LONG DISTANCE TRANSPORT POVERTY: CRITERIA SETTING AND TESTING WITHIN EUROPE

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Abstract

The concept of transport poverty is a relatively new area of research and policy focus and what has been proposed thus far has only been through the lens of urban mobility. Given the essential nature of many long-distance journeys, there is currently a dearth of research into the concept of long-distance transport poverty and the role of air transport connectivity within that. Using in-development definitions of urban transport poverty as a basis, a new working definition and criteria for long-distance transport poverty has been proposed and then tested against a sample of NUTS3 level European regions. According to this new definition of long-distance transport poverty, it was found that residents located in regions with very limited access to air transport services, do often benefit from road and rail alternatives, albeit with some evidence of average rail journey times being too slow to be 'convenient', particularly in those regions that are already vulnerable from an air transport perspective. There is some additional evidence across regional groups of a household affordability issue if multiple long-distance journeys need to be made annually and/or if there are a high number of dependents in each household. It is recommended that, as urban mobility transport poverty is further developed as a concept and gains more prominence from a policy perspective, that it is important not to ignore long-distance transport equality research given its journey purpose essentiality for several socio-demographic groups.

Key words: transport poverty, transport inequality, long-distance transport poverty; air transport connectivity, rail connectivity, road connectivity

1.0 Introduction

Long distance transport continues to be an under-researched area due to its non-routine nature, its lower frequency of occurrence for many residents and its data collection complexities (Ullman and Aultman-Hall, 2020). Nevertheless, despite the inconveniences of undertaking long distance transport, with travel fatigue chiefly amongst them (see Reilly et al, 2008 for a full discussion), it is often considered to be an essential or at least highly desirable aspect of today's global society. According to Dowds et al (2018), access to long-distance travel and to more distant destinations is increasingly important for maintaining social networks and accessing economic opportunities and specialized services.

Long distance transport has been defined as any trip distance over 80 kilometres both in the US (BTS) and the UK (DfT National Travel Survey). The EU and Eurostat, within its guidelines on passenger mobility statistics (Eurostat, 2018) recommends the use of three separate distance classes, namely short distance (0-300 kilometres), medium distance (301-1,000 kilometres) and long distance (over 1,000 kilometres). This contrasts with Eurostat's earlier definition as used for the DATELINE survey, for instance, where long-distance travel was defined as a journey to destinations at crow-fly distances of at least 100 kilometres (Jeppe and Lindhard, 2012).

There have been several generalised attempts to study and improve data available on long distance transport with examples coming from the US National Household Travel Survey, the UK National Travel Survey and the EUs attempts to synthesise various member state National Travel Surveys into a common framework (e.g. the DATELINE survey).

A focus on the concept of long-distance transport poverty has hitherto been neglected in the literature. Lucas et al. (2016) covered transport poverty in some detail and stated that transport poverty in general transportation has been neglected and needs urgent attention. In the UK, Gates et al (2019) produced a study on the relationship between transport and inequality and as part of this produced the following working criteria of what aggregate level transport poverty means building on work carried out by Sustrans:

• Proportion of households with low income (that would have to spend 10% or more of income to run a car)

• Proportion of households that are more than one mile from the nearest bus stop or railway station

• Proportion of households that would need to travel for more than one hour to reach essential services (Titheridge et al., 2014)

Gates et al (2019) then stipulate that using the above criteria, that around 1.5 million residents in England would fall under the definition of going through some form of transport poverty.

At the European level, the European Parliament has also started to think more about the concept of urban transport poverty based on the 20th European Pillar of Social Rights, which lists transport amongst other essential services to which everyone should have access (European Commission, 2023) and has pulled together five potential components to describe urban transport poverty from the literature as follows (Kiss, 2022):

1. No transport availability (the lack of transport options or low frequency, also referred to as mobility poverty)

2. No accessibility to transport (for disabled people for instance)

3. Low transport affordability (inability to meet the cost of transport)

4. Too much time spent travelling (also referred to as time poverty)

5. Inadequate transport conditions (available transport options are dangerous or unsafe)

It has a similar structure to the Sustrans criteria though its coverage spans slightly wider to include a focus on accessibility for passengers with reduced mobility and so called conditions of transport which can include safety and security and though not explicitly listed, hygiene and cleanliness would fall under the same category.

It is clear from the focus in this area to date, however, that long distance transportation has not been included within the scope of transport poverty. This poses a risk given the global nature of world populations and the range of essential journey purposes being cited to justify the undertaking of long distance journeys, whether it is to visit relatives, spend quality time with family members during school vacations periods or access essential health, education or business services.

Gates et al (2019) further found that the transport system itself in terms of cost, geographic accessibility and the scheduling of transport services play a significant contributing role to wider social and economic inequalities that can be related to transport. By way of example Warnock-Smith et al. (2022) found that significant disparities in direct air connectivity have built up in Europe over time, despite air transport services in the region growing overall between 2010 and 2019. By 2019, for some regions such as in Finland, for example, population weighted direct connectivity in the most connected regions was as much as 37 times greater than population weighted direct connectivity in the least connected regions.

