Measuring the impact of accessibility to different types of bus, metro and train stations on the use of public transport in France

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S53-Accessibility and Inequality in the Context of Transport and Urban Form

Abstract:

Transport is the world's largest source of CO_2 emissions. In France, the transportation sector accounts for about one-third of CO2 emissions, 53% of which are attributable to passenger cars (Format Secten, Citepa, 2022). The car remains the dominant mode of transport for everyday journeys in general, and for commuting in particular. It accounts for 69% of commutes, compared with 15% for public transportation (INSEE, RP 2022). In response to climate challenges and other negative externalities, public policies are focused on expanding public transportation to reduce this dependence on cars, particularly by improving its accessibility and service coverage.

While the literature has extensively documented the determinants of public transportation use, most of this research has been conducted at the urban level. By utilizing INSEE's housing database at the national and IRIS levels, this paper aims to measure the combined effect of socioeconomic and spatial factors on public transit use in France. Particular attention is paid to accessibility and service coverage, distinguishing between different levels of service (subway, tram, BRT, and types of stations). To construct spatial variables, the housing database was supplemented with external data. Metro stations (threshold: within 500 m) and tram stations (threshold: within 300 m) were geolocated using OpenStreetMap relative to the centroid of each municipality. BRT lines (threshold of less than 200 m) use data from Cerema. Finally, we developed a typology of SNCF train stations using SNCF Open Data, based on their ridership and connections to the tram or metro.

Several models were successively applied: a logistic regression, two multilevel models, and then a within-between model.

Preliminary results show that the biggest barrier to public transit use is owning one or more vehicles, particularly in rural areas. Estimates from the multilevel model indicate that in dense urban areas, car ownership reduces the odds of public transit use by a factor of 5.2 (OR = 0.191), and household ownership of multiple vehicles reduces it by a factor of 10.3 (OR = 0.097). In rural areas, the effect of geographic isolation alone already reduces the likelihood of public transit use by a factor of 6.6 (OR = 0.152), but the combination of low density and owning two or more cars leads to a massive drop, reducing the likelihood by a factor of nearly 42 (net OR = 0.024).

Conversely, the presence of a subway system reduces car dependence, with a particularly marked benefit for those with lower levels of education. While subway ridership has increased by 42.1% among those with a master's degree or higher, it has risen by 107.3% among individuals with less than a high school diploma.

Furthermore, when other factors are held constant, women and those with higher levels of education are significantly more likely to use public transportation. However, this trend among women diminishes as population density decreases, particularly in rural areas. In densely populated urban areas, women are 84.2% more likely to use the service. This lead narrows to +51.0% in intermediate urban areas and drops to just +19.7% in rural areas.

The distance of the commute plays also a decisive role: the longer the commute (involving a change of municipality, department, or region), the greater the likelihood of using public transportation. Accessibility plays an important role in the use of public transport for work-related journeys, with varying effects depending on the different types of railway stations and transport stops:

- High-traffic, unconnected suburban stations: these stations are particularly effective to commutes within the department, where they provide a +55.6% bonus to public transit ridership. The effect is even stronger for intra-regional trips, where this type of station increases net ridership by +78.1%.

- Urban regional stations connected to a major network: These stations are highly effective for medium-distance travel within the department and for intraregional trips. For short distances within a municipality, they provide a +76.9% bonus. At the intermunicipal level within a department, the bonus reaches its maximum at +108.4%, and at the intraregional level, the bonus remains positive at +36.9%. However, they are less effective for very long-distance interregional trips. At the national level, usage is reduced by a factor of 2.1 (net OR = 3.315, compared to the distance-alone effect of 7.0).

- Small local stops: These are effective only for short-distance trips within the department. (+9.5% net increase for commutes within the department). Their very limited impact confirms that the mere geographic presence of a train stop in a less densely populated area is not really sufficient unless it is supported by a quality of service capable of competing with the immediate flexibility of a car.

The results highlight the need to improve access to public transport, including at stations serving inter-departmental and inter-regional connections where the train is a strong competitor to the car. The regional metropolitan transport service (SERM) projects in France are fully in line with this approach.

Key-words: Accessibility, Public Transport, Stations, Modal choice, commuting, France