i}$$

Where:
di = within-zone accessibility

2.23. This formulation states that the effective density of the zone is the sum of the external effective density and the internal effective density.

2.24. In operationalising this formula, accessibility was measured by travel time and the decay parameter was set at unity. Two measures of activity were used viz. zonal employment and zonal population. These are effectively measures of access to employment and access to the population (or market).

Summary

2.25. Firms that locate in dense urban areas provide spill-over benefits to other firms in their locality. The result is that firms in dense urban areas have higher productivity and lower costs than those in more rural settings, other things being equal. The scale of a firm's "locality" is in part determined by accessibility.

2.26. If transport system improvements bring geographic areas closer together through accessibility enhancements, then the "effective density" of that area is raised. Thus, economic productivity gains can be realised through transport system improvements that raise effective density.

2.27. Studies in the UK and New Zealand support the view that increasing the effective density of a given area increases the productivity of firms with the area. The evidence is that a doubling of effective density leading to a 4 to 7%% increase in productivity of firms overall, with very much higher impacts in the service sector.

3. Methodology

Background

3.1. As discussed previously, effective density has been adopted as the measure of accessibility for the study. Demand, in terms of employment and population levels and road journey time data are required to generate an effective density value for a given location.

3.2. The National Traffic Model (NTM) was identified as a suitable data source. The NTM is comprised of 874 zones derived as combinations of the 3,447 District Electoral Divisions (DEDs) nationwide. These zones are sufficiently granular to allow detailed analysis of the national, regional and local distribution of accessibility. Accessibility here refers to accessibility by the road mode.

3.3. Using the NTM also allowed the impact of improvements to the national highway network on accessibility to be measured. Section 3.2 discusses the approach to quantifying the change in accessibility scores as a result of upgrades to the road network between 2006 and 2010.

3.4. The methodology used to generate effective density values and the accessibility scores derived from them will be discussed in greater detail in Section 3.3 below. Zonal population and employment data were created by aggregating from the DED level data available from the Central Statistics Office (CSO).

The National Traffic Model

3.5. The National Traffic Model (NTM) was developed in 2008 using the VISUM network modelling software. The model included all National Road schemes which were open to traffic in July of 2006. The modelled network comprises five key link types:

- Motorways;
- National Primary Roads;
- National Secondary Roads;
- Regional Roads; and
- Local Roads.

3.6. A limited number of key local roads were also included. Figure 1 illustrates the network as modelled in the 2006 NTM.

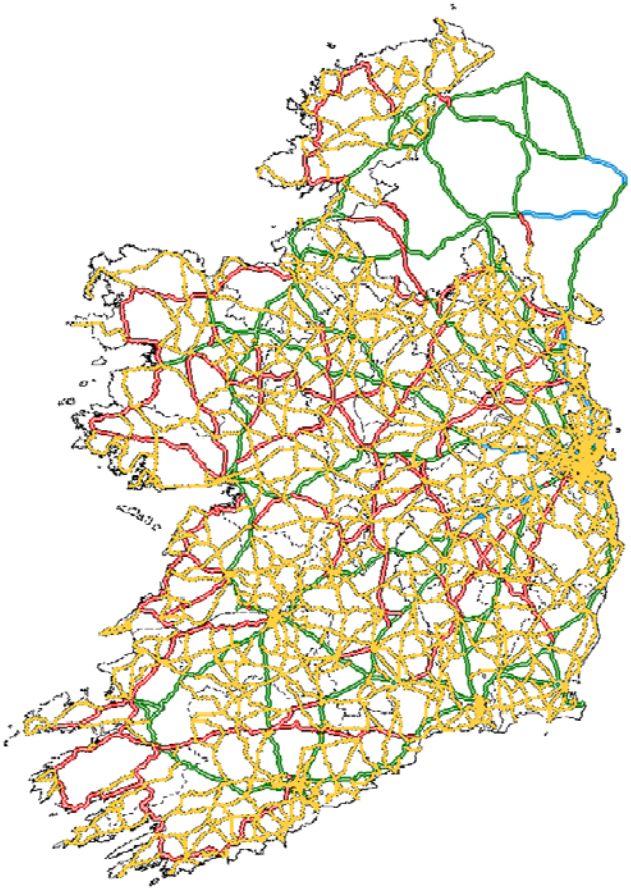
3.7. Demand matrices used in the model were derived from observed trip data obtained from the 2006 and 2007 road side interviews (RSI) and the 2006 Place of Work – Census of Anonymous Records (POWCAR).

3.8. The model was developed for both the AM and Interpeak periods. For the purposes of this study, both the AM and Interpeak models were interrogated, and accessibility calculated for an average hour. The methodology used to generate this average hour is discussed in greater detail in Section 3.3 below.

3.9. The model was interrogated to extract the 874 x 874 matrix of average zone-to-zone journey times by private car for both the AM (07:00 – 09:00) and Interpeak (12:00 – 14:00) periods. Average journey times are recorded assuming a fully loaded network and therefore network congestion, in both the AM and Interpeak periods is incorporated into the accessibility score for each zone.

