Comparing social needs for transport, gaps in transit service and the Mobility Index for the west of Ireland

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Introduction

Research Background

A wide selection of indexes, metrics and other indicators have been developed by researchers, practitioners and others to assess transport and related factors. Examples include: *Walk Score* and *Transit Score*,[1] which rate a location out of 100 for walkability and transit accessibility respectively; metrics within the *Transit Capacity and Quality of Service Manual (TCQSM)*;[2] and the UK's Public Transport Accessibility Level (PTAL) approach and the Public Transport Accessibility Index (PTAI)[3]

What may sometimes be lacking is comparison of the results obtained using one set of indicators versus others. In part this can be because of the variability in data availability. For example, national censuses often provide a key resource for understanding transport-related issues, yet the collection practices used, questions asked and other characteristics tend to be highly variable from one jurisdiction to another. As well, some indicators have been developed for specific contexts, for example McHenry et al. (2023)[4] recently developed a Mobility Index (MI) for rural centres in the west of Ireland/ This differs from other MIs, which may tend to be focused on urbanised locations.

Finally, some indicators are difficult or impossible to calculate independently. Some are closed-source, in that they may be propitiatory or otherwise only available from a single website[5]. Others may just be challenging to calculate due to a lack of tools.
Some research progress is being made on this, however, with (for example) James Wong[6] reporting the development of a set of software tools that allow many of the TCQSM indicators to be calculated from General Transit Feed Specification (GTFS) datasets.
Wong[7] shows results comparing 50 USA transit operators, but has also published the code base (on github) to allow others to undertake similar comparisons in other places or at other times.

While censuses and the collection of many other datasets at local, regional and national levels appear likely to remain specific to their own geographic contexts, there have been some recent developments in technology and transport practices that allow for universal (or at

[1] Walk Score, "Transit Score Methodology," 2023, https://www.walkscore.com/transit-score-methodology.shtml.

[2] Kittleson & Associates et al., *Transit Capacity and Quality of Service Manual, Third Edition*, Third Edition, TCRP Report 165 (Washington DC: Transportation Research Board; Transportation Research Board, 2013), http://www.trb.org/Main/Blurbs/169437.aspx.

[3] E Saghapour, S Moridpour, and R Thompson, "Public Transport Accessibility in Metropolitan Areas: A New Approach Incorporating Population Density," *Journal of Transport Geography* 54 (2016): 273–85.

[4] Helen McHenry, Amaya Vega, and Catherine Swift, "Understanding Mobility in Rural Towns: Development of a Mobility Index for the West of Ireland," *Transportation Research Procedia* 72 (2023): 3730–37, doi:https://doi.org/10.1016/j.trpro.2023.11.545.

[5] e.g. WalkScore and Transit Score cannot be independently calculated, and the exact algorithm remains unpublished

[6] "Leveraging the General Transit Feed Specification for Efficient Transit Analysis," *Transportation Research Record* 1, no. 2338 (2013): 11–19, doi:10.3141/2338-02.

[7] Ibid.

least internationally-applicable) tools and approaches. The aforementioned GTFS allows transit operators to publish their static timetable data in an open, simple and text-based format. This was originally developed to support the provision of transit directions in Google Maps, but has since been adopted by over 10,000 agencies.[8] Hence, software tools that take GTFS data as inputs can generally be adapted easily and rapidly to many systems and locations.

One such recently developed software tool is the *gtfssupplyindex* R package,[9] which builds on other GTFS-related R packages including *gtfstools*;[10] and *tidytransit*.[11] The *gtfssupplyindex* can be used to calculate a transit Supply Index, developed by Graham Currie et al.[12] Graham Currie,[13] Graham Currie and Zed Senbergs[14] and Graham Currie[15] in research related to identifying gaps in public transport services on the basis of social needs for transport. This approach, and its potential application to route and service planning, and for policy making was suggested to be "substantially more useful than the presentation of anecdotal evidence, which is the most common means of identifying transport needs in local transport studies throughout the world".[16] However, its development predated the GTFS, and the results presented in Currie[17] for Melbourne, Australia, in 2006 had required bespoke cleaning and processing of data obtained directly from the transit agency.

