

Towards the Development of a Transport Accessibility Index

An Analysis of Geographical Remoteness to Support
the Rural Transport Programme in the Republic of Ireland

Prepared for Pobal by Gamma and Trutz Haase



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The Rural Transport Programme (RTP) is funded by the Department of Transport and receives contributions from the Department of Social and Family Affairs in terms of the Free Travel Scheme. The Department of Community, Rural and Gaeltacht Affairs also fund the RTP through a pilot evening rural transport scheme.

In late 2007, Gamma and Trutz Haase were commissioned by Pobal to develop a rational and impartial methodology for determining transport deprivation in the Republic of Ireland.

Initially, the objective was to develop a transport deprivation index to include all aspects of opportunity deprivation and accessibility deprivation. However, after assessing the resources, timing and data availability, the objectives were narrowed to focus on developing a transport accessibility index using the main data sources available. This index could then be used in combination with the New Measures of Deprivation (Haase & Pratschke 2008).

The purpose of the index is to provide an important input in determining relative accessibility in Ireland that assist Pobal, Rural Transport Groups and the Department of Transport in their work under the Rural Transport Programme (RTP). The index has a number of potential uses for the RTP including its use as a needs assessment tool and secondly, as a potential tool in forward planning, to identify future transportation requirements at the local level.

The team identified an approach that could stand up in its own right, but which also could be improved later through the further introduction of additional data and analyses not available to the study team within the timeframe.

This report is a summary of the study and provides the main findings of the analysis.

Objectives

The study's key objectives are as follows, to:

- identify a simple but effective methodology for assessing and scoring transport accessibility at the Electoral Division (ED) level
- apply this methodology to produce ED level accessibility scores
- provide mapped and tabular output showing the resulting scores
- provide a report outlining the approach and results achieved
- identify potential future improvements for the Index.

Approach

Following a project workshop, the team identified an approach that could be delivered within time and resource constraints. The approach is based on the following factors:

- The accessibility index should measure accessibility that comes from proximity to public transport services and to service centres.
- The index can be used in conjunction with the New Measures of Deprivation index¹ – also prepared at ED level – to take account of accessibility issues due to deprivation. This allows the accessibility index development to focus purely on transport based accessibility factors.
- An accessibility index score should be prepared at both ED and county level.
- Other variables that may be considered in assessing or measuring an area's opportunity deprivation² would be included only as under-lays to the accessibility index. These could be used in conjunction with the index and may be provided as separate outputs.

Methodology

The methodology used can be described in four parts;

1. Capture of data inputs
2. Calculation of scores
3. Combining scores to create index
4. Other considerations that were not included in index construction

Capture of Data Inputs

A. Electoral Divisions and Geodirectory Buildings

In order to estimate a detailed population count within each area, two datasets were used; the Census of Population and the national building file, Geodirectory.

The base unit of the Census and of the Index is the Electoral Division (ED) of which there are 3,409 recorded in the 2006 Census of Population. For each ED, we have a total population figure from the Census. As some of our analysis

¹ Haase & Pratschke (2008) New Measures of Deprivation in the Republic of Ireland – An Inter-temporal and Spatial Analysis of Data from the Census of Population 1991, 1996, 2002 and 2006. Pobal

² Opportunity Deprivation: People can be said to be deprived if they do not have the attributes, possessions or opportunities which society in general takes for granted (Coombes, 1995). For example, people may experience 'Opportunity Deprivation' if they cannot access jobs in the nearest town due to the lack of public transport.

relies upon estimating population proportions within EDs, we have used the national building file, Geodirectory,³ to estimate the distribution of the residential population within an ED.

The assumption underlying this is that the population is distributed in the same proportion as the residential buildings within the ED. Therefore, if 60% of an ED's residential buildings fall within a drive-zone,⁴ we assume that 60% of the ED's population, as of 2006 also falls within it. Whilst, this is not always a 100% reliable method, it was deemed sufficient for the purposes of the study.

B. Availability of Public Transport

The importance of public transport in determining the accessibility of an area is unquestionable. Therefore, it was essential to get as much information as possible on national public transport networks included in the index.

Bus stops were captured from a dataset provided by Bus Éireann and Dublin Bus and geocoded (assigned coordinates) as accurately as possible. Private Operators or existing RTP services were not included (with one exception⁵) due to time constraints and the lack of availability of this type of information.

All train stations were plotted from a dataset provided by Irish Rail. In total, 2,503 bus stops and 135 train stations were captured for the project.

C. Distance to Key Services

The final key determinant used in the index is distance to services. The rationale used is that the accessibility of a location is affected by its proximity to key services such as hospitals, schools, retailing, financial services and professional services. The extent of availability of these services in a town is assumed to be correlated with the size of the town. Therefore, close proximity to a larger town is likely to yield a greater benefit for an ED under this category, than close proximity to a village, where key service provision is limited.