3.10. Population and employment data for each zone was also extracted from the model. Average intrazonal travel time was calculated within the model for each of the 874 zones. This is an approximation of the average travel time for trips which take place exclusively within that zone.

Figure 1: 2006 NTM Network



3.11. The effective density of a given zone is measured in two parts; the first is internal and the second, external component is the sum of the effective densities of all other zones. It is calculated as follows:

$$U(E)_i = {E_i}/{t_i} + \sum_{j}^{n \neq 1} \left({E_j}/{t_{ij}} \right)$$

Where:

U(E)i = total effective density of Employment in zone i
Ei = total Employment in zone i
ti = the average internal travel time in zone i
Ej = total Employment in zone j
tij = journey time between zones i and j

3.12. The above equation was formulated in such a way that the greater the employment density in a given zone, the higher its effective density of employment value. Similarly, the shorter the journey time between a given zone and a zone with high employment, the higher is its effective density of employment. A similar calculation was undertaken to determine the effective density of Population of each zone.

3.13. In order to generate an Average-Hour accessibility score for each NTM zone, the AM and Interpeak accessibility scores were summed, weighted based on daily traffic volumes across the national roads network. The following procedure is used to generate Annual Average Daily Traffic (AADT) volumes on a given link from AM and Interpeak data:

$$\boldsymbol{AADT} = \{\mathbf{5.8442} \times (\boldsymbol{AM\ traffic\ flow})\} + \{\mathbf{9.83311} \times (\boldsymbol{Interpeak\ traffic\ flow})\}$$

3.14. This formula was derived from regression analysis of data collected from 96 Automatic Traffic Counters (ATCs) across the national road network. The above formula was adapted to generate an average hour accessibility score as follows:

$$\boldsymbol{U(E_{Ave})_i} = \frac{\{\mathbf{5.8442} \times \mathbf{U}(\boldsymbol{E_{AM}})_i\} + \{\mathbf{9.83311} \times \mathbf{U}(\boldsymbol{E_{Int}})_i\}}{\mathbf{24}}$$

Where:

$U(E_{Ave})_i$ = total effective density of Employment in zone i for an average hour
$U(E_{AM})_i$ = total effective density of Employment in zone i during the AM peak
$U(E_{Int})_i$ = total effective density of Employment in zone i during the Interpeak

3.15. In order to make the raw figures more intelligible, the effective density of a given zone was used to develop its accessibility score on a 1 – 100 scale where the zone with the highest effective density value is set to 100 and all other zones are measured relative to it, as follows:

$$A(E)_i = {U(E)_i . 100}/{Max\ U(E)_{i-j}}$$

Where:

A(E)i	= accessibility score for Employment in zone i
U(E)i	= total effective density of Employment in zone i
Max U(E)i-j	= maximum effective density for all zones from i to j

3.16. This means that the effective density of each zone was marked out of 100.

3.17. Accessibility scores were calculated twice. The scores were first calculated based on the NTM model with the 2006 road network and demand in place. In order to gauge the impact of the road investment programme over the period 2006 to 2010, the model was run a second time with the 2010 network in place, but using 2006 demand levels. This process ensured that the impact of the road network improvements on accessibility would be identified, the level of network congestion being held constant.

3.18. In implementing this process, all of the A(E) scores were based on the zone with the maximum effective density from the 2006 average hour data set being assigned an accessibility value of 100. As a result some zones exhibited a score greater than 100 in the 2010 model run. This was due to the road network improvements that took place in the intervening period.

4. Accessibility to Employment & Population 2006

Introduction

4.1. This Section of the Report presents the result of the accessibility calculations for the 2006 road network and demand. Accessibility was measured at the zonal level and a brief overview of the results is presented. This is followed by the results at a local authority and more importantly town and city level. The latter are particularly important as substantial agglomeration effects are most likely to arise for urban areas. The urban areas identified in this report are the Gateways and Hubs of the National Spatial Strategy.

Zonal Accessibility

4.2. An accessibility score was calculated for each of the 874 zones in the network. The six zones making up the counties of Northern Ireland have not been included in the results due to the limited data available for the country. This left 868 zones covering the Republic of Ireland. Figures 2 and 3 thematically illustrate the distribution of employment and population accessibility scores respectively across the country at a zonal level.

