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

PhD Thesis

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Copyright

1. Introduction

1.1. Research background

Commuting is a form of daily mobility that can rarely be avoided by most of the active population as the locations of our essential life activities of work, school and living are seldom situated at the same locality. In Hungary, 54.8% of all trips made by 25-64 year olds are commuting trips to work making it the most important single purpose of travel (KSH, 2010). Regular daily travel with the same origin and destination of the trip is, however, not restricted to the journey to work. Compulsory education and the free choice of schools have prompted a daily flow of children between their homes and schools. 65.3% of all journeys of the population aged 15 or under are trips to or from school in Hungary (KSH, 2010), whether it be a short walk around the corner or a 60-minute train ride to another town.

Commuting has an impact on several aspects of our lives. It contributes to traffic congestion on our roads, decreases time available for other activities such as leisure, it may have adverse effects on health, it incurs a cost to the commuter and the provider of the necessary transport infrastructure, and its motorised forms contribute to environmental pollution. These consequences are even more pronounced in urban areas, where the high concentration of homes, jobs and schools generate enormous travel demand for daily commuting and a considerable strain on the transport system.

Commuting is essentially a link between the home and the place of employment or schooling. Therefore, the localities of these fundamental human activities determine commuting patterns. The differences between commuting patterns are reflected in the spatial relationship of the origins and destinations of the journeys, as well as in the length, duration and modal split of commuting trips. Changes in home, job and school locations may transform attributes with far-reaching consequences for people's lives, the economy and the environment.

Due to its wide-ranging effects and variety of underlying causes, commuting has received considerable attention in various disciplines. Economic theory, for example, has investigated the optimal combination of wage, residential quality and commuting distance to maximise utility (Van Ommeren, Rietveld & Nijkamp, 1998; Ong & Blumenberg, 1998; Kertesi, 2000; Köllő, 2002). In sociology, *inter alia,* the commuting behaviour of minorities, and different races (Taylor & Ong, 1995; Ibipo, 1995; McLafferty, 1997), gender issues (Cristaldi, 2005), social integration (Bőhm & Pál, 1979, 1985; Viry, Kaufmann & Widmer, 2009), residential segregation (Hwang & Fitzpatrick, 1992), and inequality (Ong & Blumenberg, 1998; Fóti & Lakatos, 2006; Ohnmacht, Maksim & Bergman, 2009; Bartus, 2012) have received attention. Transport research has focused on the mode choice of commuters (Asensio, 2002; Bhat, 1997; Zhang, 2004) and its effects on traffic congestion, infrastructure networks and the environment. The health consequences of commuting have also been extensively researched (Punpuing & Ross, 2001; Wen *et al.*, 2008; Guell *et al.*, 2012; Voss & Sandercock, 2010).

As commuting is most importantly a spatial activity, it has also been in the focus of different sub-disciplines of geography especially since detailed home-to-work data is available from national censuses and labour market surveys (Dickinson, 1957; Becsei, Dövényi & Simon, 1973; Hidas, 1979; Beluszky, 1981; Erdősi, 1982). As 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 (see *inter alia* Clark & Kuijpers-

Linde, 1994; Schwanen, Dieleman & Dijst, 2001; Sultana, 2002; Dieleman, Dijst & Burghouwt, 2002; Sohn, 2005; Næss, 2007). Specific commuting patterns have been linked to the different stages of urban development. Residential suburbanisation has been associated with the Fordist regime of production and traditional suburb-to-city commuting (Van der Laan, 1996). Subsequently, urban areas in the developed world have entered a new phase of development influenced by globalisation and the shift from manufacturing to post-Fordist service-based economies. 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 (Knox & Pinch, 2009). This new form of suburbanisation supports the development of a polycentric urban structure and the emergence of a mosaic of post-modern urban forms and processes (Soja, 2000). Far-reaching changes in society, the economy, politics and culture have produced new structures that are strikingly different from the dormitory towns of the era of classic suburbanisation (Borsdorf, 2004). Therefore, the new urban structures and processes have been distinguished from the earlier stage of residential suburbanisation by the term *post-suburbanisation* (Kling, Olin & Poster, 1995). This process has had a profound effect on urban forms and flows in metropolitan areas. The relocation of jobs to suburban areas have changed commuting patterns thereby increasing the significance of reverse commuting from the central city to the suburbs and cross-commuting within the suburban areas (Van der Laan, 1996; Small & Verhoef, 2007). The past two decades have seen the publication of a multitude of studies on commuting dynamics (commuting pattern, time, distance, mode) affected by changes of residential and job locations in the urban areas of the USA (e.g. Cervero, 1989; Gordon, Richardson & Yun, 1991; Landis & Cervero, 1992; Cervero, 1996; Cervero & Wu, 1997; Cervero et al., 2002) and Western Europe (France: Aguiléra, 2005; Aguiléra, Wenglenski & Proulhac, 2009; Switzerland: Moser, 2007; Frick et al., 2007; the Netherlands: Schwanen et al., 2001, 2004; Bontje, 2007; Germany: Siedentop, 2007).

In the metropolitan areas of Central and Eastern Europe (CEE)[1], 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 (Sýkora & Bouzarovski, 2012). In the course of residential suburbanisation the locations of homes have changed, while the regional distribution of workplaces has transformed through the suburbanisation of jobs. It has been suggested that the latter is an indication of emerging post-suburban transformation, but research is still very limited on this issue (see *inter alia* Hirt, 2007; Sýkora & Ourednek, 2007; Hirt, 2008; Golubchikov & Phelps, 2011). In addition, there is an ongoing debate over how unique the urban restructuring of cities in post-socialist[2] countries is. A group of researchers argues that the urban structure created by post-communist legacy and post-modern global forces creates a unique urban structure (Ladányi & Szelényi, 1997; Nuissl & Rink, 2005; Harloe, 1996; Gentile, Tammaru & van Kempen, 2012; Sýkora, 2009; 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 residential suburbanisation and gentrification have been researched extensively in this context, post-suburbanisation and commuting patterns, however, have seldom been studied (see Tammaru, 2005 as an exception).

[1] Central and Eastern Europe (CEE) will be used in this study to cover the former socialist countries of Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Slovenia, and the three Baltic States: Estonia, Latvia and Lithuania (Organisation for Economic Co-operation and Development, 2001).

[2] 'Post-socialist' is used here to refer to countries in Central and Eastern Europe which were part of the socialist block before 1990.

Budapest, as a city with a socialist legacy, has also experienced this duality of influence. There has been a considerable amount of research carried out on residential suburbanisation (see for example Dövényi et al., 1998; Váradi, 1999; K. Kovács, 1999; Izsák, 1999; Daróczy, 1999; Izsák & Probáld, 2001; Dövényi & Kovács, 1999; Kok & Kovács, 1999; Brade et al., 2009; Szirmai et al., 2011) and employment or economic suburbanisation (Barta, 1999; Bihari, 1999; Izsák, 2001; Kovács, Sági & Dövényi, 2001; Koós, 2004; Tóth & Koós, 2004) around Budapest. While references to possible post-Fordist transformation (Kovács, Sági & Dövényi, 2001) and more specifically post-suburbanisation have been made (Izsák, 2001; Burdack, Kovács & Dövényi, 2004; Somlyódiné Pfeil, 2006; Hardi, 2010), no sufficient empirical evidence has been provided that could support the existence of post-suburbanisation in Budapest.

Similarly, a special aspect of post-suburbanisation, i.e. the potential relationship between post-suburbanisation and commuting, has not been explored in much detail in Hungary either. On the one hand, analyses of commuting data available from the latest Census in 2001 indicated changes in commuting patterns around Budapest, but no link was established to urban transformation (Kapitány & Lakatos, 1993; Szabó, 1998; Kapitány & Lakatos, 2005a, 2005b; Némethné Csehi, 2008; Lakatos & Váradi, 2009). On the other hand, some geographers have suggested that the suburbanisation of population and employment led to the transformation of commuting patterns in the functional urban area of Budapest (Izsák, 2003; Tóth & Koós, 2004; Dövényi & Kovács, 2006), but the connection between the change of the urban structure and commuting has not been established. Consequently, while 'traditional commuting' has been researched extensively (see, for example, Bőhm and Pál, 1985; Szabó, 1998; Lakatos and Váradi, 2009; Bartus, 2012), 'cross-commuting' and 'reverse commuting' have not been studied.

While research on commuters to work has been fairly extensive, we know considerably less about how the mobility of social groups other than workers are affected by urban change. Society has many more layers than those in employment defined by gender, age, socio-economic status, and ethnicity among others. 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. Many statisticians and researchers do not even consider it as commuting (see Section 2.1 for a detailed analysis of this issue). Only in recent years has there been increased attention directed to children's travel to school. A number of studies investigated the travel behaviour of students focusing on travel mode choice (Wilson, Wilson & Krizek, 2007; McMillan, 2007; Wilson *et al.*, 2010) and the health consequences of travelling to school by car (Hillman, 1997; Cooper *et al.*, 2003). As regards the relationship between urban form (i.e. density, neighbourhood layout) and students' travel, recent research focused on the influence of urban form on mode choice at the neighbourhood scale (Schlossberg *et al.*, 2005; McMillan, 2007; Larsen *et al.*, 2009; Lin & Chang, 2010), while studies on the potential linkage between the location of homes and schools and commuting are sparse (see, for example, Marique et al. 2013 as an exception).

Previous research in Hungary on students' travel patterns is even more limited. The topic has been studied primarily by educational researchers investigating the relationship between student commuting and primary school segregation (Kertesi & Kézdi, 2005a, 2005b), and the effects of free choice of schools on mobility (Andor & Liskó, 1999; Econmet Kft., 2008). Transport researchers have primarily approached students' travel to school with a focus on traffic safety (Nemzeti Közlekedési Hatóság, 2009). The relationship between the transformation of urban structure and commuting to school, however, has not been addressed.

Commuting patterns are reflected in the various attributes of commuting trips and the characteristics of commuters. The main differences between the spatial behaviour of commuters are manifested in different characteristics of their commuting trips (commuting

pattern, travel mode, travel time and travel distance) (Van Ommeren, 2000). These differences and the propensity to commuting are closely related to the socio-economic characteristics of the commuters (age, educational attainment, income and gender) (Nemes-Nagy, 1998). There has been limited research conducted relating to the linkage between urban structure, commuting patterns, trip characteristics, and socio-economic status. This is partly due to the lack of disaggregate data on commuting. Schwanen, Dieleman & Dijst (2004) proposed that commuting should be studied at different spatial and social levels. They drew attention to the role of the characteristics of commuting individuals whose resources and constraints determine commuting patterns. This, I think, warrants the use of detailed data about the travel behaviour of individuals through the analysis of household survey data.

In conclusion, there appears to be a gap in the body of knowledge on post-suburbanisation in Hungary especially pertaining to the link between urban structure and commuting. Empirical evidence is missing about changes in commuting patterns in the context of (post)-suburbanisation. The availability of research results on the commuting patterns of social groups other than employees is even more limited. Relatively little is known, for example, about students' daily travel to school and how it has been affected by urban change. Considering the diverse consequences of commuting, investigating and understanding commuting patterns in the context of the changing urban structure may provide input for further research and planning in the fields of geography, transport, sociology, health and economics as well as recommendations for policy makers.

1.2. 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.

I attempt to identify post-suburban development patterns by using changes in the commuting patterns of employees and students as a diagnostic tool. The study aims to contribute to the better understanding of the potential post-socialist nature and patterns of transformation of Central and Eastern European cities and the consequences of the dual influence of the suburbanisation of people and jobs.

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***. The research addresses the following specific sub-questions:

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?*

The theoretical underpinnings of post-suburbanisation and its relationship with commuting have been laid down in the USA and Western-Europe (see Section 3.1). The objective of this study is to investigate if forms and processes identified in Western countries can be found in Budapest. If post-suburbanisation followed a pattern similar to that of Western countries, it would support the standpoint that stresses that urban development in

Western Europe and Central and Eastern Europe are fundamentally similar (Timár, 2010). If, on the other hand, unique features were discovered, it would substantiate claims that there is a distinct post-socialist development path.

1.3. Research methodology

The research methodology describes the process of the research. There are many research paths that one can follow to explore the subject of this research. Consequently, the researcher has to make a number of decisions at the milestones of the research process (Bryman, 2001).

While the main question of this research can be interpreted as a theoretical question concerning the existence of a post-socialist development path, this study focuses on a special aspect of urban restructuring: post-suburbanisation in the context of changing commuting patterns. As previous research is missing both in terms of theoretical and empirical investigations, I think gathering empirical evidence and analysing trends based on primary and secondary data is more feasible and it could provide the necessary underpinnings for future theoretical research. Consequently, the basic approach of this study is empirical and no new theoretical models will be suggested.

Another important decision point was about the choice of an exploratory and descriptive approach. Exploratory research places the emphasis on discovering new insights and ideas, whereas in descriptive research the focus of the examination is well established and usually an association between variables is sought. Research design is determined by the availability of staff, financial and time resources, research objectives, the nature of the problem and the availability of potential sources of information (Kothari, 2009).

As it was highlighted in the introductory section, research on post-suburbanisation in the post-socialist context is scarce; hence first, the existence of post-suburbanisation in the study area needs to be confirmed in order to justify further, empirical research. Therefore this research combines explorative and descriptive research designs. In the first stage of the research, questions are clarified by exploring previous research on post-suburbanisation and commuting. In the second stage, empirical evidence is provided to answer these research questions. (The research stages are described in detail in Fig. 1.)

In the first stage of the research, secondary sources have been consulted. First, previous research on post-suburbanisation in the USA and Western-Europe was reviewed and the indicators of post-suburbanisation identified. Then, these indicators were highlighted in the functional urban region of Budapest to ascertain if post-suburbanisation can be detected and further research into post-suburbanisation in the context of commuting could be justified. Then, potential links between urban change and especially post-suburbanisation and commuting have been explored based on the review of previous studies mostly from Western countries and the small number of studies available from Central and Eastern European countries. This first stage of the research was concluded with a list of potential variables, the association of which is investigated in the second, empirical phase. The intensity of the main commuting patterns (traditional, cross-, reverse commuting) has been defined as the dependent variable. Socio-economic characteristics of commuters that influence commuting patterns (income, educational attainment, car ownership) and the attributes of commuting trips (mode choice, trip length and duration) that reflect the effect of commuting patterns on commuting trips have been defined as the independent variables.

At this point, an important decision had to be made concerning the choice of qualitative and quantitative research designs. In the classic quantitative design, existing theory is usually extended based on statistical analyses. However, for research areas in which theory has not yet been established usually the qualitative approach is applied. Access to data, the sample size of this data, the time-scale of the research project, the nature of previous studies in the

area of research need to be considered when choosing between the two research designs (Queen & Knussen, 2002).

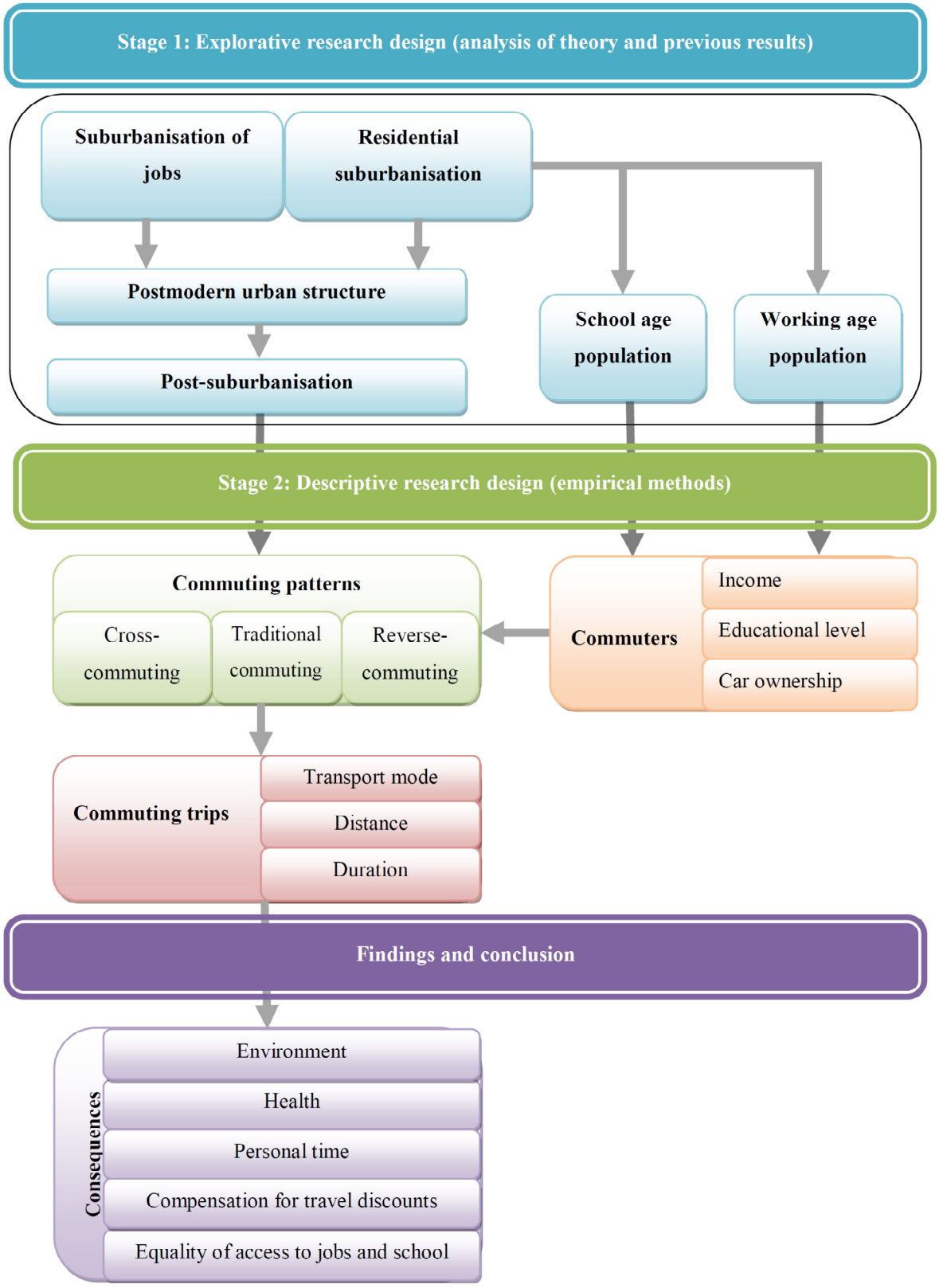


Fig. 1
The conceptual framework of the research
(Source: Own elaboration)

It would be possible to study commuting patterns by both methodological approaches. It would have been feasible to use the mixed methods approach by combining quantitative and qualitative methods, as both types of studies are scarce. This approach, however, would have restricted the scope of the research. Due to the limitations of the extent of a PhD research project the mixed methods approach would have only permitted the study of commuters to work. One of the novelties of this research project, however, is the study of commuting to school in addition to commuting to work. Hence I decided that only quantitative methods will be used but the subject of the research will be extended to cover both employees and students. Another issue to be considered was that my resources were limited. Qualitative methods usually require more time and human resources than quantitative methods (Queen & Knussen, 2002). In addition, previous studies on commuting patterns in Western-Europe and the USA are primarily quantitative in nature. As this study aims to compare results in Budapest to previous results from Western countries, comparability was another reason for choosing quantitative methods.

In the second – descriptive – stage of the research, association between the identified variables was investigated. The quantitative analysis followed the multi-level approach at different geographical scales (Schwanen, Dieleman & Dijst, 2004) (see Section 4.1 for details). The analysis of aggregate (at the level of the functional urban area and municipalities) as well as disaggregate data has been carried out with statistical methods. The methods were chosen based on the characteristics of the variables as recommended by statistical textbooks (Healey, 2011). As the majority of aggregate statistics were available for longer periods, longitudinal analysis was carried out to trace changes over time. Disaggregate data was only available for one specific point in time so only cross-sectional analysis could be performed. The quantitative methodology is detailed in Chapter 4.

1.4. The structure of the thesis

The thesis is divided into seven chapters. After the introduction, the aim of Chapter 2 is to critically discuss and clarify the terminology used in this research by reviewing and reflecting on research literature. The three central themes that are discussed are: commuting, suburbanisation and the functional urban region, which is the study area for this research. Having outlined the broad theoretical constructs, the first section of Chapter 3 (Section 3.1) reviews post-suburban development in the Western European and American context to establish the theoretical background to this research. Section 3.2 offers a non-exhaustive catalogue of post-suburban forms and processes. Then, in Section 3.3, the post-socialist transformation of metropolitan areas in CEE countries is reviewed in order to trace existing signs of post-suburban development. In Section 3.4, further study of the linkage between post-suburbanisation and commuting is justified by identifying some indicators of post-suburban development around Budapest. In Section 3.5, a review of previous findings concerning the relationship between urban transformation and commuting patterns follows, and a framework for the quantitative analysis is provided by identifying descriptors of commuting patterns. The quantitative research methodology is outlined in Chapter 4 with a justification of the methods and presentation of the data sources used. This chapter also critically reflects on the strengths and weaknesses of the approach. Chapter 5 presents the findings of the data analysis on commuting to work, which is carried out in two stages. First, aggregate data are explored at the level of the functional urban area and municipalities to identify changes in demand for and supply of jobs. It is followed by the statistical analysis of the data from two household surveys carried out in Budapest (2004) and in the functional urban region (2007). This provides evidence towards answering the research questions at the level of individuals and households. The socio-economic characteristics of commuters and attributes of commuting patterns (modal split, travel time and distance) are analysed to find statistically significant associations and possible explanations. Chapter 6 presents the results of the data analysis in a

similar structure for commuting to primary and secondary school. The results of the data analysis are discussed in Chapters 5 & 6 to avoid separating the presentation of data, analysis and discussion. Chapter 7 synthesizes the core findings of the analysis and discusses them in the context of the research questions. The theoretical and methodological contributions and the limitations of this study are also discussed here with recommendations for further research. Some of the supporting maps and tables are presented in the Appendices.