For the purposes of comparison, towns were categorised into four distinct categories based on their population in Census 2006, specified by the following four levels below;

- Level 1** – 1,500 to 5,000 persons
- Level 2** – 5,000 to 10,000 persons
- Level 3** – 10,000 to 50,000 persons
- Level 4** – Over 50,000 persons (i.e city)

EDs were scored based on their proximity to these service centres. The scoring methodology used is dealt with in the next section.

Calculation of Accessibility Scores

ED level scores are calculated by combining two parts, - the access to public transport score and the distance from service centre score.

1. Access to Public Transport Score

The access to public transport score for an ED is calculated by measuring the EDs proximity to a bus stop or train station.

For bus stops, a 1km⁶ zone was created around every bus stop captured. The proportion of the population of each ED that fell within this combined zone was calculated and the ED received a score as follows;

- 0% of ED's population within 1km of a bus stop – Score 0
- 1 to 50% of ED's population within 1km of a bus stop – Score 1
- 50 to 99% of ED's population within 1km of a bus stop – Score 2
- 100% of ED's population within 1km of a bus stop – Score 3

³ Geodirectory is a database of every building in the country with precise geographical coordinates that may be mapped using a GIS system. It is provided by An Post and the Ordnance Survey of Ireland.

⁴ Drive zones are estimated zones that are within a specified drive time from a point using the road network.

⁵ The Londonderry and Lough Swilly Railway Company provide a bus service in NE Donegal that covers several towns including An Bun Beag – Derrybeg, Buncrana, Carndonagh, Moville, Ramelton.

⁶ In the absence of other studies, it was necessary to be subjective in deciding how far was a "reasonable" distance to travel to a public transport network. One kilometre was selected as a reasonable walking time to a bus stop. For train stations, a ten minute drivetime was considered a reasonable travel time.

For train stations, a 10 minute off-peak drivetime zone was created around every train station captured. The proportion of the population of each ED that fell within this combined zone was calculated and the ED received a score as follows;

- 0% of ED's population within 10 minutes drive time of a train station – Score 0
- 1 to 50% of ED's population within 10 minutes drive time of a train station – Score 1
- 50 to 99% of ED's population within 10 minutes drive time of a train station – Score 2
- 100% of ED's population within 10 minutes drive time of a train station – Score 3

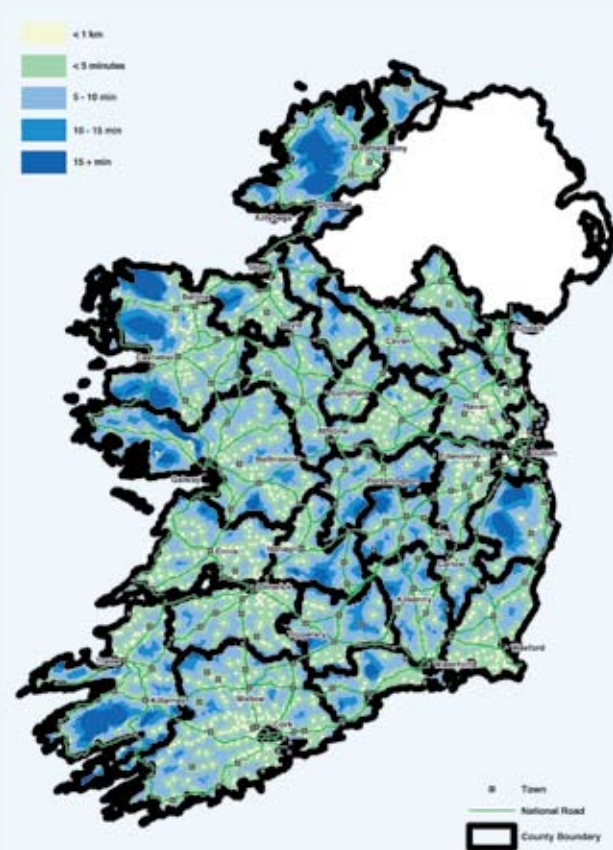
In summary, the scoring system is shown in Table 1.0 below;