Figure 2: Employment Accessibility Score by Zone (Average Hour 2006)

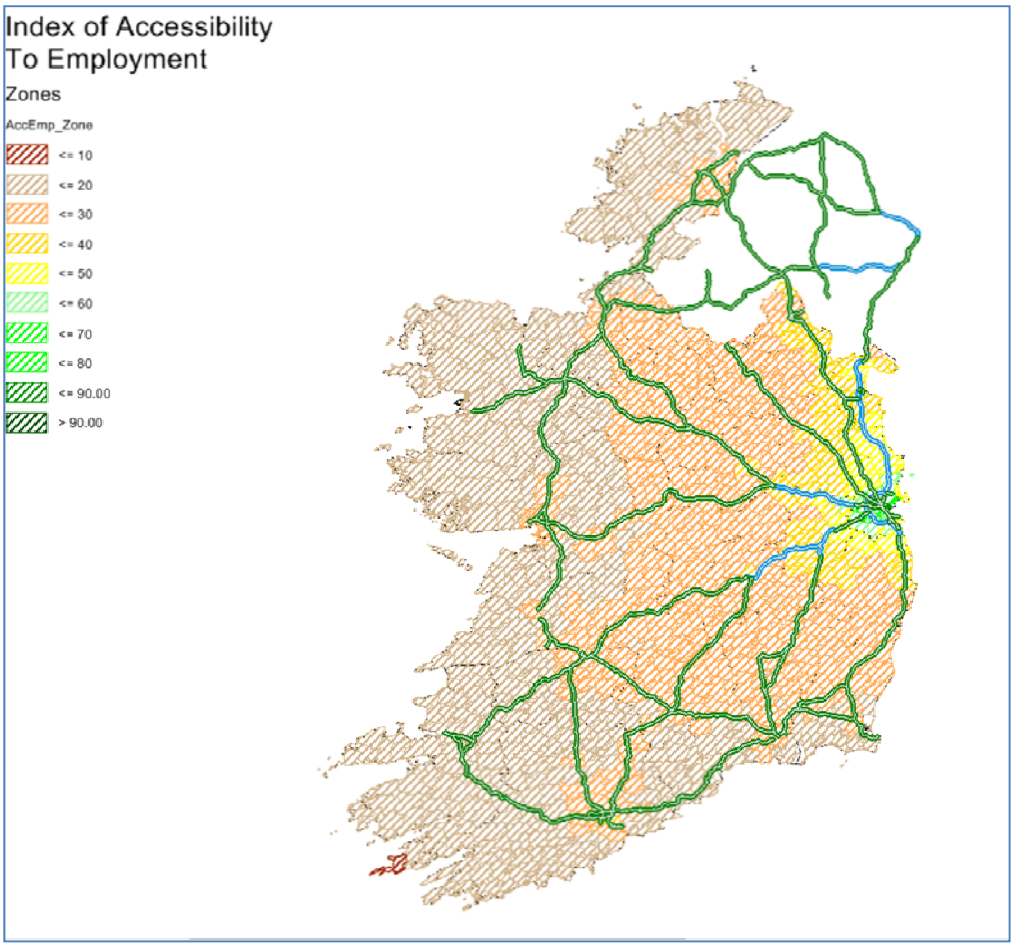
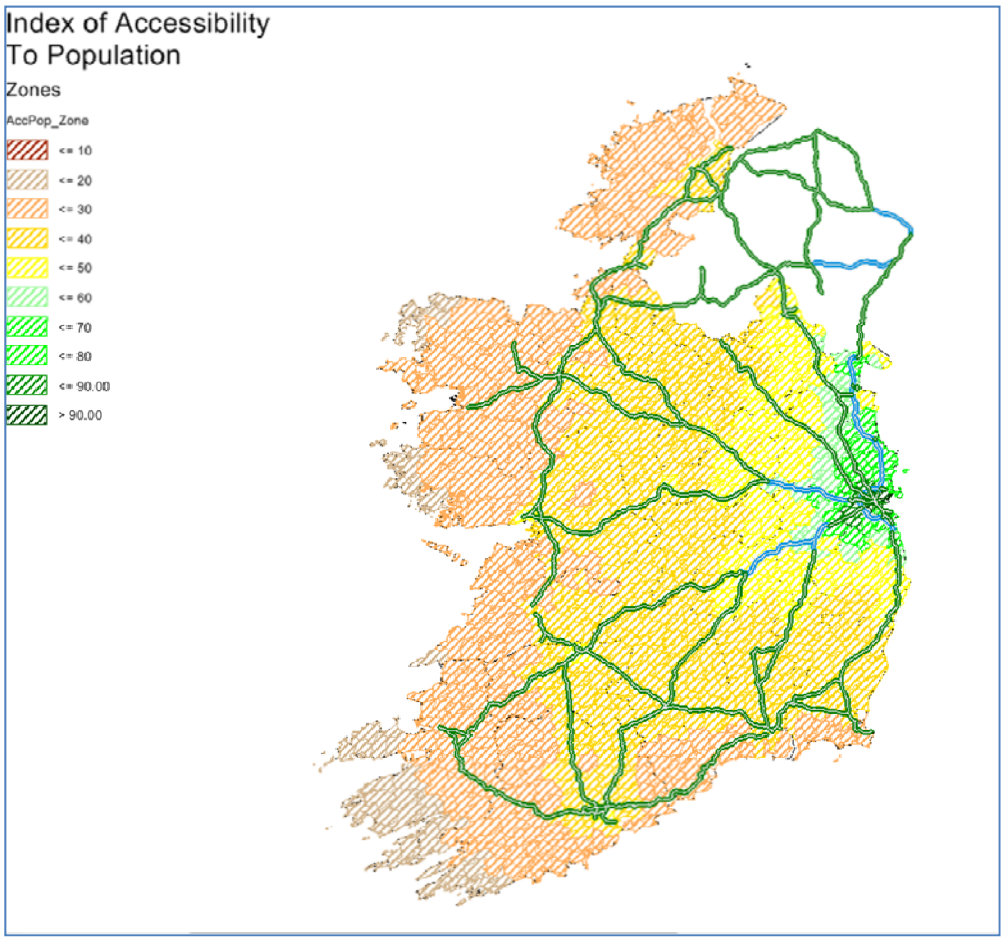


