A journey across scales, borders and data sources: minimum commute distance (MCD) analysis of home-to-work trips in Belgium

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1. Problem and research questions

Minimum commute distance (MCD) and excess rates are increasingly used to address the theoretical efficiency of a given territorial structure, both at the urban and regional scale (Bar *et. al.*, 2010, Frost *et. al.*, 1998, Ma & Banister, 2007, Niedzielski, 2006). It is based on an easy to understand metric, which compares observed displacements with the ones that could be achieved if an entire population would "optimize" its destinations so as to minimize the overall sum of travelled distances. Several algorithms have been proposed so far in order to compute this optimum. An advantage of MCD when compared to other indicators is that its calculation is rather straightforward. Most importantly, it is based on a limited set of input data sources, as it solely requires an OD and a distance matrix to be computed.

Given the lack of a recent census survey in Belgium, we propose to use Social Security (ONSS) Origin Destination data to analyse MCD at the Belgian scale. Social Security databases record the living and working places of the entire working population in Belgium. This type of administrative data source is likely to witness an increased interest for transport research in Belgium, since census data is not anymore collected since 2001 and is not expected to be collected in the nearby future. In addition, it is often considered that the 2001 census survey may no longer be an appropriate representation of home-to-work displacements. This is a first question that will be prospected within this article, considering mostly the spatial distribution of displacements.

It is further argued in the article that the national scale should remain being considered as a pertinent one in the context of home-to-work distances, given the large dependencies between the three Belgian regions with regard to the distribution of jobs and housing (Dujardin *et. al.*, 2012). Quite interestingly MCD may provide an interesting indicator of potential border effects on travel behaviour.

It should finally be stressed that at present Social Security data in Belgium is not available at a more precise level than the level of municipalities. Still this scale is not necessarily the most adequate one for analysing travel behaviour, given the size of municipalities and, most importantly their internal disparities. As the impact of the scale of analysis on MCD results could not be prospected through Social Security sources, we propose to address this issue via 2001 census data, on a theoretical plan at least.

2. **Methodology and research strategy**

The methodology is based on Boussauw's algorithm (2011) to compute MCD, using two sets of data, the first one related to census surveys of 1991 and 2001, and the other one using an OD matrix provided by ONSS services.

The research addresses the respective effects of scale, border and data sources upon the observed results, considering that the Social Security matrix is partly biased by the fact it does

not record independent workers, nor workers who are working abroad (depending on other social security services). Furthermore, the attribution of a single municipality for each job is subject to caution since information about employment may not be available at the fine grain of enterprise sites but aggregated at the scale of the entire company (which is a problem for multi-site companies) – the connection between jobs and destinations is then based on estimates.

3. **Major findings**

The analysis confirms the results of Boussauw for Flanders. The minimum commute at the origin in Brussels and important cities (Antwerp, Gent and Liege) is significantly lower than periurban and especially rural areas. In the case of Brussels, it is the entire area from Brussels to Antwerp, where a majority of jobs are located at the national level, that is characterized by a low minimum commute distance at the origin. By contrast, the area located at 20-40 km from the centre of Brussels forms a ring with high minimum commute distances. This situation tends to worsen between 2001 and 2010. The polarizing nature of Brussels largely transcends regional borders.

By contrast, the effect of the linguistic border is clearly revealed by the excess rate maps, especially in municipalities located closed to important urban areas located on the other side of the regional border. Besides this it further stresses the role of urban areas as well as municipalities located near to important infrastructures (motorway and train stations) as major "exporters" in the daily commute. This is especially the case when one compares the results of 2001 and 2010.

Finally, results at the old municipality scale highlights a much higher diversity of patterns, especially in the rural areas, where very performing places, with a low excess rate, are directly adjacent to performing ones. At the Belgian level, the difference between Flanders and Wallonia appears clearly through the MCD maps, at the exception of some sub-regions of Flanders (Limburg for instance).

4. Take away

The previous observations should still be considered with caution, especially when one compares results issued from two different data sets, characterized by their own limitations. On the first hand, an important border effect is neglected in the model due to the absence of data about home-to-work trips between Belgium and Luxembourg in both models even though these have witnessed a significant increase over the last years (and notably during the last 10 years). The definition

Besides, the internal limitations of the Social Security OD matrix should also be acknowledged. Most importantly there is a significant uncertainty regarding the work location of employees working in multi-site companies. This will progressively be addressed through stricter requirements and penalties for those companies that do not provide accurate figures at the site level. It may then be possible to organize a monitoring of home-to-work trips on a shorter time frame than the usual decennial census period.

5. Keywords : minimum commute distance, administrative data sources, border effects

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