Table 1 Distance to Travel

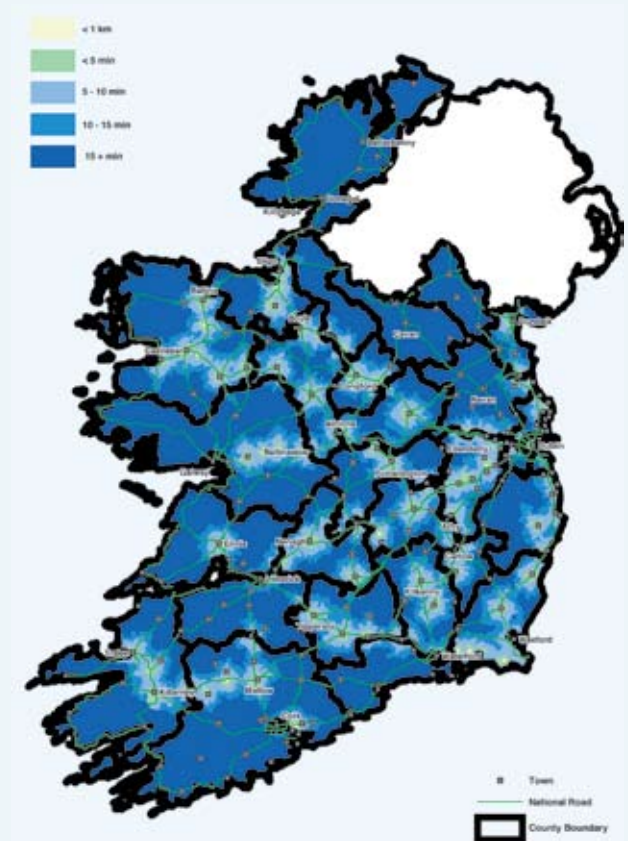
% ED Population within Range	<10 Minutes Drivetime from nearest Train Station	< 1km Walk from nearest Bus Stop
0	0	0
1 to 50	1	1
50 to 99	2	2
100	3	3

The ED was then given the maximum (NOT combined) score it received from its proximity either to bus or rail services. The maximum score any ED could receive for proximity to both bus and train services was therefore, 3.

Maps 1 & 2 show all EDs colour coded based on their proximity to the national network of bus stops and train stations. They highlight areas which are below 1km walking distance and drive time ranges from bus and rail stops. The same ranges are used for comparative purposes.



Map 1: Access to Public Transport Distance/Drivetime to Bus Services



Map 2: Access to Public Transport Distance/Drivetime to Train Services

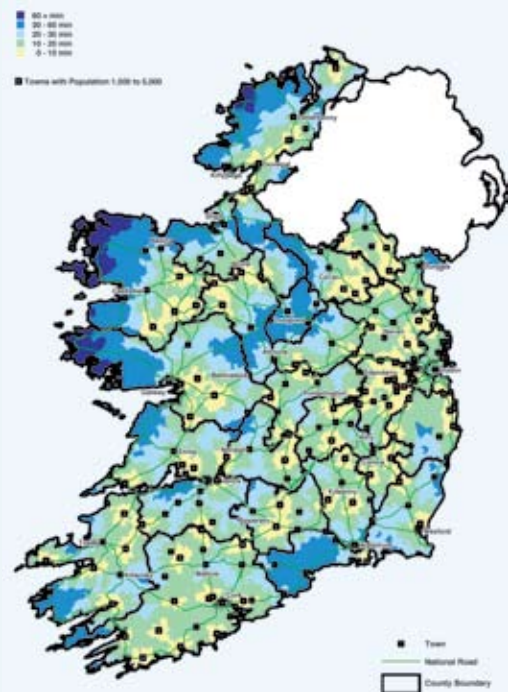
2. Proximity to Service Centre Score

Every ED was also scored based on the distance to its nearest town within 4 size categories. The scoring scheme used was as follows;

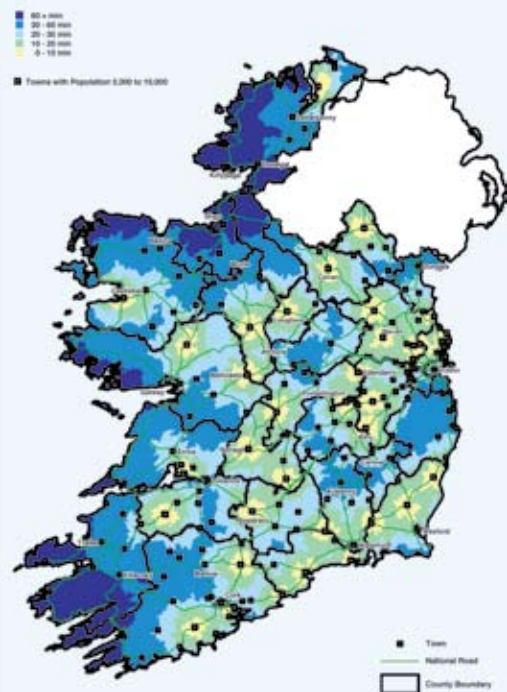
Population	Level	Time from ED				
		Under 10 mins	10 to 20 mins	20 to 30 mins	30 to 60 mins	Over 1hr
Towns 1,500 to 5,000	1	4	3	2	1	0
Towns 5,000 to 10,000	2	5	4	3	2	0
Towns 10,000 to 50,000 (exc. 5 cities)	3	6	5	4	3	0
Towns over 50,000 (i.e. 5 Cities*)	4	7	6	5	4	0

*(Dublin, Cork, Galway, Limerick & Waterford)

