

TRANSPORT DISADVANTAGE AND CAR DEPENDENCY IN RURAL IRELAND

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Abstract

This paper explores the concepts of car dependency and deprivation and the correlation between them in areas of rural Ireland as a means of highlighting incidences of possible forced car ownership with the use of GIS. Challenges related to the prevalence of the private car as the main or in some cases the only form of mobility for people living in rural Ireland are examined. Three out of four journeys outside of Dublin were made by car in 2016 [1], and car dependency tends to be even more exacerbated when there is a need to travel over longer distances within rural areas [2]. However, potential ways of promoting sustainable 'car-shedding' behaviour [3] in these areas must equally consider the pressing issue of transport disadvantage.

The increasing car ownership within this context may not be necessarily caused by economic growth. Rather, it can be a sign of deprivation and necessity leading to forced car ownership (FCO). Hence, this paper will examine the existing gap between the transport necessity and the provision of reliable public transport in rural Ireland, which is frequently attributed as a major determinant of FCO. This study presents the following: (i) a delineation of the complexity of FCO and the barriers to achieving a favourable solution in such areas experiencing poor public transport accessibility; (ii) an analysis of the correlation between transport disadvantage and deprivation in rural Ireland by means of a deprivation index administered through geospatial and statistical tools, and; (iii) an evaluation of the performance of measures currently in place to tackle such issues (e.g. local services and community transport schemes). GIS tools and statistical indicators are applied to identify the most affected areas related to car-dependency and transport disadvantage and a further discussion focuses on these hot-spots to suggest potential transport improvements which could provide a holistic solution to this topic of national importance.

1. INTRODUCTION

The aim of this research is to highlight instances of possible FCO in rural areas of Ireland and to explain the root cause of this, namely transport disadvantage. In the UK, research conducted by Jones [4] and Banister [5] suggests that the ownership of a car is not necessarily a decision that is made willingly, but in some cases 'forced' upon socially disadvantaged and isolated people where no practical alternative to the private car exists. There are many reasons, why such people opt to live in rural locations, however much research has 'illustrated that low income households trade off lower housing costs for transport costs by deciding to locate on the urban fringe' [6].

This research examines the results of study that investigated hotspots of FCO in Ireland, with the use of GIS and deprivation indexes. This work identifies specific Electoral Divisions (ED) that have or are experiencing high levels of disadvantage to vital social services, such as access to schools, health care, banks and post offices as well as employment centres in rural Ireland. The work reported in this paper provides weight to the argument that more resources and policy action need to be introduced to adequately reduce dependency on the private car in rural areas by providing more alternatives and support to people who are often overlooked, as priority is often fixed to transport improvements in the Greater Dublin Area.

This paper is organised in five sections, the first section has introduced the context for the research explored and the work that will be presented; Section 2 provides a review of relevant literature on car dependency, FCO, the Rural Transport Programme (RTP) and the how it relates to transport disadvantage. Section 3 delineates the methodology of the analysis using GIS software, Census data and qualitative data from rural transport providers. Section 4 then presents the results of interviews and analysis of Census data, in addition to the graphic representation of the analysis. The paper concludes with a further discussion of the results and its implications.

2. LITERATURE REVIEW

Car dependency as a result of transport disadvantage and the deprivation or inaccessibility to alternatives to the private car in rural areas has been examined in several empirical studies in this field of research, yet there is scope for more. Previous studies in Dublin have shown high levels of car ownership and several areas with no other options other than the private car [7, 8] For example, Lucas, et al. [9] state that transport poverty is under-explored and a poorly articulated issue, even within developed countries'. Table 1 displays a review of the findings of some of the literature concerning transport disadvantage, car dependency and FCO.

Table 1
Review of the literature

Author(s)	Findings
Ahern, Hine (2012)	Focus group discussions demonstrated that men find it more difficult to move from car use and car ownership to public transport and community transport use. Older women, while still experiencing difficulties in travelling, seemed to adjust to life without a car more easily than older men who were more likely to have driven themselves.
Curl, et al. (2017)	At the individual and aggregate levels, the relationship between financial difficulties and car ownership has weakened, indicating a more complex and dynamic relationship between financial circumstances and car ownership than conventional wisdom would indicate.
Currie and Delbosc (2013)	The vulnerability of low income households, living in the urban fringe is a major policy concern with regard to their inability to afford potential increases in fuel prices.
Currie, et al. (2009)	FCO households make less trips (12.9%), travel shorter distances (-7%) and slightly shorter time (-6.8%) than average 2+ car households in Outer Melbourne. This propensity to travel less might be illustrative of financial pressures and a desire to reduce the costs of travel compared to other income groups in similar circumstances.