Of course, where infrastructure is available long-distance road and rail connections can play an important role in reducing any risks associated with a lack of air connectivity, particularly over distances of less than 1,000 km where high speed rail is available and between 100 and 400km for road (European Technology Assessment Group 2008).

Based on recent work on urban transport poverty, this paper aims to develop an initial working definition of long-distance transport poverty (LDTP) and using a bottom-up approach, to test if there are any regions across Europe where there could be some presence of LDTP, whilst at the same time testing the fit and suitability of the novel working definition as presented in this paper. To this end, the rest of the paper is set out as follows: Section 2 reviews the literature related to the importance of long distance transport access and mobility, Section 3 outlines the data strategy and methodology including the proposed working definition of LDTP, Section 4 present the main results and findings of the preliminary regional testing phase while Section 5 presents the conclusions and next steps in the research.

2.0 Long distance transportation and mobility

Demand for long distance journeys is derived from demand for essential and desirable activities and services that are available beyond a residents' immediate geographical area. US Department of Transportation (US DOT, 2023) travel data, analysed over the 2010 to 2017 period (Thunder Said Energy, 2023), found that for journeys over 100 miles there was a mix of underlying journey purposes including for employer and personal business reasons as well as long distance commuting (making up 53% of all long distance miles travelled) and for visiting friends and relatives and a range of leisure purposes (making up 47% of all long distance miles travelled). There was evidence that between 200 and 4,000+ miles there was a progressive increase in mileage undertaken for business purposes, which contrasts with UK National Travel Survey evidence, suggesting that the percentage of long-distance trips undertaken for non-business activity increases with distance. For instance, between 2015-2019 71% of all long-distance journeys over 350 miles was for non-business purposes in contract with 66% in the 100-150 mile category and 61% in the 75-100 mile category.

By income grouping it is quite clear that the higher the income group, the generally higher amount of spending there is on long distance transport and travel. In the UK the highest five percent of income earners in 2018 spent as much as 25% of their disposable income on international air fares alone. This contrasts with the lowest five percent of UK income earners spending only 3.4% of income on international air fares (ONS, 2018). When other forms of long-distance travel are included, however, expenditure proportions are likely to be higher to a proportional level between different income groups. In terms of the number of flights abroad as many as 52% of all UK National Travel Survey respondents in 2019 stated that they have taken at least one flight abroad in the previous 12 months, increasing from 47% in the year 2006, with 8% of respondents stating that they had more than four flights in the last 12 months (DfT, 2022).

Residents should not just be broken down by income group but also by socio-economic status. In the UK the 'Cosmopolitan' supergroup tend to spend most on air travel but tend to spend the least amount on transport in general, in stark contrast to the Rural Resident supergroup, for example, who tend to spend much more on every day transport in general but tend to spend a lower amount on longer distance air travel (ONS, 2018). This tallies with social grouping data from Germany, which examined travel survey data from 893 people living in Berlin and Munich, and concluded that Urbanites tend to display a higher demand for long-distance transport as they travel more frequently and to more distant places, despite having lower daily travel costs and associated emissions.

According to the European Technology Assessment Group (2008), long-distance passenger transport comprises: -

• Road and rail transport (car, motorcycle, coach, train), which is typically over distances of 100 to 400 km (but can of course be longer, especially for leisure purposes when users are more sensitive to price than travel time);

• Air transport, which starts to compete with land modes at distances of around 250 km or more, although where high-speed rail services exist, this increases the distance at which air travel can become more competitive;

• Only limited water-borne transport (normally short sea ferry routes)

• Use of local or regional transport networks to access and egress the long-distance mode

US Department of Transportation data (Thunder Said Energy, 2023) collected over the 2010-2017 period shows that there was a majority reliance on private vehicles between 100 and 1,000 miles with air dominating most of the mileage undertaken for any journey above 1,000 miles. The most competitive mileage band was the 500-1,000 mile range with an almost 50-50 split between private and public transport options (air, rail, coach). Europe generally benefits from more rail options that the US though shorter average distances are often counterbalanced with a significant level of topographic challenges which can serve to increase average journey times.

There is a growing research focus, particularly in lieu of the Covid-19 pandemic and the climate emergency, in promoting measures such as progressive taxation to reduce the number of long-distance trips where possible, particularly with respect to air travel (e.g. Buchs and Mattioli, 2022). Although long-distance travel adds up to only a small share of trips made by households, they represent a major share when measuring mileage and therefore environmental effects. At the European level, trips above 100 km represented more than half of the total mileage (Mabit et al 2013). There is a trade-off therefore in balancing the seemingly conflicting needs to provide citizens with improved and continued access to long-distance and global markets to fulfil a range of desirable and essential activities, particularly where there are currently imbalances in connectivity between regions, with the need to constrain growth in air transport emissions as long as low-carbon aviation remains a distant prospect. It is important, however, that any future policy measures to constrain demand are taken in a targeted way, by ensuring that populated yet relatively isolated areas in terms of long-distance connectivity are not further disadvantaged by such measures. Gaining an enhanced understanding of existing access and mobility disparities in long distance and global networks is therefore an important research gap that needs to be addressed.

