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**Post-suburban transformation in the
functional urban region of Budapest in the
context of changing commuting patterns**

Summary of the PhD Thesis

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1. Introduction

Commuting is essentially a link between home and the place of employment or schooling. Since commuting patterns are closely linked to urban structure through the location of homes, workplaces and schools, the transformation of the urban structure and its potential influence on commuting has been in the forefront of geographic research for the past decades (Clark & Kuijpers-Linde, 1994; Schwanen, Dieleman & Dijst, 2001; Sultana, 2002; Dieleman, Dijst & Burghouwt, 2002; Sohn, 2005; Næss, 2007). As a consequence of the post-Fordist transformation of the economy the spatial distribution of production sites and labour markets have been restructuring since the 1980s resulting in the decentralisation of employment in urban regions, i.e. the suburbanisation of jobs. This form of suburbanisation promotes the development of a polycentric urban structure with the emergence of new suburban multifunctional centres far from the city centre. This process has been distinguished from the classic phase of suburbanisation that creates typical dormitory towns by the term *post-suburbanisation* (Kling, Olin & Poster, 1995). The relocation of jobs to suburban areas have changed commuting patterns increasing the significance of *reverse commuting* from the central city to the suburbs and *cross-commuting* within suburban areas.

In the metropolitan areas of Central and Eastern Europe (CEE), intensive suburbanisation was delayed under state socialism (Enyedi, 2012). After the economic and social changes in the 1990s, residential and employment suburbanisation became two of the most important transformations that are reshaping the urban structure of CEE metropolises. There is an ongoing debate over how unique the urban restructuring of cities in post-socialist countries is. One group of researchers argue that the urban structure created by post-communist legacy and post-modern global forces can be understood as a unique 'post-socialist city' (Harloe, 1996; Ladányi & Szelényi, 1997; Nuissl & Rink, 2005; Sýkora, 2009; Gentile, Tammaru & van Kempen, 2012; Sýkora & Bouzarovski, 2012). Others claim that the processes in CEE countries are fundamentally similar to those in Western-Europe (Enyedi, 1995; Timár, 1999, 2010; Timár & Váradi, 2001).

While research on gentrification and residential suburbanisation, for example, has been fairly extensive in CEE countries, knowledge is still very limited on post-suburbanisation (see *inter alia* Hirt, 2007; Sýkora & Ourednek, 2007; Hirt, 2008; Golubchikov & Phelps, 2011). It is debated

whether post-suburban development – if detectable at all – has created unique urban forms and processes. Even less is known about the change of commuting patterns in the context of post-suburbanisation in these regions (Tammaru, 2005).

Research on commuters to work has been fairly extensive (Kapitány & Lakatos, 1993; Szabó, 1998; Kapitány & Lakatos, 2005a, 2005b; Némethné Csehi, 2008; Lakatos & Váradi, 2009). We know, however, relatively less about how the mobility of social groups other than employees is affected by urban change. Children's daily journey to school, for example, is the third most important travel purpose within the population after travelling to work and shopping (KSH, 2010). Previous research on students' daily travel is, however, limited in number and scope. The relationship between the transformation of urban structure and commuting to school has not been addressed in the context of cities in post-socialist countries.

Considering the diverse consequences of commuting, investigating and understanding the changes in commuting patterns could provide input for further research and planning in the fields of environmental studies, transport, sociology, health and economics.

2. Research objectives

The aim of this research is to explore post-suburbanisation in the context of changing commuting patterns using the functional urban region (FUR) of Budapest as the study area. This research also highlights the potential consequences of changes in commuting patterns.

The main question of the thesis is *to what extent is post-suburbanisation in the Budapest functional urban region different compared to western countries with respect to changing commuting patterns*. In order to answer the main question the following sub-questions were formulated:

- A. *Can the signs of post-suburban transformation be detected in the FUR of Budapest that can justify a more detailed study?*
- B. *Is post-suburban restructuring reflected in the changes in commuting patterns in the Budapest functional urban region?*
- C. *How do the commuting patterns of primary and secondary school students differ from commuters to work in relation to the urban structure?*

- D. To what extent are commuting patterns influenced by the socio-economic characteristics of commuters?*
- E. How are the attributes of commuting trips (travel mode, commuting distance and time) influenced by commuting patterns?*

3. Research methods and study area

A two-stage research design was applied during this research. In the first, exploratory stage, results of previous research were critically reviewed and compared. On the one hand, this stage contributed to the definition of the fundamental concepts of the study (commuting, functional urban region and suburbanisation). On the other hand, it supported the identification of the indicators of post-suburban development in general and in Budapest, in particular. The literature review also contributed to the construction of the conceptual framework of empirical methods.