Figure 3: Population Accessibility Score by Zone (Average Hour 2006)



4.3. With regard to accessibility to employment, zones in the Greater Dublin area score highest, with peripheral zones in the west, northwest and south west of the country having the least access to employment. A similar picture emerges with respect to population. However, population accessibility is not as concentrated. This reflects the fact that employment is more concentrated in urban areas than population, and particularly more concentrated in the Greater Dublin area.

4.4. Table 1 tabulates the highest and lowest accessibility scores for both employment and population based accessibility indices.

Table 1 – Maximum and Minimum Average Hour Accessibility Scores (2006)

Employment Accessibility			Population Accessibility		
Zone	**Location**	**Score**	**Zone**	**Location**	**Score**
826	Dublin City Centre (South)	100	827	Dublin City (West)	100
755	Beara Peninsula	10	755	Beara Peninsula	16

4.5. As can be seen in Table 1 the Beara Peninsula, the most remote area of West Cork, receives the lowest score both in terms of accessibility to Employment and Population. At the other end of the scale, Dublin City centre is the most accessible

area. The south city centre, a busy office district, receives the highest score for accessibility to employment, while a zone to the west of the city incorporating Clonsilla and Lucan and with direct access to the M50 receives the highest score in terms of accessibility to population.

4.6. The average level of accessibility for the country as a whole was estimated at 23 to Employment and 35 to Population in 2006.

Accessibility at Local Authority Level

4.7. Weighted average accessibility results were aggregated from the zonal results to generate local authority rankings. Table 2 summarises these local authority level scores. Along with the county council areas, individual scores have been provided for Waterford City, Galway City, Cork City and Limerick City. There is a close correlation between relative scores in terms of employment and population accessibility. That is, when the local authority areas are ranked by score, the rank order does not differ much between employment and population accessibility.

Table 2: City & County Council Area Accessibility Scores (2006)

County/City Council Area	Accessibility to Employment	Accessibility to Population
Donegal	19	28
Sligo	22	31
Leitrim	22	33
Cavan	26	39
Monaghan	31	45
Louth	41	59
Mayo	17	27
Galway	20	30
Galway City	29	40
Roscommon	22	34
Longford	25	38
Westmeath	28	43
Offaly	25	39
Laois	29	43
Limerick City	29	43
Clare	20	30
North Tipperary	23	35
Limerick	24	34
Kildare	41	59
Meath	38	57
Wicklow	38	57
South Tipperary	22	34
Kilkenny	24	36
Carlow	27	40
Wexford	21	33
	19	29

Waterford City	25	37
Cork	21	32
Cork City	36	50
Kerry	16	24
Fingal	55	77
Dublin City	86	93
South Dublin	66	93
Dún Laoghaire-Rathdown	56	76

4.8. Focusing on accessibility to employment, the local authorities in the Greater Dublin area exhibit the highest employment accessibility, with Dublin City ranked first. Access to employment for Dublin City zones is five times that of Kerry, which is the least accessible local authority area. What is surprising perhaps is the good performance of Louth and Monaghan. This probably reflects their proximity to the conurbations of both Dublin and Belfast and the fact that the M1 motorway was completed by 2006. The actual economic performance of these two counties does not reflect their employment accessibility and this relates to the impact of the Border in inhibiting economic connectivity

4.9. The lowest local authority scores are those for Kerry, Mayo, and Donegal which are areas that are geographically remote and do not have large centres of population. [4] The low score for Wexford, despite its relative proximity to Dublin is noteworthy. The quality of road access in 2006 may have been a factor in this, as the town is relatively close to both Waterford and Dublin in crow-fly terms.

Accessibility to Employment & Population for National Spatial Strategy Gateways & Hubs

4.10. The National Spatial Strategy (NSS) designated as gateways the urban areas of Dublin, Cork, Limerick/Shannon, Galway, Waterford, Dundalk and Sligo and the linked urban areas of Letterkenny/(Derry) and the Midland towns of Athlone/Tullamore/Mullingar. These Gateways were to act as drivers of regional economic growth. In addition, the NSS identified nine, strategically located, medium-sized "hubs" which will support, and be supported by, the gateways and will link out to wider rural areas. The hubs identified were Cavan, Ennis, Kilkenny, Mallow, Monaghan, Tuam and Wexford, along with the linked hubs of Ballina/Castlebar and Tralee/Killarney, working together to promote regional development in their areas. In order to estimate accessibility for these cities and towns, an approximate radius of influence of 30km for larger Gateways, and 15km for Hub towns was assumed and a weighted average accessibility score calculated for each based on the NTM zones falling within each study area.