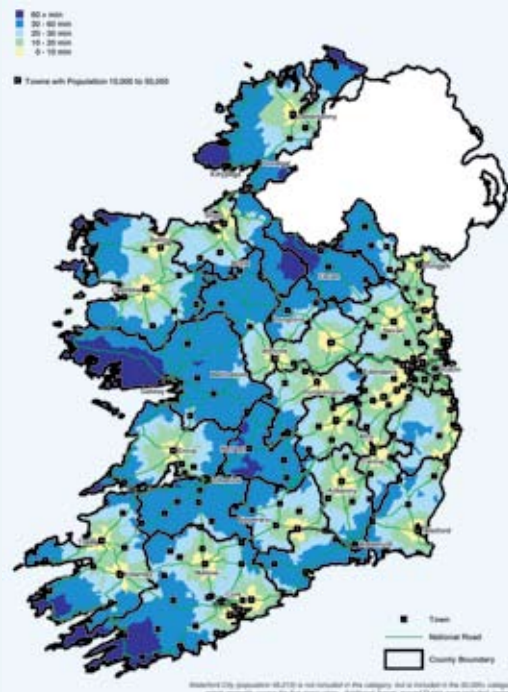
As in the public transport scoring, the maximum figure was used for each ED and travel time was calculated using average off-peak road speeds. Therefore, if an ED was within 30 minutes of a city and also within 10 minutes of a town with between 1,500 and 5,000 residents, a score of 5 was assigned, it being the higher of the two scores allocated. The result of this scoring is shown in the four maps on the opposite page.



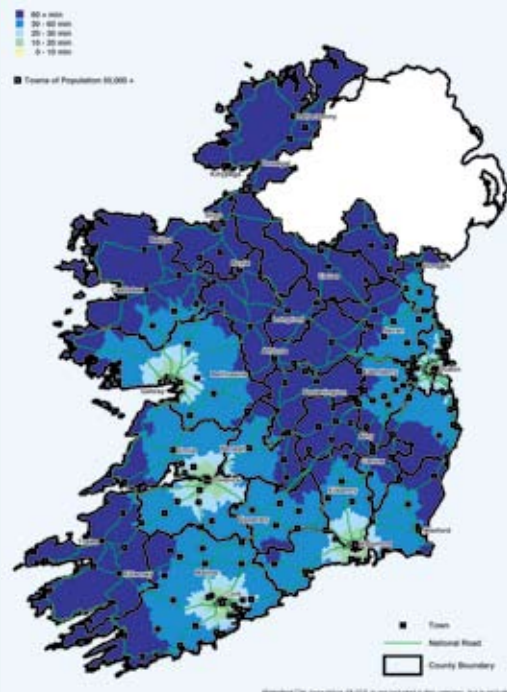
Map 3a: Access to services
Drivetime to Towns of size 1,500 to 5,000 (2006)



Map 3b: Access to services
Drivetime to Towns of size 5,000 to 10,000 (2006)



Map 3c: Access to services
Drivetime to Towns of size 10,000 to 50,000 (2006)



Map 3d: Access to services
Drivetime to Towns of size 50,000 + (2006)

Combining Scores to Create Index

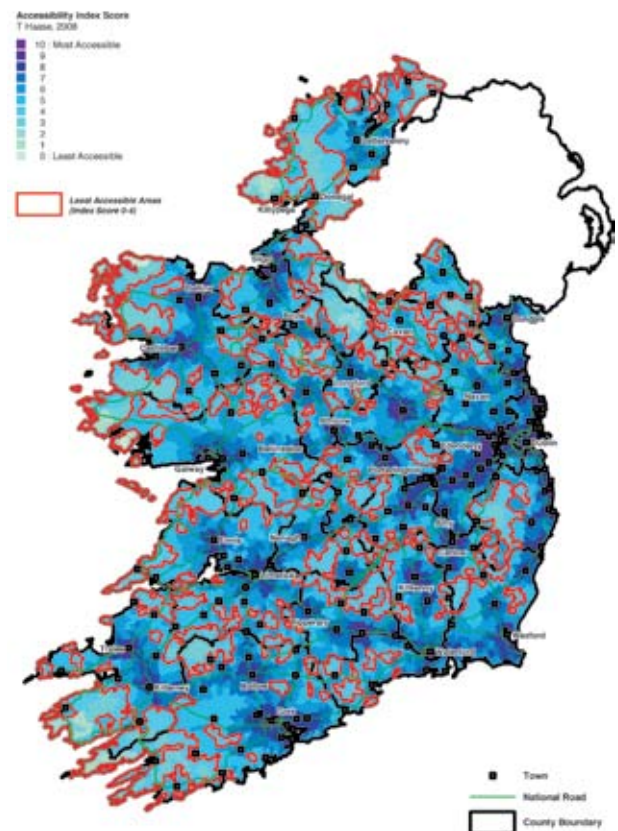
The final stage in creating the Accessibility Index involves combining the two maximum scores from the public transport analysis and the service centre analysis. Following testing of several options, we have simply combined the two scores. This effectively implies that we are giving a greater importance to the distance to a town/city in the first instance (with a maximum score of 7) whilst the question of transport accessibility comes second (with a maximum score of 3). This is considered reasonable on the basis that, even if one lives close to a bus or train stop, the distance to a town still remains a considerable burden in terms of travel time and expenses.

