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MOBILITIES AND LONG TERM LOCATION CHOICES IN BELGIUM

"MOBLOC"

A. BAHRI, T. EGGERICKX, S. CARPENTIER, S. KLEIN, PH. GERBER
X. PAULY, F. WALLE, PH. TOINT, E. CORNELIS

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FINAL REPORT (PHASE 1)

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"MOBLOC"

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Promotors

Eric Cornelis & Philippe Toint
Facultés Universitaires Notre-Dame De La Paix (Fundp)
Groupe De Recherche Sur Les Transports (GRT)

Thierry Eggerickx
Université Catholique De Louvain (UCL)
Groupe D'étude De Démographie Appliquée (GéDAP)

Philippe Gerber
Centre D'Études De Populations, De Pauvreté Et De Politiques Socio-Economiques
CEPS/Instead (Luxembourg)
Géographie et Développement (GEODE)

Authors

Eric Cornelis, Xavier Pauly, Philippe Toint & Fabien Walle – FUNDP (GRT)
Amel Bahri & Thierry Eggerickx – UCL (GéDAP)
Samuel Carpentier, Philippe Gerber & Sylvain Klein – CEPS (GEODE)

BELGIAN SCIENCE POLICY

BELGIAN SCIENCE POLICY

Rue de la Science 8
Wetenschapsstraat 8
B-1000 Brussels
Belgium
Tel: +32 (0)2 238 34 11 – Fax: +32 (0)2 230 59 12
http://www.belspo.be

Contact person: Marie-Carmen Bex
+32 (0)2 238 34 81

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Abstract

Mobility and transport evolve with time and the passing generations. Interactions are numerous between daily mobility and household migration (house moving implying a municipality change). New residential choices induce at the same time new mobility behaviours, based on an extensive and probably excessive use of the private car in daily trips (home-work/school, shopping, leisure ...). The MOBLOC project aims at investigating the cycle linking long-term society evolution, residential choice, transportation demand and the resulting accessibility evolution. Final results consist in interacting models for residential migration and daily accessibility, Belgian population forecasts at municipality's level and a municipality based origin-destination matrix for work/school, with indication of the modal split for each destination. A fitting car accessibility model and a propensity to move model were designed in the first phase. The remaining models and their interactions will be proceeded in the second phase.

Since the MOBLOC project involves several models and interactions, we first describe the global applied methodology. Then, we present the technical aspects of each model. The project scheme is mainly composed by the residential migration models and the accessibility models. Further models are necessary to complete the full scheme.
The residential migration model describes the individual behaviour of migration. A migration here is defined as a change in the municipality of residence between two firsts of January. The span is thus annual and the observed migration "intercommunal" (from a given municipality to another one). Such a definition is imposed by the available data. This model predicts the municipality of each individual according to both socio-econo-demographic variables and municipal characteristics. It is actually split up into two sub-models: a propensity to move model and a localization model. The first one gives the probability to move for each individual while the subsequent one assigns a new residence municipality for people who migrated.
Then, the accessibility models use the aggregate results on a municipality base. There are two independent accessibility models, one for private car and one for public transport. Their outputs are travel times between each pair of municipalities, by car and by public transport. These allow the computing of municipal accessibility indicators to several opportunities. These indicators are in turn processed in the localization model, thereby modelling the loop and the interaction between the daily and the long term mobility.
Additional models are necessary: a gravity model estimates the commutes between each municipality pair, a modal split model isolates the travel demand by car. Evolution models should be designed in order to simulate several evolutions.

After the description of the global methodology, let us now focus on the technical side of each model.

The accessibility model computes travel times between two municipalities according to the mode (bi-polar accessibility). Two different modes are considered: car and public transport (without distinction between train, bus, tram or metro). The first achieved step is the choice of representative points for each Belgian municipality. Since the link should be done between the localization choice and the constraints of commuting

duration, computations rely on a municipal travel demand matrix for home/work purpose. Since it should be the most constraining part of the trip, the traffic is modelled during the morning peak hours.

The calculations of the public transport model should be carried out thanks to a unique database integrating timetables of every Belgian public transport operators. In this regard, the collaboration with SRWT (Société Régionale Wallonne des Transports) could be very helpful. The expected results consist in a matrix of the travel times for each municipalities pair.