As a lack of quantitative analysis on post-suburbanisation and commuting was identified in the post-socialist context this research used a number of quantitative data analysis methods and a variety of data sources. A multi-level approach was applied using aggregate (regional, metropolitan, and municipality and disaggregate (household and individual level) data in order to capture variations in travel behaviour influenced by factors at different geographical scales.

At the aggregate level, data pertaining to population, number of jobs and commuting dynamics were used from the national Censuses (1980, 1990, 2001). Census data was supplemented by aggregate commuting data from the 2005 Microcensus and employment statistics from the yearly labour market surveys (1992-2010). The intensity of commuting to school in the functional urban area was estimated by analysing data about the number of students attending and commuting to primary (2006-2010) and secondary schools (1990-2010) at municipality level.

At the disaggregate level, data from two previous representative household surveys was used in this research. The household travel survey carried out in Budapest (2004) provided data about weekday travel of employees from 30,258 households in Budapest to assess reverse commuting. The travel survey which was organised in the area of the Budapest Transport Association (BKSZ) (2007) was carried out in 9,000 households in 50 municipalities. Data from the survey was used to analyse traditional and cross-commuting in the functional urban area including individual and

household level socio-economic characteristics of commuters and attributes of commuting trips (travel mode, distance, duration and time) as independent variables.

Aggregate statistics were analysed by using descriptive methods (proportions, means, median) and the Pearson product-moment correlation coefficient to measure the strength of linear dependence between two variables. GIS maps were also produced as a tool for analysis of spatial distribution and regional differences. In order to analyse commuting data I proposed a composite commuting index which was calculated based on the following formula:

$$CCI = \frac{OC}{LE} - \frac{IC}{LJ}$$

where CCI: composite commuting index; OC: number of out-commuters; LE: number of employees living in the municipality; IC: number of in-commuters; LJ: number of jobs in the municipality (Fig. 1.).

I also calculated the exchange commuting index for municipalities in Pest County for 2001 based on Burger et al. (2011) as the proportion of in-commuters from Budapest and out-commuters to Budapest.

For the analysis of the household surveys a combination of descriptive statistics (contingency tables, means, frequencies, median) and inferential statistics (chi-square test for independence) were applied to test the significance of the relationship between variables with a level of confidence of 0.05. Cramer's V statistic was used to estimate the strength of the association.

In order to explore any potential links between suburbanisation and commuting to school a method for the calculation of the index of residential suburbanisation was proposed based partly on Bajmócy (2003; 2006). It accounts for the definition of suburbanisation as a deconcentration process by using only measures that reflect change over a certain period (1995-2010) (change in population; migration balance, change of housing stock; change of total yearly domestic income per resident). My definition of suburbanisation is limited to the decentralisation of higher status population for the purposes of empirical research.

The study area was defined as the functional urban area (FUR) of Budapest. It was delimited according to the widely used principle of labour market areas (van den Berg, 1982). All municipalities from where at least 15% of resident employees commuted to Budapest in 2001 were included in the area of the FUR.

4. Research findings

The findings of the research are presented in a structure that follows the research sub questions:

A: Can the signs of post-suburban transformation be detected in the FUR of Budapest that can justify a more detailed study?

