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Trends in regional jobs-housing proximity based on the minimum commute: The case of Belgium

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ABSTRACT

This paper investigates recent trends in the efficiency of the Belgian territorial structure in terms of commuting, at both the urban and regional scales. The minimum commute distance (MCD) and excess rate (ER) are used to compare observed home-to-work trip lengths with an "optimal" alternative commuter pattern in which the sum of the distance traveled by the working population is minimized. The MCD is a proximity indicator that measures the spatial match between the labor market and the housing stock, which can also be regarded as an interesting indicator of potential border effects on travel behavior, especially in the inter-regional context of Belgium. An MCD calculation requires an origin–destination (OD) matrix and a distance matrix. In our Belgian case study, we employ a recent OD matrix (2010) originating from Social Security (ONSS) data. We compare this matrix with data from the 2001 and 1991 census surveys. In addition to identifying trends in jobs-housing proximity, the article assesses methodological implications regarding geographical scale arising from the use of the two data sources mentioned. Based on the available data, it was found that average actual commuting distance increased over both periods studied, while in general, growth rates of MCD are considerably lower than growth rates of the actual commuting distance. This indicates that the spatial proximity between the labor market and the housing stock in Belgium has declined over all periods studied, although this loss of spatial proximity only explains a small part of the increase of the actual commuting distance. Furthermore, we found that the comparison of excess commuting metrics between regions and time periods sets high standards on data requirements, in which uniformity in data collection and spatial level of aggregation is of great importance. Finally, as the main contribution of this study, the results demonstrate, through a statistical approach, that municipalities that are experiencing a higher-than-average increase in MCD and ER in one of the considered time frames are more likely to continue to exhibit a higher-than-average increase in the subsequent period. Therefore, the observed trends appear to be consistent over time.

1. Introduction

In the 1970s, most industrial countries experienced a general energy crisis, involving petroleum shortages and high oil prices. In response to this crisis, governments all over the world recognized the necessity of developing a strong policy with the aim of greater independence from oil and increased energy efficiency. Consequently, in the early 1990s, further increases in energy prices and more pronounced concerns about livability, sustainability and climate protection forced authorities to take energy issues at both local and global scales into serious consideration (Blanco et al., 2009). In this context, Hamilton highlighted the necessity of understanding urban commuting efficiency by introducing the concept of excess or wasteful commuting (Hamilton and Röell, 1982). This excess was defined as the difference between the actual mean commute and the theoretical minimized mean commute based on the spatial structure of the considered city (Hamilton and Röell, 1982). This measure is an interesting indicator of how urban spatial structure may influence travel distances for commuting and the associated levels of fuel consumption.

As outlined by Boussauw et al. (2011), several reports related to transportation policy and mobility management have emphasized the importance of spatial planning as a key area of policy, which has the potential to improve the sustainability and efficiency of mobility patterns. Indeed, the territorial structure of a region, which constrains the interactions between morphological elements and activities, is regarded as an important factor in explaining travel patterns

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(e.g., patterns resulting from commuting behavior) (Dujardin et al., 2012; Giuliano and Small, 1993; Van Acker et al., 2007). Various studies have revealed that commuting distances have been continuously increasing, especially in European and North American metropolitan areas, mainly driven by households' aspirations to combine the challenge of dual careers with a pleasant residential environment (Aguilera, 2005; Banister et al., 1997; Sandow and Westin, 2010; Sharma and Chandrasekhar, 2014). In contrast to these increasing travel distances, travel times have remained relatively constant because of the urge to employ ever faster means of transport (Ma and Banister, 2006a). Boussauw et al. (2011) argued the importance of distinguishing between the main reasons for expanding commute patterns, such as land-use policies and general growth in prosperity, and other factors such as congestion levels, the quality of the transportation network, and the market price of fuel. In this regard, the concept of excess commuting might help to better understand mechanisms underlying trends in commuting distance.

Originally, excess commuting analyses were applied to monocentric urban models (Hamilton and Röell, 1982), after which concerns were raised about the implications with respect to actual metropolitan urban structures and about the applicability of the traditional urban economics model to modern metropolitan areas (Ma and Banister, 2006a). In this context, White (1988) re-examined the principle of cost minimization by considering the minimized excess commute from a "transportation problem" perspective. Following White's work, no equivalent to the "transportation problem"-based approach arose until recent years. Over the past two decades, the main issues addressed have been related to explaining the underlying reasons for excess commuting (Aguilera, 2005; Banister et al., 1997; Rouwendal, 1999; Sandow and Westin, 2010; Sharma and Chandrasekhar, 2014), estimations of regional variations in jobs-housing proximity and the associated excess commuting (Boussauw et al., 2011; Frost et al., 1998; Lee, 2012; Rodriguez, 2004), and detailed assessments of jobs-housing imbalances (Jiangping et al., 2014; Loo and Chow, 2011; Suzuki and Lee, 2012; Wang and Chai, 2009; Zhao et al., 2011; Zhou et al., 2012).