2. Terminology and definitions

A few major concepts will be used in this study, which will be defined in this chapter as their meaning have been a matter of debate in the research community and within the circle of statisticians. This section offers a brief overview of the various understandings of three of the basic concepts applied in this research. First, regular travel between home and work as well as school is defined with a focus on the purpose and spatial extent of commuting. Then, the meaning of suburbanisation is explained distinguishing between residential and employment suburbanisation. Finally, the concept of the functional urban area is discussed and the method to delimit the study area is justified.

2.1. The definition of commuting

Mobility is a key term in human geography. It may refer to social mobility (changes in social status) or geographical mobility (the movement of individuals, ideas or goods) (Illés, 2000; Hanson, 2011). In my thesis, I focus on the latter interpretation: the movement of employees and students. Geographical mobility is classified into migration and commuting based on the time spent away from home (Fouberg, Murphy & Blij, 2009). Commuting is understood by some scholars as a special form of migration, when people leave their hometowns temporarily for work (Szabadi, 1964; Bőhm & Pál, 1985). According to another group of researchers, commuting is different from migration because migration is a form of spatial mobility that involves temporary or permanent change of residence as opposed to commuting, which covers cyclic movement without changing residence (Fouberg et al., 2009).

For the purpose of this research project, cyclic movements of individuals will be taken into consideration and no permanent change of residence is assumed. Also, because urban areas are in the main focus of this study, only daily, short-distance movements will be examined and long-distance commuting (weekly or monthly travel between home and work) will not be considered (Illés, 2000; Öhman & Lindgren, 2003).

There is no internationally accepted definition of commuting. Definitions differ according to the purpose of commuting, the level of spatial units analysed and the possible origin and destination combinations.

The purpose of commuting can be approached from three different viewpoints: the etymology of the word, its usage in statistics and in research. The word 'commuter' originates from the term 'commutation ticket' (season ticket) used by early rail travellers in the United States to go to work regularly (Wordreference.com, 2012). The word 'commute' itself refers to 'the journey that you make when you travel to or from a place that you go to regularly' (Merriam-Webster, 2012) or more restrictively to 'a regular journey between work and home' (Cambridge University Press, n.d.). In other languages, the notion is not restricted to work trips. In German, for example, *pendeln* (to commute) suggests a regular movement between two places, especially home, work or school (Duden, 2012), similarly to the Hungarian equivalent *ingázni*.

Statistical definitions also demonstrate a similar difference in meaning. Some only embrace regular travel *to work.* In the United States and the United Kingdom, commuting as a statistical term only refers to the 'journey to work' (U. S. Census Bureau, 2012), or 'trips to a usual place of work from home, or from work to home' (Department for Transport, 2010). In Austria, Switzerland and Germany, however, the statistical definition also covers *pupils and students* at all levels of education regularly attending school (Statistisches Bundesamt, 1991; Bundesamt für Statistik, 2005; Statistik Austria, 2012). The Hungarian definition identifies commuting as regular travel to and from work with the residence and the workplace being in different settlements (KSH, 2007, 2008).

Research literature is also inconsistent in explaining the contents of commuting. Some researchers consider commuting as a regular movement between home and work or school (Hidas, 1979; Beluszky, 1981). Definitions in the majority of cases, however, cover the commute to work in the international (Gordon, Richardson & Kumar, 1989; Van Ommeren, 2000; Schwanen, Dieleman & Dijst, 2004; Sohn, 2005; Aguiléra, 2005; Helminen *et al.*, 2012) and in the Hungarian literature (Kapitány & Lakatos, 1993; Szabó, 1998; Illés, 2000; Berényi, 2003; Lakatos & Váradi, 2009; Bartus, 2012). Recently, however, there has been an increasing number of studies that refer to regular travel to school as 'school commuting' (Yeung, Wearing & Hills, 2008; Hołowiecka & Szymańska, 2008; Halás *et al.*, 2010; Andersson, Malmberg & Östh, 2012; Marique *et al.*, 2013).

If we consider the daily movement of employees and students between home and work or school, a clear-cut distinction between employee commuting and daily school trips cannot be justified. Daily travel to and from school can suit the definitions of commuting mentioned above, since a regular and cyclic movement is involved. The only major difference from the above definitions is that the purpose of the journey is not employment but education.

According to Bőhm and Pál's research carried out in Hungary in the 1970-80s (1979, 1985), commuting to work emerges when the following four conditions prevail:

- a qualitative or quantitative mismatch of the demand and supply of workforce in the sending settlement;
- vacant jobs in the destination settlement;
- suitable transport connections between the two settlements;
- the travel time to the other settlement is acceptable for the commuter.

I am of the opinion that students' daily travel to school is fundamentally similar to commuting to the workplace as it conforms to Bőhm and Pál's criteria. Therefore, if we transcribe the above criteria to students, commuting to school emerges if

- educational services are not available in the sending settlement at all or they do not offer the required specialisation or quality;
- destination settlements need to have available places at schools;
- transport connections are necessary between home and school;
- travel time should be acceptable for the students.

There are, nevertheless, some dissimilarities between commuting to the workplace and travel to school. While commuting for employment is mostly based on the supply of and demand for workplaces, as well as the financial and practical feasibility of commuting, the spatial characteristics of students' travel to school are also affected by factors such as the institutional framework of education (i.e. compulsory schooling between certain ages; compulsory enrolment of pupils in the school district where they live, pre-defined school holidays), children's limited freedom to choose the transport mode for commuting (ability or inability to use public transport independently, unavailability of a car), travel characteristics different from commuting to work (in the afternoon children leave school at different times depending on the type of education) and the influence of parents concerning school choice.

Notwithstanding the differences, I think that daily travel to school is essentially similar to daily commuting to the workplace. Based on the fundamental similarities between regular travel to work and school, for the ease of understanding, I will, henceforth refer to daily travel to school as *commuting to school* or *school commuting* in contrast to *commuting to work* or *employment commuting.*

In a number of countries, all home-to-work trips are considered as commuting irrespective of municipality borders, length or duration of trips (e.g. United Kingdom, United States, Germany, Austria) (Statistisches Bundesamt, 1991; Bundesamt für Statistik, 2005; Department for Transport, 2010; Statistik Austria, 2012; U. S. Census Bureau, 2012). In some other countries, like Finland or Sweden, only travel to work across municipality borders is considered as commuting (Sandow, 2011). The latter is also the case in Hungary[3] (Losonczi, 1964; Berényi, 2003; KSH, 2007). This may distort the full picture of home-to-work trips: travel to work between the districts of larger settlements (e.g. Budapest) may involve a much larger distance and longer time than commuting from a village to the neighbouring town in the countryside. Nonetheless, the former is not considered to be commuting (Szabó 1998). Due to the availability of data and in order to be consistent with the terminology used in Hungary, *commuting* in this study will refer to intra-municipality trips only.

Based on the above clarifications *commuting to work* or *employment commuting* is henceforth referred to as regular travel between home and work, where the origin and destination of commuting are not in the same municipality. Similarly, *school commuting* is understood as regular travel between home and school (including all levels of education), where the municipality of the residence and the school are not identical.

Commuting can also be classified according to its pattern, i.e. the combination of the origin (location of the home) and the destination (workplace or school) of trips within or in relation to the urban area (Pisarski, 2006). If the home is located in a suburb and work or school in the central city, there is *traditional commuting* between them (Van der Laan, 1996; Burger *et al.*, 2011; Helminen *et al.*, 2012). If commuters live and work or study in the suburban area and do not travel to the central city for work or school, they carry out *cross-commuting* (Van der Laan, 1996; White, 1988; Bontje, 2007). When residents of the central city commute to suburban locations, they are *reverse-commuters* (Landis & Cervero, 1992; van der Laan, 1996; Cervero *et al.*, 2002; Aguiléra, Wenglenski & Proulhac, 2009). When residents in the metropolitan area (city or suburb) commute to outside its territory, or people living outside the metropolitan area commute into it, they are called *external commuters* (Holmes, 1971) (Table 1). The analysis of commuting patterns based on the above classification is a key objective of this study.

A special form of commuting considered at the aggregate level is *exchange commuting*. It is a combination of traditional and reverse commuting, i.e. when residents of a suburb commute to the core city and people living in the core city commute to the suburb exchanging workforce (Schwanen, Dieleman & Dijst, 2004). It usually occurs when there is a mismatch between the job market in the suburb with respect to the required qualifications and/or salaries, and those of the resident population.

[3] The only exception is Budapest, where district level commuting data are available from the censuses.

Type of commuting	Location of home	Location of employment or school
Traditional	Suburb	City
Cross	Suburb	Suburb
Reverse	City	Suburb
External	Suburb	Outside the metropolitan area
	City	Outside the metropolitan area
	Outside the metropolitan area	Suburb
	Outside the metropolitan area	City

Table 1
Commuting patterns in metropolitan areas
(Source: Own elaboration)

2.2. The definition of suburbanisation

As this research investigates (post)-suburbanisation in the context of commuting, it is necessary to define (post)-suburbanisation itself. It is not my aim to compare existing definitions or create a new one as this has been done elsewhere (see see Timár, 1999 for a detailed review of approaches). In this section, only suburbanisation will be defined, while post-suburbanisation, which is a more recent concept without a widely accepted definition, will be explored in Section 3.1 in the context of postmodern urban transformation.

There are fundamentally two major strands of theories concerning suburbanisation: those which consider suburbanisation as a stage of urbanisation and focus on the process as opposed to those, which concentrate on the outcome of suburbanisation, i.e. the suburbs themselves (Timár, 1999). Based on a critical review of the available approaches, Timár developed her own definition based on the first approach, which has since then been widely used in Hungary. According to her: 'suburbanisation is the decentralisation of the urban population and activities, which is a vital part of the broader urbanisation process. It is decentralisation in a sense that the urban population, some of the productive and non-productive human activities, capital and investments are not concentrated in urban centres but in adjoining areas; and/or it is decentralisation in a sense that a certain range of former city dwellers, factories, offices, services, etc. actually relocate from centres to their immediate surroundings' (Timár, 1994, p.21). As regards residential suburbanisation, this definition does not limit the process to middle-class city-dwellers who move from the core city to the suburbs. On the contrary, it also encompasses a special aspect of suburbanisation in Hungary. It has been detected that lower-class population also moves from Budapest to surrounding villages, especially in the eastern and southern part of the agglomeration (Dövényi, Kok & Kovács, 1998; Izsák, 2003; Kovács, 2005). Their objective is to minimise living costs and produce fruit and vegetables for their own consumption.

Those who focus on the suburbs themselves often make an attempt to distinguish between suburban and non-suburban settlements. One approach is to find an objective measure using statistical data on demographics and socio-economic characteristics of the population (Timár, 1994). Population dynamics (the change of permanent residents), migration balance between Budapest and its surroundings, and the dynamics of housing developments have frequently been used as indicators of suburbanisation in Hungary (Daróczy, 1999; Dövényi, Kok & Kovács, 1998; Dövényi & Kovács, 1999; Bajmócy, 2006). Others used indicators of socio-economic status of the population (income, educational attainment, car ownership) (Kovács, 1999a; Bajmócy, 2003), company statistics for economic suburbanisation (number of registered companies, company density) (Bihari, 1999; Barta, 1999) and various combinations of the above (Izsák, 1999).

While I agree with Timár's definition and I focus on the *process* rather than on the *outcome*, I have to apply two restrictions to her definition for the purpose of this research.

Firstly, my research includes a quantitative analysis which takes the dynamics of suburbanisation as a variable. Secondly, with regard to residential suburbanisation, I consider higher socio-economic status as an indication of suburbanisation, which restricts residential suburbanisation to the middle and upper classes. While I recognise that suburbanisation in Hungary is not limited to the population with a higher socio-economic status, it has been shown that around Budapest a western-style 'welfare suburbanisation' prevails (Kovács, 2009) and the socio-economic status of suburban residents is higher than the national and regional average (Kovács, 1999a; Dövényi & Kovács, 1999; Szirmai *et al.*, 2011). It has also been confirmed in other CEE countries that the majority of the new suburban residents who moved out of core cities are characterised by a younger age, an above-the-average income and higher qualifications (Hirt, 2007; Sýkora, 2007; Kährik, Leetmaa & Tammaru, 2012). Previous studies in Hungary have also found an association between the propensity of primary school pupils to commuting and the income and educational attainment of parents as well as the number of cars they own (Kertesi & Kézdi, 2005b; Econmet Kft., 2008). Therefore, I think that excluding suburbanisation of lower-status residents from my understanding of suburbanisation does not cause considerable distortion. Hence the suburbanisation of residents with an income and educational attainment over the average of the FUR will be considered in this study.

Timár's above-mentioned definition also encompasses the suburbanisation of economic activities in addition to that of people. She distinguishes between residential, recreational, industrial and commercial suburbanisation, based on the type of activities that may relocate. Others in Hungary approach non-residential suburbanisation by focusing on the relocation of economic actors rather than on economic activities, and consequently they refer to economic suburbanisation (Barta, 1999; Bihari, 1999; Kovács, 1999a; Koós, 2004; Tóth & Koós, 2004). For the study of commuting, the location of homes and jobs is of primary interest irrespective of the type of activity (commerce, industry or services). Therefore, 'employment suburbanisation' and the 'suburbanisation of jobs' will be used interchangeably in this study referring to the decentralisation of jobs of all types from urban centres to adjoining peri-urban areas.

2.3. The definition and delimitation of the functional urban region

As one of the objectives of this research project is to explore the relationship between dynamic spatial changes around the Hungarian capital and flows of people generated by the spatial structure of the urban area (commuting), it is necessary to delimit the study area where these spatial transformations take place. The study area must cover the *city-region***,** the central city (Budapest) and its region, where the influence of the city can still be detected in terms of commuting and suburbanisation. Administrative boundaries are not suitable because they limit the scope of the analysis to areas delimited either historically or on the basis of data, which are largely obsolete today. The commonly used definitions of the city-region focus on the central city and are based on the economic relationship between the city and its region (Davoudi, 2009).

The concept of Functional Urban Regions (FURs) was created in the 1950s by American researchers. They suggested that FURs should consist of the central city and the surrounding area defined by the proportion of commuters to the resident workforce (Hall, 2009). This definition has since been widely applied across the world with various names. At the beginning of the 1980s, van den Berg (1982) used the concept of FURs to study the stages of urban development all across Europe. The European Union's research project ESPON 1.1.1 introduced the term Functional Urban Areas (FUA) (Antikainen, 2005), while the terminology of the Urban Audit of EUROSTAT named them Larger Urban Zones (LUZ) (Eurostat, 2004). Besides having different names, a common methodology of delimiting FURs has not been drawn up, so the definition varies country by country due to the different

urban structures and availability of data. The most widespread approach uses labour market areas[4] to identify FURs (Organisation for Economic Co-operation and Development, 2002).

Most analyses about Budapest and its surrounding region cover the area of the *Budapest Agglomeration* (Kapitány & Lakatos, 1993; Kovács, Sági & Dövényi, 2001; Barta, 1999; Dövényi, Kok & Kovács, 1998; Kapitány & Lakatos, 2005a, 2005b; Kovács, 1999a; Bihari, 1999; Váradi, 1999), which was first delimited in 1971 and included 43 municipalities around the capital. Budapest's labour market extended, however, much further even then, as only 50% of commuters to the capital lived in the newly delimited agglomeration. The official agglomeration was extended in 1996 to include 81 municipalities (including Budapest) (Kőszegfalvi, 1995). It has long been recognised that Budapest has functional relationships beyond the boundary of the agglomeration and it would be necessary to delimit the functional urban area of the capital (Tóth & Schuchmann, 2010). According to the 2001 Census, 37% of commuters to Budapest live outside the official area of the agglomeration (Kapitány & Lakatos, 2005b). Although the immediate dynamic zone around Budapest extends to 15-20 km from the centre of the city but the influence of the city can still be detected at 30-40 km from the core (Bajmócy, 2003).

There is a long tradition of research into the definition of functional areas (Mendöl, 1963; Beluszky, 1974, 1981; Tóth, 1985) and agglomerations around major towns (Kőszegfalvi, 1995; Tóth, 2006) in Hungarian geography. Recently, several attempts have been made to delimit *functional urban regions* according to the terminology introduced by the ESPON research at the beginning of the 2000s (Nagy & Timár, 2010).

In 2008, functional urban areas were delimited to support the development of the new national settlement network development concept (Faragó, 2008). Based partly on the results of an ESPON research project (REPUS), FURs were delimited according to labour market areas and official boundaries of microregions (*kistérség*) (Salamin, Radvánszky & Nagy, 2008; Sütő, 2008). Subsequently, the *Innotárs (2009-2011)* research project proposed several different methodologies to delimit functional urban areas in Hungary: cluster-analysis (Bajmócy, 2010), the cross-tabulation method using demographic and socio-economic data (Koós, 2010), the gravity model (Nagy, 2011) and road traffic data (Szalkay, 2010).

Although commuting plays an important part in many methodologies to delimit FURs, it is not the objective of this study to discuss the methodological issues in relation to the delimitation of FURs. For practical reasons, however, it has been necessary to limit the area of the study in order to define a framework for data collection and analysis. On the one hand, unfortunately, the national settlement network development plan has not yet been completed and the detailed results of the delimitations of Hungarian FURs have not been published. Consequently, this methodology could not be used in the current research. On the other hand, the methodologies proposed in the *Innotárs* project have appeared to be too complex for my purposes. I, therefore, have returned to the original idea of delimiting the functional urban region based on the labour market area of the capital, which has offered me a relatively straightforward and internationally used method.

In the literature, commuting thresholds to delimit travel-to-work areas differ country by country. Van den Berg (1982), for example, used 15% of the commuters to the central city in his landmark study on the urbanisation process in Europe. The proportions used for reporting to Eurostat range from 10% in Norway to 40% in France with 15-20% being more common (Antikainen, 2005; Faluvégi, 2008; Eurostat, 2010). As one of the objectives of this research is to explore potential linkages between commuting, the FUR should – as a minimum – include areas affected by residential and employment suburbanisation around Budapest based on previous studies on suburbanisation around Budapest (Izsák, 1999; Bihari, 1999; Bajmócy, 2006; Koós, 2007b). The 15% threshold has been chosen as it provides the best coverage

[4] The labour market area of a city covers the area from which employees dominantly commute to the city.

which is not limited to the agglomeration and extends beyond Pest County into Fejér and Komárom-Esztergom Counties, where previous studies have indicated suburbanisation (Bajmócy, 2003). Municipalities have been included in the FUR if at least 15% of the employees living there commuted to Budapest according to the 2001 Census. The area of the FUR delineated according to this method is shown in Fig. 2.

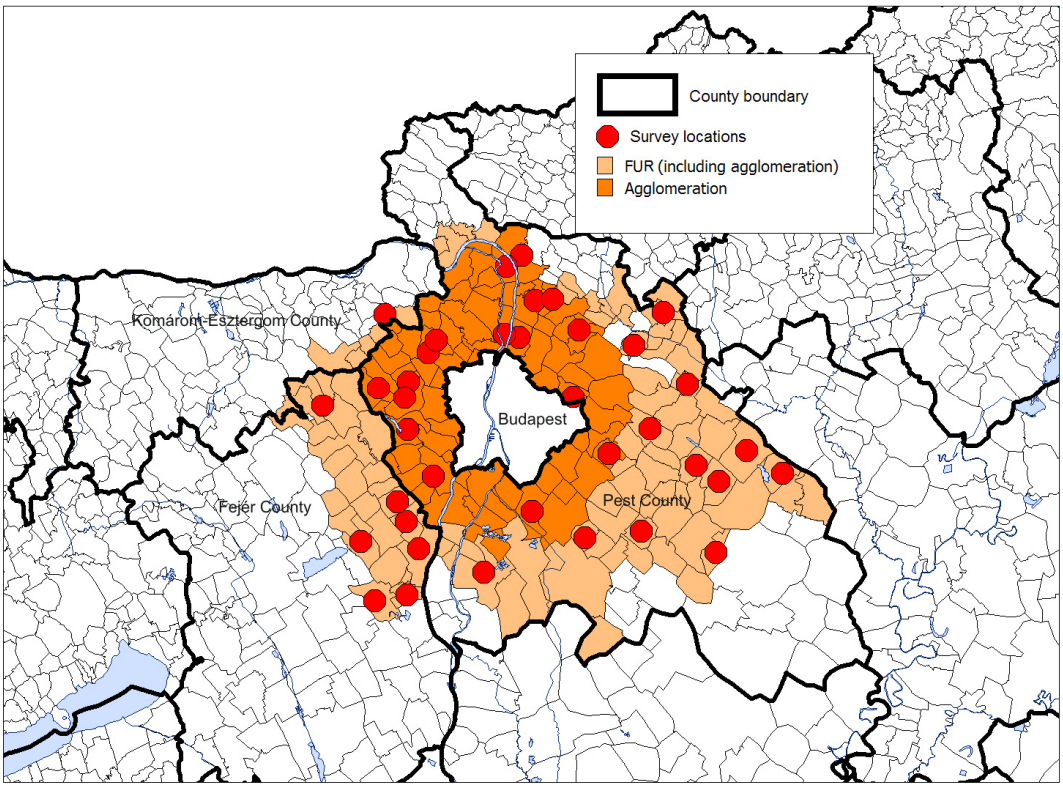


Fig. 2.
The area of the Budapest functional urban region (FUR) with other administrative territorial units
(Source: Own elaboration based on HCSO[5] data, 2001)

Nevertheless, this delimitation of the FUR has a number of limitations. Firstly, the data having been used for the delimitation are somewhat old. Until commuting data from the latest, 2011 Census become available, no up-to-date statistics about commuting can be generated. Secondly, only the commuting relationship is taken into account, while other relationships (education, transport, administration) are not reflected. Nonetheless, due to the unavailability of data, it has not been feasible to include other attributes in the delimitation. Thirdly, FURs have been criticised for reflecting the monocentric, Fordist urban models, as the basic concept of the FUR is based on a strong centre city and its dependent region (Gordon & Richardson, 1996b) (see Section 3.1 for more details on mono- and policentricity). While there are signs of newly emerging suburban centres around the city (e.g. Budaörs), I assume that Budapest is still fundamentally monocentric so its attraction of commuters still very much defines its labour relations.

