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LONG ABSTRACT

Accessibility to public transport. A comparison among European cities

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Public transport is a vital function of most of large European cities. Not only to reduce the use of private transport and guarantee a basic mobility for every citizen, but also as a structuring urban function, linked with land use development and management.

Despite we generically refer to "public transport", it is clear that every city is a story by its own due to historical and geographical characteristics, planning choices, capital intensity, land use, etc. Many elements may differentiate the supply of public transport: hierarchy among modes and lines, commercial speed, capillarity of stops and ultimately door-to-door speed, fares integration. Such a variety, together with the scarcity and heterogeneity of data, makes difficult to compare among cities and represent their accessibility in the same way.

Accessibility is a delicate matter, as it is something that depends on how the indicator is actually designed. Moreover, many different definitions exist making any comparison tricky. Generally speaking, accessibility deals with the easiness to reach *something*. This *something* might be the ultimate destination, but also to something that enables to perform the needed activities. In this sense, it is relevant also to define the accessibility *to* public transport – as a mean to do something else, in addition to the accessibility *with* public transport.

In this paper we aim at comparing European cities, under the lens of accessibility to public transport system. The comparison aims at pointing out how the mix of land-use and network structure makes more or less easy the access to the system.

The method used must respond to some conditions:

- Does not depend on zoning or statistical units, that may vary considerably across the sample;
- Does not require to model the network, and is in general easily reproducible;
- Works on openly accessible and homogeneous data;
- Uses the very same assumptions on all applications;
- Relates with the land-use.

We chose to develop and adapt a well-known method – the PTAL indicator, introduced and used by Transport for London (2015) – to calculate the accessibility *to* public transport for ten cities selected among 2nd tier ones. Cities are: Milan, Rome, Munich, Hamburg, Glasgow, Brussels, Barcelona, Wien, Prague, Zurich.

PTAL in its basic version associates to a point of interest – in our case a pixel of 100x100 metres – the distance to walk to any access point of the transport network (a station, a stop) and the frequency

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of all lines passing from each access point. The outcome is an "accessibility index" (AI) which is the highest if a POI is near to many stops and stops are served from many lines.

PTAL has some advantages: easy to compute and relatively data parsimonious, requiring just a description of stations and frequency of services, which is more and more common thanks to GTFS repositories. Moreover, it is independent from local data structures and this makes it perfectly transferrable. Easiness is however also a limit: the method does not require to know anything about the network, so the AI does not "know" where lines bring the potential passengers, nor the possibility to interchange among lines. For this reason, it is a measure of accessibility *to* public transport system.

We introduced two elements of novelty to the basic method, to better respond to our requirements:

1. The association to each POI (i.e. each pixel) of population allows to calculate the distribution of accessibility levels in a city (for example, which fraction of population has a PTAL level of 6) and ultimately compare cities.
2. The basic PTAL is "punishing" cities with mass transit and hierarchical networks. A diffused bus network with lines overlapping up to frequencies of few minutes, can apparently perform better than an excellent metro network with distant stops and frequencies of , say, 5 minutes. For this reason we modify the PTAL indicator by weighting with commercial speed of lines, in order to embed at least the performance of the lines and not consider a 5' bus identical to a 5' metro.

The methodology can be outlined as follows. Our main inputs are the GTFS files of a city, describing the geometry of stops, and the timetables. Timetables are elaborated by a procedure written in Python and a frequency per line is associated to all access points, having controlled for the calendar. Using the walkable OSM network, we compute the walking time to any of the stops of the city and mount together the indicator as indicated in PTAL guidelines. The outcome is a grid of pixels, each one with a level of accessibility. Every POI has also population, taken from Schiavina et al. (2022), which allows to elaborate the fraction of city population by PTAL level. The same procedure is repeated for the modified indicator, weighted by the commercial speed of each line.