With the *gtfssupplyindex* package, however, results can be obtained directly from GTFS files. However, this package and approach has yet to be applied outside of the urban and suburban areas of Melbourne (as reported in Reynolds, Currie, and Qu[18]). It is unclear whether transit Supply Index and needs-gap assessment approach can be easily applied to other jurisdictions or to more rural locations. Also unclear is how such results might compare to other transport-related indicators, including those developed for rural areas (such as the McHenry, Vega, and Swift[19] MI).

In the following sections, therefore, this paper reports the application of the *gtfssupplyindex* package to the west of Ireland, adopting the same case and context as McHenry, Vega, and Swift.[20] Results from a needs-gap analysis are compared to those from McHenry, Vega, and Swift[21] so as to provide insights into the differences between these indicators. This research is anticipated to be part of a larger programme that would continue to apply different indicators and approaches to this case, so as to allow deeper understandings of both transport in the west of Ireland, but also how well existing techniques might help researchers, practitioners and policy-makers understand and improve networks.

[8] MobilityData, *General Transit Feed Specification (GTFS)*, undated, `%7Bhttps://gtfs.org/%7D`.

[9] James Reynolds, Graham Currie, and Yanda Qu, "Social Needs for Transport and Gaps in Transit Service: New GTFS Tools," *Submitted to Australasian Transport Research Forum. November, Auckland, NZ.*, under review.

[10] **R-gtfstools?**

[11] **R-tidytransit?**

[12] "Quantitative Approaches to Needs Based Assessment of Public Transport Services: The Hobart Transport Needs Gap Study," Journal Article, 2003, `https://www.semanticscholar.org/paper/2c049091cafb56c66efc532ad2bdd774d8efc0eb`.

[13] "Gap Analysis of Public Transport Needs:measuring Spatial Distribution of Public Transport Needs and Identifying Gaps in the Quality of Public Transport Provision," *Transportation Research Record* 1895 (2004): 137–46, doi:10.3141/1895-18.

[14] "Identifying Spatial Gaps in Public Transport Provision for Socially Disadvantaged Australians: The Melbourne 'Needs Gap' Study," 2007.

[15] "Quantifying Spatial Gaps in Public Transport Supply Based on Social Needs," *Journal of Transport Geography* 18, no. 1 (2010): 31–41.

[16] Ibid.

[17] Ibid.

[18] "Social Needs for Transport and Gaps in Transit Service."

[19] "Understanding Mobility in Rural Towns."

[20] Ibid.

[21] Ibid.

Methodology

The transit Supply Index (SI)

Reynolds, Currie, and Qu[22] provide a generalized form of the Currie[23] SI equation, which is:

$$SI_{area,time} = \sum_{i=1}^{n} \frac{Area_{Bi}}{Area_{area}} SL_{i,time}$$

where:

- $SI_{area,time}$ is the Supply Index for the *area of interest* and a given period of time;
- $Area_{Bi}$ is the amount of the buffer zone for each stop (i) that is within the *area of interest*[24];
- $Area_{area}$ is the area of each *area of interest*; and
- $SL_{i,time}$ is the number of transit arrivals for each stop (i) within the given time period.

Based on the SI scores Currie[25] grouped areas of interest into seven categories. The first category includes areas of interest with zero SI scores, i.e. those areas without any transit services at all. The remaining areas of interest are than categorised into three even groups (Very Low, Low and Below Average) across those with areas with SI scores below average, and three even groups above the average[26] (Above Average, High and Very High). This approach, which was also used in Reynolds, Currie, and Qu,[27] has been used in this paper as well so as to maintain consistency with the previous research.

The areas of interest adopted in this study at the 2022 definition of *Small Areas*, used in the Irish Census.

[22] "Social Needs for Transport and Gaps in Transit Service."
[23] "Quantifying Spatial Gaps in Public Transport Supply Based on Social Needs."
[24] In Currie, ibid this burffer zone was based on a radius of 400 metres for bus and tram stops, and 800 metres for railway stations. The same definition is used here.
[25] Ibid.
[26] Based on only including areas of interest with non-zero scores
[27] "Social Needs for Transport and Gaps in Transit Service."