The Budapest FUR delimited according to the above-mentioned method incorporates 170 settlements with more than 2.8 million inhabitants, which is more than one-quarter of the population of Hungary. The study area is similar to other major Central and Eastern European metropolitan areas (Prague, Warsaw) concerning population, size and the level of economic development. As not all data used in this research are available for the FUR, a number of

[5] HCSO: Hungarian Central Statistical Office

different territorial units will be referred to in this study. Table 2 explains their meanings and coverage.

Territorial unit	Area (km^2)	NUTS/LAU[6] level	Number of municipalities	Population (2012)	Comment
Budapest (central city, core city, capital)	525	NUTS 3	23 districts	1 740 041	
Budapest Agglomeration	3063	n.a.	81	2 268 652	Budapest and 80 municipalities around it as delimited in 2007
Agglomeration belt	2538	n.a.	80	755 290	The agglomeration without Budapest
Pest County	6393	NUTS 3	187	1 245 048	
Central Hungary	6919	NUTS 1 & 2	188	2 925 500	Budapest and Pest County
Functional Urban Region (FUR) without Budapest	5748	n.a.	170	1 150 968	See definition above
Microregions	n.a.	LAU 1	n.a.	n.a.	
Municipalities or settlements (used as synonyms)	n.a.	LAU 2	n.a.	n.a.	

Table 2
Territorial units used in the study
(Source: Own elaboration based on HCSO data)

The area from where commuters travel daily to Budapest extends beyond the FUR. The reduction of travel time especially along the major motorways has extended the labour market areas. By applying the 15% threshold, however, this research only considers commuting within the functional urban region.

2.4. Chapter conclusions

The objective of this chapter has been to clarify the basic concepts of commuting, suburbanisation and define the functional urban region and delimit the study area of the research. It has been demonstrated that there is great controversy over the meaning of commuting. For the purpose of this study, it has been suggested that commuting would cover both commuting to work and school due to the fundamental similarities between them. Due to the limited availability of statistics in Hungary, commuting is understood as a daily movement between home and work where the home and the workplace are not in the same municipality.

Based on Timár (1999), suburbanisation is understood as a decentralisation process affecting population as well as their activities (production-related and non-productive). Nevertheless a restriction to this definition have been applied: only the suburbanisation of people with medium to high socio-economic status has been considered.

The functional urban region has been defined as the study area of this research. It has been delimited according to the widely used principle of labour market areas. All municipalities from where at least 15% of resident employees commuted to Budapest in 2001 were included in the area of the FUR.

[6] According to the territorial categorisation of the EU: NUTS (Nomenclature of Territorial Units for Statistics) LAU: local administrative units.

3. Urban change in the post-Fordist context

In the 1970s, the world economy underwent structural changes and the Fordist system of mass production was challenged. Fordism denotes the production system and social development of the first half of the 20th century and it is characterised by large-scale assembly line production at centralised locations with a limited variety of products. After the economic crisis of the 1970s, a new production regime emerged that replaced the previous principle of mass production (Pál & Boros, 2010). Under post-Fordism workforce is flexible, production is disintegrated to a wide network of suppliers, and there is emphasis on high-quality, small-batch, specialised products. The economic and social changes caused by the transition have created the post-industrial city with new urban forms and flows (Hanson, 2011).

The objective of this chapter is to place my research into the context of post-Fordist urban development. Section 3.1 reviews the key processes of the transformation of the post-Fordist city; Section 3.2 focuses on the emergence of new urban forms and processes and changes in the patterns of suburbanisation and commuting. In Section 3.3, recent trends of urban change will be explored in cities in post-socialist countries in the context of post-Fordism. Then, in Section 3.4 indicators of post-suburban development will be traced in Budapest based on the catalogue of post-suburban features introduced in Section 3.1. The aim of this section is to answer the first sub-question of his research and justify the study of post-suburbanisation in the FUR of Budapest. Finally, in Section 3.5 the link between suburbanisation and commuting patterns will be discussed in detail.

3.1. Post-Fordist urban transformation

Residential suburbanisation was the key transformation process of urban areas in the USA and Western Europe until the 1970s. Large-scale residential suburbanisation has traditionally been identified with the Fordist regime of accumulation (Schumacher & Rogner, 2001). As a consequence of the fundamental changes in the economy, from the 1970s, the deconcentration of employment, services and commerce was gaining momentum in areas which had been once considered to be bedroom communities. At the same time, the functional dependence of these municipalities on the central city decreased and the focus of economic development shifted to suburban areas (Knox & Pinch, 2009). These changes induced a radical transformation of the urban structure in Western metropolises. As a reaction to these changes, postmodern urban geography emerged. One of the interpretations of postmodern geography suggests that it is a product of Marxist and post-Marxist traditions focusing on the postmodern city, and the social, cultural and economic consequences of postmodern changes in urban areas (Minca, 2009).

It was the objective of the Los Angeles school of urban theory to try to find an explanation for the 'postmodern city'. According to Soja (2000, p.239), the 'Era of the Modern Metropolis' based on Fordism, mass production and consumption was over. He argues that the new urban structures of scattered fragments of functional spaces typified by Los Angeles could not be explained by conventional urban theory. The urban space has become a 'patchwork' of polarised thematic spaces as a reflection of consumer society (Lukovich, 1999). The new phenomenon of the development of fragmented, multi-centred urban spatial structures has been extensively researched by postmodern urban theorists but no common agreement exists on the terminology (Helbich & Leitner, 2009). Kling et. al. (1995), for example, introduced the term 'post-suburban' to differentiate these new structures from conventional residential suburbs dependent on their core cities, whereas Garreau (1991) calls the multi-functional concentrations of services, employment and housing further away from

the core city 'edge cities'[7]. Several other names have been applied for the new urban structure: suburban downtowns, centerless cities, *antipolis*, *zwischenstadt*, *netzstadt*, *exopolis*, *stadtland*, to mention but a few (for a detailed review of terms, see Borsdorf, 2009). According to Helbich (2012, p.40), a common feature of these terms is the 'fragmented and polynucleated functional patches of services, located within the urban fringes'. He considers post-suburbia to be the most comprehensive of all the terms and concepts. I think it also makes it feasible to use this term because it implies that post-suburbia comes *after* suburbia. Henceforth, I take *post-suburbia* and *post-suburbanisation* to describe the development of quasi-urban structures on once urban fringes characterised by a mixture of functions: homes, shops, businesses, recreational areas and entertainment centres.

The Los Angeles School has been criticised for considering Los Angeles as the ultimate urban form of the future (Knox & Pinch, 2009). Nevertheless, even if Los Angeles cannot be deemed as a model for future urban development in other parts of the word, the Los Angeles School highlighted the potential consequences of post-Fordist urban development and globalisation.

How does post-suburbanisation fit into the traditional four-stage model of urbanisation? Enyedi (1984, 2011), building upon van den Berg's landmark study (1982), suggested that urbanisation is followed by suburbanisation, desurbanisation and the 'urbanisation of globalisation'[8]. This latter stage is characterised by the development of 'global urban regions' integrating traditional cities, urban and rural areas and exurbs (cities on the urban periphery) (Enyedi, 2012). The post-suburban development described by the Los Angeles school can be linked to this fourth stage of urbanisation.

Several elements of post-suburban development have appeared in and around European cities, too (Borsdorf, 2004). Kunzmann (2001) conceptualised the European city-region as a mixture of specialised functions and forms, where the spatial differentiation between urban and suburban is not valid any longer (Fig. 3). This concept contains several 'archipelagos' that are characteristic of post-suburbia (e.g. edge-city, technology park, airport city, knowledge city, hypermarkets, etc.).

The extent of post-suburbanisation in Europe is, however, still debated. Burdack (2002) argues that the development of metropolitan peripheries in Europe is different from its North American counterparts, because core cities remain the dominant urban centres as opposed to declining cities in the USA. It is true that the suburbanisation of people and jobs is a dominant trend in Western Europe, but at the same time, the revitalisation of city centres and brownfield areas counteracts them by making city centres more attractive and by increasing their population (e.g. Berlin, Oslo, Paris or Vienna) (Barta, 1999; Burdack, 2002; Næss, 2007; Cattan, 2011; Görgl *et al.*, 2011). Another major difference from the United States is the fact that the development of public transport networks (suburban trains, S-Bahn, metros, light rail systems) has provided an alternative to commuting by car in the major corridors (Barta, 1999).

[7] According to Garreau, edge cities have at least 464,000 square metres of leasable office space and at least 55700 square metres of leasable retail space; they offer more jobs than homes; they are perceived by the population as one place and were not considered as a city thirty years ago (Garreau, 1991).

[8] Enyedi does not agree with the existence of van den Berg's fourth stage of "reurbanisation'. He thinks that moving back to the city centres is not a global phenomenon. Therefore, he called the fourth stage the 'urbanisation of information technology', which he later renamed as the 'urbanisation of globalisation' (Enyedi, 2011).

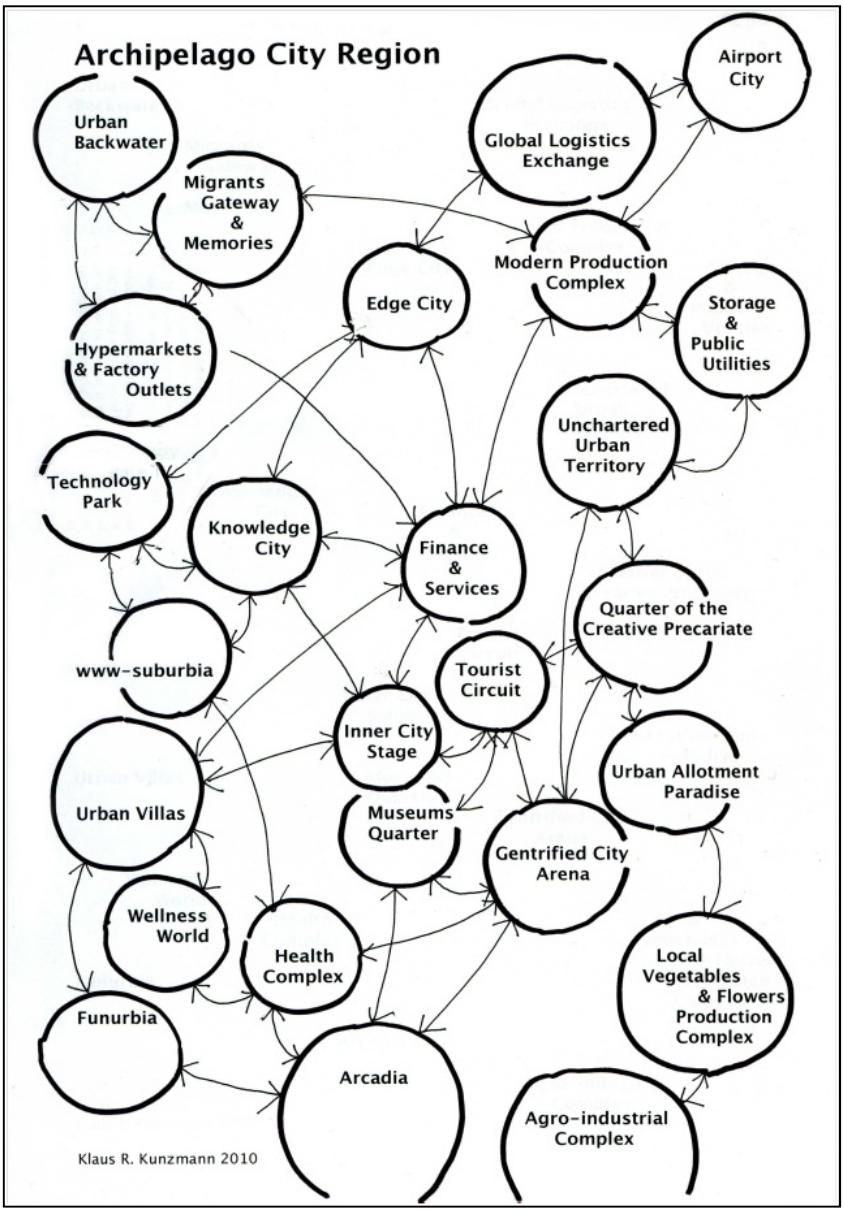


Fig. 3
The functional archipelago of the European city-region
(Original drawing by Kunzmann, reproduced from Leber, 2010, p.671)

3.2. Typical forms and processes in post-suburbia

Post-suburbia can be characterised by a number of special urban forms and processes. The following paragraphs comprise a non-exhaustive catalogue of them (based on Borsdorf, 2004, 2009; Knox and Pinch, 2009; Leber, 2010). They are introduced here to provide a framework for my investigation of the presence of these forms and processes in Budapest in Section 3.4.

I consider that following urban forms and processes to be the indicators of post-suburban development:

- Suburbanisation/decentralisation of employment
- Polycentrism
- New suburban centres with mixed use (edge cities)
- Company headquarters in suburban locations
- Airport cities

- Post-Fordist economic structure in suburban areas (services, high tech industries, and research and development centres)
- Emergence of suburban entertainment centres and accommodation facilities
- Postmodern architecture
- Gated communities

One of the most important reasons for changes in the urban form is the large-scale *suburbanisation of employment*, which has first been detected in the United States. According to Hartshorn & Muller (1989), suburban economic development had five stages. During the post-war boom of residential suburbanisation, suburbanisation of employment was limited. This stage was followed by the first wave of constructing industrial and office parks between 1955 and 1965, and regional shopping centres from the 1960s. These malls became the major nodes for further development with a clustering of commercial and office facilities between 1965 and 1980. In the next stage, during the 1980s, high-rise office buildings sprang up in the suburban centres with high-tech research and development companies. By the fifth stage, the 1990s, these new suburban centres became the new urban centres. This process could also be observed around European cities with a 10-15 year delay (Borsdorf, 2004).

Gordon and Richardson have demonstrated in a number of papers that job growth, including all major sectors of the economy in the largest metropolitan areas of the United States, has been concentrated in the urban peripheries rather than in the city centres (Gordon & Richardson, 1996b, 1996a; Gordon, Richardson & Yu, 1998). Between 1960 and 1980, two-thirds of all metropolitan job growth occurred in suburban areas. By 1980, 47% of all metropolitan jobs were located in the suburbs (Hooper, 1995). A similar trend was identified in Western Europe in the 1980-90s. Central Paris, for example, lost 11.5% of its jobs between 1982 and 1999, while employment grew in the inner and outer periphery of the urban area (Aguiléra, Wenglenski & Proulhac, 2009). Amsterdam's role as a major employment centre also declined, while in the sub-centres around the Dutch capital the number of jobs increased rapidly (Bontje, 2007). In German urban regions, a similar trend was detected by Siedentop (2007) for the period between 1990 and 1998.

One of the consequences of job growth in the peripheries of cities has been the transformation of the monofunctional urban structure into a *polycentric fabric* (Helbich, 2012). According to Scott and Soja, urban form has become a 'complex and polycentric regional mosaic of geographically uneven development' (1996, p.436). In the monocentric model of urban development, the core city (central business district, downtown) is the centre of financial, governmental and business activities, and most spatial flows are concentric and are directed to the city centre. In monocentric urban areas, the fundamental movements are between the suburbs and the core city (Hall, 2009). In a polycentric urban fabric, however, the development of new nodes is not dependent on the urban core any more. Fragmentation, network of locations, mosaic city, new nodes and clustering are the keywords of the polycentric urban model (Burdack, 2002).

The 'new economic poles', the cornerstones of polycentric development, which emerged around major cities in Europe during the past 20-30 years, have also received considerable attention. In Paris, for instance, suburban centres around the city became new economic nodes in the 1970s and 1980s (Touloise-Labegé, Sophia Antipolis, St. Quentin). In Madrid, new economic centres sprang up as well, as a result of the dynamic development of the service sector (e.g. Tres Cantos, Las Rozas-Majadahona) (Burdack, 2002). The latest tendency is the emergence of 'airport cities' around large airports with a complex clustering of logistics, service and commercial activities (e.g. Amsterdam-Schiphol, Paris-Roissy, Frankfurt am Main) (Burdack, 2002; Bontje & Burdack, 2005).

In the course of the suburbanisation of jobs, manufacturing was followed by technological companies and later by back offices for national headquarters. Finally, company

headquarters started to move to suburban locations in American cities (New York, Los Angeles and San Francisco) (Hall, 1997). This indicates that the business sector confirmed the relocation of traditional functions of core cities into regions, which were once called urban peripheries but became the new centres.

Post-suburbia is dominated by *services, high tech industries as well as research and development centres.* In the 1970s, traditional Fordist heavy industry faced a serious crisis which sparked the transformation of the economic structure of Western countries with a shift to services (Kovács, Sági & Dövényi, 2001). In the new post-Fordist regime, the majority of the workforce is employed in the tertiary (services), the quaternary (IT, media, research and development) as well as quinary (managerial and decision making) sectors. Manufacturing, wholesale and retail trade were quicker to decentralise reaching suburban dominance by the end of the 1970s. The financial services, however, – which is considered to be have the strongest ties to city centres – usually followed in the 1980s paralleled by the shift of professional, scientific and technical services (Muller, 2004). These activities are characteristic of the new industrial, office and logistics developments in suburban areas.

Entertainment and leisure facilities have also appeared in the suburban zone along with employment and services, thus, the monopoly of central cities in providing opportunities for recreation has been diminishing. Such a feature is the development of suburban entertainment centres: water parks, artificial beaches, ski-slopes, amusement parks, cineplexes (giant cinema complexes) were constructed farther from the central cities to serve not only the population of the urban area but whole regions as well. Legoland in Denmark and Disneyland in Paris are the most well-known examples of these facilities (Borsdorf, 2004). They are frequently accompanied by large-scale accommodation facilities (hotels and resorts). Thus, visitors can have a holiday without staying in or even visiting the central city. Another form of suburban *accommodation* is the line of cheap motels and hotels along the approach roads and motorways to large cities. They provide possibilities to overnight for transit passengers or budget-minded visitors of the central city.

Postmodernism is reflected in the various architectural styles of post-suburban developments often by a mixture of different motifs that wish to express diversity. The fake representation or rather misrepresentation of culture and society is often called Disneyfication with new, mixed-use developments that create a closed, socially uniform, commercialised urban environment in sharp contrast to contemporary city centres (Knox & Pinch, 2009). Social separation is also demonstrated by enhanced private security and *gated communities*, where public spaces are privatised with controlled access and secured boundaries (Blakely & Snyder, 1997).

3.3. From proto-suburban to post-suburban: transformation of cities in post-socialist countries

Enyedi (1984) suggests that while local specialities exist, the stages of urbanisation are fundamentally globally determined and spread all over the world. Western European countries mostly completed the (residential) suburbanisation phase in the 1960s, while cities in socialist countries were 'trapped' in the *urbanisation* phase until the late 1970s. By the time political and economic changes made large-scale suburbanisation possible in CEE countries, the USA and Western Europe already entered the desurbanisation phase and in certain large urban regions even the fourth stage of the urbanisation of globalisation. According to Enyedi's suggestion, post-socialist countries shall go through the phases of suburbanisation, desurbanisation and eventually reach the urbanisation of globalisation (Enyedi, 2012).

The countries of Central and Eastern Europe underwent a rapid transition from centrally planned to market-based economies in the 1990s. As a consequence of fundamental economic, social and political changes in 1989 and 1990, the spatial organisation of urban

areas was significantly transformed (Burdack, Kovács & Dövényi, 2004). There is an ongoing debate whether 'post-socialist' cities have been following a special development path or their urban development has been similar to Western Europe before and after the 1990s (see Timár, 1999).

Some researchers argue that urban development in post-socialist countries cannot be understood simply by drawing on western urban development patterns (Nuissl & Rink, 2005). One reason for this can be that the transition from the socialist regime to capitalism has not occurred in an instance without the legacy of the past (Harloe, 1996). According to Gentile et. al. (2012, p.295), 'post-socialist' cities have been developing under the dual influence of local 'legacy effects' and postmodern global political, economic, social and cultural stimuli. Sýkora (2009) considers this transformation as a combination of the adaptation of the socialist legacy and the emergence of new forms and trends under these dual influences. Sýkora and Bouzarovski (2012) argue that cities in post-communist[9] countries undergo multiple transitions. Although institutional (political) reforms have been completed, the resulting socio-economic transformations (economic restructuring, postmodernism, global influences, neoliberalism) are still ongoing and manifested in the third dimension of transformation, i.e. urban change. They consider these three types of transformations sequential: institutional changes took place in the short-term, social and behavioural change has occurred in the medium term, and urban structure changes in the long term. The 'urban circumstances' produced by these transformations are considered by Sýkora and Bouzarovski to be unique (2012, p.54). Suburbanisation patterns, for example, and specifically the suburbanisation of lower status residents specifically have been cited as supporting evidence for 'post-socialist' urbanisation (Dövényi & Kovács, 1999; Brade, Smigiel & Kovács, 2009).