Combining the two scores via a simple sum results in an overall Accessibility Index score ranging from zero (most inaccessible) to 10 (most accessible) as shown below in Table 2.0.

Accessibility Score	Number of EDs	Total Population 2006
0	8	3,544
1	22	10,265
2	25	10,065
3	144	44,369
4	556	220,914
5	709	367,162
6	631	530,071
7	432	516,907
8	334	786,781
9	319	1,282,414
10	229	467,356
Total	3,409	4,239,848

As can be seen from the table, only 8 EDs in the country have an accessibility score of zero, with a total population of 3,544 persons resident in those EDs in 2006. The results show that the vast majority of the population have relatively good accessibility to transport and services, which is an obvious result where the State's population is mainly resident in larger towns.

Map 4 below, shows the geographical spread of the EDs, thematically shaded by accessibility score.



Map 4: Accessibility Index based on Town Size, Proximity to Town and Public Transport Network, 2008

Other Considerations that were not Included

In the development of the methodology, many options were evaluated and considered before the final approach was taken. Some were not considered due to methodological arguments, others were not considered due to time and resource constraints. The principal omissions were as follows;

Car Ownership Levels

Car ownership data was available at ED level from Census 2006. It was, however, decided not to include this variable in the analysis. Car ownership has a very different meaning in urban and rural spaces. In urban areas, with ready access to public transport, car ownership could be seen as a measure of affluence or choice. In contrast, car ownership in (remote) rural areas becomes an absolute necessity. Thus people living in remote rural areas tend to be willing (or effectively are forced) to spend a larger proportion of their income on private transport. High car ownership in a remote rural location should thus not be interpreted as an indication of lesser need. However, including car ownership in the Accessibility Index would effectively do that. We believe that the ability to buy a car, which is correlated to income, is sufficiently captured by the deprivation index through the social class measures.

Car ownership clearly provides a way, by which certain individuals are able to overcome their spatial disadvantage, but this will confer no benefit on those who cannot avail of private transport; i.e. Those who are either too poor to afford a car or who, on account of their age, disability or other reasons are unable to drive.

Bus and Train Frequencies

It is clear, that proximity to a bus stop or train station does not in itself guarantee good public transport availability. Much depends on the frequency of service and the capacity of the vehicles. It is accepted that more work is required to include qualitative information regarding the quality of services offered by any stop or station that will have an impact of its contribution to accessibility levels. There is a considerable amount of work required to gather and include this data and it was not part of this study due to resources,

time constraints and the difficulties in obtaining accurate information.

Other Public Transport

This study only considered public transportation services provided by the main bus and rail companies. Clearly, there are other sources of public transport such as taxis, private bus companies, RTP Groups already funded under the Rural Transport Programme and voluntary sector organisations. These were not included within the scope of this study due to difficulties in accessing information.

Disability Levels and other contributors to opportunity deprivation.

The number of disabled persons resident in an ED contributes to its opportunity deprivation and was considered for inclusion in the Index. However, an examination of disability level patterns, showed proportionately higher numbers in urban areas, often close to medical facilities. This is likely to be due to an essential requirement for this group to access specialised services and good transport, which may only be available in larger towns. Thus the inclusion of disability levels in the accessibility index would bias urban areas, where accessibility levels are clearly highest. Other variables that can impact on an ED's accessibility levels were also considered including voluntary group activity in the area and the proportion of elderly present. In all cases, they were considered as relevant but it was decided that they would take away from the clarity of the Accessibility Index. It was determined that a better approach to look at such variables would be in their own right as a separate consideration when considering opportunity deprivation.

POWCAR

The Place of Work - Census of Anonymised Records (POWCAR) database offers an exciting dataset for modelling travel patterns in Ireland. The data contains details of Census respondents categorised by place of work and residence, down to ED level accuracy. This information would assist in the identification of travel to work catchment areas of every town in Ireland. Its inclusion was not possible within the timeframe of this project but could certainly contribute to this research in the future.

Using the Accessibility Index with the Haase-Pratschke Deprivation Index

One advantage in limiting the inputs into the accessibility index to those selected, is that it may be overlaid on many other complimentary datasets without concerns about collinearity. An example of this is seen when overlaying the accessibility index on the Haase-Pratschke (HP) Index of Relative Deprivation⁷.

The Index of Relative Deprivation measures the relative deprivation of Ireland's ED's based on a wide ranging set of economic, demographic and social variables. These include the following subsets;

Demographic Profile is measured by five indicators:

- the percentage increase in population over the previous five years
- the percentage of population aged under 15 or over 65 years of age (age dependency)
- the percentage of population with a primary school education only
- the percentage of population with a third level education
- the percentage of households with children aged under 15 years and headed by a single parent

Social Class Composition is measured by five indicators:

- the percentage of population with a primary school education only
- the percentage of population with a third level education
- the percentage of households headed by professionals or managerial and technical employees, including farmers with 100 acres or more
- the percentage of households headed by semi-skilled or unskilled manual workers, including farmers with less than 30 acres
- the mean number of persons per room in a residential unit.