GTFS data

Data for this paper was sourced from Transport for Ireland[28] on October 1, 2025[29]. The analysis was run for the week starting October 1.

[28] "Public Transport Data" (National Transport Authority, undated), `https://www.transportforireland.ie/transitData/PT_Data.html`.
[29] Selecting the "All GTFS Operators" feed

Results

West of Ireland

Table 1 shows summary statistics for SI scores and the population, overall for all of the west of Ireland and split by transit supply category. The total population of the west of Ireland is 801,971, of whom

Table 1: Summary statistics; SI score by transit supply category, by Small Area.

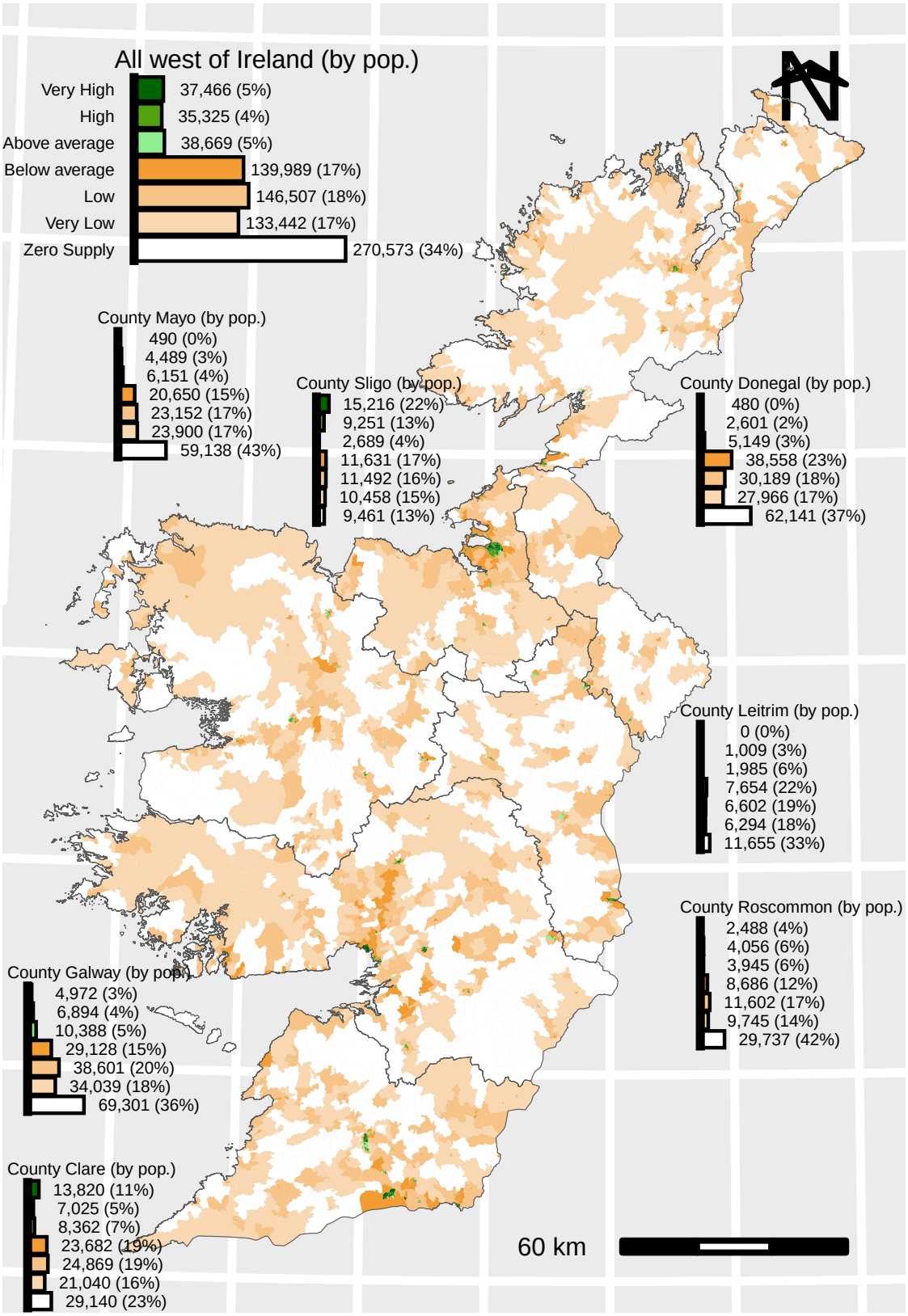

Figure 1: Transit Supply Index categories across the west of Ireland, by Small Area and by population