4.11. Table 3 summarises the local accessibility scores for each Gateway and Hub town or city outside of Dublin.

[4] The low scores for Waterford, Galway, Cork and to some extent Clare reflect the fact that the cities of Waterford, Galway, Cork and Limerick have been treated separately, so that the scores are influenced by the rural nature of much of the residual county area.

Table 3: Gateway/Hub Town Accessibility Scores (2006)

NSS Gateway/Hub	Accessibility to Employment	Accessibility to Population
Letterkenny	21	30
Ballina Castlebar	18	28
Sligo	22	32
Cavan	26	38
Monaghan	30	43
Dundalk	51	70
Galway	27	35
Tuam	20	31
Athlone Tullamore Mullingar	27	41
Ennis	20	31
Limerick Shannon	26	37
Tralee Killarney	17	26
Kilkenny	25	37
Wexford	20	31
Waterford	24	34
Mallow	20	32
Cork	31	42
Dublin	72	85

4.12. Again the performance of the North–East is noteworthy with Dundalk and Monaghan exhibiting high levels of accessibility to employment. The low scores for Tralee–Killarney and Ballina-Castlebar would be expected given their peripheral nature. However, the low score of Mallow is a surprise given its proximity to Cork, although the M8 had yet to be built in 2006.

Summary

4.13. Based on a maximum rating of 100, the average accessibility to employment for the country as a whole was 23 as of 2006. Zones in the Dublin region have the highest access to employment, with peripheral zones in the west, northwest and south west of the country having the least access. A similar picture emerges with respect to population. However, population accessibility is not as concentrated on zones in the Dublin region.

4.14. The local authorities in the Dublin Region exhibit the highest employment accessibility. Access to employment for Dublin City zones is five times that of Kerry, which is the least accessible local authority area. Louth and Monaghan counties have high access to employment, reflecting their proximity to the conurbations of both Dublin and Belfast and the fact that the M1 motorway was completed by 2006. The actual economic performance of these two counties does not reflect their employment accessibility and this probably relates to the impact of the Border in inhibiting economic connectivity.

4.15. With regard to the performance of Gateways and Hubs, the towns of Dundalk and Monaghan exhibit high levels of accessibility to employment. More peripheral hubs such as Tralee–Killarney and Ballina-Castlebar have low levels of accessibility. The low score of Mallow is a surprise given its proximity to Cork, although the M8 had yet to be built in 2006.

5. The Impact on Accessibility to Employment & Economic Productivity

Introduction

5.1. This Section of the Report considers the impact of the road investments in the period 2006-2010 on the accessibility of areas to employment. It commences with an outline of the major road investments made and then the improvements in accessibility are outlined. The impact on the economic performance of local areas is then discussed.

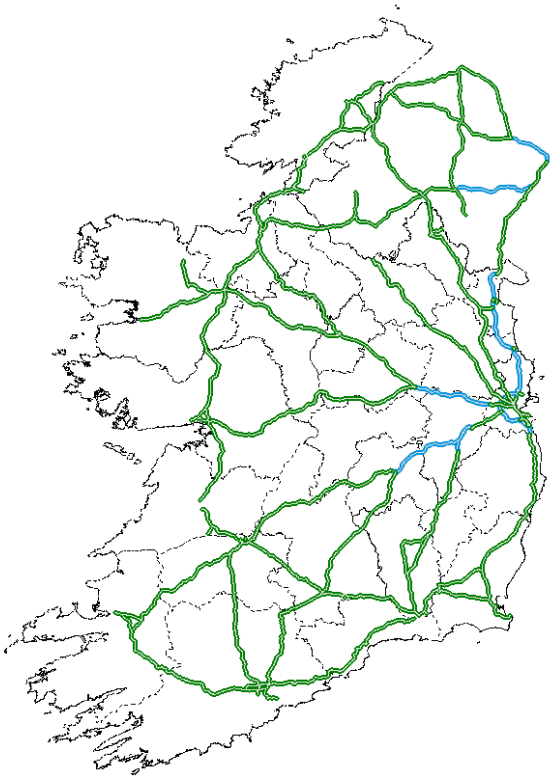
The Road Network – 2006 & 2010

5.2. In order to isolate the impacts on accessibility of improvements to the national road network, the 2010 National Traffic Model was interrogated. The 2006 demand matrices were run through the updated 2010 network and average zone-to-zone journey time data extracted for both the AM and Interpeak. As per the 2006 analysis, average hour accessibility scores were generated from this data. In this way the absolute change in travel time due to network upgrades could be quantified. The period between 2006 and 2010 saw the rapid expansion of Ireland's motorway network. The 2006 NTM included:

- The M50,
- The M1 motorway from North Dublin to Dundalk,
- The M4 from Leixlip to Kinnegad,
- The M7 from Naas to Portlaoise, and
- Short sections of the M11 motorway.