On the other hand, Timár (2010) for example, argues that it is the underlying causes of urban transformation that need to be taken into consideration. She concludes that the current processes of suburbanisation and gentrification in Hungary have more similarities to the urbanisation of global capitalism, as they are the products of uneven spatial development controlled by capital; and the factors of post-socialist development act as amplifiers of this uneven development. Referring to suburbanisation specifically, Timár and Váradi (2001) argue that post-socialist suburbanisation results in social tensions, segregation, and exclusion in a very similar way as in Western Europe.

Urban change in cities in post-socialist countries has been focused on new locations of dynamic growth in city centres (regeneration and gentrification), some important locations within the inner city and in the suburbs (Sýkora, 2009; Gentile, Tammaru & van Kempen, 2012). Cities in socialist countries underwent residential suburbanisation already before 1990. In Budapest, for example, high-status residents moved to the attractive villages of the Western and North Western agglomeration in the 1970s and 1980s (Beluszky, 1999). This process, which I call 'proto-suburbanisation', was however a small-scale one compared to suburbanisation in Western Europe. Large-scale residential suburbanisation took place after the political changes in 1990 and reached its peak at the end of the decade (Kovács, 1999b).

A plethora of studies have been published about the process of the classic suburbanisation phase manifested by large-scale suburban residential development in the urban periphery across Central and Eastern Europe (see, for example, concerning Hungary: Timár & Váradi, 2001; Dövényi & Kovács, 2006; Kovács, 2005; for Bulgaria: Hirt, 2006, 2007; for Russia: Brade et al., 2009; for the Czech Republic: Sýkora, 2007; for Estonia: Tammaru, 2001; Kährik et al., 2012; and for Poland: Kupiszewski et al., 1998; Hołowiecka & Szymańska, 2008; Zębik, 2011).

[9] Sýkora and Bouzarovski (2012) use the word ‘post-communist’ instead of ‘'post-socialist', the latter being more widespread in studies on cities in CEE countries and also used in this research.

Soon after – or in the case of East Germany parallel to – the boom of residential suburbanisation, the suburbanisation of jobs also followed (Sailer-Fliege, 1999). In the suburban zone of the Prague metropolitan area, for example, the rate of job growth was 32% between 1991 and 2001 compared to a 14% increase in the core city itself (Sýkora & Ourednek, 2007). In Warsaw, the number of workplaces grew by 11.1% per year in the area bordering the capital and by 5.8% per year farther away between 1992-1997 (Lisowski, 2004). In Moscow, the growth in the number of medium-sized and large enterprises was first detected in the suburban areas in 2000 (Brade, Smigiel & Kovács, 2009). The new companies appearing in the expanding urban spaces are predominantly of service-industry profile (Sýkora & Bouzarovski, 2012). While tertierisation generally affects the whole economy in the post-industrial phase, the emergence and development of the service industry is usually faster in dynamic suburban locations and catches up to the level of the central city (Koós, 2007b).

In the USA and Western Europe, employment typically followed residents to suburban areas 20-30 years later. In CCE metropolitan areas, however, the delay between residential and employment suburbanisation was much shorter as the concentration of economic actors appeared in the suburban zone 5-6 years after the first wave of residential suburbanisation. Today, suburbanisation of homes and employment are occurring concurrently signalling a duality of suburbanisation and post-suburbanisation.

The dual influence of residential and commercial suburbanisation fundamentally changed monocentric cities. The strong monocentric urban structure and the dominance of the city centre of the socialist metropolis have been challenged by the newly emerging nodes of development of commerce and services creating a more polycentric fabric (Sýkora, 2009). At the same time, residential suburbanisation continues to shift population to suburban areas. This is supported by Hirt (2006, p.464), who – while acknowledging that transformations of 'post-socialist' and capitalist cities are fundamentally similar – argues that they 'proceed with different intensity in the two contexts – the 'post-socialist' and the capitalist one'.

Whether the parallel workings of suburbanisation and post-suburbanisation create unique urban forms and processes remains a widely debated question. Can the transformation of commuting patterns support the unique nature of ongoing transformation in CEE countries? One of the aims of this research is to contribute to this continuing debate by exploring commuting patterns within the framework of urban restructuring.

3.4. Post-suburbanisation around Budapest?

In order to decide whether a more in-depth analysis of post-suburbanisation and commuting can be justified for the Budapest FUR, indications of post-suburban development around Budapest are explored in this section. Several characteristic elements of the mixture of urban forms in 'post-socialist' cities may signal post-suburban development demonstrated by distinct urban forms that were briefly presented in Section 3.1.

Suburban development is driven by different agents. Investors are important because they provide the necessary capital, municipalities on the other hand may offer land and favourable tax conditions and development policies (Timár, 2006). At the end of the 1990s, several municipalities in Budapest's suburban belt changed their development policies as – due to changes in the tax system – it became important for them to attract enterprises to increase their income from local business tax, and to fund costly infrastructure development required by the increasing population (Brade, Smigiel & Kovács, 2009). This led to an expansion of areas affected by *economic suburbanisation* in the functional urban area (Koós, 2007a). While many businesses relocated from Budapest to the agglomeration, they were mostly small enterprises with relatively few employees (Koós, 2004), while new greenfield investments launched predominantly by foreign companies, which preferred locations with

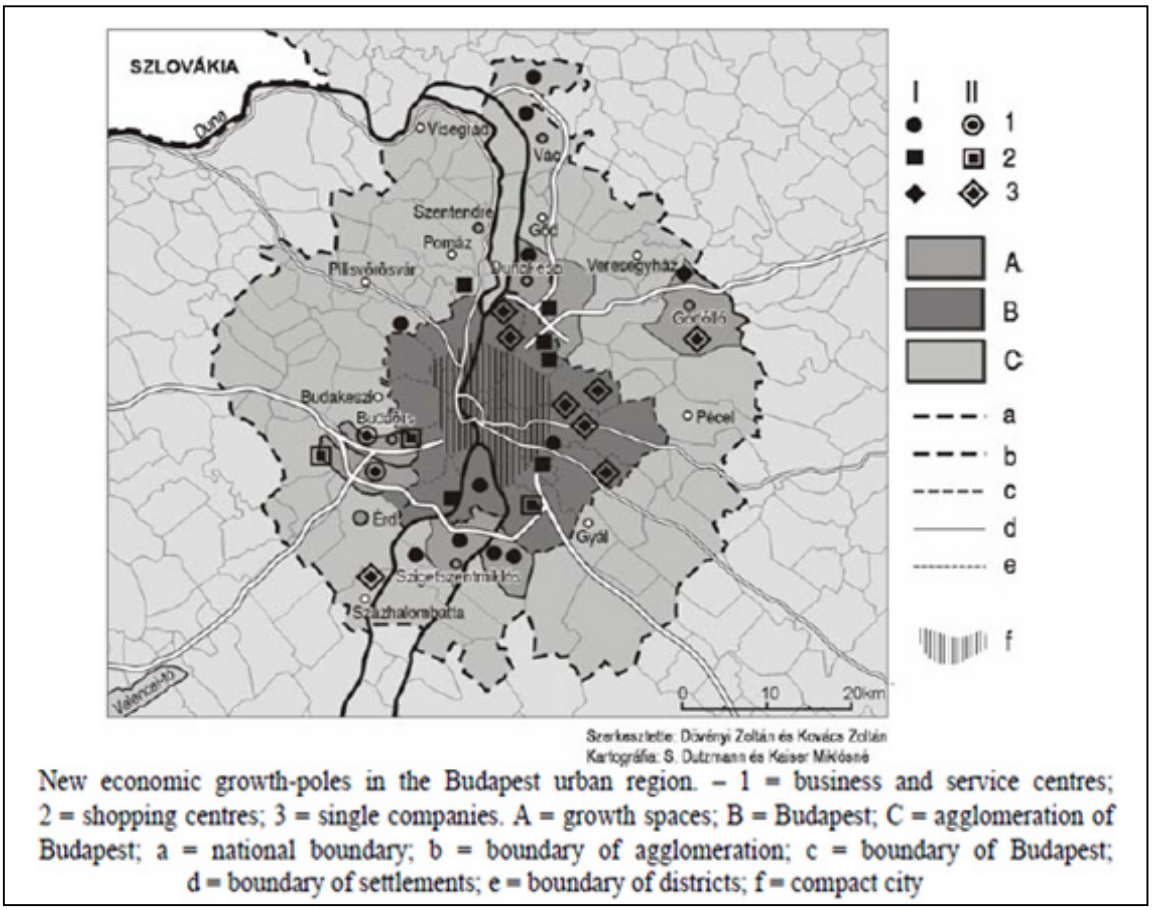
excellent transport links (e.g. motorway junctions) and the proximity of customers, created the majority of the jobs (Dövényi & Kovács, 2006).

Hypermarkets have been the first representatives of suburban employment mushrooming around the edge of Budapest from the mid-1990s. The new retail facilities also established their distribution centres in suburban areas. After 2000, as the market of hypermarkets saturated, retail parks with specialised shops appeared followed by strip malls and outlet centres (Nagy, 2006). Parallel to commercial developments, warehouses and logistics centres have been the other form of the suburbanisation of employment taking advantage of good locations along motorways and close to motorway junctions. The suburbanisation of offices is still limited. The majority of foreign investment in office development flowed into the core city where the market of office space saturated by 2001 (Földi & Weesep, 2007). In the FUR most of the office developments have been attached to retail and logistics sites similarly to Prague (Sýkora & Ourednek, 2007). In 2006, Nagy (2006) forecast that lower land acquisition costs, more relaxed building and land use regulations and the reduction of available brownfield land in the city might prompt a boom on the suburban office market in Hungary in the (then) near future. Due to the adverse effects of the global economic crisis of 2008 on the real-estate market[10], however, large-scale office developments outside Budapest are likely to be delayed.

The distribution of business developments is uneven in the FUR. Similarly to residential suburbanisation, municipalities in the western, north-western and northern sectors of the agglomeration have been found to attract most businesses (Tóth & Koós, 2004). Economic development has been clustered in the so-called economic growth poles in Gödöllő (high-tech companies), Szigetszentmiklós-Dunaharaszti-Soroksár (logistics), Dunakeszi-Fót and Budaörs-Törökbálint (the largest employment centre of the periphery) (Burdack, Kovács & Dövényi, 2004). New economic poles are developing in the northern periphery near Fót and Budakalász on both sides of the Danube triggered by the new motorway bridge (Dövényi & Kovács, 2006) (Fig. 4).

Hardi (2010) examined the change in the number of residents and jobs between 1990 and 2001 in the Budapest Agglomeration and found that the role of several municipalities changed as regards their residential and employment functions. In some settlements, the predominance of their employment function decreased while their population was rising (Vác, Szentendre, Szigetszentmiklós). He suggested that another group of municipalities in the Western (Budakeszi, Budaörs) and North Western Agglomeration (Pilisvörösvár, Piliscsaba) of Budapest showed the signs of post-suburban transformation (i.e. job expansion greater than residential growth). The town of Budaörs, attached to the western border of Budapest and situated at important motorway junctions, has been cited as the economically most successful suburban municipality (Izsák, 2001). With the development of new economic nodes, the monocentric nature of the urban area is changing owing to the recent connections formed between these suburban nodes (Barta, 1999). The M0 ring motorway, which was originally constructed to divert transit traffic of heavy goods vehicles from Budapest, has become a major connector of suburban economic nodes, which may eventually become the centres of a new *polycentric fabric*. Although this polycentrism is not to be compared with the complex multi-centred region of the Randstad in the Netherlands, but the underlying causes of the dispersal of urban functions in the urban-suburban space are similar.

[10] Consider for example the halted construction of the TóPark complex further below in this section.



New economic growth-poles in the Budapest urban region. – 1 = business and service centres; 2 = shopping centres; 3 = single companies. A = growth spaces; B = Budapest; C = agglomeration of Budapest; a = national boundary; b = boundary of agglomeration; c = boundary of Budapest; d = boundary of settlements; e = boundary of districts; f = compact city

Fig. 4
New economic growth poles in the Budapest urban region
(Reproduced from: Kovács et al. 2001)

Multi-functional suburban centres or *edge cities* are also characteristic of the post-suburban landscape (Garreau, 1991). Izsák (2001) and Somlyódiné Pfeil (2006) suggest that as a culmination of employment suburbanisation, the town of Budaörs became the first post-suburban centre within the functional urban area. Similarly, Burdack et. al. (2004), and Dövényi and Z. Kovács (2006) refer to the concentration of industry, services and commerce on the western border of the capital around Budaörs and Törökbálint with excellent transport links, as a development reminiscent of edge-cities. Halász (2012) cites Gödöllő as an example of post-suburban development in Hungary based on its labour market zone, transport connections, tertiary and quaternary economic orientation. In the eastern part of the agglomeration, business clustering around Liszt Ferenc International Airport created a new concentration of employment. This area linked to the logistics and commercial developments of the neighbouring Vecsés and Üllő could become a future, smaller scale *airport city*.

The relocation of *company headquarters* to suburban locations is an indication of the most recent stage of the suburbanisation of jobs (Hall, 1997). Several international companies created their national or Central European regional centres in Budapest's suburban zone. The Törökbálint-Budaörs area has the highest number and greatest variety of such headquarters (for example: Media Markt, TESCO, Auchan, METRO, Regional Centre of Tetra-Pak, Opel Hungary, ENI Hungaria, Telenor). A unique feature of these headquarters is that they did not relocate from Budapest to the suburban zone as in the USA or Western Europe, but set up their sites as greenfield developments in the suburbs including their head offices when they appeared in Hungary in the 1990s (Kovács, Sági & Dövényi, 2001; Dövényi & Kovács, 2006). On the one hand, most of these companies set up their headquarters attached to their new production, logistics or commercial sites. Thus they could economise on the costs of establishing their offices. On the other hand, the incentives for the relocation of company

headquarters (e.g. unavailability of free land in the city centre, workforce moving out of the city) has not been strong. This is especially true for companies that require large office spaces as brownfield development areas in or near the city centre could still attract most of the office developments. There are, however, some exceptions. Telenor, one of the major mobile phone providers, whose headquarters contains exclusively offices, relocated within the suburban zone, from Budaörs, its first headquarters, to a newly built company head office in Törökbálint.

Post-suburbia is dominated by *services, high tech industries, as well as research and development centres* (Borsdorf, 2004). Kovács Sági & Dövényi (2001) carried out an empirical study among the businesses in three areas of the new economic nodes around Budapest in 2000 (Budaörs-Törökbálint, Szigetszentmiklós, Gödöllő). They found that the economic nodes are specialised in certain economic sectors. Services are dominant in the Budaörs-Törökbálint area, a mixture of services (logistics) and industry characterise Szigetszentmiklós, while high-tech, just-in-time industry prevails in Gödöllő. The economic character of the regions is reflected in the educational level of the employees as well. The Budaörs-Törökbálint area has a high proportion of employees with university or college degrees. In Szigetszentmiklós skilled workers, while in Gödöllő predominantly unskilled and semi-skilled workers are employed. The findings of Kovács et al. indicate that most of the newly established businesses around the capital are post-Fordist enterprises based on their size, ownership structure, network of suppliers and business relations, similarly to suburban job centres in Western countries.

Suburban entertainment centres have also appeared around Budapest at the end of the 1990s. The open air water park in Mogyoród, its covered equivalent on the Northern border of Budapest (Aqua World), the Korda Filmpark, the visitor centre of Korda Film Studios in Etyek are good examples for this trend. Hotels and motels also sprang up along major motorways leading to Budapest providing cheap accommodation for transiting passengers or visitors with a car but a on a tight budget. The higher end of hotels is represented, *inter alia*, by a four-star Ramada hotel adjoining the Aquaworld water theme park and a luxury golf hotel (Pólus Palace Thermál Golf Club Hotel) in Göd. *Gated communities* have also been created in and around Budapest, although the majority of them are situated within the boundaries of the city. In 2010, there were 23 gated communities in the agglomeration with 2100 residential units (Hegedűs, 2011).

As a culmination of post-suburban development, the construction of a large-scale artificial town started in 2008 in the Western-Agglomeration adjoining the Budaörs-Törökbálint cluster that would feature a combination of the above post-suburban elements in an *edge-city* manner. *TóPark*[11], the first complex residential, office and commercial development in the inner suburban area will offer 5-6,000 office jobs in the short term and 20-30,000 jobs in the long run. In addition, flats, an exhibition centre, Hungary's largest shopping mall, and services on 20,000 square metres (hotels, school, medical centre) will be constructed on an area of 200 hectares (Walker and Williams Investment Group, 2008). The designs for the completely covered high street reflect a *postmodern* mixture of 'neoconservative new urbanism' with facades resembling buildings in Paris (Fig. 5). The complex, which is completely sealed off from its surroundings by motorways and a railway line, will provide a totally controllable environment for its select residents and visitors (Szemerey, 2011). This new development is meant to replicate a city, with all the services it can offer without the problems of contemporary city centres. TóPark, if ever completed, will represent a typical post-suburban development in the architectural style of the postmodern.

[11] At the end of 2010 amidst the current economic crises construction was halted due to financial problems.

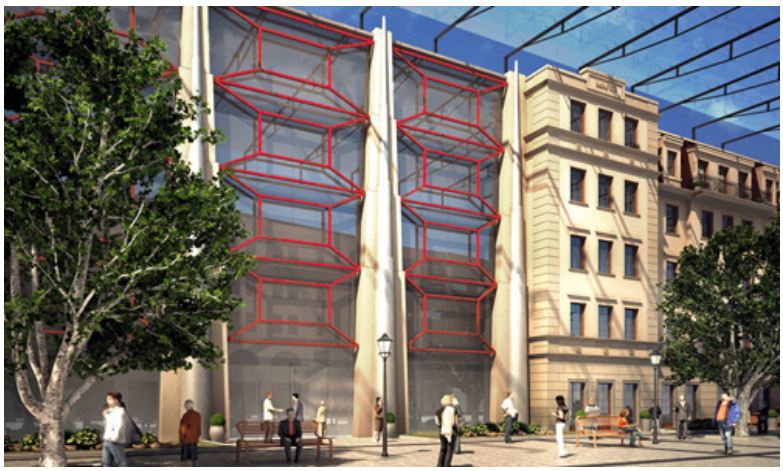


Fig. 5
Design of the covered High Street of the first stage of the development of TóPark (Source: http://www.octogon.hu/szerkezetkesz+a+topark+elso+uteme+1.html)

I think the above examples indicate that several post-suburban forms and processes of urban development can be traced in the Budapest functional urban area. This confirms that further, more in-depth analysis of the decentralisation process and changes in people's mobility patterns affected by the inferred post-suburban development patterns is justified. Therefore, the next section focuses on commuting patterns in the context of suburban development.

3.5. Urban transformation and commuting patterns

3.5.1. The USA and Western Europe

The suburbanisation of jobs and the emergence of polycentric urban structures have had profound consequences for commuting patterns because commuting is an outcome of the urban spatial structure, i.e. the distribution of jobs and homes (Sohn, 2005). During the past few decades, the change of commuting patterns has been detected in many Western European countries and the United States. The most profound changes occurred in the travel directions of commuters. According to Enyedi (2011), globalised urban regions are characterised by a combination of traditional, cross- and reverse commuting. While the major commuting pattern in monocentric cities is the traditional suburb-to-city one, in polycentric regions, an increasing proportion of cross-commuting between suburban homes and jobs and reverse commuting from core cities to suburban job locations are generated (Hall, 2009). As commuting is determined by the regional jobs-housing balance, it is also strongly affected by the extent of residential and employment suburbanisation.

In the United States, commuting between suburbs has become the major commuting pattern representing 41% of all commuting trips[12]. Commuting from the suburbs to core cities has dropped to 17%, while reverse commuting has accounted for 8% (Small & Verhoef, 2007). A similar tendency was detected in Western European countries with an approximately 20-year delay after the USA. In Switzerland, cross-commuting was the fastest growing of all types of commuting between 1990 and 2000. In Zürich, Genève and Bern, its volume reached the level of commuting to the core cities. In Zürich, rising reverse-commuting from the city to the suburban areas has been detected, while the number of people living and working in Zürich fell by 25% between 1990 and 2000 (Frick, Keller & Wütrich, 2007). French urban

[12] In the United States, commuting statistics take account of all home-to-work trips including those within municipalities.

regions also saw a significant increase in cross- and reverse commuting due to the suburbanisation of jobs between 1995 and 2005. In the Paris, Lyon and Marseilles urban areas, three-quarters of the employees living in the suburbs work in suburban employment centres (Aguilera, 2005); in Paris the number of reverse commuters increased by 25% between 1982 and 1999 (Aguiléra, Wenglenski & Proulhac, 2009).

While the transformation of commuting patterns was similar in the USA and Western Europe in terms of the increasing importance of cross- and reverse commuting, the socio-economic background of it is different. Aguiléra, Wenglenski & Proulhac (2009), for example, found that the proportion of 'executive' reverse commuters grew considerably in the Paris metropolitan area, while the percentage of 'labourers' was halved between 1982 and 1999. This indicates the gentrification of the city centre with some of the higher status residents commuting outwards, and demonstrates also changes in employment needs in the outskirts. These findings are in sharp contrast to the profile of reverse commuters in the United States, where poor, often predominantly African-American central city residents commute to job locations in the suburban areas (Grengs, 2010).

Van der Laan (1996) established a relationship between the polycentric structure of modern metropolitan areas in the Netherlands and the direction of commuter flows. He categorised the 26 daily urban systems[13] of the country based on the proportion of traditional and reverse commuting. He defined four functional types of urban areas: central, decentralised, cross-commuting and exchange commuting. He argues that two-thirds of Dutch urban systems are some variation of the latter three functional types. Consequently, suburban areas are important as suppliers of jobs and by generating commuter flows from the central city and/or other suburbs. Therefore, significant cross- and reverse commuting are indications of a polycentric urban structure.