Characteristic	Overall N = 3,357	Transit supply category						
		Zero Supply N = 1,166	Very Low N = 576	Low N = 576	Below average N = 576	Above average N = 155	High N = 154	Very High N = 154
SI								
Min	0.0	0.0	0.0	1.7	18.7	130.6	213.7	487.0
Q1	0.0	0.0	0.1	2.7	30.5	150.4	265.4	604.2
Mean	85.2	0.0	0.5	6.5	56.4	168.7	321.9	1,128.0
Q3	36.5	0.0	0.8	9.0	78.1	187.1	372.0	1,421.3
Max	3,237.0	0.0	1.7	18.6	129.2	211.8	485.7	3,237.0
Sum	285,944.6	0.0	296.2	3,738.0	32,478.6	26,149.7	49,574.2	173,707.9
population								
Min	69	71	74	97	76	79	69	78
Q1	181	175	176	197	182	191	168	193
Mean	239	232	232	254	243	249	229	243
Q3	286	280	284	297	296	288	280	282
Max	827	577	511	760	714	827	478	574
Sum	801,971	270,573	133,442	146,507	139,989	38,669	35,325	37,466

86% (690,511) live in Small Areas where the SI score is below the average (of those Small Areas with a non-zero SI score) (130.5). This includes the 270,573 people (34%) who live in Small Areas with no transit at all.

Figure 1 shows transit Supply Index (SI) categories by Small Areas across the west of Ireland. It also shows to the population living in Small Areas in each category for both the entire west of Ireland and for each county. In general, there appear to be large areas of the west of Ireland with SI scores below the average, or with no transit supply at all. Also, as might be expected, Small Areas where SI scores are higher than the average (of those with non-zero scores) appears to be located in very small and scattered geographic areas (at population centers).

Table 2 summarises the Small Area populations in each County by transit supply category, shown as a share of the total west of Ireland population. Table 3 shows SI scores and transit supply categories by County, weighted by population.

Table 2: County Small Area populations, by transit supply catergory.

Table 1: West of Ireland: County Small Area populations by Transit Supply grouping

County	Transit Supply category							Total
	Zero Supply	Very Low	Low	Below av.	Above av.	High	Very High	
GALWAY	8.6% (69,301)	4.2% (34,039)	4.8% (38,601)	3.6% (29,128)	1.3% (10,388)	0.9% (6,894)	0.6% (4,972)	24.1% (193,323)
DONEGAL	7.7% (62,141)	3.5% (27,966)	3.8% (30,189)	4.8% (38,558)	0.6% (5,149)	0.3% (2,601)	0.1% (480)	20.8% (167,084)
MAYO	7.4% (59,138)	3.0% (23,900)	2.9% (23,152)	2.6% (20,650)	0.8% (6,151)	0.6% (4,489)	0.1% (490)	17.2% (137,970)
CLARE	3.6% (29,140)	2.6% (21,040)	3.1% (24,869)	3.0% (23,682)	1.0% (8,362)	0.9% (7,025)	1.7% (13,820)	16.0% (127,938)

ROSCOMMON	3.7%	1.2%	1.4%	1.1%	0.5%	0.5%	0.3%	8.8%
	(29,737)	(9,745)	(11,602)	(8,686)	(3,945)	(4,056)	(2,488)	(70,259)
SLIGO	1.2%	1.3%	1.4%	1.5%	0.3%	1.2%	1.9%	8.8%
	(9,461)	(10,458)	(11,492)	(11,631)	(2,689)	(9,251)	(15,216)	(70,198)
LEITRIM	1.5%	0.8%	0.8%	1.0%	0.2%	0.1%	0.0% (0)	4.4%
	(11,655)	(6,294)	(6,602)	(7,654)	(1,985)	(1,009)		(35,199)
Total	33.7%	16.6%	18.3%	17.5%	4.8%	4.4%	4.7%	100.0%
	(270,573)	(133,442)	(146,507)	(139,989)	(38,669)	(35,325)	(37,466)	(801,971)

As shown in Table 2, the largest shares of the total population of the west of Ireland are the 69,301, 62,141 and 59,138 people living in County Galway, County Donegal and County Mayo in Small Areas with no transit at all.