Delbosc and Currie (2012)	Voluntary and involuntary one-car households were more likely to be low-income and contain unemployed households than households running 2+ cars. Involuntary one-car households were still heavily reliant on car travel which resulted in greater problems with access, lower participation and social support and lower well-being.
Lucas, et al. (2016)	Transport subsidies such as concessionary fares for targeted populations, such as older people and disabled do little to address the widespread issues transport poverty.
Lucas (2012)	Transport-related exclusion can be identified as a universal and operational concept, although it is differentially experienced within and between nations and by different social groups in different social and geographical contexts.
Njenga and Davis (2003)	Transport is necessary in achieving a wide range of objectives including economic growth, personal welfare, governance and empowerment as well as security. However, the effectiveness of the sector in delivering these objectives is limited by an absence of policy links to other sectors to which it plays an important role.
Preston and Rajé (2007)	Accessibility planning should not be limited to analysing social exclusion. In particular, charging mechanisms targeted at the included should also be examined as they provide funding streams to promote personalised travel marketing and transport services that may more effectively deal with exclusion.
Rock, Ahern, Caulfield (2016)	Results from the study survey pointed to considerable problems in suburban areas of Dublin that are disproportionately and unfairly impacting on particular population groups, including those that are not traditionally seen as disadvantaged.
Velaga, et al. (2012)	Challenges to providing accessibility and connectivity in rural communities include: understanding basic technological requirements in rural areas, considering trust and reliability issues with the crowd-sourced information provided by passengers during their journeys, and understanding an anticipating passenger behaviour change in response to technological innovations.

2.1 The Rural Transport Programme

The Rural Transport Programme (RTP) launched in 2007 was formed, based on the foundations built by the Rural Transport Initiative of 2002, to meet the transport demand of those experiencing rural social exclusion and isolation or cases of 'market failure' [21]. The programme has grown to become a major lifeline for people in rural areas of Ireland, who previously experienced difficulties in accessing service like hospitals, banks, post offices, retail centres and areas of employment etc. To demonstrate this, there were 1.76 million RTP passengers recorded 2015 alone [1]. Since its restructuring in 2012-13, the NTA established 17 Transportation Coordination Units (TCUs), that reduced the number of previous Rural Transport Groups, of which there were 35. These TCUs are responsible for identifying the demand for local transport services to the NTA [21]. This restructuring was conducted for a number of reasons, of which the principal ones were: a lack of data on the changes made to social exclusion as a result of the Programme, the organisational structure being cost-ineffective and could be improved by addressing certain inefficiencies such as high administration costs in comparison to other state funded programmes, and various issues regarding the structuring of fares and the branding or marketing of the programme nationwide [21].

However as confessed by the Minister of State for Public and Commuter Services, Alan Kelly, 'not every area of the country is covered by an RTP company despite our best efforts' [21]. In rural Ireland, McDonagh [10] identifies that there are still many areas with poor access to public transport services that only operate on one day per week from a 'hinterland catchment area' to a market town, and suggests that there must be a multi-faceted solution that must be tailored to the needs of each specific area, with local community support. This paper presents a tool that can be applied to such as solution by initially detecting the worse hits areas of transport disadvantage and inaccessibility. Thus, this paper seeks to offer an approach of identifying areas of the country that are currently not being serviced by the RTP and that are presenting signs of transport disadvantage and deprivation [22].

It is understood by the authors that research highlighting hotspots of FCO in Ireland has not been conducted to date, therefore, this paper offers a novel approach that could aid transport planners in identifying areas in need of service provision under the RTP.

3. METHODOLOGY

This methodology aims to build on previous work conducted in this area [10, 19, 23], by adding an innovative tool to complement the evaluation of areas in most in need of public transport. As supported by DTTS [22], this methodology utilises variety of GIS analyses to enable a more objective verification of transport needs. In that sense, a fourfold analysis was developed, which is presented in the following section.