Commuting to school has received considerably less attention than the commute to work especially in relation to the changes of the urban structure. Several studies have focused on the travel behaviour of students concentrating on mode choice (Wilson, Wilson & Krizek, 2007; Wilson *et al.*, 2010; McMillan, 2007; Morris, Wang & Lilja, 2001), and there is rich research literature on the health consequences of travelling to school by car (Hillman, 1997; Cooper *et al.*, 2003; Wen *et al.*, 2008; Voss & Sandercock, 2010). Previous research on the relationship between urban form and students' commuting emphasised mainly the influence of urban form on transport mode choice at neighbourhood scale (Schlossberg 2005, McMillan 2007, Larsen et al. 2009, Lin & Chang 2009), while studies on the potential linkage between the location of homes and schools versus school commuting are few in number (see, for example, Marique et al. 2013).

In case of the commuting of students, the location of the home and the school are the determining factors of commuting patterns. The question is to what extent the pattern of commuting to school reflects the changing urban structure? Post-suburbanisation has been linked to commuting above in the context of the relocation of jobs in the urban region. By analogy, schools should follow the population to suburban areas and consequently cross-commuting from suburban homes to suburban schools should increase, while the dominance of students' commuting to the core city is expected to diminish.

Marique *et al*. (2013) explored links between land use patterns, energy consumption and commuting to school in Belgium. They found that urban structure is an important factor in determining commuting to school through the location of home and school. There is also an important link to the level of school in the educational system as well. Higher levels of education tend to concentrate in urban centres, which leads to increased commuting. This has implications for transport mode choice and travel distance. They concluded that the

[13] A daily urban system of a city is the area from where commuters are attracted to the city (Coombes *et al.*, 1979).

decentralisation of schools leads to decreased energy consumption and more favourable mode choice.

Marique *et al.*'s results could, however, not be generalised as the regulatory systems are differ country by country regarding free choice of schools, for example. While in a school system where district schools provide compulsory education and little flexibility exists concerning school choice the availability of school places is determining factor. In countries, however, where parents are free to choose the schools, factors like, quality, reputation, specialisations etc. may be more important.

Children's commuting to school could also be influenced by the travel patterns of their parents. Therefore, if the commuting patterns of the parents change due to post-suburbanisation, this may affect how and where their children travel to school. Trip chaining, i.e. multi-purpose and multi-destination trips, have become common especially among mothers. Taking the children to school has become just one element of the daily trip chain and these trips do not necessarily originate or end at home. Hence, the mode of travel to school is also determined by what activities the mother has to do before and after the school run. In addition, the abundance of extracurricular activities – often at different locations from the school – supports the use of car to provide flexibility (Morris J. et. al. 2001). Trip chaining can also be a consideration for school choice especially if parents go to work by car. They might consider choosing a school that is along their daily route (Derek Halden Consultancy 2002). The intertwinement of the trips of the parents and their children may indicate a potential link between the commuting patterns of them. If, for example, parents find a job in the suburbs and change their commuting destination from the core city to a suburban location (cross-commuting), they may be inclined to find a school that is on the way to this new job location, especially if they drive to work. Thus, they could economise on their and their children's travel. It would, however, be only possible on condition that there is suitable school offer available in the suburbs.

3.5.2. Central and Eastern Europe

Few empirical studies have been carried out to investigate how the interplay between the suburbanisation of jobs and homes affects commuting patterns in Central and Eastern Europe. Previous research in Sofia (Bulgaria), Riga (Latvia) and Tallin (Estonia) emphasized that commuting to the core city increased due to suburbanisation of residents. Hirt (2007) found that 87% of residents who had recently moved to a suburban area around Sofia commuted to the capital and only 7% to other municipalities. The proportion of commuters to the capital among long-time residents was lower (65%) and to nearby municipalities higher (20%). Krisjane et al. (2012) examined the demographic and socio-economic differences between commuters and locally employed citizens in the Riga metropolitan area. They found a strong relationship between suburbanisation and commuting. Tammaru (2005) analysed commuting trends in Tallin and found that commuting to Tallin increased significantly between 1982 and 2000, as the capital is the most important employment centre in the country. Out-commuting from Tallin remained at the same level as in 1982, although agricultural production that attracted reverse commuters in the 1980s collapsed. Tammaru suggests that out-commuters today work at factories that relocated from Tallin to the suburbs. He found that commuters to Tallin have lower educational and occupational status compared to non-commuters living in Tallin. He suggests that the reason for this is that suburbanisation has not yet reached a level that would have increased the socio-economic status of commuters from the suburbs above that of the city-dwellers of Tallin. He proposes that it is a legacy of the Soviet times when people with higher educational and occupational status are concentrated in cities.

These analyses did not indicate post-suburban trends; on the contrary, it demonstrated the intensification of the classical Fordist pattern of commuting to the city centre due to suburbanisation.

Whilst post-suburban development trends concerning Budapest have been discussed in Section 3.4, evidence for post-suburban commuting is limited. Although a direct link between changes in commuting patterns and post-suburban change has not been suggested, Izsák (2001), Dövényi & Kovács (2006) as well as Hardi (2010) highlighted the transformation of commuting patterns around Budapest. Izsák (2001) referred to the changing function of the suburban town of the most significant new economic pole in the suburban zone, Budaörs and its relationship with Budapest. While in the 1980s the town functioned as a labour provider for the capital with 90% of the employees commuting to Budapest, by the 2000s it became a major destination of in-commuting from nearby settlements. Dövényi and Kovács (2006) highlighted that residential and commercial suburbanisation generated new commuting flows. They noted that the 50% rise in the number of jobs in Budaörs and Törökbálint between 1990 and 2001 intensified in-commuting from nearby settlements and from Budapest itself. Hardi (2010) stated that commuting patterns changed considerably between Budaörs and Budapest due to the increasing number of jobs offered in Budaörs. Both reverse commuting from Budapest to Budaörs and cross-commuting from surrounding municipalities to Budaörs increased. Hardi also detected that the proportion of white-collar workers among commuters between Budaörs and Budapest increased in both directions as a consequence of the service-oriented job growth in Budaörs and also due to residential suburbanisation with an overrepresentation of middle- and upper-class households. More detailed analysis of these changes in commuting patterns has not been carried out due to the lack of data. Although differences in commuting patterns were not directly linked to post-suburban development trends, they may indicate a possible correlation with urban change.

The number of studies on commuting to school in CEE countries is even more limited. As one of the few exceptions, Bajerski (2010) highlighted a potential relationship between suburbanisation and the commuting of primary school pupils in the Polish city of Poznan. He registered a 102 per cent increase in the number of students commuting to Poznan from the surrounding municipalities. At the same time, the share of students attending local schools in suburban municipalities decreased. Burgmanis (2012) explored children's travel behaviour in Riga, Latvia. She confirmed previous findings of research on western cities that home-to-school distance and car ownership are determining factors of children's mode choice. She also found that the likelihood of parents driving their 12-17 year-old children to school to the city centre is high. According to these two studies, education has remained highly monocentric in CEE urban areas and it does not show trends of decentralisation.

3.6. The characteristics of commuting patterns

Commuting patterns can be best grasped through studying the various attributes of commuting trips and the characteristics of commuters. Commuting patterns, trip characteristics and commuter attributes are interrelated in numerous ways. On the one hand, the socio-economic and demographic characteristics of commuters (income, educational attainment, car availability) determine commuting patterns. On the other hand, the consequences of commuting can best be expressed through the study of the attributes of commuting trips (commuting pattern, distance, duration, transport mode).

The environmental impact of commuting trips is, for example, related to commuting distance and travel mode (Marique *et al.*, 2013). Commuting duration is important, because it may influence the well-being and daily activity patterns of students and employees in a negative way (Costal, Pickup & Martino, 1988). Commuting distance, duration and mode were usually treated as dependent variables in previous research while the socio-economic

status and demographic characteristics of commuters have often been used as independent variables.

3.6.1. The characteristics of commuters

According to previous research, commuters with higher income usually commute farther as they can easily cover the higher cost of travel (Næss, 2007). Nevertheless, it does not necessarily mean that their travel time is longer. As higher income groups have better access to car, their average speed of travel is higher, which means they can cover larger distances in shorter time. Gordon et. al. (1989) found that in the USA, higher income brings about lower commuting time as wealthier families are more inclined to economise on commuting. They are also more likely to travel by car as car availability is higher in wealthier families (Schwanen, Dieleman & Dijst, 2004). Family income has been shown to influence mode choice for trips to school as well. Children in families with higher income are more likely to travel to school by car (Kerr *et al.*, 2007). Similarly to income, higher educational attainment increases commuting distance (Rouwendal & Rietveld, 1994; Næss, 2007)

According to Berényi (1997), school choice is influenced by both economic factors and the social status of the parents. Income of the family and educational attainment of the parents also affect students' commuting distance (Kertesi & Kézdi, 2005b). The decision that determines commuting patterns is usually made when the secondary school is chosen at the age of 13-14 (or earlier in case of secondary schools with 6 or 8 grades). The mode of travel, however, may change in the course of secondary school studies depending on changes in income and car availability. Families with a higher social status can provide more resources for their children in terms of schooling (Andor & Liskó, 1999). Previous research in Germany pointed out that school choice depends on the educational attainment, occupation and income of the parents (Schneider, 2004). In the USA, it was found that the quality of teaching at schools is more important for parents with a higher income (Hastings, 2006), hence, they can support a longer and more expensive commute to school. In Hungary, the higher the qualifications of the parents are, the more probable it is that their children choose a grammar or a technical secondary school instead of a vocational school[14]. In addition, higher qualifications of the father increase the probability of the children going on to an elite school (Andor & Liskó, 1999).

Access to car is also a determining factor of commuting distance, time and mode choice. Limited or no availability of a car can prevent lower-income households from finding jobs in the suburban area (Kovács, 1999a; Siska & Keserű, 2009) or commuting to a school that is not easily accessible by public transport (Kertesi & Kézdi, 2005b). This is a particularly important factor because in CEE countries the car ownership rate is lower than in Western Europe or in the USA (Keserű, 2004c). In addition, typical suburbanites are more likely to use car. In one of Sofia's suburbs, for example, 66% of the people who have recently moved there commute by car either as a driver or a passenger, as opposed to only 46% of the long-time residents (Hirt, 2007). Car ownership has been shown to influence mode choice for trips to school, too. Children in families that own more cars are more likely to travel to school by car (Kerr *et al.*, 2007). Car ownership usually shows a strong correlation with household income, so caution must be exercised when both of them are used as variables in order to avoid multicollinearity[15] (Cervero, 1996)

There is very limited knowledge about the relationship between the commuting patterns and the above-mentioned attributes in post-socialist countries. In Hungary, for example, no research has been carried out about the connection between the above-mentioned socio-

[14] See Section 6.1 for an explanation of school types in Hungary.
[15] Multicollinearity: when two or more predictor variables are correlated in a regression.

economic characteristics of commuters and the attributes of commuting trips. It is due to the limited availability of data, as statistics about commuting behaviour collected during the national censuses are not suitable for detailed analysis.

3.6.2. The attributes of commuting trips

Commuting distance and duration have been linked to the proximity of homes and jobs in urban areas. There is an ongoing debate over whether the decentralisation of employment affects commuting time and distance. According to the co-location hypothesis, employees try to minimise their commuting costs, therefore, they choose their homes and jobs close to each other (Gordon et al., 1991). Thus, it was suggested that the decentralisation of employment reduces commute time (Gordon, Richardson & Kumar, 1989). Studies trying to find evidence for the validity of the co-location hypothesis however produced conflicting results. Gordon et. al. (1989) demonstrated that polycentric metropolitan areas with decentralised employment have shorter commuting trips. They detected the fall of average commute times in the top twenty metropolitan areas of the United States between 1980 and 1985 (Gordon, Richardson & Jun, 1991). Siedentop's (2007) findings confirmed the co-location hypothesis for metropolitan areas in Germany, i.e. the average commuting distance was discovered to be larger in monocentric urban areas than in polycentric regions, hence, cross-commuting trips were found to be shorter than those to the core city (Siedentop, 2007). Others, however, had conflicting results. Contrary to Gordon's findings, the proportion of workers aged 16 or above who commuted more than 45 minutes to work increased by 3.2% in the 49 metropolitan areas of the USA between 1990 and 2000 (Kirby & LeSage, 2009). In Europe, Schwanen et. al. (2004) examined commuting distances and time in Dutch urban areas and concluded that polycentric urban structure had not reduced commute time and distance for car drivers.

In the latter cases, a mismatch between the requirements for and the availability of the workforce continued to generate commuting even if there is a balance between the amount of jobs and available housing (Cervero, 1989). In Haarlammermeer, in the Netherlands, for example, there are twice as many jobs as local residents, and still 30,500 residents commuted elsewhere in 2001 (Bontje, 2007). Schwanen et. al. (2004) had similar findings as commuters living in the so-called growth centres with a significant amount of jobs had above-the-average commuting distance and time. The mismatch may be caused by the unavailability of local employees with the required profession, educational level or salary requirement. In addition, if the income level of employees does not correspond to the price level of properties in a certain area, employees may not be able to find a place to live in the proximity of their employment. This can lead to reverse commuting from the core city as lower skilled labour is missing from the vicinity of suburban employment centres (Cervero, 1989). Exactly the opposite problem occurred in Hungary, in the Budaörs-Törökbálint-Biatorbágy area, which is the fastest developing economic centre around Budapest. Interviews with company managers revealed that there was a shortage of employees with college or university degree and also of skilled labour already in the mid-1990s (Kovács, 1999a).

Previous research into the relationship between commuting patterns and travel mode has revealed that cross-commuting is not easily served by public transport because fast, high-capacity public transport lines (commuter rail, S-Bahn, metro, light rail) have been built radially towards the core city (Schwanen, Dieleman & Dijst, 2001). Cervero & Wu (1997) found that commuters to suburban employment centres in low-density areas are more likely to travel by car. This was confirmed by Schwanen et. al. (2001) in the Netherlands, who discovered that deconcentration encourages car driving. The distance of the home from the city centre seems to influence mode choice.

Mode choice has been one of the central themes of school travel as well (Wilson, Wilson & Krizek, 2007; McMillan, 2007; Wilson *et al.*, 2010). It has been shown that the number of children driven to school has been increasing. In the United States the proportion

of children going to school by car grew from 16% to 55%, while walking and cycling decreased from 42% to 13% (McDonald, 2005). It has been detected that children's mode choice for trips to school is largely influenced by the distance between home and school (McDonald, 2008).

Travel time has turned out to be closely related to mode choice. In Switzerland, the share of public transport is only 20% along the routes where the travel time by public transport is twice as much as by car. If public transport travel time is only 1-1,5 times higher than that of the individual transport, this proportion rises to 50% (Moser, 2007). Consequently, cross-commuters depend on their cars to a higher degree because of limited alternatives (Mace, 2009).

The independent variables of the quantitative analysis of this research have been determined based on the above findings of the explorative phase of this research in order to be able to make comparisons to previous results. Educational attainment, net family income and car availability are suggested to describe socio-economic and demographic characteristics of commuters. Commuting pattern (traditional, cross- and reverse commuting), trip distance and duration, and travel mode are proposed to characterise commuting trips (see also Table 3 on page 35).

3.7. Chapter conclusions

I have demonstrated in this chapter that, post-suburban development has reshaped the urban structure in metropolitan areas. I outlined a non-exhaustive catalogue of post-suburban forms and processes that can indicate this restructuring. The suburbanisation of jobs; polycentric urban development with newly emerging suburban centres of employment, homes, commerce and services (edge cities); airport cities and suburban entertainment centres; tertiarisation of the suburban economy; postmodern architecture and the reorganisation of commuting patterns have been suggested as some of the main indicators of recent post-suburban development.

I have argued that major cities in Central and Eastern Europe entered a stage of their urban development where suburbanisation and post-suburbanisation are occurring concurrently but it is still debated if it creates a unique post-socialist urban development path. While suburban development has a rich body of literature, there is limited evidence of post-suburban forms and processes. It has been pointed out that while references have frequently been made to post-suburban development in CEE countries and in Budapest, empirical evidence is scarce. The post-suburban elements of the urban mosaic demonstrated in Budapest proved that the urban region of the Hungarian capital shows the signs of post-suburban development. This provides a justification for further, more in-depth study of the potential link between post-suburbanisation and commuting. As the transformation of commuting patterns is a good indicator of post-suburban change, the investigation of commuting patterns could provide additional evidence for post-suburban development trends.

Commuting patterns can best be characterised by the attributes of commuting trips and commuters. Based on the analysis of the available results of previous research, the following sub-questions have been formulated concerning the Budapest FUR (in addition to the first subquestion analysed in Section 3.4):

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?

The questions will be answered on the basis of the results of the empirical stage of this research presented in the subsequent chapters.

4. Methods used for the quantitative analysis

In order to explore the commuting patterns in the functional urban area of Budapest and find evidence for the relationship between commuting and post-suburbanisation, empirical research is needed. This chapter sets out to explain and justify the quantitative research methods applied during this research. As it was concluded in the previous chapter, empirical evidence for the change of commuting patterns is limited in the context of cities in post-socialist countries. Especially quantitative analysis is missing due to the limited availability of data. Previous empirical surveys on residential suburbanisation (Dövényi, Kok & Kovács, 1998; Izsák & Probáld, 2001; Szirmai *et al.*, 2011) and the suburbanisation of jobs (Kovács, Sági & Dövényi, 2001) in the Budapest FUR did not provide information on commuting patterns. This chapter first reviews the data sources used for this research. Then the methodology for analysis is introduced for both aggregate and disaggregate data. Finally, the method for the calculation of the suburbanisation index is presented.

4.1. Data sources

Data sources for the quantitative analysis have been surveyed in order to make a decision about the methodology of the analysis. The analysis of commuting figures can be carried out at different geographical scales according to how aggregate the available data are. Schwanen et. al. (2004), for example, examined commuting in the urban areas in the Netherlands at four levels: metropolitan, municipality, household and individual. Such a multi-level approach makes it possible to capture variations in travel behaviour influenced by factors at different geographical levels. The number of levels investigated depends on the accessibility of data. Aggregate (regional, metropolitan, and municipality) levels are used more frequently because officially collected statistics is usually available. Household and individual level figures are more limited. These investigations usually require surveys with a sufficient sample size, which entails using significant financial and human resources.

At the aggregate level, national censuses (1980, 1990, 2001)[16] provide the most reliable information on commuting as the sample includes all residents at the time of the survey. According to the terminology used for the censuses, commuters were defined as residents in employment who leave the municipality of their residence to work in another municipality on a daily basis. As I noted in Section 2.1, this definition limits commuting to inter-municipality trips. For the purpose of this study, in the analysis of aggregate data, commuting refers to trips across municipal borders. Census data provided information about the number of in- and out-commuters of municipalities, average travel time, as well as education and occupation. As I had no access to the raw figures of the Census, it was not possible to link socio-economic characteristics and trip attributes to the commuting trips themselves. Census data were

[16] Results from the latest Census in 2011 have not been published yet. Consequently, they were not taken into account in this research.

supplemented by aggregate commuting statistics from the 2005 Microcensus[17] and the yearly labour market surveys. Data from these sources, however, were only available at county level so comparisons between Budapest and Pest County[18]have been made. It is a limitation of the HCSO dataset that the latest commuting data at municipality level are only available for 2001 until the results of the 2011 Census are published. As soon as it happens, it will be possible to extend this research using the latest commuting figures.

There is more recent information available from HCSO on the commuting of students. The intensity of commuting in the FUR has been estimated by analysing data about the number of students attending primary and secondary schools in each municipality and the number of in-commuters to these municipalities.

Data from HCSO could only be used to carry out the analysis at an aggregate level and without being able perform a statistical analysis of association between variables. In order to carry out a more detailed analysis, data from two household surveys have been used:

- The Household Travel Survey in Budapest and in the surrounding municipalities (2004): The survey was commissioned by BKV, the public transport operator in Budapest, and was managed by Transman Kft. It included a total of 50,627 households. In this analysis, survey results about weekday travel from 30,258 Budapest households have been used to assess reverse commuting from Budapest
- The Household Travel Survey in the area of the Budapest Transport Association (BKSZ) (2007) was commissioned by BKSZ and carried out by Transman Kft. and Közlekedés Kft. collecting travel data from 9,000 households in 50 municipalities (for the survey locations see Fig. 2). Figures from the survey have been used to analyse traditional and cross-commuting in the FUR.

The survey respondents were selected by multi-stage cluster sampling. The population was subdivided into a number of clusters (municipalities) based on their population and distance from Budapest. Then a random sample of cases was drawn within each selected cluster. The results were weighted according to socio-economic factors (gender distribution, age, income)[19] in order to reflect the characteristics of the surveyed population (Transman Kft. & Közlekedés Kft., 2007). This probability sampling ensures that all members of the population in the study area had a chance of being selected.

As the original purpose of these surveys was the identification of main travel origins and destinations as well as travel purpose, travel mode and preferences in order to support transport planning activities and modelling in Budapest and the territory of the transport association, it was necessary to convert the data for the purposes of this research. My objective was to create a database that contains the commuting trips of employees and students. Incorrect or inaccurate records have been removed from the database (e.g. records without identifiable travel origin or destination). While commuters were not identified explicitly during the surveys, I identified commuters by trip purpose ("going to work/school from home"). As for students, their age was also taken into account in order to identify primary and secondary school commuters. In case of the 2004 survey, the regularity of the trip could also be identified ('daily' for commuters), while in the 2007 survey, I assumed that all

[17] Microcensuses are held in the middle of the period between two full censuses on a smaller sample in order to provide up-to-date information on social-economic processes between full censuses. In 2005, the sampling rate was 2% of the households (KSH, 2005).

[18] Pest County largely overlaps with the FUR (see Fig. 2).