A1: In the first phase of the research, the critical analysis of research literature revealed that post-suburbanisation had been identified as a major trend of urban transformation in the USA and Western-Europe. Limited research exists for metropolitan areas of CEE countries and in particular for Budapest. A non-exhaustive catalogue of the most important post-suburban forms and processes has been proposed, which has been used to identify post-suburban patterns in Budapest. This research has found evidence for post-suburban development in the functional urban area of Budapest. It is indicated by the following urban forms and processes: the emergence of new suburban employment centres (growth poles) in the western, and northern agglomeration of Budapest (Burdack, Kovács & Dövényi, 2004); the emergence of a polycentric urban fabric with the edge-city like development in Budaörs-Törökbálint (Izsák, 2001); company headquarters relocating to suburban locations; services dominating new business development in the suburbs (Kovács, Sági & Dövényi, 2001); the emergence of suburban entertainment centres and accommodation facilities as well as gated communities (Hegedűs, 2011); and the construction of a postmodern artificial edge-city (*Tópark*).

A2: It was also revealed that job growth in the suburban areas had surpassed the rise of employment in Budapest after 2000. Between 2005 and 2010, for example, the number of employees working in Budapest decreased by 23,643, while during the same period the figure increased by 12.279 in Pest County.

A3: There was a significant increase in service employment. A significant increase in tertiary employment as well as in the number of white-collar employees has been detected around Budapest. While this could be considered as a post-suburban development pattern, the analysis of job growth by economic sectors has shown that the predominance of Budapest in the financial, research and development, business services sectors has been decreasing only very slowly. The structure of employment growth bears a

resemblance to the early phases of the suburbanisation of jobs in the USA and Western Europe when manufacturing, wholesale and retail trade were the primary targets of employment growth. The emergence of the quaternary and quinary sectors has been sporadic.

B: Do changes in commuting patterns support the existence of post-suburbanisation in the Budapest FUR?

B1: The increasing proportion of cross- and reverse commuting is an indication of a polycentric development, which is one of the major features of post-suburbanisation. The results of the analysis of aggregate data suggest that while commuting in general stagnated in the FUR between 1990 and 2001, a significant reconfiguration of commuting destinations took place. While traditional sub-centres (e.g. Vác, Dunakeszi, Szentendre) lost their significance, the new economic poles around Budapest became the main destinations for cross- and reverse commuting (e.g. Budaörs, Törökbálint, Érd, Dunaharaszti, Fót, Vecsés). It has been demonstrated by comparing the composite commuting index for 1990 and 2001 (Fig. 1).

B2: A statistically significant strong correlation has been found between the proportion of reverse-commuters and average travel time by car from Budapest ($r = 0.52$, $p < 0.001$ N=167). Municipalities which have a better accessibility from Budapest attract a higher proportion of reverse-commuters.

B3: The analysis of aggregate commuting data has shown that both cross-commuting and reverse commuting increased between 2001 and 2005, most probably because of accelerated job growth in Pest County. I consider the fact that the new economic nodes restructured commuting patterns and attract a high proportion of cross- and reverse commuters as an additional evidence of post-suburban development. Hence it can be expected that further economic development in the suburban zone would contribute to transforming the monocentric urban structure, create new centres of a polycentric region and increase cross- and reverse commuting to these centres.

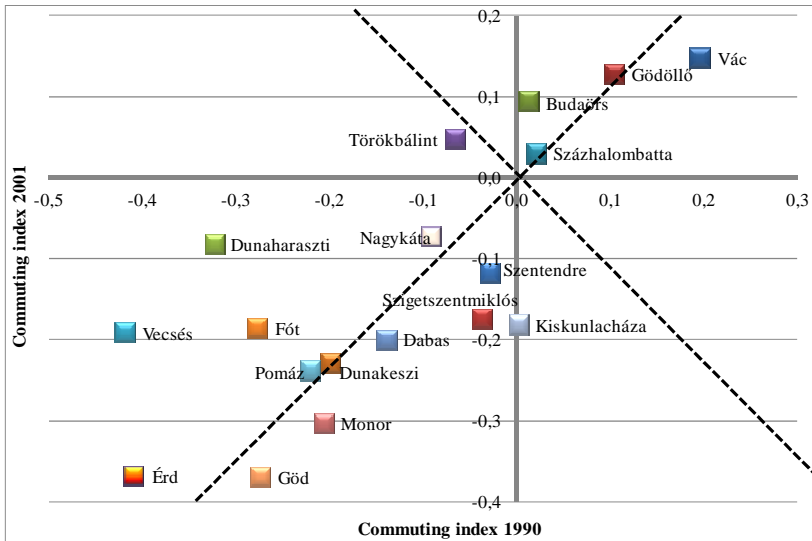


Fig. 1

Changes in the composite commuting index between 1990 and 2001 in selected municipalities in the Budapest FUR

