

# Modelling effects of a new infrastructure on accessibility: does the new urban motorway favour the richest?

**Aurélie MERCIER\*, Yves CROZET, Nicolas OVTRACHT**  
**Transports Economic Laboratory - University of Lyon, CNRS**

\*Corresponding author: aurelie.mercier@let.ish-lyon.cnrs.fr

## Context and objective

The paper focuses on an accessibility modeling applied to the future Lyon metropolitan area in 2030. Various scenarios of transport policy are proposed in Lyon on the 2030 horizon. One option being explored is called “Sciences’ ring scenario”. More than road and public transport infrastructures already planned for this period, it integrates a new tolled road infrastructure named in French “anneau des sciences” (or “sciences’ ring”). This infrastructure is the western segment of the ring motorway, linking several scientific areas around Lyon. This 14.8 km tolled motorway will be used by car drivers and passengers but also by public transport users in light-rail lines or bus rapid transit systems (BRT). In the same, the capacity of the existing urban motorway (motorway A6/A7) crossing the famous “Fourvière channel” is cut by half. For the local authority (the Greater Lyon), also project manager, this “sciences’ ring” aims at:

- Shifting level of road traffic from city centre to peripheral areas;
- Increasing accessibility between the main living sites;
- Linking innovative and technological centers around Lyon;
- Developing economic activities in western areas.

In this context, the paper proposes to assess the effects of this planned project in terms of mobility management and land use planning. First it develops an analysis on accessibility measure comparing the “Sciences’ ring scenario” to the « business as usual » situation (i-e situation considering population and jobs levels and their location at an infra-municipal level for 2030 and including road and public transport infrastructures currently planned for this period). Then the paper explores the redistributive effects of such infrastructure analyzing correlation between accessibility gains and income level.

## Methodology

Accessibility is measured using a gravity-based formula (also classified as potential accessibility measure). This measure is based on the idea that the distribution of traffic between areas depends on the “attracting masses” of each area and the difficulties of connections between the centroids. The accessibility measure is expected to increase with the quantity of opportunities and to decline the farther the opportunities are from the origin. Gravity-based accessibility takes the following form:

$$A_i = \sum_j D_j e^{-\beta C_{ij}}$$

where  $A_i$  is accessibility from zone  $i$ ,  $D_j$  the opportunities available in zone  $j$ ,  $\beta$  a parameter reflecting the sensitivity to the generalized cost of travel, and  $C_{ij}$  the generalized cost of travel between areas  $i$  and  $j$ .

Traffic forecasts are developed using a four-step urban transportation modeling, applied on the evening peak period, between 05:00 and 06:00 PM. This slot is the most congested in week-days, with more than 210,000 car trips in the Lyon urban area. The model has been developed using the VISUM software, for the Lyon metropolitan area (perimeter 1999) divided in 777 Iris zones. It is one of the main components of the modeling platform MOSART developed in the Transport Economics Laboratory. The transport model is combined with a Geographical Information System and both are integrated in the modeling platform MOSART. Therefore it benefits from socio-economic and transportation systems databases. Indeed traffic modeling is built considering a road network composed by more than 90,000 nodes and 220,000 links. Infrastructures planned for 2030 are also considered using data from the Greater Lyon. Public transport is composed by all existing urban lines in 2012 (i-e 6 subway and funicular lines, 4 tram-lines, 143 bus lines) and mainly non-urban lines like regional rail lines. New public lines planed in 2030 (whatever the scenario) are also integrated under hypothesis given by the Greater Lyon.

Income data refers to an INSEE database for the year 2009. Three levels of income are used: average income per household, average income at individual level and average income per consumption unit (i-e assuming household consumption expenditures differ according to the person's age, INSEE the first adult counts for 1 UC; the other persons of 14 years old or older count for 0.5 UC; those under 14 years old count for 0.3 UC). More than the level of income, we are interested in the income distribution between zones. Therefore, because of the lack of available data, we assume a constant income distribution between zones for the years 2009 and 2030.

Correlation between accessibility variation and income is determined using standard and Pearson's Correlation Coefficients. These correlation coefficients are computed focusing on a sample of Iris zones with an accessibility increase higher than 5% with the tolled highway implementation.

## Results

The "Sciences' ring" implementation offers a positive access variation. At a metropolitan level, gain is estimated to 2%. No negative accessibility variation is observed. Zones that have been "winners" with the new infrastructure are mainly located on the west part of Lyon, or connected to the previous existing east ring. Note that feeder access road locations impact access variation. The more important is not to be closed to the new ring but to be connecting to it. These connected zones benefit from travel time gains to join jobs centres either located on the city of Lyon (inside the ring) either on peripheral areas (close to the ring). Due to the new ring, road users from the west part of Lyon can avoid the "Fourvière channel" and the A6/A7 axis to join southern and western areas. It is nevertheless interesting to note that travel time gains are not very high (less than 5 minutes for most of winner zones). Indeed the toll in the sciences' ring, level of toll is not always balanced by time gains and generalized costs can increase for road users in the "sciences' ring".

Pearson and standard analysis at the Iris level show a positive but very low correlation between accessibility increase and level of income. If the new highway improves accessibility in the west part of the Lyon metropolitan area, i-e the richest part of the area perimeter, at a detailed level (sub-municipal level) the most favored zones are not necessarily the richest.

**Key words:** accessibility, income, four-step modeling, correlation analysis, Lyon metropolitan area.