3.1 Transport Disadvantage mapping

The National Public Transport Access Node database (NaPTAN) dataset [25] was consulted as a source of georeferenced coordinates for Irish public transport nodes. In total 19,630 nodes including bus stops, rail stations, taxi stands and ferry ports were captured for the project. It is important to mention that the transport nodes introduced by the Rural Transport Programme were not included in this dataset, rather the focus was to examine the current level of public transport. With this source of data, it was possible to build a Kernel density map (output cell size of 3,380 meters wide) of public transport in Ireland. Each cell in this raster map received an attribute from the density of transport nodes within a search radius of 10 km from the centre of each cell. The average density of cells intersecting each of the 3,409 EDs was then given as a new attribute in each ED. This procedure (represented in Figure 1) was adopted as it considers the mutual influence of nodes placed at neighbouring EDs, and it also offers a spatial measure of transport disadvantage, considering the large pockets among settlements (1,500+ people) where the majority of the rural population live. According to the 2011 Census, only 17% of rural population were living in settlements with 90 to 1,500 people, while 1.7 million people (30% of the total population of Ireland) were still living in remote areas of low population density [26].

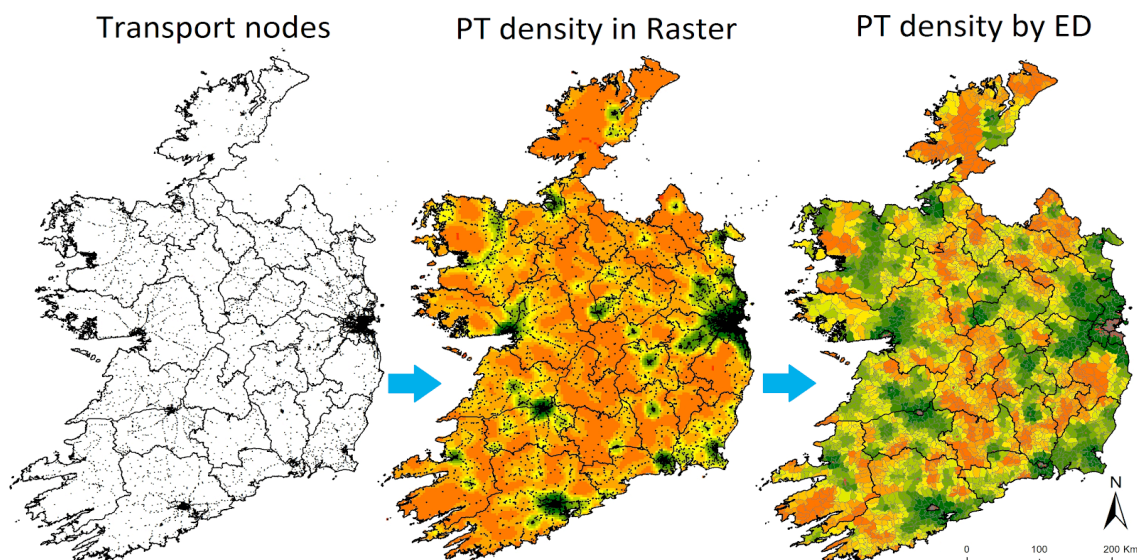


Fig. 1 Public Transport density map procedure

3.2 Deprived areas mapping

For the purpose of this research the deprivation values from the Pobal HP index [21] were applied to each ED in a shapefile extracted from the CSO database [26]. The HP Index is widely recognised as an accurate proxy for deprivation in Ireland [19]. This measure of

deprivation varies from a value of -35 (most disadvantaged) to +35 (most affluent) and it is based on a number of factors including age dependency rate, level of education, number of persons per room, unemployment rate, number of lone parents, and professional classes [22]. In order to further evaluate the presence of hotspots of deprived ED's, a clustering analysis was then carried out with the aid of ArcMap 10.1. The Moran's I test was applied to verify the presence of spatial autocorrelation, and a Hot Spot Analysis was also performed to identify the location of clusters of ED with low HP index scores. All areas below the line of -10 in the HP index were considered as deprived areas. Finally, statistical correlations between transport disadvantage and deprivation were performed through (i) a Spearman's correlation analysis with the aid of SPSS 24, and (ii) linear regression between these two variables also. At this stage EDs were aggregated at county level excluding data from cities and EDs within County Dublin.

3.3 Forced car ownership

In addition to the previous layers, another map was then plotted, in order to assess potential FCO. The data from the CSO 2011 was combined to the indices previously mentioned of Deprivation and Transport Disadvantage. Thus, it was possible to track the EDs with a high share of single-car ownership that were placed in deprived and transport disadvantaged areas on the map.