[19] All further calculations and analyses were carried out by applying the weights provided in the databases for the BKV (2004) and BKSZ (2008) surveys.

trips to work having been reported as 'journey to work' were daily commuting trips except where the distance between the home and the workplace deemed it improbable. For students, individual trip characteristics had to be linked with features of the household (income) and those of the parents (father's and mother's educational attainment). This was carried out by creating relational queries in Micosoft Access. The original questionnaires of the surveys can be consulted in Appendix 1 & 2.

The analysis of the household survey has some limitations. As the surveys were not designed and carried out by me, I had no control over the sample size, the sampling rate, the contents of the questionnaire, and neither over data entry and possible errors. Consequently, there were some aspects of commuting that could not be investigated because related questions were missing from the survey questionnaires. The analysis of the relationship between suburbanisation and commuting, for example, would have been significantly easier if respondents had been asked when they had moved to their current home or when they had started to work for their current employer. On the other hand, the two household surveys provided a sample size and depth of information that could not have been achieved through a survey carried out with my own resources.

As the Census data were not available in the same level of detail as the household surveys (individual record level), the possibility of comparing statistics from different time periods was limited. Due to the different nature and sampling of the data sources, drawing conclusions based on the comparative analysis of the three datasets requires caution. Such possible discrepancies will be noted later during the analysis of the results. As the household surveys were carried out in a selection of municipalities, when I compared data from them with Census data, only Census information available for the respective municipalities was considered to provide a more reliable basis for comparison.

4.2. Quantitative methods

4.2.1. The methodology of statistical analysis

During the analysis, I have applied a variety of methods. Aggregate statistics collected and published by HCSO were analysed by using descriptive statistics (proportions, means, median) and the Pearson product-moment correlation coefficient to measure the strength of linear dependence between two variables. The results are presented in tables, charts, graphs and maps. GIS maps were also used as a tool for analysis of spatial distribution.

For the analysis of the household surveys, a combination of descriptive statistics (contingency tables, means, frequencies, median) and inferential statistics (statistical tests of association between dependent and independent variables) were adopted. The variables included in the analysis were selected based on the review of previous research (see Section 3.6) and the availability of the data from the surveys (Table 3).

Independent variables	**Type of variable**
Travel mode (car, public transport, other)	Categorical
Trip duration (minutes)	Interval* (treated as categorical)
Trip length (km)	Interval* (treated as categorical)
Number of cars in the family	Interval
Net family income (HUF)	Interval* (treated as categorical)
Educational status	Categorical

Table 3
Variables chosen for the statistical analysis
(* These variables are treated as categorical variables because the values are given in ranges.)

The choice of which statistics to use with a combination of variables has been determined by the types and number of the variables. Most of the variables were either originally categorical variables (educational level, commuting pattern) or were grouped into categories (e.g. income, trip duration). To analyse and present categorical data, contingency tables have been used and the chi-square test for independence has been applied to test the significance of the relationship between the variables. It has been ensured that the expected frequency will not fall below 5 in more than 25% of the cells, which is a prerequisite of the validity of the test. Adjusted standardised residuals have also been calculated to find out more about the nature of the association between the variables. A residual greater than 2 or less than -2 indicates a significant difference between observed and expected values (i.e. the cell percentage is significantly different from the expected percentage in the row or column total) (Diamond & Jefferies, 2001). Therefore, inferences were only drawn from the cells of the contingency tables that had adjusted residuals in these ranges. These cells are marked with orange shading in the subsequent tables. A confidence interval of 95% has been used. If the alpha value quoted is less than 0.05, the chi-square value is considered to be significant indicating that there is an association between the tested variables in the population from which the sample has been drawn.

As the chi-square test does not indicate the strength of the relationship, Cramer's V has been applied to estimate the strength of the association. It can only take a positive value; hence, the direction of the relationship is not indicated. Its value ranges between 0 and 1; the higher it is, the stronger the relationship is (Bryman, 2001). The strength of the relationship for nominal variables is usually regarded in social sciences as *strong* if the measure is greater than 0.3, *moderate* if it is between 0.11-0.3, and *weak* if it is between 0 and 0.11 (Healey, 2011).

Graphs and charts have been produced with Microsoft Excel, and the quantitative statistical analysis has been carried out with Microsoft Access 2007, Excel 2007 and IBM SPSS Statistics v20. Spatial analysis has been carried out and maps have been prepared with Mapinfo Professional 11.0.

4.2.2. Calculation of the suburbanisation index

In order to explore any potential links between suburbanisation and commuting to school, I have calculated a suburbanisation index to be able to compare out-commuting and the level of suburbanisation in municipalities in the FUR.

First, I reviewed previous attempts to calculate such indices. Dövényi et. al. (1998), Dövényi and Kovács (1999) and Daróczy (1999) compared the change in housing stock, population and migration between municipalities in the Budapest Agglomeration and in Pest County. Others combined socio-economic, demographic and economic measures (Izsák, 1999; Kovács, 1999a). Bajmócy (2003, p.12) defined suburbs as 'peri-urban settlements, which are mainly dynamised through the relocation of a certain part of the urban population and/or urban activities'. He tested several indicators (e.g. car ownership, change in the housing stock, migration) and their combinations, and concluded that although none of the combinations of the indicators are suitable for the identification of suburbanising settlements for the whole country, an index of suburbanisation[20] would be viable to define such municipalities within a well-defined region. He tested the index on Fejér County and discovered that it appropriately indicated suburbanising settlements at the regional level.

[20] He suggested that the following indicators should be combined into an index: change in population (1995-2000), migration balance (1995-2000), change in the housing stock (1995-2000), car ownership per 1000 inhabitants (2000), taxable income per person (1998), and non-activity index (1998) calculated from the proportion of tax-payers and unemployed in a settlement.

Based on this latter method I calculated the index for Pest County using more up-to-date data and delineated suburbanising municipalities (Keserű, 2004b). In his later papers, Bajmócy (2006; 2012) only used demographic measures (population change and migration balance).

While it would have been practical to use one of the previously reviewed indices, there are three important reasons why I decided to produce a new index. Firstly, I think as I suggested in Section 2.2, only dynamic measures should be used in the suburbanisation index, which better reflect the process itself. Secondly, the data taken for the above indices are out-dated today, as most of the required statistics is available up to 2010 from THE HCSO. Thirdly Bajmócy's (2003) index was not produced for the Budapest urban region or later results were not available for all municipalities in the FUR (Bajmócy, 2006).

Unfortunately, data on the migration balance between Budapest and municipalities in the FUR are not available, so other measures have to be used that can indicate deconcentration from the core city. As population change and the total migration balance of municipalities between 1995-2010[21] have been found suitable to indicate the movement of population from the centre to the periphery (Bajmócy, 2006), they have been used as components of my index as well. The change in the housing stock has also often been used as an indicator of residential suburbanisation as the expansion of the population is expected to boost new construction. Hence, the change in the building stock is used as the third component. As it was indicated earlier, my index should avoid including population changes other than medium-to-high status people moving from Budapest to the suburbs. To ensure that this restriction is considered by the index, a measure expressing the change of the socio-economic status of the population is used here: the change in the yearly domestic income[22] of the population between 1995 and 2010[23]. In order to avoid favouring municipalities with a small population and discriminate municipalities with already high values in 1995, not only the percentage change but also the absolute change have been taken into consideration for all four measures (Bajmócy, 2006). The components of the index are summarised in Table 4.

Component	**Dimension**
Change in population (1995-2010)	per cent
Total change in population (1995-2010)	persons
Migration balance (1995-2010) (only permanent change of residence was considered)	per cent
Total migration balance (1995-2010) per 1000 inhabitants (only permanent change of residence was considered)	persons
Change of housing stock (1995-2010)	number of buildings
Change of housing stock (1995-2010)	per cent
Change of total yearly domestic income per resident	Hungarian Forints
Change of total yearly domestic income per resident	per cent

Table 4
Components of the suburbanisation index
(Source: Own elaboration)

In order to be able to combine the different components of the index, they had to be normalised, i.e. values should range from 0.0 to 1.0. The municipality with the best value

[21] The starting date for the data comparison has not been changed as there are significant discrepancies between pre- and post-1995 data due to data collection issues (Bajmócy, 2003).

[22] Although only about 40% of the total income of people are registered through the yearly domestic income subject to personal income tax, it has widely been used to compare the level of socio-economic development of different regions or settlements due to its accessibility and availability from 1988 onwards (Kozma, 2006; Kiss, 2007; Faluvégi & Tipold, 2012).

[23] The inflation was not taken into consideration as it affected all members of the population equally and hence would not distort inter-municipality differences in the database.

received a score of one, while the one with the worst value has been given a score of 0. All the other settlements received a score between 0 and 1 based on their original distribution within the effective range of the variable. Normalisation was carried out on all eight components of the index. The suburbanisation index was calculated as the mean of the eight scores multiplied by 100 (Bajmócy, 2003; Keserű, 2004b). The scores calculated for each municipality[24] in the FUR are listed in Appendix 4 and presented on a map in Fig. 7 on page 40.

The mean suburbanisation index is 17. The ranges above and below the middle range are one standard deviation above or below the mean. Values above the mean indicate moderate (17-26) and high (26-68) dynamics of suburbanisation, while any values below the mean suggest that the municipality is not affected by suburbanisation measured by this index.

5. The characteristics of commuting to work in the Budapest FUR

This chapter presents the results of the data analysis on commuting to work. It is divided into two main sections. In the first part, an overview on recent trends concerning the demand for and supply of employment as well as commuting trends will be given by analysing aggregate data (county and municipality level). As the suburbanisation of employment is one of the indicators of post-suburbanisation, the distribution of jobs between Budapest and its surroundings is analysed with special consideration given to service-sector and white-collar jobs. In the second part, the analysis of data from the household surveys will be presented and discussed giving a more detailed picture of commuting and commuters in the FUR of Budapest.

5.1. Analysis of aggregate data

5.1.1. Demand for jobs

The demand side of commuting to work is determined by the location of the homes of the working-age population[25]. The growing size of the working-age population increases the demand for jobs and – if they are not available locally – the need for commuting as well. The size of the working-age population may change due to the changing age structure of the population and also owing to migration. In the Budapest FUR, the proportion and distribution of working-age population is influenced by two factors: the ageing population of Budapest with a decreasing number of people in the working age, and migration to the suburbs that increases the demand for jobs in suburban areas. Although this migration originates from all over the country and also from abroad, the main source is Budapest. The dynamics of migration between Budapest and Pest County is a good indicator of population deconcentration (Dövényi & Kovács, 1999, 2006). According to these data, suburbanisation reached its peak in 2000, and since then its dynamics have been decreasing. While Bajmócy (2006) could still detect an intensification of suburbanisation measured by the population increase in municipalities around large towns for the period between 1995 and 2004, the latest

[24] Data for municipalities that did not exist as an independent entity in 1995 was not available hence they were not included in the calculations (Óbarok, Csörög, Remeteszőlős).

[25] Although the working age is between 15 and 64 according to the definition of HCSO, here the age group 18-59 will be used, as population data are easier to access for this group, and it allows for comparison of data back to 1990 irrespective of changes of the retirement age. As the majority of 15-17 year olds are in education, I think that not including them in the working-age population has not distorted the analysis significantly.

statistics indicate that migration from Budapest to Pest County decreased to pre-1995 levels after 2008, while moves from Pest County to Budapest slightly increased dropping the migration balance to just 4500 in 2011 (Fig. 6). By 2010, the suburban zone around Budapest started to shrink. In 2010 only 55% of the municipalities in the capital's suburban zone increased its population in contrast to 83% in 2002 (Bajmócy & Györki, 2012).

Migration data indicate that residential suburbanisation has been a major determinant of changes in the size of the labour force in Central Hungary. The significant fall in migration balance after 2008 is probably the consequence of the economic crisis, although it could indicate a permanent decline and the end of the boom of residential suburbanisation. At the moment, it is not possible to confirm either.

The extent of residential suburbanisation has not been even within the FUR. I calculated a suburbanisation index described in Section 4.2.2 that is expected to reflect the dynamics of residential suburbanisation between 1995 and 2010 at municipality level. The most dynamically suburbanising municipalities are usually close to Budapest. Their regional distribution has not changed considerably compared to previous similar analysis at the end of the 1990s (Kovács, 1999a) and beginning of the 2000s (Keserű, 2004b). A slight expansion of the dynamic area can be detected in the south (e.g. Dunaharaszti), in the west outside the official Budapest Agglomeration (Etyek), in the northwest (Pilisjászfalu), in the north (Pócsmegyer) and in the northeast (Csomád). The south-eastern agglomeration continues to be less affected by suburbanisation with only four municipalities showing moderate dynamics (Gyál, Üllő, Gyömrő, Maglód).

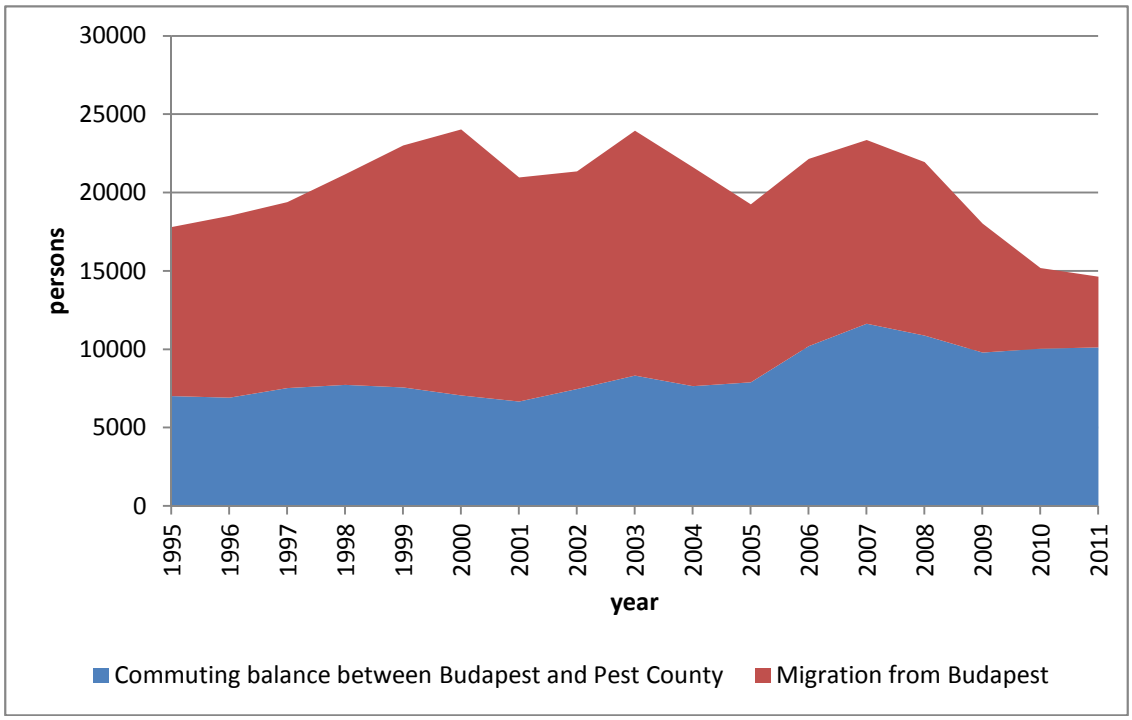


Fig. 6
Migration balance between Budapest and Pest County (only permanent migrants are included) (Source: Own elaboration based on HCSO data)

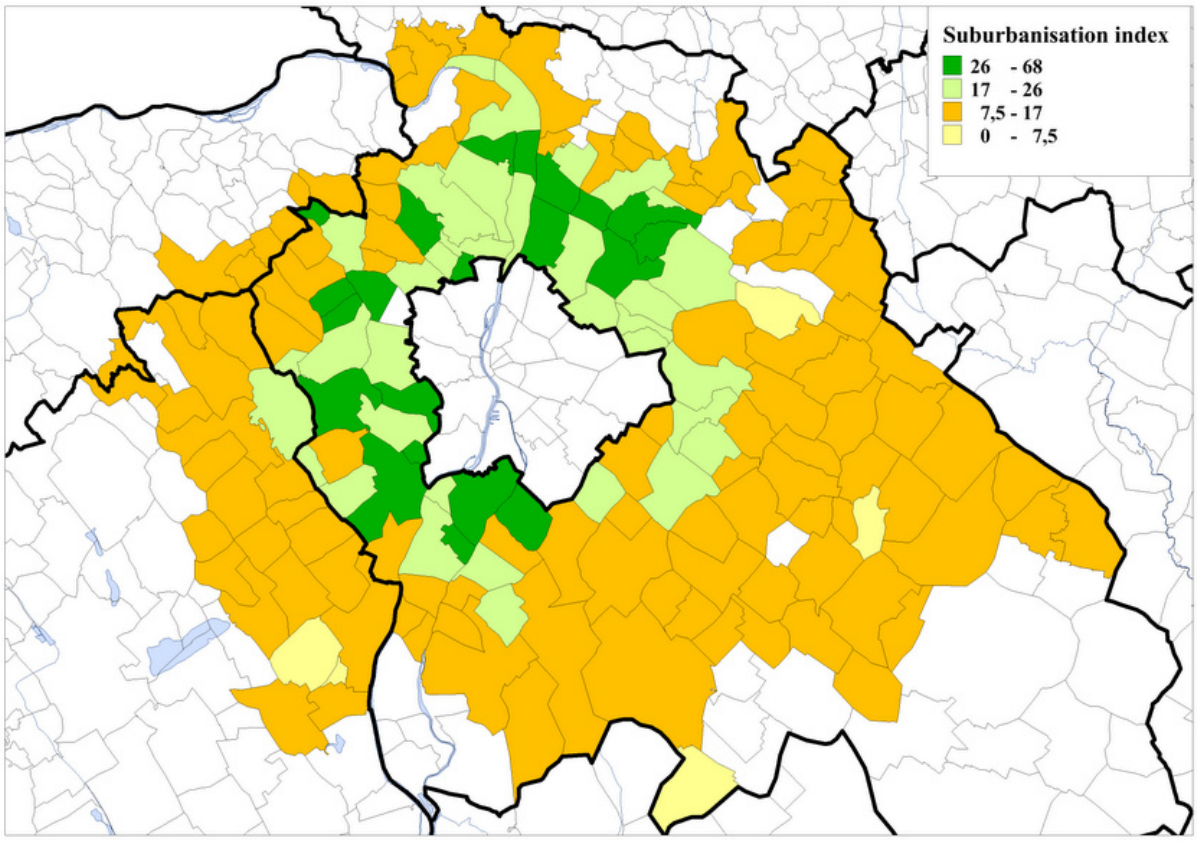


Fig. 7
The suburbanisation index of the municipalities of the FUR
(Source: Own elaboration)
(The actual values of the index can be consulted in Appendix 4)

Due to migration and the younger age structure in the FUR, the size of the working-age population increased by 33% between 1990 and 2010. During the same period, the population in this age group grew only by 2% nationally and decreased by 9% in Budapest. This indicates that the demand for jobs increased considerably in the FUR between 1990 and 2010. At the same time, the active population (those aged between 18-59) continued to shift from Budapest to Pest County due to continuing residential suburbanisation and ageing in Budapest. In 2010, 42.5% of the working-age population of Central Hungary lived in Pest County compared to 38.2 % in 2000.

5.1.2. Supply of jobs

One of the most important determinants of commuting is the number of jobs available in a certain area (Kapitány & Lakatos, 2005a). The balance of jobs and homes in a particular locality is a good indicator for the propensity to commuting. In Hungary, accurate data about the number of jobs at municipality level are only available from the national censuses in the form of the *number of persons in employment*[26]. Between 1990 and 2001 – the last full Census from which statistics are available – the number of persons in employment in Budapest decreased by 21% due to the economic transformation of the country and the ageing of the population. Contrary to national trends and the decrease in Budapest, the number of jobs grew in the agglomeration belt during the same period. The growth was more intensive in

[26] *Persons in employment* are those people 'who are aged 15 and over, who, during the reference week, performed some work, even for just one hour per week, for pay, profit or family gain' (Eurostat, 2012).

the western and north-western sectors of the agglomeration. The growth poles that we referred to in Section 3.4 excelled at job growth (Fig. 8).

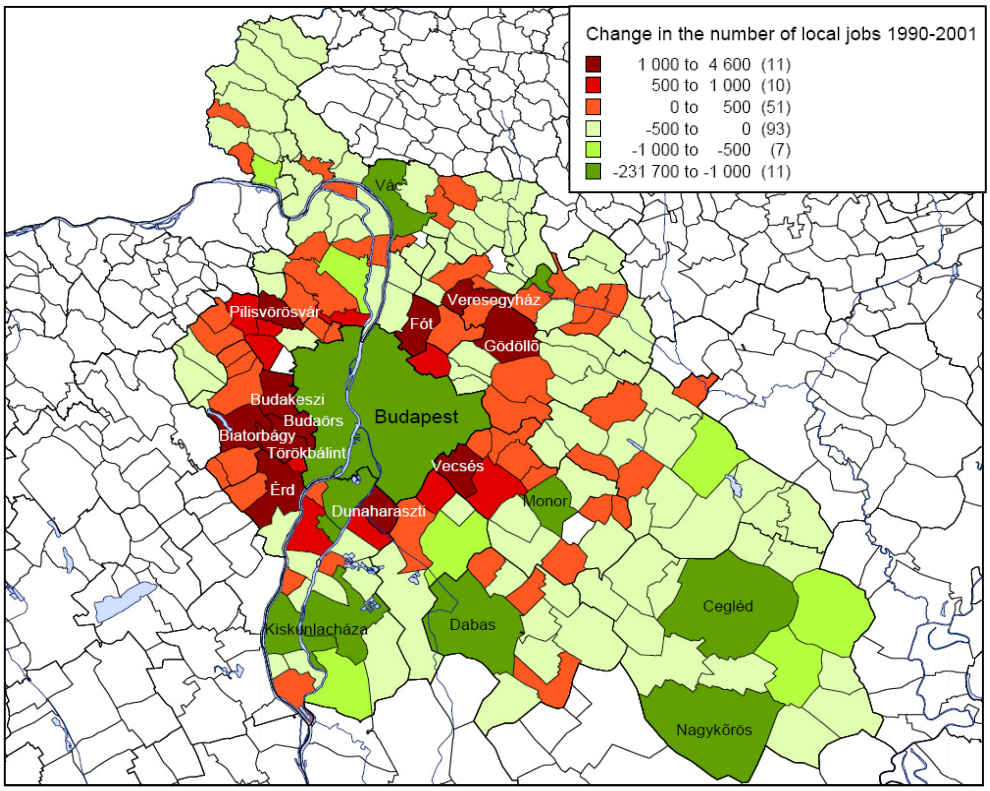


Fig. 8
Change in the number of jobs in the FUR 1990-2001
(Source: Own elaboration based on HCSO Census data, 1990, 2001)

Apart from the censuses, employment data are only available at a county level based on the yearly labour force surveys[27] carried out by THE HCSO. In these statistics, the number of employees[28] is collected as opposed to the number of jobs. Entrepreneurs and self-employed people, for example, are not included in the category of employees. Nonetheless, as the majority of jobs are filled by employees (87.5% in Pest County in 2005), I think these statistics provide an acceptable representation of the distribution of jobs. An advantage of this data is that employment is given based on business sites as opposed to the municipality of the company headquarters. Although these figures do not provide such a detailed picture as censuses, the distribution of employees between Budapest and the surrounding Pest County can be calculated.