3.0 Data strategy and methodology

In line with the study's aim, the overall approach to the study was to design a working definition of LDTP based on preliminary work carried out on urban transport poverty and to determine if there is any evidence of LDTP across the European regions using the base regional air transport connectivity data provided in Warnock-Smith (2022) and for the same regions, exploring alternative ground based long distance transport options to build up a more comprehensive comparative picture of long distance connectivity.

In the absence of a one-stop-shop database for long distance transport options covering air, rail and road for regions across Europe, a bottom-up approach was selected as an appropriate way to test the initial working definition of LDTP and to see if there are any initial signs that any European regions are more likely to have some degree of LDTP. For air connectivity information, a subscription only Sabre search tool was used (Sabre Market Intelligence version 6.5) along with the Cirium database. For comparative road and rail information, publicly available sources were used covering mainly Google maps and National rail operator websites. The last available full year of normal operations, being 2019, were used for the broader air transport indicators, whilst the modal comparisons in the bottom-up analysis were performed on live data over the March to April period in 2023.

4.0 Results

4.1. Working definition of Long-Distance Transport Poverty

Given that there is currently no discussion in the literature about the concept of Long Distance Transport Poverty, the new working definition proposed in this research, as shown in Table 1, represents an amalgam of urban transport poverty criteria from two separate sources (Gates et al, 2019 and Kiss, 2022) coupled with typically used long distance transport decision making conventions derived from household and national travel survey data in the UK and Europe.

Table 1: Working definition of Long-Distance Transport Poverty

- Affordability: 15% or more of total household transport budget being spent on long distance transport (any mode on trips over 300kms) excluding other non-transport trip related expenses
- Convenience: *'Zero convenient options' available to access essential or desirable long-distance destinations and destination activities

* 'Zero convenient options' is defined as the absence of at least one daily possibility (using any available mode or combination of modes) of travelling from a true origin point to an essential or desirable destination point (over 300kms straight line not topographic distance) at an average of 100 kms distance per hour of journey time (i.e. a total journey time indicator)

The UK ONS Household Expenditure Survey 2018 suggests all but one Output Area Classification (OAC) supergroup spent 10% or more of total household income on transport. By extension, the principle used for this study is that long distance transport costs should not form a large percentage of total household transport costs, which would have the effect of increasing the percentage of total transport costs as a proportion of total household costs, which in turn would put undue pressure on other everyday household costs. The resulting affordability criterion places a threshold of no more than 15% of weekly transport costs being spent on long distance transport, excluding other overnight trip expenses such as hotel costs. In line with Eurostat (2018) guidance, a distance threshold of 300km > has been employed to denote a long-distance journey.

The second criterion uses the umbrella term of 'convenience' to encapsulate points 1 and 4 of the Kiss (2022) urban transport poverty definition as well as the final two points of the Gates et al (2019) definition. In order for a journey to be practically feasible for the vast majority of regular travellers, there is a tolerance threshold with respect to total journey time, which itself is impacted by the distance/time taken to access the nearest airports and railway stations, levels of service frequency or choice and the average speed, duration and directness of the main journey sector. In line with Mabit et al (2013), there is on average a greater value placed on time savings over long-distance trips (on a decreasing scale) and as such it can be inferred that there may be some evidence of long-distance transport poverty, when overall door-to-door journey times become prohibitively long, rendering essential or desirable destinations 'out of reach', for all intents and purposes. In such cases time savings for such trips would be negligible, and residents would almost always decide not to travel. The term 'Zero convenient options' is used in this paper to describe such a scenario with the total journey time parameter set to 100 kms distance per hour of journey time for any trips over 300kms. In practice therefore, an individual wanting to reach an essential destination 500 kms away from their true origin point with only one 5 hours option by road would consider it prohibitive under most circumstances and so for the purposes of this study, this original-destination pairing would be classed as having 'zero convenient options' (500kms/100kms per hour = 5 hours).

The two additional criteria found in Kiss (2022), those of ensuring access for disabled people and of maintaining transport conditions (e.g. safety and security) are also issues of fundamental importance for long distance transport to be feasible, but are assumed to only be a consideration when the initial journey time and affordability indicators are positive.

4.2. Broader headline indicators

European airports located in the Most Vulnerable Regions (MVR) in terms of direct air connectivity, as identified in Warnock-Smith et al (2022), along with those regions that have access to between 50 and 99 direct destinations clearly have a greater proportion of total trips in the 250km-1,000km distance bracket in comparison to the Least Vulnerable Regions (LVR) and those that have access to a generally higher number of direct air connections (Figure 1). This is potentially significant contextual information with respect to the MVRs, whose serving airports tend to offer routes that are more likely to have ground based alternatives and where any increased modal substitution for long distance trips over this sector length may not impact overall levels of transport poverty, but may have the effect of making already vulnerable airports, more vulnerable to not achieving a critical mass of traffic to be commercially sustainable. Where suitable alternatives are present, it may not be a concern for most residents living in those regions though it could also pose a risk to the lower number of longer distance routes operating from those airports for which there are likely to be a lower number of modal alternatives. There is a small splattering of longer distances services in the MVR and 50-99 groups, for instance, over which ground based modes are likely to not be competitive (Figure 2). In regions with 50-99 direct air connections, five percent of all trips are above 2,500 kms, for example. As the last full year of normal operations 2019 trip data were compiled from Sabre analytics for the broader indicators.