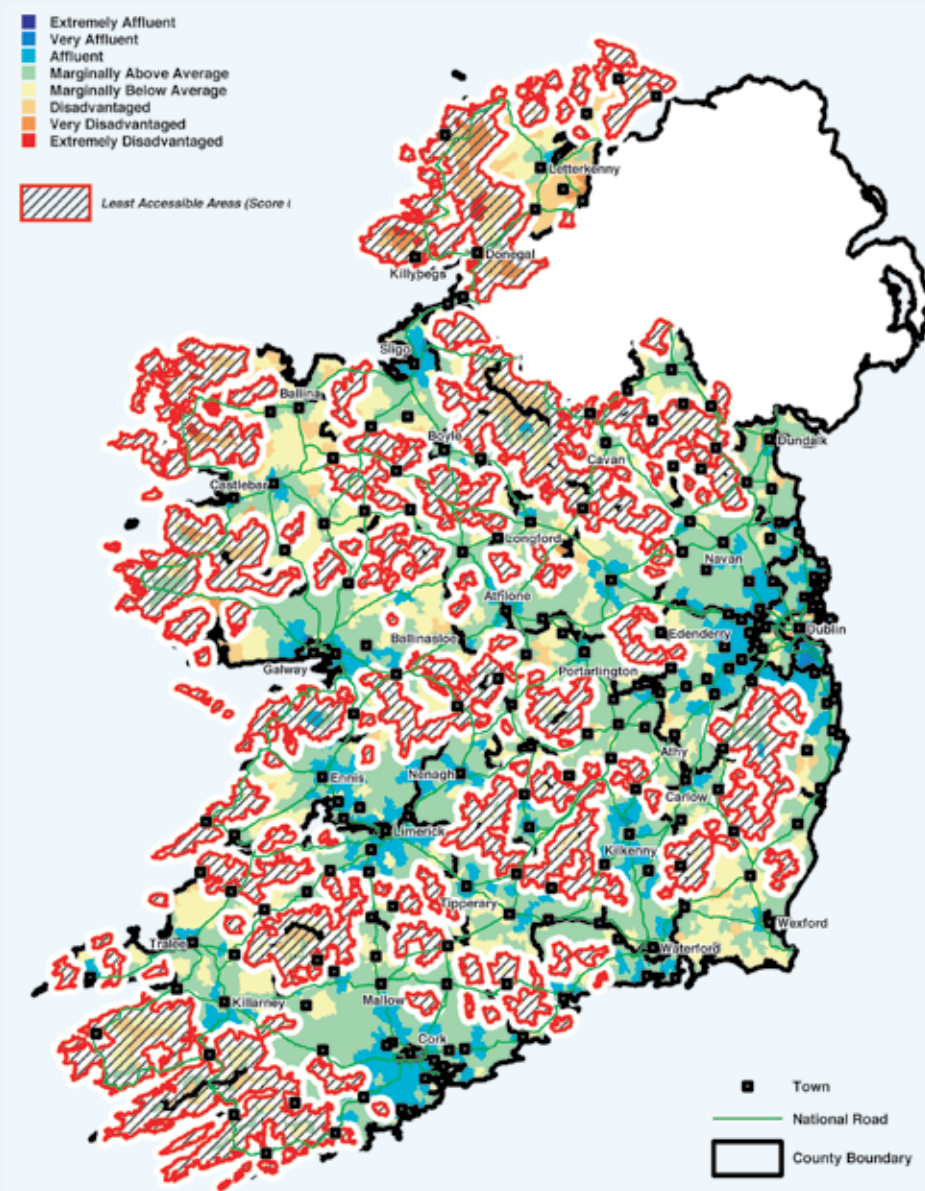
Labour Market Situation is measured by four indicators:

- the percentage of households headed by semi-skilled or unskilled manual workers, including farmers with less than 30 acres
- the percentage of households with children aged under 15 years and headed by a single parent
- the male unemployment rate
- the female unemployment rate

The HP Index provides a comprehensive and widely accepted measure of relative deprivation in Ireland based on the above themes. It does not, however, attempt to take account of accessibility levels. Therefore, by overlaying the results from the accessibility scoring on top of the relative deprivation map, we create a new and powerful view of Ireland in terms of both deprivation and accessibility.