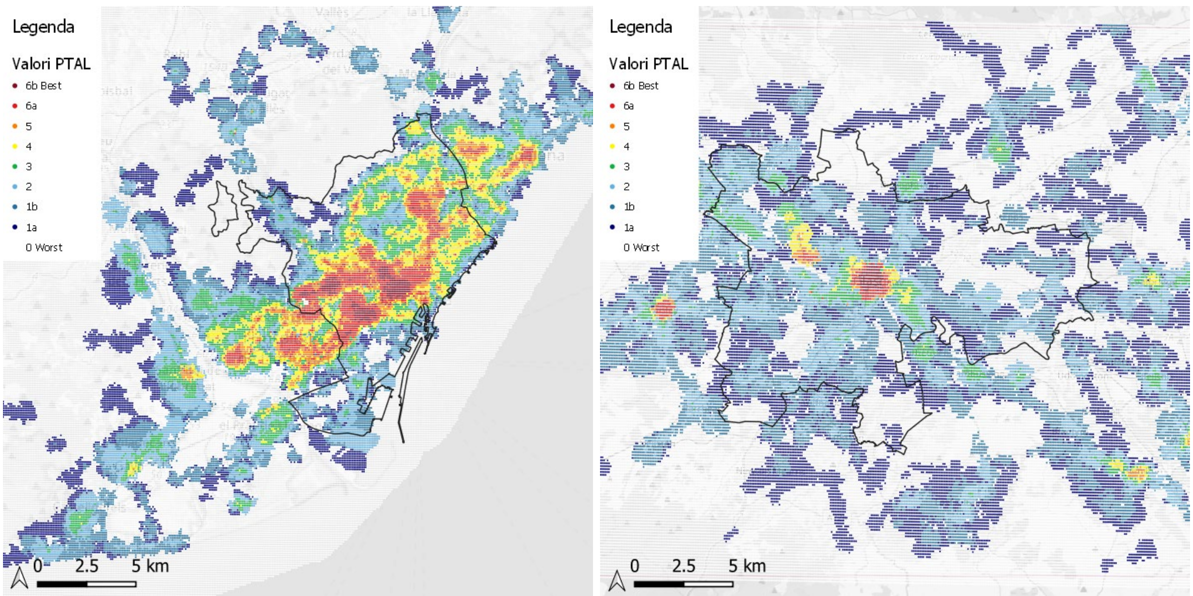

Figure 1. PTAL indicator for Barcelona (left) and Glasgow (right)

The procedure produces a map for each city, detailing the level of accessibility with the 100x100m precision. These representations are very useful to highlight spatial differences among cities, for example in terms of coverage of peripheries, extension of the high-accessibility cores, multi-core cities vs. single-core, existence of external hubs, etc. Figure 1 is an example of that.

Thanks to the information on population, it is possible to perform further interpretative elaborations. First of all, the share of population per AI score of each city is computed. In Figure 2 we can observe for example that some cities have part of their population (up to 14% in Glasgow) without any accessibility to public transport. Other – in particular Milan – offer a full coverage of municipal territory.

In general, the more the profile is right-skewed, the more a city is accessible. Also, the more a city has peaks, the more its accessibility is dishomogeneous.

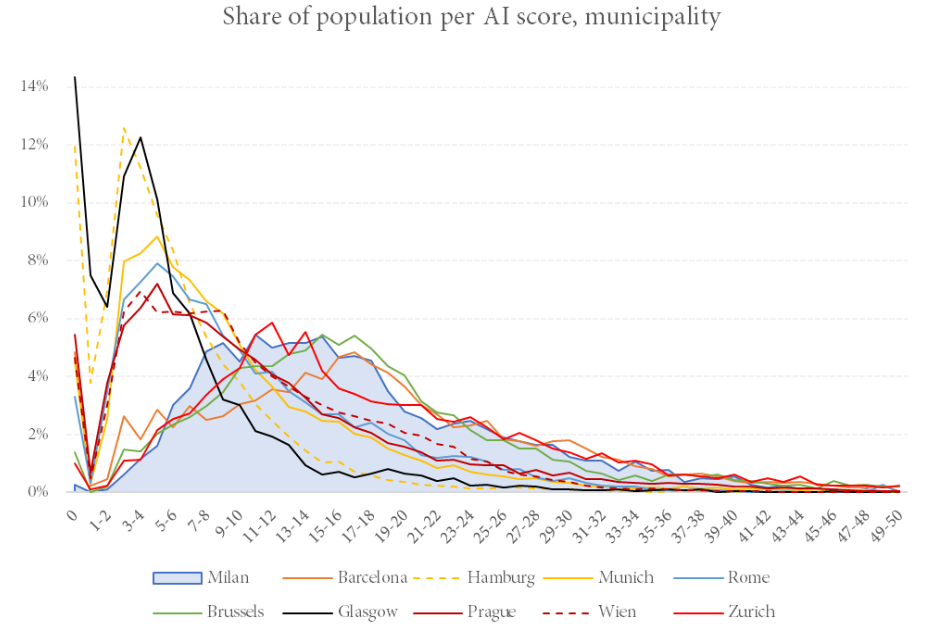

Figure 2. Comparison of share of population per AI score.

Policy implications of these results are also discussed, in particular thanks to the comparison of the "classical" PTAL and the one modified with speed. Accessibility to public transport is not less important than its functionality. Some cities may prefer a highly structured system, working at high commercial speed thanks to spaced stops and protected lanes (Zurich or Munich, for example), but for this reason lose in spatial distribution. This means that users trade access costs with network integration and performance. On the other hand, cities that – voluntarily or not – privilege the distribution and variety of stops and lines, but in turn lose in commercial speed. This is the case of Milan or Barcelona. The case of Glasgow is particularly interesting because points out the outcome of a regulatory approach based on direct competition in the market, that loses on both sides: few stops, concentration of supply on main corridors only and at the same time a total absence of hierarchy and integration. The outcome is pretty clear: most of the urban area has a very low PTAL score.

Parole Chiave: public transport; accessibility; PTAL; Europe.

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