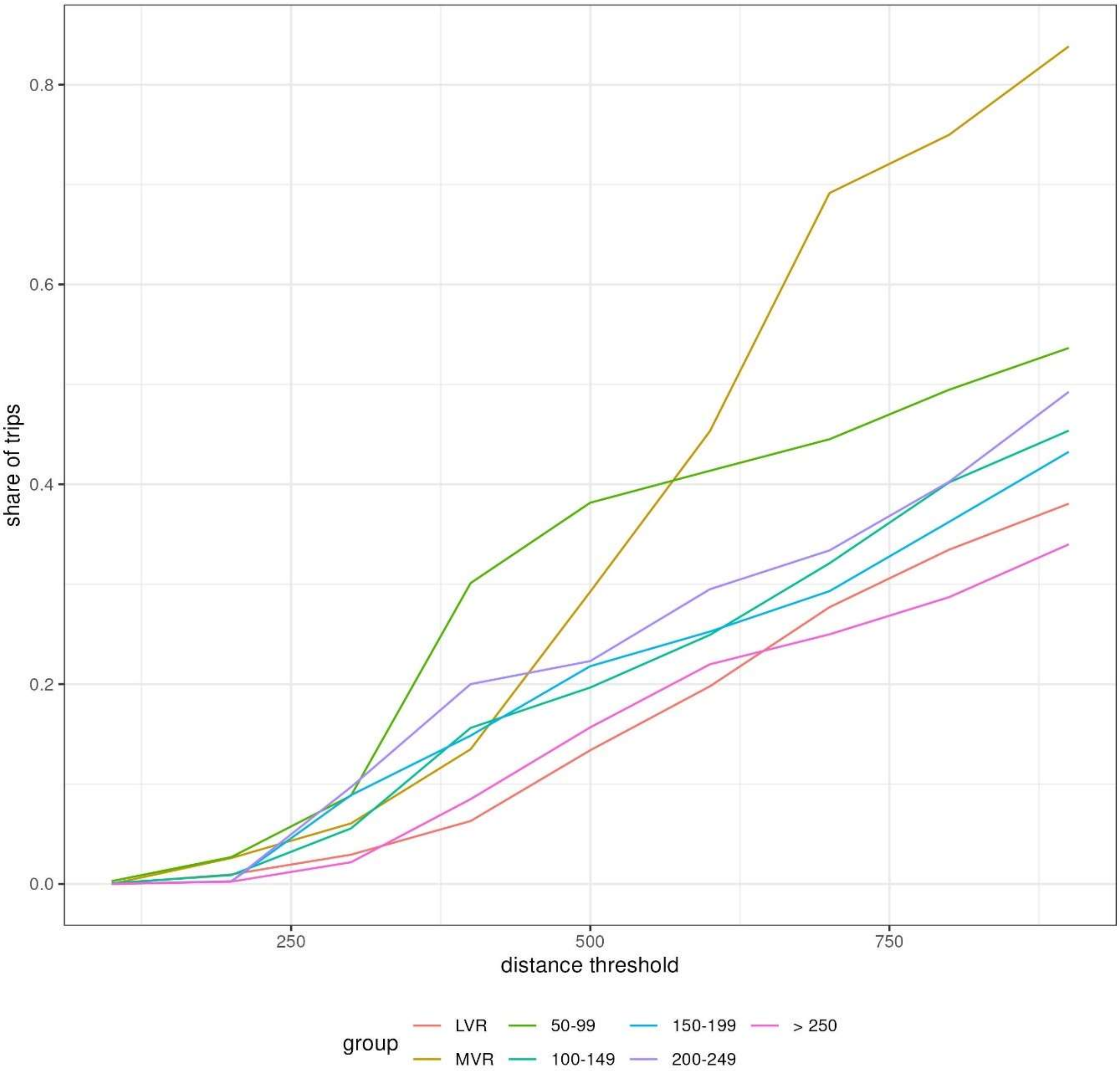

Figure 1: Number of long-distance passenger trips by air in the 250-1,000 km distance bracket split by regional grouping

Source: Sabre Analytics (2019 data), Warnock-Smith et al. (2022)