In the car accessibility model, after the choice of a point to represent a municipality, a simplification of the road network is carried out. Since we work at the municipal level, we consider here motorways and level 1, 2 and 3 national roads. The connection of representative points to the network is performed when necessary by the mean of connectors. A heavy task, then, consists in checking road intersection on the network. Free flow speed and road capacity are set according to the type of the road and their lanes number. A traffic assignment using the Wardrop hypothesis is performed on the demand matrix afterwards. This demand matrix is derived from the O/D matrix of home/work – or school – journeys provided by the Socio-Economic Survey of 2001. The outputs of the traffic assignment are the travel times. Improvements of the current model could be tested in the future.
Since simulations will be proceeded to estimate accessibility over time, travel demand will have to evolve. This demand is updated by calculating new margins for the O/D matrix: one given by the localization model, the other by an estimation of the employment per municipality.
The flow between two municipalities is then determined through a gravity model reflecting interactions between two municipalities. This takes into account the "weights" of these municipalities and their distance. Parameters of the model can be estimated thanks to two matrices: the O/D one from the national census of 2001 and the matrix of Euclidian distances between the pairs of municipalities.

Regarding the residential migration model, the chosen technique for its first component, the propensity to move model (which try to predict whether an individual moves or not), is a binary logistic regression. It is calibrated with exhaustive individual data from the Socio-Economic Survey (2001) and the National Register which keeps track of everyone's municipality of residence in Belgium and of household evolution in term of structure or size. The output variable is the change (or not) in municipality between two first of January for an individual.

First of all, literature review and exploratory analysis helped us to pre-select variables (among available ones which could be incorporated into the model). Correlations between variables were also taken into account in order to avoid co-linearity problems between covariates. This, for example, led us to prefer the education level rather than the activity status, or to choose the housing tenure type among housing-related variables. Let us note that an important transformation task was carried out on the data in order to clean them and to adapt them: e.g. for interpretation convenience and to limit co-linearity, household variables such as households type and size were combined

in a composite variable. For the same reasons, the creation of transition variables (transformation between two static variables) was also helpful.
Choices of the covariates and data manipulation were also affected by constraints related to the project objectives:

- the objective of future simulation conducted us to prefer explanatory variables whose evolution is possible to achieve;
- the wish of taking into account the past (and to a lesser extent short-term future) of the individuals, since this extremely valuable information is available in the data led us to create transition variables.

After the pre-selection of the variables, the logistic regression model could be designed. Different models were tested. For each of them, the most significant of the pre-selected variables were kept, according to statistical tests. Further tests were also performed on the discrimination power of the models. These considerations led us to choose the simplest one. The main result for the propensity model (besides having a predictive model) is that four variables really stand out of the crowd according to their significance: the household evolution (simultaneous to the migration), the relation with the household head, the housing tenure type and the age class.

The propensity to move model was constructed and tested in the first phase of the MOBLOC project while the localization model remains to be completed in the second phase. Nevertheless, the following aspects of this model were yet discussed. First, the technique is more complex than the one used for the propensity to move model. Discrete choice methods will be used as they allow to deal with multiple alternatives and include explanatory variables related to both alternatives (municipalities) and deciders. The model structure has also already been addressed. Since the number of alternatives is important, hierarchical choice has been chosen (first, choice of potential alternatives, and then final choice) and different criteria considered in order to group the municipalities. These groupings have to be tested to keep the most valuable one for the residential localization modelling.
The input data globally consists in the same input data as for the propensity model, but also includes characteristics of the Belgian municipalities in order to measure their attractiveness. For this purpose, accessibility indicators such as the accessibility to job opportunities, schools or health care services should be built from the travel time matrices calculated by the accessibility models. Other factors which could influence the location choice (such as property price) could be added. The output variable is the new localization of each individual, in the best case at the municipality level.

Finally, since the ultimate objective of the MOBLOC project is to simulate projections, we plan to make evolve all the explanatory variables thanks to evolution models. Aggregate methods, such as demographic forecasts, would be useful, but we also consider disaggregated techniques as the residential migration model works at the individual level. Basic methods would first be operated, but could be refined afterwards. For instance, transition matrices could be computed in order to model household transition between two consecutive years; others variables such as activity status, level of education or the housing tenure type should be predicted thanks to simple regression according to other covariates.

As a conclusion, let us say that the global scheme of the MOBLOC project has been concretized since some bricks -propensity model, accessibility models methodologies- were developed. At the end of the second phase, we should not only have further models for the residential migration modelling and for accessibility, but also a measurement of the interactions between these elements, as well as tools to simulate evolutions of population or travel demand according to scenarios. Besides providing a better understanding of the studied behaviours, simulations could help authorities in their decisions in terms of land use or daily mobility policies.