3.4 Rural Transport Programme Analysis

This step in the methodology aims to shed light on the potential causes of endogeneity, as an uncontrolled confounder causing both transport disadvantage and deprivation. Therefore, a number of interviews were conducted with representatives from various TCUs in isolated areas of rural Ireland. An in-depth insight into the service operation of these TCUs was recorded, in addition to gaining an understanding of the challenges that these units experience. The interviewees were selected through a purposive sampling technique [27]. Semi-structured and focused interviews were performed setting a flexible environment for the participants to discuss transport disadvantage and car dependency in the framework that each one experienced more deeply. Nevertheless, topics related to their service planning, data collection, passenger demands and car-sharing schemes were principally addressed in all interviews. Additionally, the RTP spatial coverage was plotted from the Transport for Ireland (TFI) database, showing then the areas responsible for each Transport Co-ordination Unit. This map was overlaid to the previous maps aforementioned, conducive to a final evaluation of the areas in most need for transport alternatives.

4. RESULTS AND DISCUSSION

The clustering analysis performed using the deprivation scores from each ED shows that given a z-score of 120.92, there is less than a 1% likelihood that this clustered pattern could be the result of random chance. Moreover, the Hot Spot analysis also performed on ArcMap, indicates a presence of large clusters of EDs with low HP scores especially in counties like Donegal, Mayo, Roscommon, Leitrim, Cavan, Wexford and Kerry. Figure 2(a) shows in red the EDs with low HP scores surrounded by other EDs with low HP scores (LL). Clusters of affluent areas (green) are primarily found around the three largest cities of Dublin, Cork and Galway, which was expected given higher levels of transport accessibility.

It is argued that areas with the profile described in Section 3.3 are potential FCO hotspots, due to (i) the high incidence of only 1-car households, (ii) the scarcity of public transport, and (iii) the prevalence of the lowest HP scores. Under this circumstance, counties like Donegal, Mayo, Roscommon and Sligo present higher incidences of EDs with potential FCO levels. Figure 2(b) presents a graphical representation of such hotspots in areas overlaid in grey on a transport nodes density map.

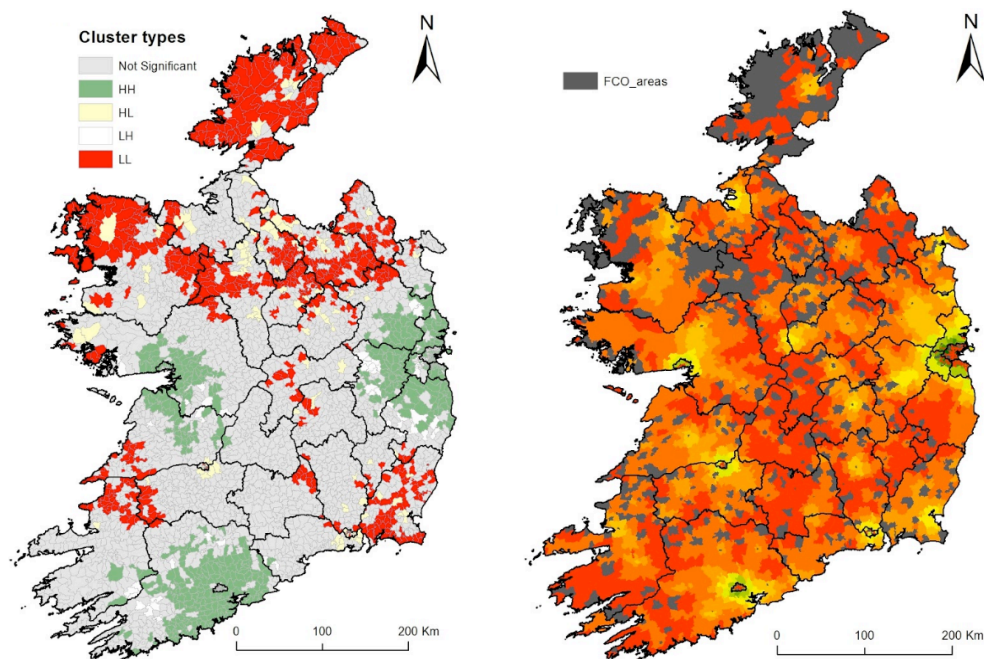


Fig. 2 (a) Deprivation clustering; and Fig. 2 (b) FCO hotspots over transport disadvantage

The Spearman's test shows that in 20 out of 26 counties there is a statistically significant ($\text{Sig} < 0.05$) correlation between the transport disadvantage and the deprivation indices. Scatter plots created with these two variables were also evaluated in order to further understand such correlations. A total of 2820 ED's were aggregated at a County level and then analysed in Table 1. The coefficient estimated from the linear regression varies from +3.6 to +36.5 and the rho-squared values vary from 0.01 to 0.38 depending on the county. This results show a clear trend in how lower levels of transport disadvantage are associated with lower levels of deprivation.