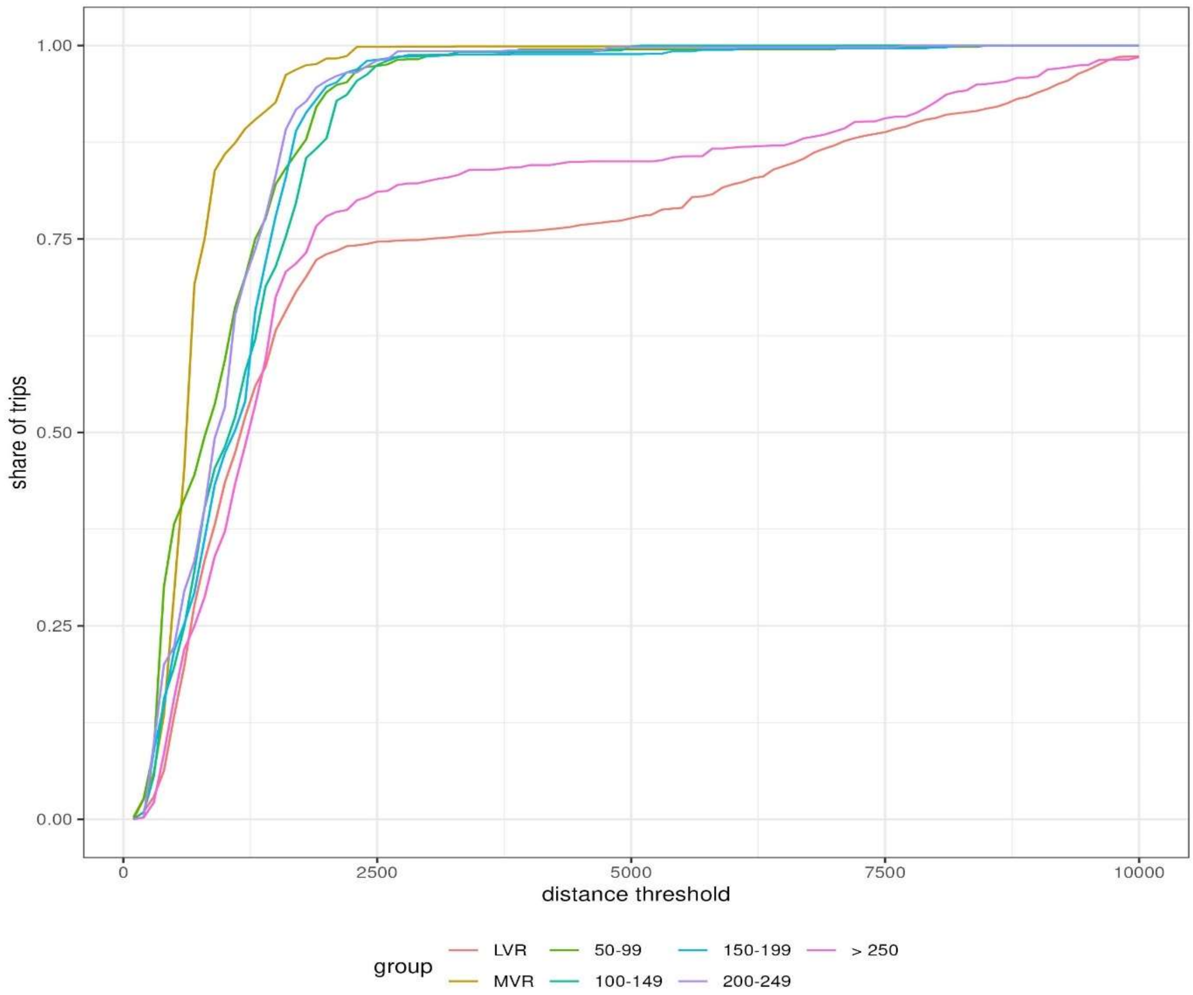

Figure 2: Number of long-distance passenger trips by air in the 0-10,000 km distance bracket split by regional grouping

Source: Sabre Analytics (2019 data), Warnock-Smith et al. (2022)

Using March 2023 data from Cirium, Table 2 contains a pandemic rebound period summary of the number of direct routes at airports in each regional grouping (taken from Warnock-Smith et al. 2022) that are over 1,000kms in straight line distance and the number of the same that would also have interrupted land journeys due to the presence of the natural sea barrier. As per the pre-pandemic data in Figures 1 and 2, airports located in the MVRs have a smaller proportion of 1,000 km + routes (16%) in contrast with airports located in the LVRs with as much as 65% of all routes over 1,000kms.

Table 2: Ratio of 1,000km+ routes of airports located in seven NUTS3 level European regions

Regions	Ratios	Average	Standard Deviation	Number of unique airports	Number of observations (rows)	Number of NUTS 3 regions	Number of routes (for all airports and all regions)	% of 1000km routes intra-continental
LVR	Ratio of 1,000 km +	0.65	0.24	73	249	17	16365	75.7
	Ratio of sea and 1,000 km +	0.38	0.28					
100-149	Ratio of 1,000 km +	0.53	0.32	41	46	11	861	97.0
	Ratio of sea and 1,000 km +	0.26	0.19					
0ver 250	Ratio of 1,000 km +	0.53	0.29	43	46	10	1981	83.7
	Ratio of sea and 1,000 km +	0.28	0.22					
200-249	Ratio of 1,000 km +	0.46	0.26	38	44	8	1044	96.2
	Ratio of sea and 1,000 km +	0.34	0.26					
150-199	Ratio of 1,000 km +	0.36	0.28	36	47	9	694	97.7
	Ratio of sea and 1,000 km +	0.22	0.18					
50-99	Ratio of 1,000 km +	0.31	0.34	45	51	13	599	97.0
	Ratio of sea and 1,000 km +	0.14	0.18					
MVR	Ratio of 1,000 km +	0.16	0.28	38	55	16	236	98.3
	Ratio of sea and 1,000 km +	0.14	0.24					