5.3. Figure 4 illustrates the Motorway and National Primary network included in the 2006 NTM.

Figure 4: 2006 Motorway & National Primary Network

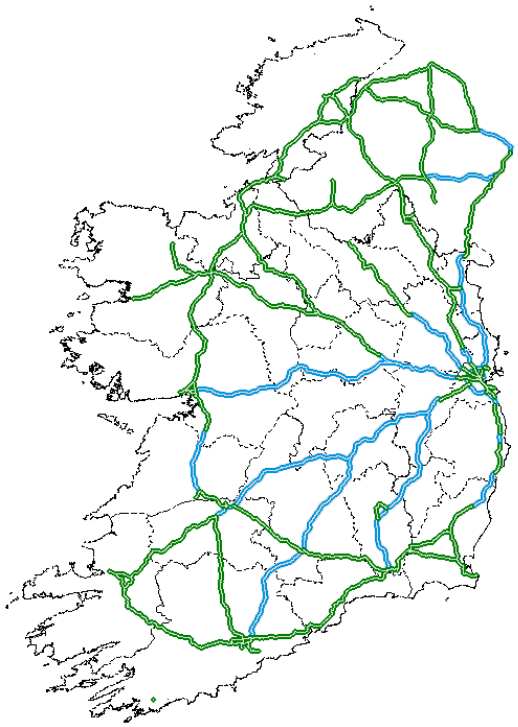


5.4. The 2010 NTM, developed in early 2010 included all major road schemes completed between August 2006 and 2010, and included for toll road and road-type classification changes up to the end of 2010. The 2010 network included among other completed projects:

- The M50 Upgrade,
- The N2 upgrade,
- The M3 Motorway,
- The M6 to Galway,
- The extension of the M7 to Limerick,
- The opening of the M8 to Cork,
- The M9 to Waterford, and
- The upgrade to much of the N11/M11 corridor.

5.5. Figure 5 illustrates the Motorway and National Primary road network included in the 2010 NTM.

Figure 5: 2010 Motorway and National Primary Network



The Impact of Road Network Improvements on Accessibility to Employment

5.6. For the country as a whole, these network improvements raise the accessibility to employment from 23.2 in 2006 to 24.8 in 2010, an increase of 6.9%.

5.7. Table 4 summarises the improvement in accessibility to employment for local authority areas. Looking at the absolute increases in employment accessibility, areas transcribed by the major interurban upgrade schemes benefited most, with Waterford, Galway , Clare, Limerick, North Tipperary, Kilkenny and Limerick all experiencing benefits in excess of 3 points.

Table 4: Improvements in Access to Employment for Local Authority Areas 2006-2010

Local Authority Area	Access to Employment Score 2006	Access to Employment Score 2010	Absolute Change	% Change
Kerry	15.9	17.2	1.3	8
Mayo	17.5	17.7	0.3	1
Waterford	18.6	21.1	2.5	14
Donegal	19.0	19.7	0.8	4
Galway	19.6	22.3	2.7	14
Clare	20.0	23.2	3.3	16
Wexford	21.3	22.3	1.0	5
Cork	21.4	23.4	2.0	9
South Tipperary	21.7	24.5	2.8	13

Roscommon	21.7	22.8	1.1	5
Sligo	21.7	21.7	-0.1	0
Leitrim	22.2	22.4	0.2	1
North Tipperary	22.6	25.6	3.1	14
Kilkenny	24.0	27.3	3.3	14
Limerick	24.3	27.7	3.4	14
Offaly	25.1	27.9	2.7	11
Waterford City	25.1	28.2	3.0	12
Longford	25.4	26.0	0.6	2
Cavan	26.2	28.1	1.9	7
Carlow	26.5	29.3	2.8	11
Westmeath	28.5	31.0	2.5	9
Local Authority Area	**Access to Employment Score 2006**	**Access to Employment Score 2010**	**Absolute Change**	**% Change**
Laoighis	28.6	30.4	1.8	6
Galway City	29.0	33.1	4.1	14
Limerick City	29.2	32.3	3.1	11
Monaghan	31.0	32.0	1.0	3
Cork City	36.1	38.5	2.4	7
Meath	37.6	39.5	1.8	5
Wicklow	38.0	38.2	0.2	0
Louth	40.9	42.9	2.0	5
Kildare	41.4	43.1	1.7	4
Fingal	55.2	57.1	1.9	3
Dún Laoghaire-Rathdown	56.1	56.4	0.2	0
South Dublin	65.7	65.3	-0.4	-1
Dublin City	85.9	87.2	1.2	1

5.8. One notable statistic is that accessibility in Sligo remained static between 2006 and 2010. Benefits to neighbouring counties Mayo and Donegal can be ascribed to upgrades to the N5 and N3 respectively. There were however no significant upgrades to the N4 serving Sligo during the study period.

5.9. While the Dublin region is clearly shown to be the most accessible in the country, the area experienced only limited benefits, due in part to the high quality of the base year 2006 network. The bias towards local trips, due to the dominance of the Dublin region in terms of employment density, results in limited benefit to the region of major interurban motorway upgrades. Those benefits which do occur in the region are largely attributed to the upgrade of the M50.