(Source: Own calculation and elaboration based on HCSO Census data 1990, 2001)

B4: Exchange commuting occurs when residents of a suburb commute to the core city, while people living in the core city commute to the suburb exchanging workforce. I detected exchange commuting between the town of Budaörs and Budapest, where the number of reverse commuters was roughly identical to the number of traditional commuters to Budapest already in 2001 (exchange commuting index: 0,5). Considering the high proportion of reverse commuters, it can be expected for additional economic poles (e.g. Törökbálint, Budakalász, Dunaharaszti, Gödöllő, Fót) to develop exchange commuting as well. This phenomenon has been considered as a further indicator of post-suburbanisation.

C: How do the commuting patterns of primary and secondary school students differ from commuters to work in relation to the urban structure?

C1: The results suggest a major difference between the influencing factors of commuting to work and school. Commuting patterns to work are

determined by the location of home and work. Both can be relatively easily and flexibly changed. In case of students, the destination of commuting may be limited by the distribution and accessibility of schools, school profiles, the level of school and also by perceived or real differences in attractiveness (teaching quality and infrastructure). While the location of homes and jobs changes dynamically through urban restructuring, the school system is constrained by state and municipal policies and budgetary constraints. Therefore school provision may be accommodated to changes in urban structure, population and demand only with a delay. My analysis showed that there is an imbalance between the demand and supply of secondary education in the Budapest FUR and it led to increased commuting of students within the FUR. In 2010, 20.5% of the primary-school-age and 40.7% of the secondary-school-age population of the functional urban area including Budapest commuted to another municipality.

C2: My results suggest that residential suburbanisation may influence the above-mentioned balance of demand and supply. I found a moderately strong correlation between the suburbanisation index and the proportion of out-commuters ($r=0.41$; $p<0.001$; $N=167$). Suburbanisation may shift demand for primary and secondary education from Budapest to its suburban zone by increasing the size of the school-age population. As a consequence, commuting to both primary and secondary school has intensified.

C3: The analysis of commuting patterns of employees indicated that the monocentric structure of the FUR may shift towards a polycentric fabric. In contrast, secondary school commuting remained highly monocentric despite the fact that the secondary school offer expanded in the FUR. Between 1990 and 2010, a threefold increase occurred in the number of secondary school commuters to Budapest while the number of students also tripled in the FUR without Budapest.

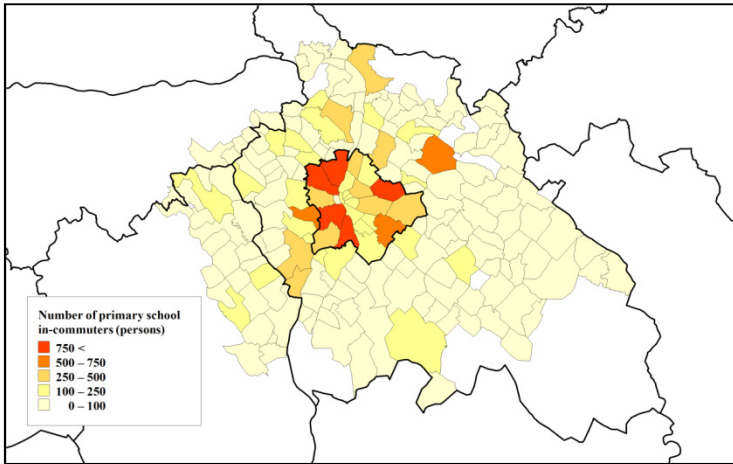


Fig. 2

The number of primary school in-commuters in the municipalities of the FUR in 2007

(Source: Own elaboration based on HCSO data)

D: To what extent are commuting patterns influenced by the socio-economic characteristics of commuters?