Source: Cirium Dashboard Note: Data correct as of March 2023

Overall, 43% of all observed routes in Europe can be immediately assumed to not have a viable alternative on average. In the MVRs 84% of routes, being under 1,000 km have the potential to have viable alternatives, provided services and infrastructures are available. Tables 3 and 4 confirm the statistical significance of mean differences in the proportion of 1,000km + routes between regional groupings with F-values above the critical values in both cases.

Table 3: Results of an Anova test for 1,000 km routes between regional groups

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F-value*	*P-value*	*F crit*
Between Groups	*14.500*	*6*	*2.417*	*32.883*	*9.91E-34*	*2.116*
Within Groups	*39.026*	*531*	*0.073*			
Total	*53.526*	*537*				

Source: Cirium Dashboard Note: Data correct as of March 2023

Table 4: Results of an Anova test for 1,000 km with a sea barrier routes between regional groups

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F-value*	*P-value*	*F crit*
Between Groups	*4.918*	*6*	*0.820*	*13.066*	*8.22E-14*	*2.116*
Within Groups	*33.314*	*531*	*0.063*			
Total	*38.232*	*537*				

Source: Cirium Dashboard Note: Data correct as of March 2023

4.3. Bottom-up analysis

In the absence of Europe-wide indicators for rail and road, a bottom-up approach was taken to provide comparisons covering journey times, frequencies and fares and focussing on routings to/from regional groupings found in Warnock-Smith et al. (2022).

Table 5 provides an initial snapshot comparison of alternative rail options in the MVR and LVR regions using a selection of origin to destination (city centre-city centre) routings in Spain, Finland, France and Germany. Major domestic city destinations were selected in all cases, which is why air options are generally available too in the MVRs despite having a generally lower number of direct destinations. Where a domestic air option is present, there are rail alternatives in both cases but the average time differential between the air and rail options are observed to be higher in the selected MVRs. This can be explained by the more isolated (despite being populated) locations of MVR towns and cities, which increase average rail journey times and make it less likely that high speed rail links will be available. The A Coruna-Madrid routing in Table 5 is something of an exception in that, starting in 2022, some high speed rail frequencies became available on part of the route from Madrid to Orense thereby reducing the air-rail time differential to 100 minutes in contrast with Kajanni to Helsinki in Finland, which has a reliable but slower rail service. Cross-checking this route against the working definition of LDTP, in the absence of an air service from Kajaani to Helsinki, residents in this region (FI1D2) would be at some risk of long-distance transport poverty with the alternative taking around 540 minutes for a straight-line distance of 473 kilometres. The fastest road option on this routing is approximately 410 minutes, faster than the rail option, but still fitting into the working criteria of ‘zero convenient options’ in the absence of an air service. As things stand, none of the four selected routings would fit the ‘Convenience’ working definition of LTDP because in all cases there is at least one current option with journey times that can be considered ‘convenient’ given the straight-line distances involved. Interestingly, only the air option on the Koln to Munich routing fits the ‘Convenience’ criteria suggesting that without it, there would be a considerable reduction in trip convenience despite the presence of good road and rail infrastructure in Germany between these two cities. This is likely to be explained by the non-linear trajectories involved on the ground transport options and the considerable straight-line distance between the two points.

Table 5: Comparison of air and rail travel times for a selection of MVR and LVR O&D routes

Group	Mode	Country	Region	Origin airport Central rail station	Destination airport Central rail station	Average journey time (mins)	Adjusted journey times mins* (time difference)	Straight line distance (kms)
MVR	Rail	Spain	ES111	A Coruna (LCG)	Madrid (MAD)	260	290 (100)	508
MVR	Air	Spain	ES111	A Coruna (LCG)	Madrid (MAD)	70	190	508
MVR	Rail	Finland	FI1D2	Kajaani (KAJ)	Helsinki (HEL)	510	540 (340)	473
MVR	Air	Finland	FI1D2	Kajaani (KAJ)	Helsinki (HEL)	80	200	473
LVR	Rail	France	FRE12	Lille (LIL)	Lyon (LYS)	209	239 (41)	556
LVR	Air	France	FRE12	Lille (LIL)	Lyon (LYS)	78	198	556
LVR	Rail	Germany	DEA15	Koln (CGN)	Munich (MUC)	331	361 (174)	456
LVR	Air	Germany	DEA15	Koln (CGN)	Munich (MUC)	67	187	456

Sources: Cirium database (air journey time), National Rail operators' website (rail journey times). Note: Adjusted journey times add a standard 120 mins for access and egress time for air and 30 mins for rail. True origins and destinations assumed to be city centre locations (Sauter-Servaes et al, 2019)