5.10. It should also be noted that the reclassification of the M50 to 'Urban Motorway' reduced the maximum speed limit on the route to 100kph. While increased capacity offsets this speed reduction elsewhere, South Dublin sees a slight decrease in accessibility. There were no major road schemes undertaken in the county during the study period; as such the only notable difference between the 2006 and 2010 models in the area is this speed reduction on the M50.

5.11. If proportionate increases in accessibility are considered, the improvement in accessibility for some areas is even more impressive. County Clare for example recorded an increase in excess of 15%. A large number of local authority areas outside Dublin recorded increases in excess of 12%. Over the period, the accessibility of many local authority areas increased relative to that of Dublin.

5.12. Turning to Gateways and Hubs, a very similar story emerges. Most Gateways and hubs have enjoyed significant increases in employment accessibility. Ballina/Castlebar and Sligo experienced negligible improvements. Letterkenny and Monaghan recorded only small increases in accessibility.

Table 5: Improvements in Access to employment for Gateways and Hubs 2006- 2010

Gateway/Hub	Access to Employment Score 2006	Access to Employment Score 2010	Absolute Change	% Change
Tralee Killarney	17.3	18.7	1.3	8
Ballina Castlebar	18.2	18.3	0.1	1
Tuam	19.6	21.2	1.5	8
Mallow	20.1	22.2	2.2	11
Ennis	20.1	23.3	3.2	16
Wexford	20.2	20.9	0.7	3
Letterkenny	20.7	21.5	0.9	4
Sligo	22.0	21.9	-0.1	0
Waterford	23.6	26.5	2.9	12
Kilkenny	25.0	28.4	3.5	14
Limerick	25.6	29.0	3.5	14
Cavan	25.7	27.8	2.0	8
Galway	26.5	30.3	3.8	14
Athlone Tullamore Mullingar	27.0	29.5	2.5	9
Monaghan	30.0	31.1	1.1	4
Cork	30.5	32.7	2.2	7
Dundalk	51.1	53.6	2.5	5
Dublin	72.1	73.0	1.0	1

Composition of Accessibility Improvements: Intrazonal and Interzonal Accessibility

5.13. Again with a focus on the employment accessibility data set, Table 6 subdivides the 2006 accessibility scores, between Intrazonal (accessibility within the zone) and Interzonal (accessibility to all other zones) at the local authority level.

Table 6: Intrazonal and Interzonal Accessibility 2006

Local Authority Area	Interzonal Score 2006 Average Hour	Intrazonal Score 2006 Average Hour	Access to Employment Score 2006 Average Hour	Intrazonal Score as a %
Kerry	15.67	0.25	16	2
Mayo	17.19	0.28	17	2
Waterford	18.47	0.11	19	1
Donegal	18.73	0.25	19	1
Galway	19.47	0.17	20	1
Clare	19.76	0.21	20	1
Wexford	20.97	0.29	21	1
Cork	21.02	0.37	21	2
South Tipperary	21.42	0.23	22	1
Roscommon	21.56	0.10	22	0

Sligo	21.45	0.30	22	1
Leitrim	22.12	0.12	22	1
North Tipperary	22.38	0.19	23	1
Kilkenny	23.80	0.22	24	1
Limerick	23.95	0.35	24	1
Offaly	24.96	0.17	25	1
Waterford City	18.21	6.93	25	28
Longford	25.28	0.17	25	1
Cavan	26.03	0.17	26	1
Carlow	26.20	0.32	27	1
Westmeath	28.17	0.30	28	1
Laois	28.44	0.16	29	1
Galway City	17.07	11.89	29	41
Limerick City	21.56	7.68	29	26
Monaghan	30.80	0.22	31	1
Cork City	18.22	17.93	36	50
Meath	37.33	0.31	38	1
Wicklow	37.53	0.48	38	1
Louth	40.09	0.77	41	2
Kildare	40.73	0.67	41	2
Fingal	52.86	2.35	55	4
Dún Laoghaire-Rathdown	53.63	2.50	56	4
South Dublin	61.76	3.95	66	6
Dublin City	72.46	13.47	86	16

5.14. Higher intrazonal scores occur in areas of dense employment. In the major cities other than Dublin, intrazonal accessibility accounts for over 25% of the total score. In the case of Cork City, the proportion is almost 50%. In Dublin City this proportion is 16%

5.15. Typically, the higher the overall accessibility score, the higher the proportional significance of intrazonal trips. The expectations from this are those counties closest to the Dublin region. The Greater Dublin Area counties of Louth, Meath, Kildare and Wicklow have high scores of which intrazonal trips account for less than 3% of the total.