D1: Post-suburbanisation in Western-Europe is usually characterised by an increasing socio-economic status of cross- and reverse commuters. My data analysis demonstrated that there is a statistically significant, moderately strong association between the commuting pattern (traditional, cross- and reverse commuters) as dependent variable and educational attainment ($\chi^2(12)=199.383$; $V= 0.145$; $p <0.001$ $N=3140$) and household income ($\chi^2(12)=427.488$; $V= 0.244$; $p <0.001$ $N=2389$) as independent variables. While in Western-Europe and in the USA cross-commuters are characterised by high level of educational attainment and income, this was, however, not confirmed in Budapest. Cross-commuters have the lowest educational attainment.

D2: The majority of suburban residents with higher social status – indicated by high net household income and/or a degree from higher education – still commute to Budapest. At the same time, the educational and income level of reverse commuters were found to be almost as high as those of commuters to the core city. Cross-commuters are characterised by the

lowest income and educational attainment of all commuter groups, and the lowest proportion of jobs in the services. This may indicate that a high proportion of residents with higher status in suburban communities cannot find jobs in the suburbs and commute to the core city.

D3: It is remarkable that reverse commuters had the highest qualification among commuters in 2001. It indicates that some of the suburban jobs requiring highly qualified workforce are taken by residents of Budapest. Nevertheless as the number of reverse commuters in 2001 was only about one third of commuters to Budapest, no significant daily exchange of workforce occurs.

D4: As regards commuting to school, a statistically significant, moderately strong association has been found between the socio-economic status of parents and the likelihood of children commuting to another municipality. Both net household income and the educational attainment of parents, and especially that of the father were found to be associated with the propensity to commute to another municipality.

E: How are the attributes of commuting trips (travel mode, commuting distance and time) influenced by commuting patterns?

E1: My results suggest that cross- and reverse commuters are more likely to use a car to go to work than commuters to Budapest. A possible explanation with reference to the structure of the public transport network and level of services was offered. As fast and frequent public transport, and especially rail transport is provided in the main corridors from the suburbs to the city centre, it is a feasible option for traditional commuters. On the other hand, however, transversal connections within the suburban area are missing or are served by infrequent bus services, which renders cross-commuting without a car unfeasible in many cases. I demonstrated the difference between the quality of public transport services for intra-suburban trips by calculating the theoretical travel speed. The average speed of journeys by public transport (15.7 km/h) is much lower than that of journeys by car (23.6 km/h). The advantage of the car in traditional commuting (25.5 km/h), however, was small compared to public transport (21.2 km/h), most probably due to the fast rail-bound connections to the city centre providing a competitive alternative to the car as well as congested roads.

E2: The average travel time of cross-commuters is 35 minutes, their travel distance is 12.7 km, about half of commuters to Budapest (62 minutes;

25.6 km). These results indicate that cross-commuters find jobs much closer to their homes than traditional commuters as it was also indicated by previous findings in Western Europe.

E3: Age was found to be associated with mode choice of students. Students primarily use public transport, but a high proportion of primary school pupils are driven to school (19%) especially in younger age groups. A statistically significant, strong association has been found between travel mode and the age of students ($\chi^2(3)=122.783$; $V= 0.453$; $p<0.001$ $N=1069$). Secondary school students are driven to school to a significantly less extent, especially compared to very young children (ages 6-10). In addition, a statistically significant, strong association has been found between mode choice and household income ($\chi^2(6)= 387.307$; $V= 0.509$; $p <0.001$ $N=747$). Children living in families with lower income are less likely to travel to school by car.

E4: Commuting distance and time of secondary school students are significantly higher than those of primary school pupils. It was confirmed that primary school pupils typically commute to neighbouring settlements, while the main destination of secondary school students is Budapest and larger towns with secondary education.

F: The main question of the research: to what extent is post-suburbanisation in the Budapest functional urban region different compared to western countries with respect to changing commuting patterns.

The answer to the main question of the research was constructed based on the answers to the sub-questions above. In different stages of this research, results were compared to previous findings from Western-Europe in order to find out if there are any unique features of urban transformation and especially commuting in the post-socialist context. The objective was to contribute to the debate over the existence of a unique post-socialist development path.