Table 6 shows a summary of the full long-distance modal comparison between road, rail and air across 10 of the MVRs and seven of the LVRs, as taken from Warnock-Smith et al's (2022) direct air connectivity study. Overall, there are no significant differences across the observed long-distance domestic routes between the most and least vulnerable regions. Despite having very low air connectivity, many of MVRs enjoyed a base level of accessibility by road, rail and air to and from the largest cities in their respective countries. With the exception of rail services in France, none of the LVRs or MVRs benefited from 'convenient' rail and road options as defined in this study's working definition of LTDP. In all cases across both the MVRs and LVRs, the air option was quick enough to be classed as 'convenient', leading to the finding that none of the observed regions were currently fulfilling the 'Zero convenient options' criteria for LDTP. An examination of services to large cities in neighbouring countries will form important next step to test the working definition of LDTP (see Section 5). One area of possible concern for the MVRs is that average rail journey times seem to more of an inconvenience than those serving the LVRs. In practice, this is an expected result but empirically highlights the importance of expanded air services to and from these regions to compensate for the time inconvenience of the alternative rail options. This finding was also apparent in the Table 5 MVR and LVR comparison.

Table 6: Full summary of average journey time results for MVR and LVR regions for air, road and rail options

Region code	Region name	Country	Group	Number of LD routes	Average adjusted journey times Rail mins*	Average adjusted journey times Air mins* (air advantage)	Average adjusted journey times Road mins*	Average straight-line distance (kms)
FI193	Keski-Suomi	Finland	MVR	4	299	187 (73)	260	340
FI1D9	Pohjois-Pohjanmaa	Finland	MVR	3	566	210 (307)	517	621
FI1D2	Pohjois-Savo	Finland	MVR	2	441	193 (174)	367	423
PL812	Chełmsko-zamojski	Poland	MVR	2	475	180 (120)	300	344
ES111	A Coruña	Spain	MVR	9	493	201 (287)	488	639
ES415	Salamanca	Spain	MVR	1	378	190 (188)	420	575
ES419	Zamora	Spain	MVR	1	447	205 (242)	450	653
ES432	Caceres	Spain	MVR	1	338	195 (75)	270	328
SE313	Gävleborgs län	Sweden	MVR	3	411	185 (149)	334	376
SE332	Norrbottens län	Sweden	MVR	4	746	198 (395)	593	641
MVR summary/averages				30	459	194 (201)	400	494
AT321	Lungau	Austria	LVR	1	311	160 (82)	242	240
FRE12	Pas-de-Calais	France	LVR	6	384	207 (177)	525	703
DEA15	Mönchengladbach, Kreisfreie Stadt	Germany	LVR	4	308	187 (121)	336	395
DEB3A	Zweibrücken, Kreisfreie Stadt	Germany	LVR	2	491	220 (251)	471	550
CH054	Appenzell Innerrhoden	Switzerland	LVR	1	357	172 (91)	263	279
UKG32	Solihull	UK	LVR	4	517	196 (221)	417	483
UKJ12	Milton Keynes	UK	LVR	4	480	201 (267)	468	541
LVR summary/averages				22	407	192 (173)	389	456

Sources: Cirium database (air journey time), National Rail operators' website (rail journey times). Google Maps (road journey time). Note: Adjusted journey times add a standard 120 mins for access and egress time for air and 30 mins for rail and one 30 min rest stop for road. True origins and destinations assumed to be city centre locations (Sauter-Servaes et al, 2019)

Table 7 summarises frequency and fare data collection for a sample of 52 separate origin and destination routes involving the MVR and LVR European regions as shown in Table 6. It is clear that residents located in LVRs benefit from a much higher monthly combined air and rail frequencies than residents living in MVRs, though assuming residents can obtain seat capacity, both regional groups easily surpass the minimum threshold of at least one daily service being provided per day. In terms of fares, the generally good availability of rail services, coupled with good frequencies through the day, has led to the average cheapest one-way fares being a reasonable USD $55 in MVRs and USD $98 in LVRs. Partially subsided rail fares in a number of European countries would also go some way to explaining the apparent affordability of long distance fares, though in practice it is not always possible for travellers to opt for the cheapest, least flexible tickets, particularly if commuting during peak periods where operators often charge a premium. When broken down into different countries, high average fares (air and rail) in the UK served to increase the average cheapest fares for LVRs overall. Fares were more reasonable in Germany, Austria, France and Switzerland, which is reflected in the high standard deviation figure of USD $70 for LVRs. The UK can be thought of as something of an outlier in the sense that, although frequencies are generally very good, average fares remain high and can contribute to reduced affordability for passengers wishing to make essential or desirable long-distance trips. The average cheapest fare (air and rail considered) if an individual wishes to travel to Aberdeen in Scotland from Solihull in the West Midlands of England, for instance, was as high as USD $223 one-way in March 2023.