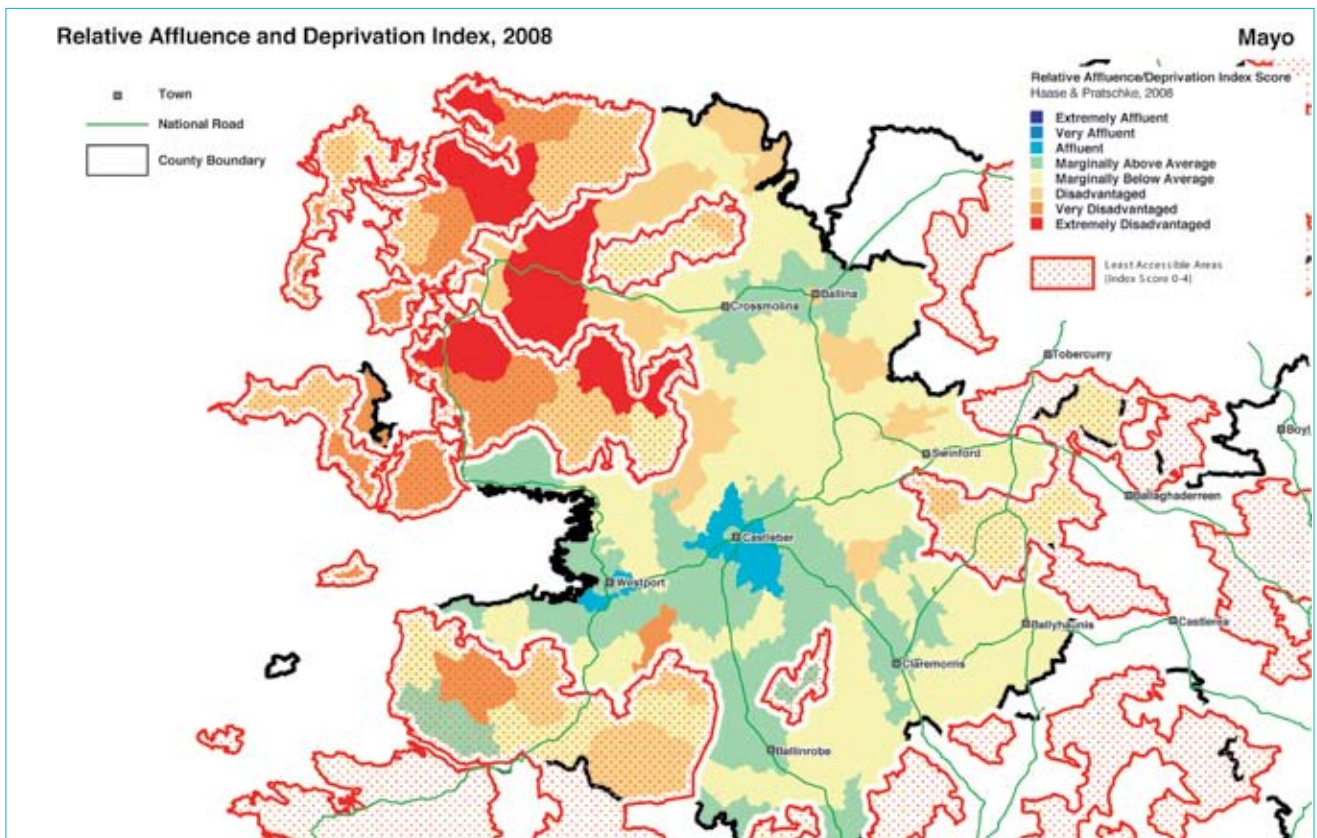
Map 5 shows the combination of the two indices at a national level and Map 6 is a sample map of County Mayo highlighting local county level analysis of the two indices.

⁷ Haase & Pratschke (2008) *New Measures of Deprivation in the Republic of Ireland – An Inter-temporal and Spatial Analysis of Data from the Census of Population 1991, 1996, 2002 and 2006*. Pobal



Map 5: Accessibility, Relative Affluence and Deprivation Index, 2008

Map 6: Overlaying results from the Haase-Pratschke (HP) Index of Relative Deprivation and the Accessibility Index, Mayo County.