From a methodological perspective, Boussauw et al. (2011) proposed an extension to the work of Niedzielski (2006) and Yang and Ferreira (2008). Two indicators were proposed to characterize spatially homogeneous non-monocentric entities, i.e., the minimum commuting distance and excess commuting. Boussauw et al. (2011) used these indicators as metrics for spatial proximity, considering physical distance instead of time distance because of their focus on environmental concerns and fuel dependency. Furthermore, they assumed the existence of important regional variations in minimum commuting distances and excess commuting, for which connections with spatial characteristics (e.g., density, functional mix and proximity to major transportation infrastructures) can be established.

In the current study, we assess the indicators of the minimum commute distance (MCD) and the excess rate (ER) in order to study the efficiency of the Belgian territorial structure in terms of commuting, at both urban and regional scales. This approach allows a comparison of observed trip lengths with the lengths of trips in an "optimal" alternative overall travel pattern in which the sum of the distances traveled by the working population is minimized. The trip length after minimization is represented by the MCD, whereas the ER is the ratio between the MCD and the observed trip length of the actual commute.

This paper contributes to the state of the art in this field of research in several respects. First, it extends the geographical scope of previous research efforts such as that of Boussauw et al. (2011) to cover all regions of Belgium, enabling an intraregional comparison. Second, this study verifies whether conclusions with respect to commuting behavior are consistent across different types of data sources. In particular, ESE 1991 and 2001 data and ONSS 2010 data are used in this study, whereas previous research such as that of Boussauw et al. (2011) has focused on regional travel surveys. Third, this paper assesses the temporal continuity of the evolution of the minimum commute across different regions of Belgium (Flanders, Brussels, and Wallonia) by investigating the trends of the MCD and ER indicators. Fourth, the paper contributes to the existing literature by critically assessing spatial-scale effects on the level of accuracy with which the MCD and ER can be measured. Furthermore, we argue that despite differences in regional policies and economies, the national scale of Belgium should be considered paramount in the context of home-to-work distances, given the large interdependency between the three regions with regard to the distributions of jobs and housing (Dujardin et al., 2012). Interestingly, the MCD appears useful as an indicator of potential border effects on travel behavior, especially between Luxembourg and Belgium.

Although excess commuting was presented earlier as a standardized way of describing urban structures, we yet want to present our research explicitly as a regional case study, about which we do not necessarily argue that the results are generalizable. The reasons therefore are partly of geographical nature (two-thirds of Belgium consist of a particular polycentric urban network, the functioning of which is strongly affected by language border effects) (van Meeteren et al., 2016), and otherwise of methodological nature (available data is usually aggregated within administrative boundaries, which makes comparison with other cases difficult). Following Flyvbjerg (2006), we argue that despite the possibly non-generalizable results of our research, this case study certainly contributes to a better understanding of the functioning of polycentric, networked, urban systems.

Our research hypotheses are formulated as follows:

1. The average actual commuting distance in Belgium is growing continuously, while the rate of growth is slowing down over the last study period, as compared to the previous periods. At the one hand, this hypothesis is fuelled by the known general trend of growth of personal mobility, while at the other hand the "peak car" phenomenon that was found in several western countries is at stake (Goodwin, 2012).
2. The growth of the actual commuting distance is partly attributable to a decrease of spatial proximity between the housing market and the labor market, measured by means of the calculated minimum commuting distance (MCD), and by non-spatial developments such as an increasing degree of specialization of the labor market and a general increase in wealth, which has an impact on the housing preferences of consumers. Regional trends in spatial proximity loss (or gain) and commuting efficiency are consistent over time.
3. Collection of data that is consistent over time and therefore mutually comparable is of great importance to be able to quantify phenomena such as those described in hypothesis no.2.
4. Due to methodological problems, such as the modifiable areal unit problem (MAUP), and assumptions with respect to intrazonal trips, both the actual and the minimum commuting distance do not necessarily have an absolute meaning, and may even be in appropriate to compare areas. By contrast, these metrics do prove meaningful for analyzing trends over time.

In order to address the research hypotheses as defined above, the paper is structured as follows. First, a concise literature review on excess commuting and jobs-housing balance is presented in Section 2. Section 3 describes the Social Security data (ONSS: Office National de Sécurité Sociale) and the 2001 Census data used in this study and is followed by a discussion of the methodology in Section 4. Subsequently, the main research results are reported