Table 2

Linear regression and Spearman's correlation between transport disadvantage and deprivation results

County	X coefficient	R-Square	Spearman's Sig	ED	Population
Carlow	28.147**	0.075	0.029	54	54612
Cavan	32.919***	0.218	0.000	85	72308
Clare	16.414***	0.173	0.000	147	116289
Cork	10.084***	0.121	0.000	323	398710
Donegal	16.857***	0.118	0.005	149	161137
Galway	15.128***	0.200	0.000	212	174418
Kerry	7.842**	0.055	0.027	162	144987
Kildare	9.565***	0.216	0.001	89	210312
Kilkenny	5.174*	0.028	0.268	113	95419
Laois	3.647	0.023	0.044	96	80248
Leitrim	36.57**	0.117	0.007	68	30631
Limerick	6.25**	0.030	0.042	135	134703
Longford	17.023***	0.093	0.007	53	38783

Louth	5.133***	0.100	0.003	43	122897
Mayo	14.267***	0.117	0.000	150	130381
Meath	13.642***	0.379	0.000	92	184135
Monaghan	24.715***	0.212	0.000	70	60483
North Tipperary	19.437*	0.037	0.052	79	69954
Offaly	13.041**	0.106	0.062	85	76246
Roscommon	10.098**	0.068	0.302	108	63516
Sligo	14.481***	0.381	0.000	76	64656
South Tipperary	5.750	0.010	1.000	94	86972
Waterford	6.004**	0.069	0.002	92	67063
Westmeath	15.541***	0.188	0.000	104	85483
Wexford	4.495**	0.049	0.187	124	145320
Wicklow	14.684***	0.156	0.008	82	136640

* Significant at 90% confidence, ** Significant at 95% confidence, *** Significant at 99% confidence

As mentioned above, notwithstanding the success of the RTP, it was found that indeed not every rural area of the country is covered by their services. As a result of the analysis conducted with GIS, it was possible to substantiate that 109 rural settlements (48,375 people) were located in areas not covered by the RTP, and in 100 out of these 109 settlements there were no transport nodes in a 10 km radius. The calculated average of the deprivation index (at a ED level) for these settlements is -8.1, with 54 out of these 109 settlements considered as deprived or very deprived (less than -10) on the HP index. Since the rural population is widespread and only a minority of it live in rural settlements, it is understood that these numbers are only a measurable part of a much larger problem.

From the interviews it was determined that the main services in the TCU operations are the house-to-house demand-responsive service, the Health Service Executive (HSE) service - linking patients with various health care clinics and hospitals in the area and the volunteer community car scheme. When discussing the most popular trip purposes of the fixed-route services, pension collection, shopping and healthcare were said to be the most frequent demands of the passengers. While there was no car-sharing or car-pooling programme in operation at the time of these interviews, such alternatives were reported as being potential future extensions of the RTP services.

5. CONCLUSIONS

The importance of car ownership in remote areas was emphasised by the TCU representatives during the interviews conducted, expressed in statements such as: “services are being removed from the rural areas more than the car is”, and “In rural areas a car is as important as your house, it’s not a question of choice”. Moreover, as presented throughout this paper, the majority of transport disadvantaged areas in rural Ireland are also deprived in socio-economic dimensions. As a result, this scenario suggests a potential causality between deprivation and transport disadvantage, which appears to be exemplified by FCO, particularly in remote areas where even programmes like the RTP are not proving to be beneficial to everyone in the community.

As the study reported in this paper has focused on making improvements to the RTP as potential solutions for tackling FCO and transport disadvantage, further studies are still needed in order to address the effectiveness of other potential alternatives like car-sharing and carpooling to this issue. In a broader extent, our findings also allude to the fact that promoting sustainable car-shedding behaviour [3], when combined with a proper access to the transport system, acts not only as an environmental friendly solution, but also a more socially inclusive transport policy that should be considered nationally by the NTA.

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