Between 1993 and 2010, there was a continuous shift in the proportion of employees within Central Hungary from Budapest to Pest County. It accelerated after 2000 rising from 20.3% to 25.4% outside Budapest (Fig. 9). In numbers, employment decreased both in

[27] The labour force survey collects data about employment activities of about 38,000 persons every year. The sample is representative of the population to county level.

[28] *Employees* 'work for a public or private employer and receive compensation in the form of wages, salaries, payment by results, or payment in kind'. They are distinguished from *persons in employment* (compare footnote 26) as the category *employees* does not include self-employed persons who work in their own business, farm or professional practice (Eurostat, 2012).

Budapest and in Pest County before 1999[29]. Between 2000 and 2005, the number of employees grew only by 2% in Budapest compared to 22% in Pest County. Between 2006 and 2010, the number of employees decreased by 2% in the capital, while it continued to increase in Pest County by 4% despite the economic crisis. The rise in the number of employees in Pest County surpassed that in Budapest. Between 2000 and 2005, 2.5 times as many new jobs were created in Pest County as in Budapest. Between 2005 and 2010, the number of jobs dropped by 23,643 in Budapest, while it grew by 12,279 in Pest County.

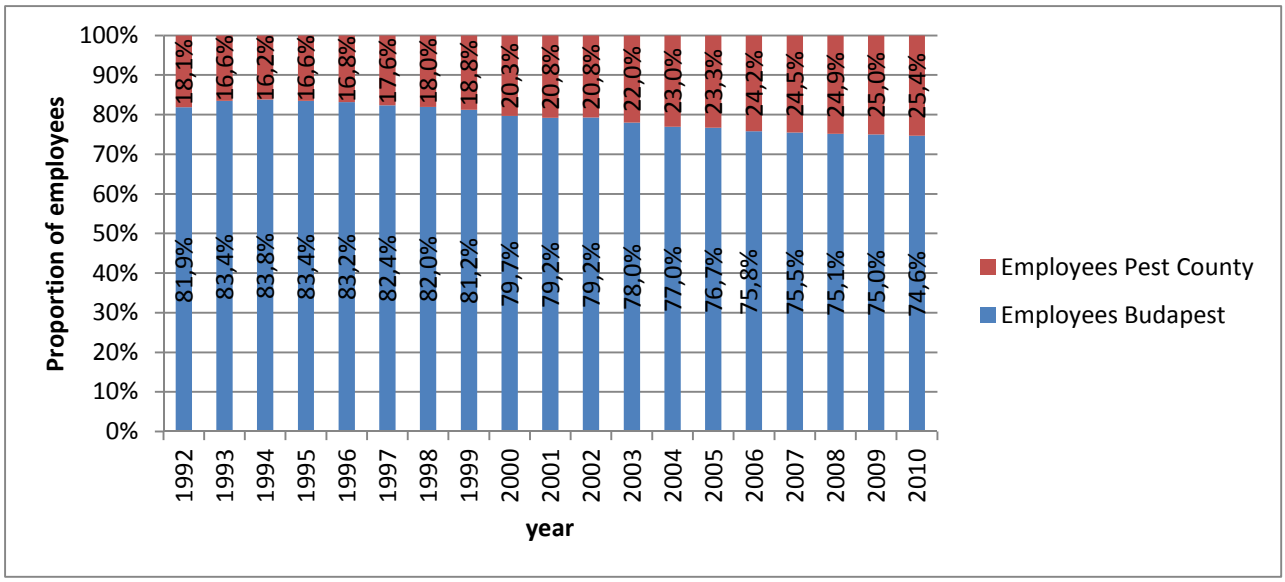


Fig. 9
The distribution of employees between Budapest and Pest County between 1992 and 2010 (Source: Own elaboration based on HCSO data)

The distribution of enterprises in the functional urban region may also indicate economic suburbanisation (Timár, 2005). Although the number of registered and active enterprises[30] may not directly refer to the number of jobs, it has been used as an indicator of economic suburbanisation as this data are available for municipalities on a yearly basis (Bihari, 1999; Barta, 1999; Koós, 2004).

The change in the distribution of active enterprises between Budapest and Pest County shows a similar pattern to employees. Suburban municipalities saw a 250% increase in the number of registered enterprises between 1990 and 1995, and a further growth of 33% between 1996 and 2001. During the same period, Budapest's growth was only modest at 22% (Soós & Ignits, 2003). While many of the new businesses in suburban areas were green-field investments by international companies, those who relocated mostly did so from Budapest. Between 1999 and 2001, two-thirds of relocating businesses that settled in Pest County had their previous seats in Budapest (Koós, 2004). The growth in the number of active enterprises

[29] Data from the labour force survey are not directly comparable over the 1992-2010 period for which they are published, as the methodology changed several times. Before 1999, only employees working at organisations with at least 20 employees were registered. In 1999, the threshold was decreased to 4 and in 2006 to 1 employee. Therefore, in order to compare the distribution of jobs between Budapest and Pest County, proportions were calculated for each year. Absolute numbers are only compared within the periods of 2000-2005 and 2006-2010.

[30] Registered enterprises are enterprises that legally exist at the moment of the statistical data collection including organisations under liquidation, bankruptcy, and dissolution proceedings. Active enterprises are organisations that reported turnover and employees for the reference year. The latter are more representative of actual economic activity as the category of registered enterprises includes so-called 'phantom entities' that do not carry out any economic activities but are prevalent in Hungary(Koós, 2007a).

was similar in Budapest and Pest County between 1999 and 2010 (31,039 and 27,978 respectively), but proportionally this meant that the number of active companies increased by 19.5% in Budapest and 45.4% in Pest County. As a consequence, a slow shift of the growth of active enterprises towards Pest County can be detected (Fig. 10).

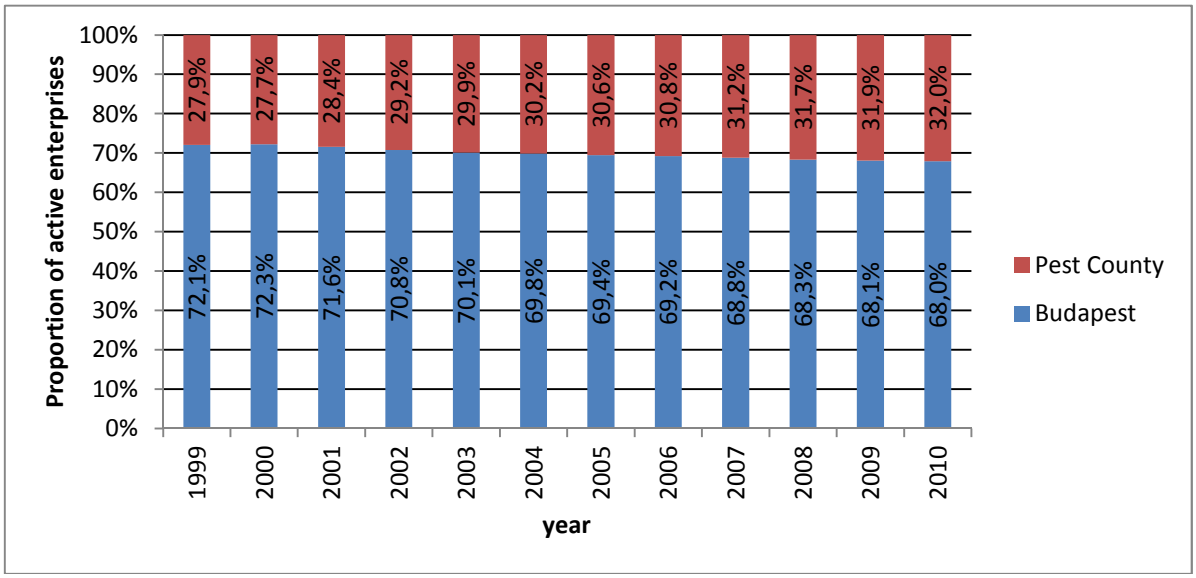


Fig. 10
The distribution of active companies between Budapest and Pest County between 1999 and 2010 (Source: Own elaboration based on HCSO data)

I think that the growth in the number of employees, the high number of relocations from Budapest to Pest County, and the increase in the number of companies indicate the suburbanisation of jobs around Budapest.

The suburbanisation of employment itself does not necessarily indicate post-suburbanisation. Post-suburbanisation is characterised by the predominance of service-sector jobs, white collar employees and high-tech companies (Borsdorf, 2004). In order to reveal if the accelerated employment growth around Budapest could indicate post-suburbanisation, the structure of employment needs to be explored.

The number of employees in the services and manufacturing has been determined by the sum total of employees related to certain economic activities based on NACE (TEÁOR) (Statistical Classification of Economic Activities in the European Community) codes[31].

The analysis of data on service employees confirmed my conjecture. The number of service employees decreased by 10% in Pest County between 1993 and 1998[32] and by 23% in Budapest. A twofold increase in the number of people working in services was detected in Pest County between 2000 and 2011, which is five times greater than the increase in Hungary or in Budapest during the same period (Fig. 11).

[31] The Hungarian classification of economic activities was changed during the past decade. For data between 2008-2011, activities with codes beginning with G to N and S were considered as services, and B to E as industry (not including construction industry); for data between 2000-2008 activities G to K and O were considered as services and C to E as industry (not including construction industry); See Appendix 3 for an explanation of the codes.

[32] Data are not directly comparable over the 1993-2010 period for which they are published, as the methodology changed in 1999. Before 1999, only employees working at organisations with at least 20 employees were registered. In 1999 the threshold was decreased to 4. Absolute numbers are only compared within the periods of 1993-1998 and 2000-2010.

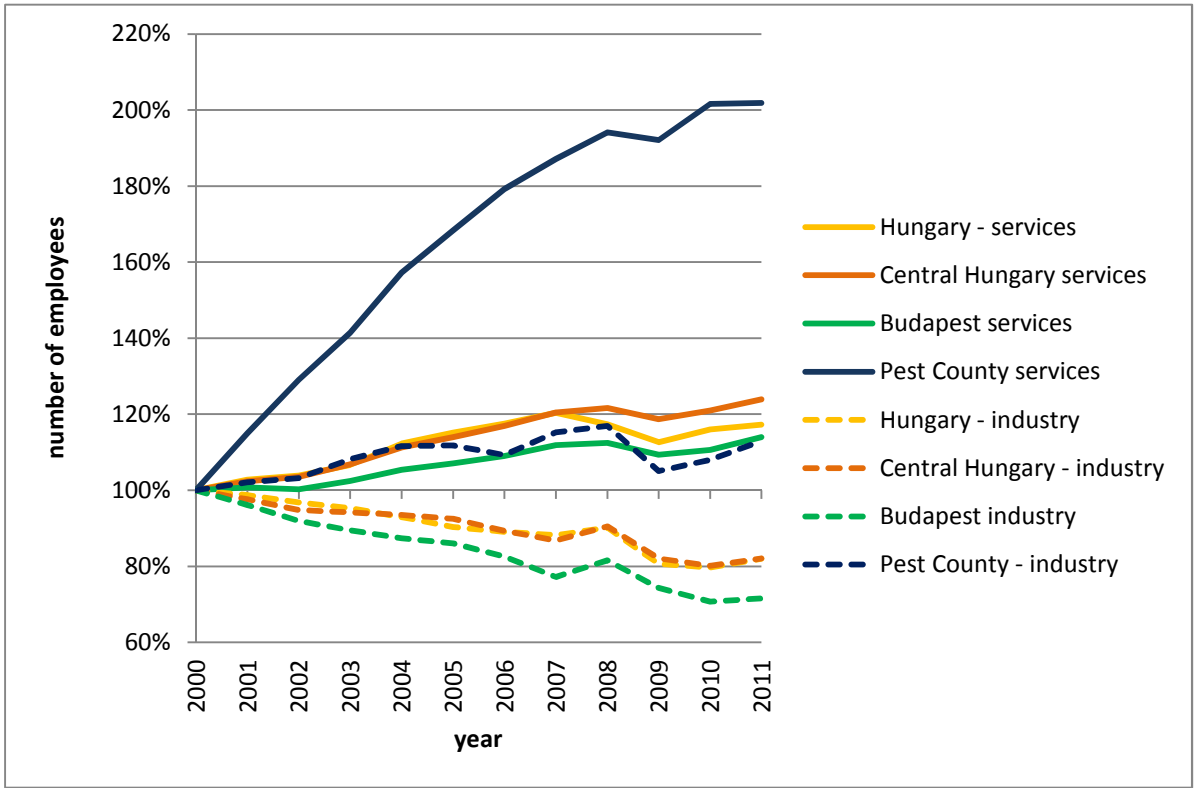


Fig. 11
Change in the number of employees in the services and industry 2000-2011 (2000=100%)
(Source: Own elaboration based on HCSO data)
(Data for the period before 2000 are not displayed as they are not comparable to post-2000 data due to the different collection methodology)

If we examine the sectoral structure of the change in employment in Central-Hungary we may be able to point out if there is a shift of some economic activities from the urban core to suburban areas. In seven of the twelve main economic sectors, employment shifted towards Pest County between 1992 and 2008 (Table 5). The most significant shift occurred in wholesale and retail trade. It is not surprising considering the mushrooming of hypermarkets and large specialised stores along the motorways leading to Budapest. Suburban growth in comparison to the core city was also marked in manufacturing, accommodation and catering services (hotels and restaurants), real estate, renting and business activities (especially in real estate activities, renting and other economic services that covers a broad range of activities like marketing, engineering and consultancy). At the same time, the position of Budapest as the centre of the financial sector, health, education and public administration was not challenged. The emergence of the quaternary (IT, media, research and development) and quinary (managerial and decision making) sectors is still sporadic (see for example the new national headquarters of Telenor in suburban Törökbálint).

Economic sector	Proportion of employees within Central-Hungary			
	1992*		2008**	
	Budapest	Pest County	Budapest	Pest County
Agriculture, hunting and forestry	19.5%	80.5%	35.8%	64.2%
Manufacturing	75.1%	24.9%	69.9%	30.1%
Construction	80.6%	19.4%	74.5%	25.5%
Wholesale and retail trade; repair of motor vehicles and motorcycles personal and household goods	86.0%	14.0%	68.5%	31.5%
Hotels and restaurants	93.5%	6.5%	84.6%	15.4%
Transport, storage and communication	88.5%	11.5%	92.4%	7.6%
Financial intermediation and services	90.5%	9.5%	97.5%	2.5%
Real estate, renting and business activities	94.7%	5.3%	88.6%	11.4%
Public administration and defence; compulsory social security	95.5%	4.5%	90.8%	9.2%
Education	73.2%	26.8%	73.5%	26.5%
Health and social work	73.4%	26.6%	83.9%	16.1%
Other community, social and personal service activities	89.7%	10.3%	86.2%	13.8%
All activities	81.9%	18.1%	80.5%	19.5%

Table 5
The distribution of employees within Central-Hungary by main economic sectors 1992 & 2008 (Source: HCSO)
*** In 1992, only employers with at least 20 employees were included in the statistics.**
****In 2008 all employers with at least 4 employers were included.**
The grey shading indicates an increasing proportion between 1992 and 2008

If we examine some of the subsectors within the above larger groups of economic activities it is suggested that while employment is growing in Pest County in the services sector in general, the shift of employment growth to the suburbs is still focused on manufacturing, wholesale and retail trade which corresponds to the initial phases of employment suburbanisation in the USA and Western Europe. Although the number of knowledge-based business services (management consulting, marketing, advertising, database management, software development and human resources management) also achieved a considerable growth between 2000 and 2007, while Budapest was losing its significance (Nagy & Nagy, 2009), in other subsectors like financial services, research and development and IT services a very slow shift from the core city to the suburbs can be identified due to the overwhelming predominance of Budapest (Table 6)[33]. For a comparison, the proportion of employment in the subsector of professional, scientific and technical services in the suburbs of metropolitan Philadelphia was 65.5% (Muller, 2004); in contrast, only 9.7% of the employees of this sector worked outside of Budapest but within Central Hungary in 2012.

[33] It must be noted that due to the relatively small number of employees in some of the sectors (e.g. Research and Development, IT services) the closure or opening of just one company with a high number of employees can significantly alter the distribution of employment between Budapest and Pest County.

	Manufacturing	Wholesale retail	Retail trade	IT services	Research and development	Miscellaneous economic services	Logistics and travel	Financial services
2000	25.5%	16.8%	31.4%	6.6%	8.0%	8.2%	9.2%	1.9%
2003	29.3%	23.5%	37.1%	5.5%	8.3%	13.5%	12.3%	2.5%
2008	32.1%	26.9%	41.6%	6.2%	8.7%	13.1%	11.6%	2.3%
2012	34.9%	30.0%	43.5%	n.a.	n.a.	n.a.	n.a.	2.7%

Table 6
The proportion of employees working in Pest County within Central Hungary in selected economic subsectors
(Source: Own calculations based on HCSO data)

While the current global economic crisis has had serious consequences for the structure and dynamics of the development of both the manufacturing industry and services, the setback has been less pronounced in Pest County (Fig. 11). After a slight drop in 2008, the number of employees continued to increase and reached or - in case of services - exceeded pre-2008 levels.

It is a general tendency in the country that the number of white-collar jobs has been increasing while blue-collar jobs are shrinking. The analysis of data about the proportion of white-collar workers in Central Hungary[34] has shown that after 2000, the rate of growth of white-collar jobs was three times higher in Pest County than in Budapest and in Hungary. During the same period, the number of blue-collar jobs increased significantly as well contrary to a countrywide shrinkage, but the rate of growth was half of that of white-collar workers (Fig. 12).

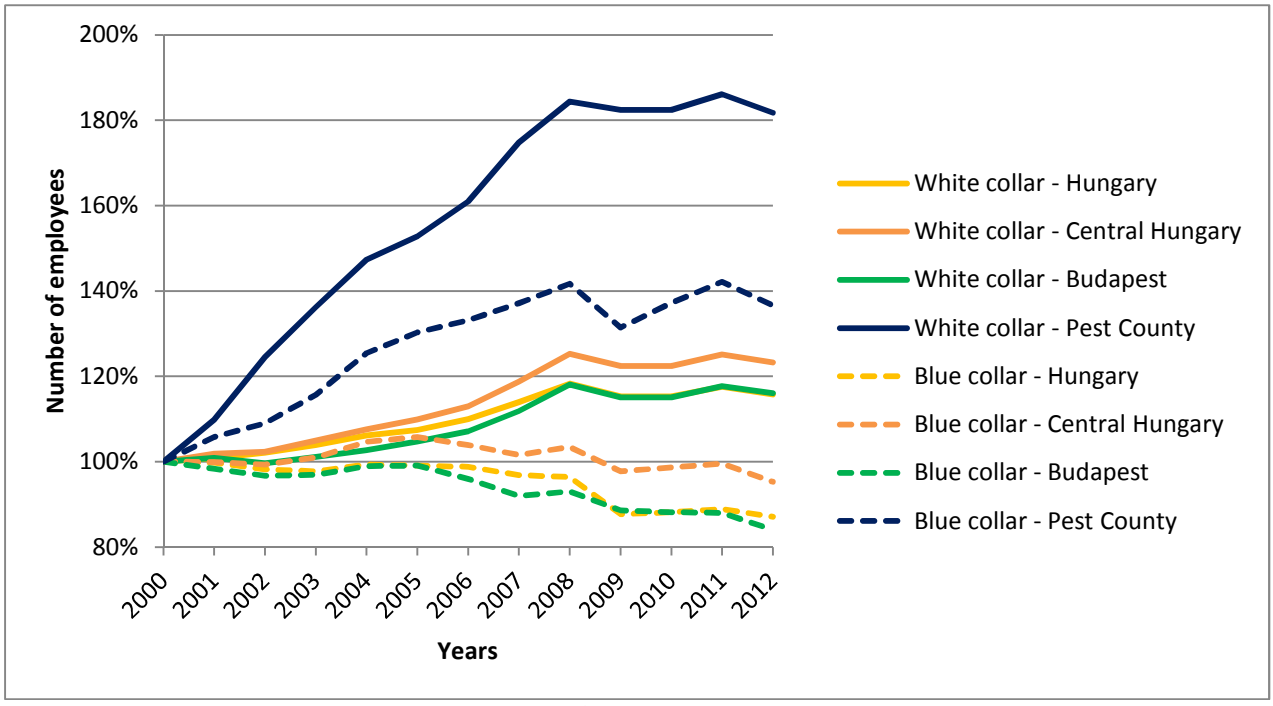


Fig. 12
Change in the number of white- and blue-collar employees of enterprises in Budapest, Pest County, Central Hungary and Hungary between 2000 and 2010 (2000=100%)
(Source: Own elaboration based on HCSO data)

If we examine the proportion of employees according to their job status (white- vs. blue-collar), however, no structural changes can be discovered. Workforce in Pest County

[34] Only employees of enterprises were considered in the data analysis to avoid the influence of public (government and municipal) services.

remained fundamentally blue-collar with the proportion of white-collar employees rising from 29% in 2001 to 34% in 2010. Over the same period, the proportion of white-collar employees increased from 46% to 54% in Budapest. The preceding analysis of sectoral changes in employment can explain this phenomenon. A considerable number of new jobs in Pest County were created in manufacturing, wholesale and retail trade, which traditionally employ a large number of blue-collar workers as opposed to research and development or financial services.