5.16. Table 7 tabulates the results of the 2010 employment accessibility analysis.

Table 7: Intrazonal and Interzonal Accessibility 2010

Local Authority Area	Interzonal Score 2010 Average Hour	Intrazonal Score 2010 Average Hour	Access to Employment Score 2010 Average Hour	Intrazonal Score as a %
Kerry	16.99	0.25	17	1
Mayo	17.46	0.28	18	2
Donegal	19.50	0.25	20	1
Waterford	21.02	0.11	21	1
Sligo	21.38	0.29	22	1
Wexford	21.99	0.28	22	1
Galway	22.16	0.17	22	1
Leitrim	22.29	0.12	22	1
Roscommon	22.68	0.10	23	0
Clare	23.01	0.22	23	1
Cork	23.02	0.36	23	2
South Tipperary	24.23	0.23	24	1
North Tipperary	25.46	0.19	26	1
Longford	25.84	0.17	26	1
Kilkenny	27.07	0.22	27	1
Limerick	27.34	0.35	28	1
Offaly	27.70	0.18	28	1
Waterford City	21.37	6.79	28	24
Cavan	27.98	0.17	28	1
Carlow	29.01	0.32	29	1
Laois	30.24	0.16	30	1
Westmeath	30.65	0.30	31	1
Limerick City	24.55	7.77	32	24
Monaghan	31.81	0.22	32	1
Galway City	20.97	12.10	33	37
Wicklow	37.71	0.47	38	1
Cork City	20.87	17.66	39	46
Meath	39.18	0.30	39	1
Kildare	42.48	0.66	43	2
Louth	42.14	0.76	43	2
Dún Laoghaire-Rathdown	53.93	2.45	56	4
Fingal	54.81	2.26	57	4
South Dublin	61.68	3.63	65	6
Dublin City	73.67	13.49	87	15

5.17. A comparison of 2006 and 2010 intrazonal scores indicates that in the majority of areas, local trip lengths have remained static. As a result of improvements to interzonal journey times however, the proportional importance of intrazonal accessibility to the total score is diminished. Intrazonal scores, as a proportion of total

accessibility, have reduced by 1 percentage point in Dublin City for example and by 4 percentage points in Cork City.

5.18. It is worth noting that in a number of zones intrazonal scores increase due to the availability of new links in the 2010 model. There are however numerous cases where the construction of a new section of motorway, has resulted in the downgrade of the parallel national road from National to Regional. In cases where the Motorway is inaccessible or undesirable for local trips, the reduction in speed limit on the former national road can result in increased journey times and consequently, a reduced intrazonal score.

Conclusions

5.19. This Report provides a preliminary analysis of the impact of investment in the road system on accessibility and effective density. The investment in the road system the period 2006-2010 led to an increase in employment accessibility of some 6.9% overall.

5.20. Local authority areas where accessibility was relatively low tended to gain most in the period, provided there were significant radial road improvements that affected them. The local authority areas of Galway, Clare, Limerick, Tipperary, Kilkenny and Waterford have all seem improvements in accessibility of 14% or more.

5.21. The Gateways and Hubs identified in the National Spatial Strategy, other than Dublin, have benefitted substantially in terms of improved employment accessibility. However, Sligo is a notable exception: the lack of a significant upgrade to the N4 in the period under review prevented an improvement in employment accessibility.

6. Implications for Roads Policy, Planning and Research

Introduction

6.1. This Section of the Report draws out some of the implications of the analysis for roads policy, planning and research.

Impact of the Road Investment on Economic Productivity.

6.2. On the basis of the analysis conducted in this report, the upgrading of the road network between the years of 2006 and 2010 has raised the effective density of the country as a whole by some 6.9% per cent. This has an impact on the productivity of firms by bringing labour and product markets closer together.

6.3. In order to measure the impact on productivity, the relationship between effective density and productivity must be established. This has not yet been done in an Irish context. However, in Section 2, it was indicated that research in the UK and New Zealand would support the view that an elasticity of productivity to effective density of 0.05 would be a reasonable estimate in the absence of specific Irish data.

6.4. Applying this elasticity to the increase in effective density of 6.9%, indicates that the road network improvements raised the productivity potential of firms by some 0.35%.

As GDP will approximate to some €150bn in 2011, an increase in productivity of 0.35% will yield an annual benefit in GDP terms of €525m. In present value terms, over a period of 30 years, this is an aggregate benefit of some €9.5bn.

6.5. The analysis has shown that road investment has the potential to raise the effective density of the peripheral parts of the country more substantially than that of the Greater Dublin Area. This reinforces the role that road investment has to play in developing the National Spatial Strategy.

Further Research

6.6. The impact analysis presented above is based on a elasticity between effective density and productivity derived from UK and New Zealand experience. Given the scale of the impacts, it would be extremely useful to undertake research to validate the elasticity in an Irish context. There are data sets at the level of the firm and assembled by the ESRI that would enable this to be done.

6.7. A second issue that needs to be examined is the relationship between these productivity impacts and the normal user benefits that arise in project appraisal. In particular, it would be useful to establish the extent to which the user benefits to freight and business travellers captures some of this productivity effect. In this way, the additional (wider) benefits could be discerned.

6.8. Once this is done, then consideration should be given to altering the Project Appraisal Guidelines to reflect these wider benefits.