Map 6: Mayo: Relative and Deprivation Index, 2008

Considerations on the Inclusion of Cross-Border Towns

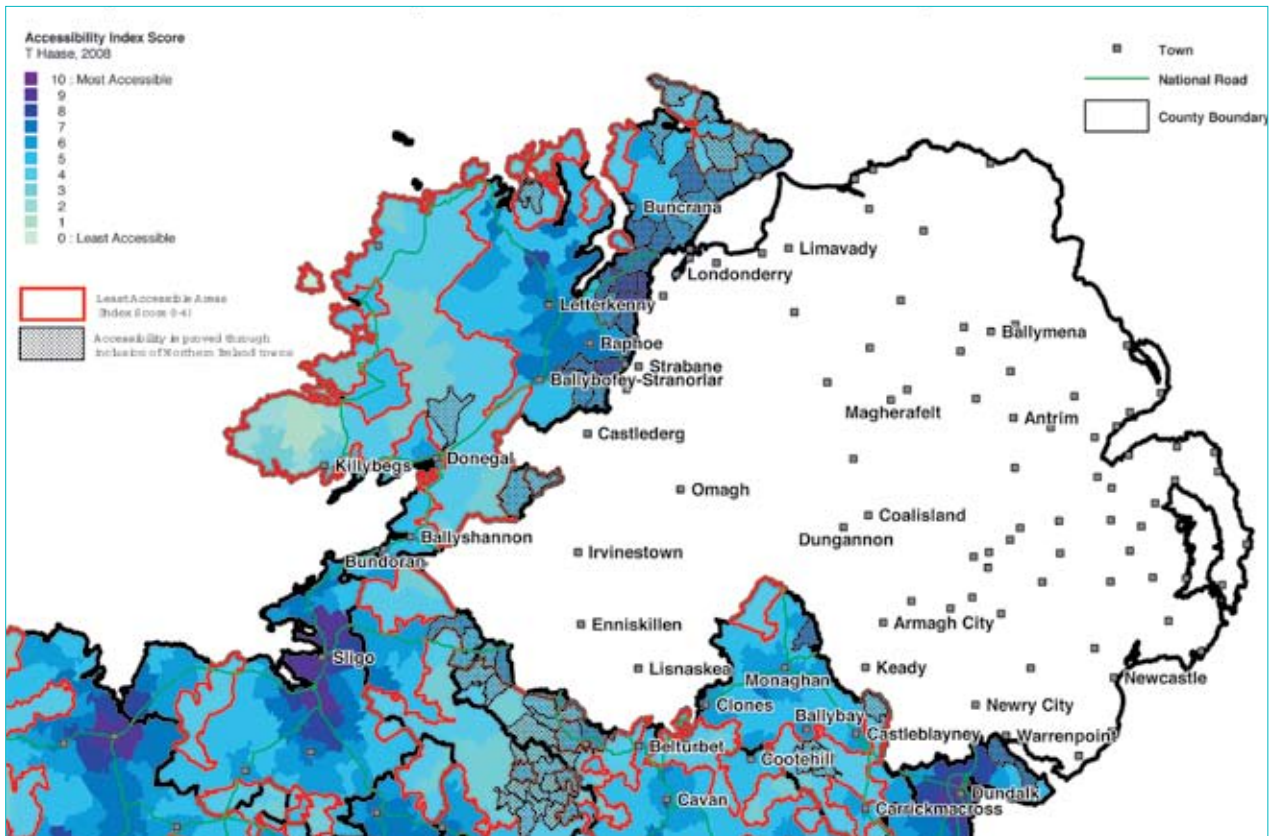
One consideration for the study was whether to include cross border towns in the calculation of an EDs distance to nearest town. In favour of their inclusion, it can be argued that some border communities rely on local services such as retailing in their nearest towns located across the border in Northern Ireland. Against their inclusion, it can be argued that many public services such as hospital care, education and social services may not be equally available to Irish citizens outside of the Republic's jurisdiction or due to the lack of cross border transport provision. The final decision was not to include cross border towns but to evaluate the impact of including them on the overall index.

Towns for Northern Ireland were sourced from, and assigned to equivalent categories according to their recorded population from, the most recent UK and Northern Ireland Census (2001). Drivetime bands were then recalculated using this combined Island-wide towns dataset. Using the same methodology as used previously in creating scores for proximity to service centres, a revised index was calculated and the results compared.

In total, only 65 EDs show a differing/improved accessibility score with the inclusion of Northern Ireland towns. As expected, these are located in the border area, as seen from Map 7. Data for these areas shows the influence on the index of some major towns (category 4 towns for the purposes of compiling the index) in Northern Ireland – Enniskillen (pop. 13,599), Craigavon (pop. 57,685), and Londonderry (pop. 83,699) and other smaller towns close to the border – Warrenpoint (pop. 7,000). The main areas with improved accessibility scores

in this case are in Cavan and Leitrim. These areas have improved accessibility scores as they are now within 30 or 60 minutes of a category 4 town (Enniskillen), where previously they were within 60 or 60+ minutes respectively of category 4 towns (Sligo and Dundalk). Some areas of 'improvement' seem isolated – this results from the combination of the town size/drivetime distance components into a single variable by taking the maximum value.

In general, the effect of Northern Irish towns on the accessibility index is quite small with some areas along the border affected by proximity to the major towns of Londonderry, Enniskillen and Craigavon.



Map 7: Accessibility, Relative Affluence and Deprivation Index, 2008

Conclusions

The accessibility index provides a first step towards a system for measuring the extent of remoteness prevailing in all parts of Ireland. Although the inputs were limited due to time and resource constraints, the results are quite reasonable and consistent with perceived and anticipated patterns.

The Index takes the form of an ED level table with scores attached along with their component variables. It is also available as a digital map for use within a GIS software system.

The hopes of the research team are that the Index will provide a basis for future expansion and improvement on the measurement of accessibility by incorporating some of the omissions noted in this document. It should also in its present form, provide a guide for forward planning and infrastructure evaluation in Ireland into the future.