F1: The results of the analysis of migration and labour market data over a period of the past 20 years revealed that residential suburbanisation reached its peak at the end of the 1990s, but continued after 2000, too. Concurrently, after 2000, the suburbanisation of jobs increased, hence residential and employment suburbanisation have been occurring concurrently since 2000. This can be understood as an overlap of the two phases of suburbanisation and provides further evidence for the stages of urban development

overlapping in post-socialist countries (Hirt, 2006). It is, however, still uncertain whether the recent setback of residential suburbanisation and stagnation of employment suburbanisation due to the current economic crises are only temporary.

F2: Urban transformation has been found to be similar to Western countries with respect to the increasing significance of cross- and reverse commuting. The magnitude of these changes, however, is still fairly small compared to Western metropolises. Another similarity is the propensity of cross-commuters to travel by car. The lack of adequate public transport connections is the main reason for this. The length and duration of cross-commuting trips have also been found smaller than the attributes of traditional commuting both in Budapest and in Western metropolises

F3: Some differences have also been discovered. The educational attainment of cross-commuters, for example, differs significantly from Western results. In Budapest cross-commuters have the lowest level of education while in Western countries high-status suburban residents often commute to suburban jobs. The difference may be explained by the fact that Budapest is still in the early phase of employment suburbanisation when the majority of the jobs in the suburban zone require lower-qualified workforce. The educational status of reverse commuters from Budapest has also been found to be relatively high. A possible explanation is exchange commuting that affects some of the new employment centres like Budaörs. While in France, for example, gentrification has been reported to increase the status of reverse commuters, Tammaru (2005) considers the traditionally high educational attainment of residents of the central city as a socialist legacy.

Further differences in modal split i.e. higher public transport use in Hungary in general can be explained by the lower rate of car ownership and the fairly extensive public transport system (apart from in transversal directions).

In conclusion, the parallel occurrence of suburbanisation and post-suburbanisation has been demonstrated in this research. No major differences to the characteristics of commuting in Western countries with regard to commuting patterns, socio-economic characteristics of commuters and trip attributes have been detected. The minor discrepancies can be explained by difference in the level of economic development and also by the fact that Budapest may still be in the early phase of post-suburbanisation

5. The relevance of this research to policy making and recommendations for further research

I highlighted in this research the potential consequences of the transformation of commuting patterns in the Budapest FUR pertaining to traffic, environment, health, social equity and the organisation and cost of transport provision.

Increasing cross-commuting may trigger rising car use since cross-commuters were found to be more likely to use cars. This may increase traffic on suburban roads, deteriorate modal split and increase environmental pollution. As cars are the predominant mode of transport for cross-commuters, new suburban job locations may not be accessible for those who do not have a car because of inadequate public transport connections within the suburban zone. This may increase inequality in access to jobs.

Student commuting was found to be associated with the socio-economic status of parents. If suburban municipalities face further suburbanisation of homes, newcomers with higher social status may send their children to non-local schools to give them 'better' education, or simply because they already started school in Budapest before moving to a suburban municipality. Consequently, residential suburbanisation may reinforce segregation at local schools through commuting. In addition, increased commuting of students may contribute to traffic congestion around schools and on suburban as well as urban roads in general, while exacerbating environmental pollution. Increasing intensity of student commuting can have a negative impact on their health and study performance as well. I also indicated that the compensation paid by the state for students' travel discounts may also increase.

Based on the above-mentioned potential consequences, this research provided justification for the improvement of transversal public transport connections in suburban areas, integrated land-use planning with a priority on good public transport accessibility, and the reassessment of the policy of free choice of schools and subsidies for commuting to school.

Several issues pertaining to the relationship between urban change and commuting were raised during this research. Hence a number of research pathways towards a better understanding of urban change in general and in urban areas in CEE countries specifically have been proposed. These include a more detailed investigation of post-suburban forms and processes; the study of the views of local agents (e.g. commuters, schoolteachers, company representatives) by qualitative research methods; examination of the reasons

for the preference for the car for cross-commuters; detailed study of the equality issues of car ownership concerning access to jobs and school; and the impact of students' commuting on traffic congestion in general and locally around schools.

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