Table 3: SI score & transit supply category by County, weighted by population.

Characteristic	**CLARE** N = 127,938	**DONEGAL** N = 167,084	**GALWAY** N = 193,323	**LEITRIM** N = 35,199	**MAYO** N = 137,970	**ROSCOMMON** N = 70,259	**SLIGO** N = 70,198
SI							
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q1	0.1	0.0	0.0	0.0	0.0	0.0	0.9
Mean	183.5	24.5	44.6	32.5	30.3	71.0	323.0
Q3	103.2	24.0	20.5	41.1	13.1	37.1	396.4
Max	3,096.1	684.6	907.2	342.6	776.7	1,320.1	3,237.0
Sum	23,471,559.2	4,098,119.7	8,621,589.6	1,145,719.8	4,183,477.4	4,988,734.5	22,671,969.6
transit_supply							
Zero Supply	29,140 (23%)	62,141 (37%)	69,301 (36%)	11,655 (33%)	59,138 (43%)	29,737 (42%)	9,461 (13%)
Very Low	21,040 (16%)	27,966 (17%)	34,039 (18%)	6,294 (18%)	23,900 (17%)	9,745 (14%)	10,458 (15%)
Low	24,869 (19%)	30,189 (18%)	38,601 (20%)	6,602 (19%)	23,152 (17%)	11,602 (17%)	11,492 (16%)
Below average	23,682 (19%)	38,558 (23%)	29,128 (15%)	7,654 (22%)	20,650 (15%)	8,686 (12%)	11,631 (17%)
Above average	8,362 (6.5%)	5,149 (3.1%)	10,388 (5.4%)	1,985 (5.6%)	6,151 (4.5%)	3,945 (5.6%)	2,689 (3.8%)
High	7,025 (5.5%)	2,601 (1.6%)	6,894 (3.6%)	1,009 (2.9%)	4,489 (3.3%)	4,056 (5.8%)	9,251 (13%)
Very High	13,820 (11%)	480 (0.3%)	4,972 (2.6%)	0 (0%)	490 (0.4%)	2,488 (3.5%)	15,216 (22%)

[1] n (%)

There is a statistically significant variation between Counties in the share of Small Areas in each transit supply category ($\chi^2(36) = 469.01$, $p < .001$). Table 3 indicates that Mayo and Roscommon have higher shares of their population living in Small Areas with no transit supply (over two people in every five), whereas Sligo has the lowest (close to one in eight). Close to one-third of people living in Sligo live in Small Areas with SI scores above the average (not including areas with no transit), followed by a little under one in four in Clare and around one in seven in Roscommon. At the other end of the spectrum, only around one in twelve people in Mayo and Leitrim live in areas with above the average SI scores, while for Donegal it is only one in twenty.

A Lorenz Curve of distribution of the west of Ireland's transit supply to the population is shown in Figure 2. The Gini co-efficient is 0.88, indicating a relatively unequal distribution. In total, the SI score across all of the west of Ireland is approximately 286,000, but 97% of this goes to Small Areas that are home to just 25% of the

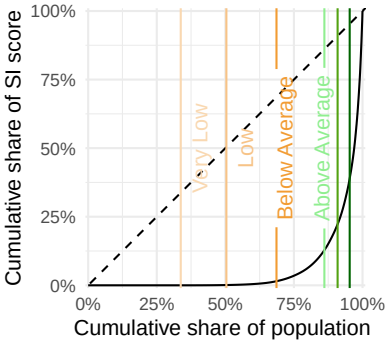

Figure 2: West of Ireland: Lorenz curves

total population. 83% of the population live in Small Areas that, in combination, receive just 10% of the total supply. This is perhaps not surprising, given that providing transit services in rural and low density areas is challenging.