Benchmarking against the second working criteria for LDTP, it can be estimated that to achieve no more than 15% of total transport household expenditure on long distance trips, no more than USD [1]$920 can be spent per household per annum on long distance transport (excluding other trip expenses). For residents living in MVRs, long distance trips to important domestic urban centres could be feasible but only up to a certain limit. Using the cheapest available fare data in Table 7, in March 2023, a household of three members would only be able to afford three annual long-distance return journeys to their domestic capitals and largest cities. Households with a larger number of dependents will find affordability more of a challenge. The examples used in the analysis have excluded international and inter-continental destinations, which if factored into annual household expenditure would put additional constraints on the total number of long-distance journeys that can be made per annum.

Table 7: Descriptive statistics for average frequencies and fares for MVRs and LVRs

Regional grouping	Number of routes	Average monthly one-way frequency (rail and air combined)	Standard deviation frequency	Average cheapest fare (of rail and air options) ($USD)	Standard deviation fare
MVR (10 regions)	30	313	168	55	23
LVR (7 regions)	22	829	430	98	70

Note: Air and rail frequency and fare data obtained during the month of March 2023 from air and rail operator websites. Fare data based cheapest available one-way fare booking two weeks ahead. UK 2018 average household weekly expenditure on transport of £74.40 was used to estimate LDT Affordability (estimated at £91.74 in real terms in 2023 or $118 USD) in accordance with the ONS Household Expenditure Survey, 2018

5.0 Conclusion and next steps

This study first sought to highlight the existing gap in transport equalities research by highlighting the lack of consideration as to whether the 20th Pillar of European Social Rights, which classifies access to transport as essential, should also apply in equal measure to long distance transport. In the urban transport domain, the concept of transport poverty has started to receive some researcher and policy-maker attention, but no such consideration has been given as to whether a lack of access to national and global markets covering journeys over 300 kms, could also be an indication of transport poverty. This study marks the first attempt to develop a working definition of long-distance transport poverty (LDPT), based on recent definitions used for urban transport poverty given that both share common utility principles, namely total journey times, frequency of service, availability of capacity, and the provision of affordable fares. Given the distances involved, however, the number of modal alternatives for long-distance transport become more limited as distance increases and journey patterns are often more irregular and infrequent.

The main findings of the study can be broken down into two parts. Firstly, the broader and bottom-up analyses both confirmed the usability of the working definition of LTDP, though further

[1] Calculated by USD $118 per week estimated household transport budget x 52 weeks x 15% maximum amount of transport spending on long-distance trips.

refinement of the concept is needed, particularly with respect to the 'Convenience' criteria, given that the 100km per 1 hour of travel time ratio led to few rail and road long-distance options being classed as 'Convenient' with the exception of rail in France. The second key takeaway from the study relates to the preceding research carried out by Warnock-Smith et al, 2022, which already established the Most Vulnerable Regions (MVRs) across Europe with respect to commercial air connectivity. For those regions, along with a sample of other regional groups (seven in total) it was possible to examine the number and extent of alternative ground-based transport options, which may or may not mitigate against the prognosis when air services are assessed in isolation. It was found that a large percentage of air routes to and from the Least Vulnerable Regions are over 1,000 kms and as such it would not be possible under most circumstances for alternatives to be available. For the MVRs, however, a lower percentage of what is already a low number of air routes are over 1,000kms (only 16%). For MVRs in particular, it therefore becomes important to fully assess modal alternatives to obtain a fuller picture of long-distance connectivity. For most MVRs, there is evidence of available rail and road options to and from the largest cities in the same country with service frequencies often not representing a major concern despite being found to be much lower than in the LVRs. One area of concern, when contrasted against the Least Vulnerable Regions (LVRs) in terms of air connectivity, was total journey times by rail, which were found to be considerably slower on the observed domestic routes in comparison with rail services operating to and from LVRs. The more isolated (yet populated) geographical location of some of the MVRs could help explain the reduced average speeds of rail services going into these areas despite generally being available.

The other noted area of risk, which seemed to be apparent for both the MVRs and LVRs was related to the 'Affordability' criteria of LTDP. The average cheapest one-way fares observed in this study appear reasonable, but for larger households, it would not be possible to make many long-distance trips annually before the total costs eat into the everyday transport budget of households or even other types of essential household expenses. Given international and intercontinental route examples were not considered, it can safely be assumed that only one annual international journey could reduce the amount of long-distance domestic trips that the average household can undertake or vice versa.

The main next steps involve increasing the number of route comparisons in the bottom-up analysis, involving a larger number of European regions to further substantiate the findings of this study and further validate and refine the working definition of LDTP. This can be an iterative process that moves from 'essential' domestic routes to and from large urban areas to routes to and from large urban areas in neighbouring countries. Adding further data streams on long distance freight and on accessibility to transport services for passengers with reduced mobility will form important extensions to this work. Moreover, it cannot be assumed that safety, security and hygiene levels, of road, rail and air options are always set to the right standard. It would therefore be useful, as part of a qualitative extension to the work, to make a more detailed assessment of specific rail and air operators as well as road conditions for a sample of observed routes.

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