Figure 3 shows Lorenz curves for each of the Counties. Gini coefficients range from 0.76 for Sligo, through to 0.87 for Roscommon. This suggests that there is some variation, but in general transit supply is unequally distributed to the population across all of the Counties in the west of Ireland.

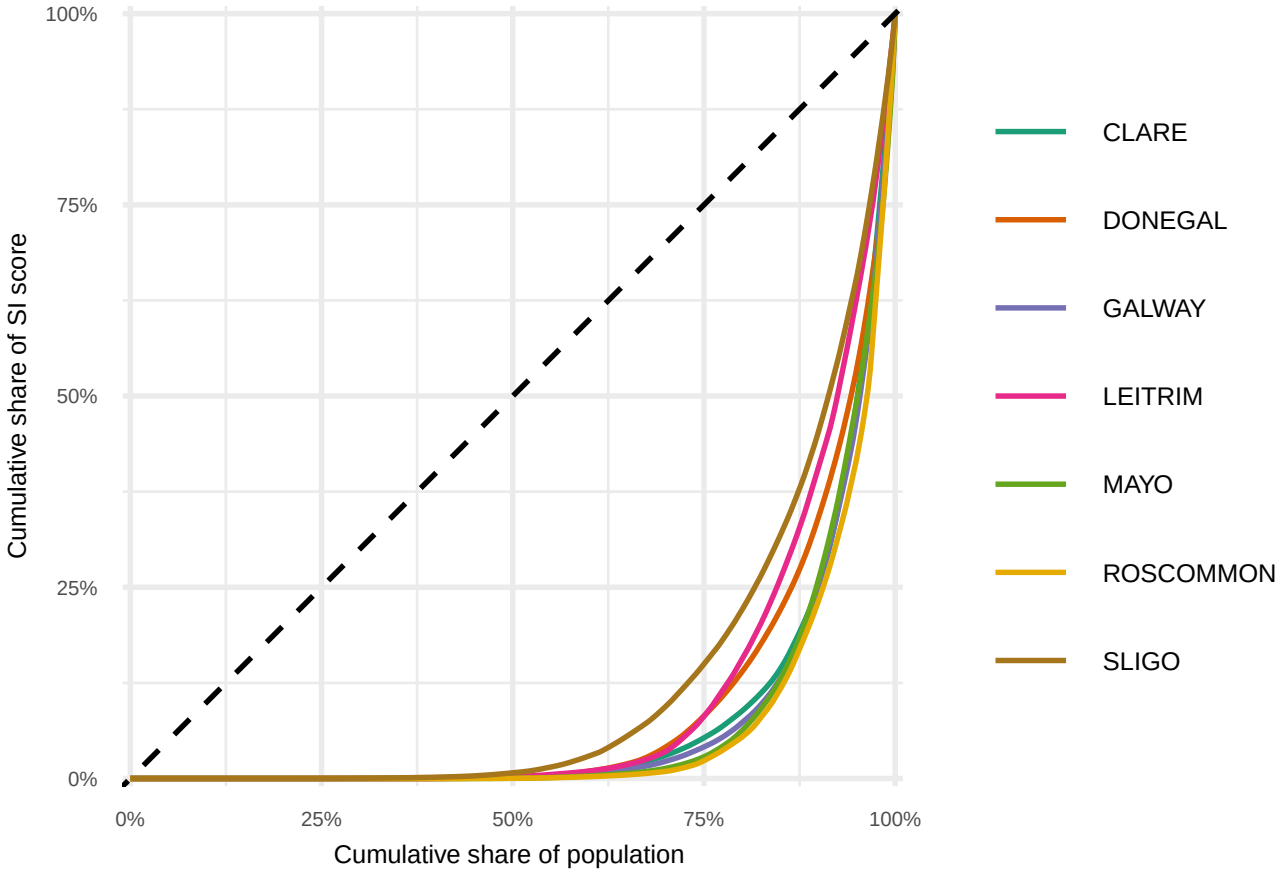

Figure 3: West of Ireland: Lorenz curves by County