The analysis of data on the changes in the distribution of employees has provided evidence for the increasing suburbanisation of jobs around Budapest after 2000. Job growth in the suburban areas surpassed the rise of employment in Budapest. In addition, there was a continuous shift of growth in the number of active enterprises from Budapest to Pest County.

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 around Budapest.

It is important to note that the scale of the transformation has not been great enough to change the fundamentally monocentric structure of the functional urban area. In 2010, still 74.6% of all employees in Central Hungary worked in Budapest, which remained the most important economic centre.

5.1.3. The development of commuting in the Budapest FUR

5.1.3.1. Commuting before 1990

Before delivering the analysis of current commuting trends, I find it necessary to give a short overview of the historical development of commuting in the Budapest FUR. Commuting to Budapest intensified in the 1920-1930s prompted by industrial development in the nation's capital and by the development of transport networks (Illés, 2000). Commuting was given another boost during the large-scale industrialisation in the 1950s. While priority was given to the development of the industry in cities, there was a shortage of housing and services, which induced commuting from nearby villages (Szelényi & Konrád, 1971). Later this was exacerbated by administrative restrictions regarding migration to Budapest[35]. Consequently, the villages and towns around the capital accommodated newcomers from the countryside. In the 1960s, around 200,000 employees commuted to Budapest. In the agglomeration, outside Budapest, only few jobs were created. In 1967, only 6.4% of all industrial jobs in the agglomeration were located outside of Budapest (Dövényi & Kovács, 2006), and there were only few notable new industrial centres in its surroundings (Százhalombatta, Dunakeszi, Gödöllő, Vác, Szentendre), which became subcentres (Izsák & Probáld, 2001). Although from the 1970s new industrial development was directed towards the countryside to reduce the disparity between the capital and the rest of the country, Budapest remained the most important employer in its region (Illés, 2000). Due to the shortage of workforce in Budapest, industrial development in the capital and its agglomeration was restricted by the government,

[35] From 1965, a permanent residence permit could only be obtained if one could certify at least 5 years of employment in Budapest and/or 5 years dwelling at a temporary address in Budapest (Dövényi & Kovács, 1999).

which prevented industrial suburbanisation common in Western Europe at that time. This also contributed to the growing number of commuters to the capital until the mid-1980s.

The Census of 1990 showed a significant fall in the number of commuters to major urban centres in Hungary due to the economic crisis and the collapse of the socialist industry. By 2001, the number of jobs in Budapest decreased by 21%, but the drop in the commuting to the capital was more moderate at 11% (Kapitány & Lakatos, 2005a). Between 1990 and 2001, the proportion of commuters within the group of employees working in Budapest increased from 18% to 21%. This indicates that the daily mobility of employees grew after the fall of communism. This was also a necessary adjustment of employees due to significant unemployment that made finding a job locally more difficult (Nagy, 2009).

5.1.3.2. Cross-commuting

A comparison of commuting patterns between 1980, 1990, 2001 (censuses) and 2005 (Microcensus) is only possible at the level of Pest County and Budapest due to the limited availability of municipality data. Commuting originating from Pest County with a destination within the county could best represent cross-commuters, while the majority of commuters crossing the county border commute to Budapest (Table 7).

The emergence of cross-commuting is not a recent phenomenon. Industrial towns around Budapest (e.g. Vác, Gödöllő, Cegléd, Dunakeszi, Százhalombatta) attracted employees from neighbouring municipalities long before 1990. This is the reason why the proportion of cross-commuters reached 27.5% in Pest County already in 1980. After 1990, the number of commuters fell due to the collapse of socialist industry around the capital. In this period, not only the growth of employment but also that of commuting in Central Hungary was still concentrated to Budapest. Between 2001 and 2005, however, a more perceptible increase in cross-commuting occurred. While both the number of commuters to Budapest and within Pest County rose, the growth was more than twice as high within Pest County (35%) than to Budapest (16%), most likely reflecting the shift of job growth from Budapest to its surroundings in the past decade. These results, however, need to be treated with caution, because the Microcensus in 2005 was based on data from only 2% of the households. The trends suggested here therefore need to be confirmed as soon as detailed commuting data from the Census in 2011 is available.

	1980		**1990**		**2001***		**2005***	
	Within the county	**To another county****	**Within the county**	**To another county**	**Within the county**	**To another county**	**Within the county**	**To another county**
	Percentage of all commuters from the county							
Proportion within all commuters	27.5%	72.5%	28.4%	71.6%	29.0%	71.0%	32.3%	67.7%
Number of commuters	n.a.	n.a.	68166	172015	60936	149161	82372	172295

Table 7
Cross-commuting in Pest County between 1980 and 2001
(Source: Own calculations based on HCSO Census [1980, 1990, 2001] and Microcensus data [2005])
***In 1980 and 1990, the number of commuters to variable settlements was negligible and not registered. For the purpose of comparability of data, they were not included in the calculations for 2001 and 2005 (Fóti & Lakatos, 2006)**
****** including Budapest**

1990			2001				
Municipality	**Number of in-commuters**	**Proportion of in-commuters to locally employed workforce**	**Municipality**	**Number of in-commuters**	**Proportion of in-commuters to locally employed workforce**	**Proportion of cross-commuters to in-commuters**	**Change in the number of in-commuters 2001/1990**
Budapest	196431	18%	Budapest	175151	20%	n.a.	-21280
Vác	8757	42%	Budaörs	9668	68%	47%	3508
Gödöllő	6396	43%	Gödöllő	8098	51%	89%	1702
Budaörs	6160	63%	Vác	7761	43%	95%	-996
Szigetszentmiklós	4579	53%	Törökbálint	3498	65%	63%	1386
Dunakeszi	3327	39%	Érd	3074	27%	72%	567
Szentendre	3304	38%	Százhalombatta	3037	37%	90%	0
Százhalombatta	3037	35%	Dunakeszi	3007	36%	70%	-320
Érd	2507	30%	Szentendre	2882	36%	66%	-422
Szigethalom	2482	69%	Szigetszentmiklós	2770	42%	74%	-1809
Törökbálint	2112	59%	Dunaharaszti	2577	48%	58%	1383
Kerepes	2054	44%	Vecsés	2070	40%	73%	1133
Monor	1907	33%	Fót	1938	41%	55%	714
Solymár	1756	61%	Budakalász	1595	54%	50%	401
Iklad	1723	79%	Biatorbágy	1591	54%	73%	1369
Nagykáta	1340	30%	Kistarcsa	1577	54%	22%	-85*
Dabas	1337	24%	Nagykáta	1411	35%	99%	71
Göd	1265	41%	Pomáz	1345	38%	66%	-106
Fót	1224	34%	Veresegyház	1315	45%	84%	825
Dunaharaszti	1194	55%	Solymár	1311	46%	16%	-445

Table 8

Comparison of the number of in-commuters between the 1990 and 2001 Censuses in the FUR; Top 20 municipalities in 1990 and 2001
Green shading indicates a better position with increasing number of in-commuters in 2001 as compared to 1990
***As Kistarcsa and Kerepes were one municipality in 1990 this figure reflects the change in both settlements combined.**
(Source: Own calculations based on HCSO Census data 1990, 2001)

The examination of the number of in-commuters for municipalities that were the most attractive for commuters in 1990 and 2001 has revealed that there was a dramatic restructuring in commuting destinations in Pest County between 1990 and 2001[36]. New destinations emerged and traditional towns and villages where industry collapsed disappeared from the list of the top commuting destinations (Table 8).

The neighbouring towns of Budaörs and Törökbálint in the western part of the agglomeration, Dunaharaszti in the south, and Fót in the north demonstrated significant increases. These are the municipalities that were identified as 'new economic poles' around the capital (Burdack, Kovács & Dövényi, 2004), which attract both cross- and reverse commuters[37]. Transport connections and proximity to Budapest seem to play a major role in determining the distribution of cross- and reverse commuters as municipalities bordering Budapest (Budaörs, Budakalász, Budakeszi, Dunaharaszti) have the lowest proportion of cross-commuters and the highest percentage of reverse commuters (Fig. 13). In contrast, municipalities like Nagykáta, Monor, Veresegyház, which are further away from the capital, attract a higher proportion of commuters from the FUR. A statistically significant, strong, positive relationship has been found between the average travel time[38] by car from Budapest and the proportion of cross-commuters ($r = 0.52$, $p < 0.001$).

Measuring commuting solely by the absolute number of in- and out-commuters may be misleading as the population and the number of jobs in a municipality may distort any comparison. As these latter measures changed considerably between 1990 and 2001, I found it essential to calculate an index of commuting that also reflects changes in the population and employment opportunities. As suggested by Guth et. al. (2010), the intensity of in-commuting has been calculated by dividing the number of in-commuters by the number of jobs in the commuting destination. Similarly, the intensity of out-commuting has been generated as the proportion of out-commuters within the number of jobs in the home municipality. In order to compare these intensities over a period (1990-2001), a complex index had to be calculated that could take into account both in- and out-commuting. Guth et. al. (2010) suggests that commuting intensity can be expressed by dividing the sum of out-commuters and in-commuters by the sum of the employees living in the municipality and the number of jobs in the municipality:

$$CI = \frac{\mathrm{IC} + \mathrm{OC}}{\mathrm{LE} + \mathrm{LJ}}$$

where
CI: commuting intensity
IC: number of in-commuters
OC: number of out-commuters
LE: number of employees living in the municipality
LJ: number of jobs in the municipality.

[36] For 1990, only the number of in-commuters to Pest County is available from the Census, which includes those who commute from the neighbouring counties other than Budapest. The proportion of cross-, reverse and external commuters can only be estimated. 65% of all in-commuters within the county live in Pest County. This means that on average 65% of in-commuters are cross-commuters.
[37] It was not possible to separate data for cross- and reverse commuters for 1990.
[38] The source of travel time data is the TEIR database (teir.vati.hu) calculated as the shortest possible path between the centres of two municipalities by car.

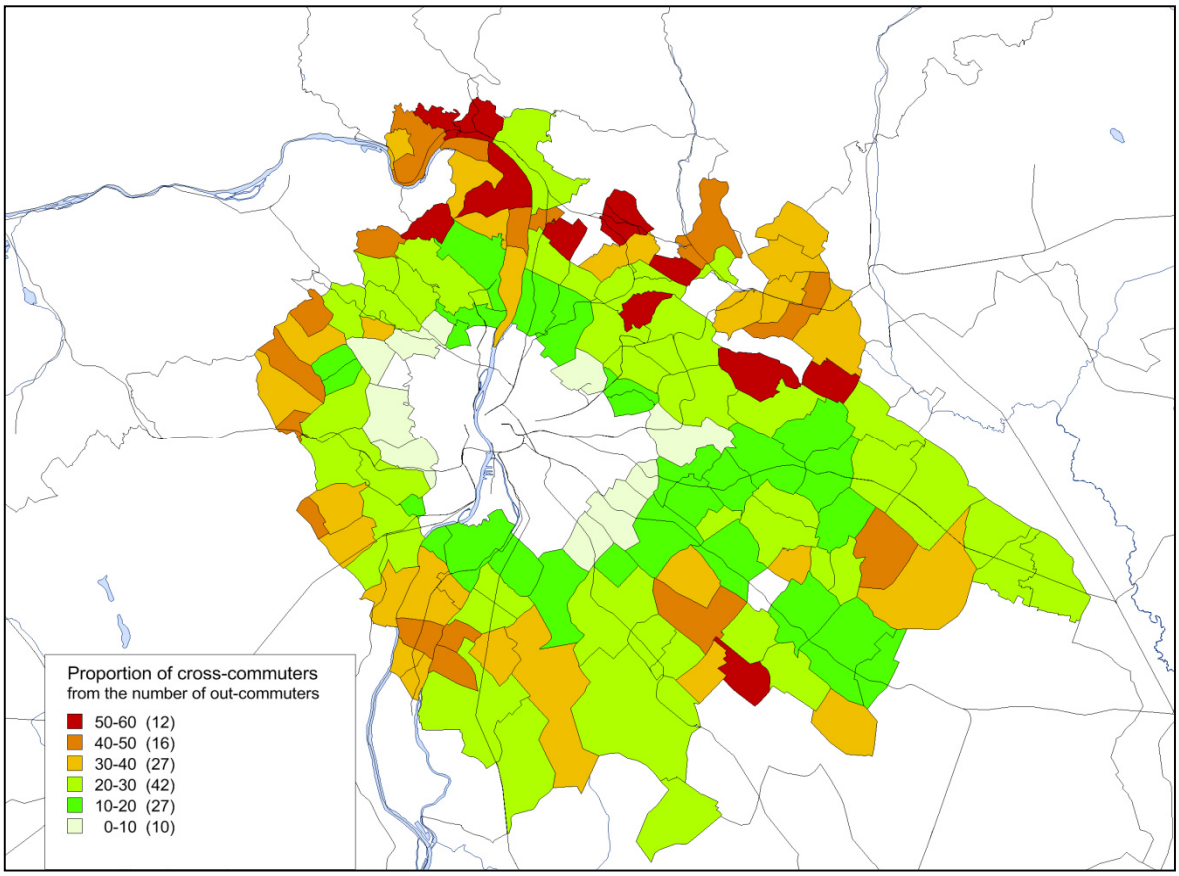


Fig. 13
Proportion of cross-commuters in the municipalities of FUR (%)
(Source: Own elaboration based on HCSO Census Data, 2001)

The indicator can take a value between 0 and 1, where 0 indicates no commuting at all, 0.5 indicates that there is an equal number of in-commuters, out-commuters and locally employed local residents, whereas 1 indicates that all residents commute out and all jobs are taken by in-commuters. This index, however, does not express the bias of commuting patterns concerning in- or out-commuting; therefore, I propose a composite commuting index that also demonstrates if the majority of commuters are in- or out-commuters. This can be achieved by combining the index for in- and out-commuting intensity described above. By subtracting the in-commuting index from the out-commuting one, the composite commuting index can be calculated:

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

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

The index can take a value between -1 and 1. Values smaller than zero indicate that the number of out-commuters is higher than that of in-commuters, zero shows that in-commuting and out-commuting are balanced, while a value greater than 0 suggests that in-commuting is more intensive than out-commuting.

As far as the whole Pest County is concerned, the index did not change significantly between 1990 and 2001: it increased from -0,22% to -0,21%. Nevertheless, this apparent stagnation masks significant regional differences. Fig. 14 shows the combined commuting

index of selected municipalities[39] for 1990 and 2001 (see Appendix 5 for the combined commuting index of all municipalities in the FUR). Municipalities above axis x had a positive commuting index in 2001, which indicates they had more in-commuters than out-commuters. Municipalities to the left of the broken line improved their commuting index between 1990 and 2001. The distance from the broken line shows the magnitude of the growth. On the other hand, for municipalities displayed on the right-hand side of the broken line the commuting index decreased between 1990 and 2001. The 'winners' in terms of attraction of workforce are the new economic nodes of the suburban area: Budaörs, Törökbálint, Dunaharaszti, Vecsés and Fót. Two of the traditional centres, Gödöllő and Százhalombatta, could keep their positions as major employers. In Gödöllő, the small- and medium-scale Fordist industry transformed into high-tech manufacturing in the 1990s (Kovács, Sági & Dövényi, 2001), while in Százhalombatta the largest oil refinery of Hungary remained a major employer even after 1990. The greatest 'losers' are municipalities where large-scale socialist industry was closed down and they could not attract businesses, such as Vác, Szigetszentmiklós. Kiskunlacháza and Szentendre. This indicates that the development of new economic centres around Budapest increased the intensity of commuting into these municipalities that were also the winners of economic transformation. Érd and Göd are both at the bottom of the chart indicating that they are predominantly bedroom communities. But while Érd improved its position slightly by attracting more commuters in 2001 than in 1990, the number of local jobs decreased in Göd prompting increased out-commuting.

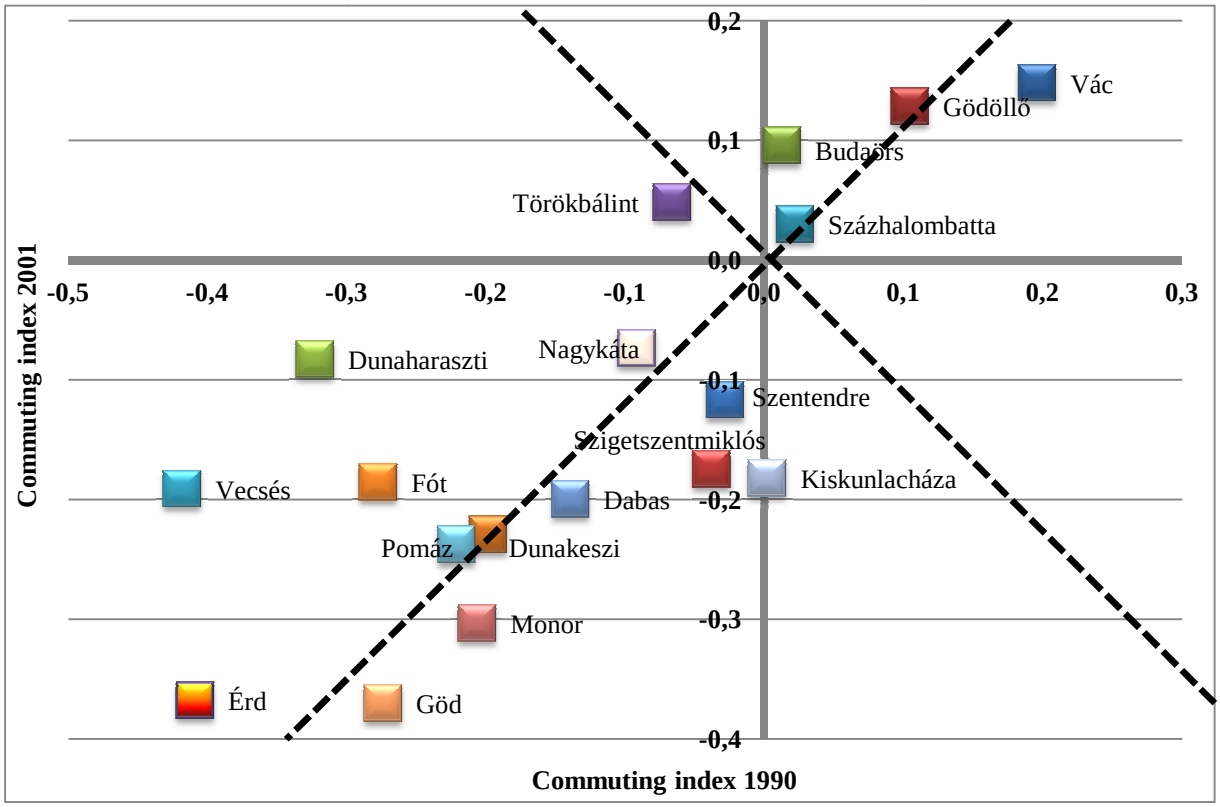


Fig. 14
Changes in the composite commuting index between 1990 and 2001 in selected municipalities in the Budapest FUR
(Source: Own calculation and elaboration based on HCSO Census data 1990, 2001)

[39] Municipalities with the highest number of local jobs either in 1990 or 2001 are included in the graph.

5.1.3.3. Reverse commuting

Similarly to cross-commuting, reverse commuting from Budapest to the FUR is not a recent phenomenon either. The number of employees living in Budapest and commuting to a job outside Budapest was around 26,000 until the 2000's. The 2001 Census revealed a twofold increase, which was mainly due to the emergence of commuting to varying job locations: a feature of economic transformation and also of the emergence of jobs involving a significant amount of travelling to diverse destinations (e.g. distribution, sales, logistics) (Table 9). If we only compare reverse commuters with a firm destination, a 7% increase can be detected between 1990 and 2001 and a 26% rise between 2001 and 2005. Similarly to cross-commuting, this latter increase may be due to the significant job growth outside Budapest from the 2000s.

Reverse commuting from Budapest	**1980**	**1990**	**2001**	**2005**
To Pest County	n.a.	n.a.	22518	30744
Other counties	n.a.	n.a.	6263	5519
Destination varies	n.a.	n.a.	36195	26659
Total with a firm destination	26780	26814	28781	36263
Total (all destinations)	26780	26814	64976	62922

Table 9
The distribution of reverse commuters
(Source: HCSO Censuses, 1980, 1990, 2001, Microcensus 2005)

The main destinations for reverse commuting were similar to those for cross-commuting in 2001 (compare Table 8), in fact, 60% of the top 20 destinations of cross-commuters and reverse commuters were identical. Similarly, the new economic nodes of Budaörs-Törökbálint, Fót-Dunakeszi, Dunaharaszti and Gödöllő were the most important destinations for commuters from Budapest as well (Table 10). As it was pointed out in the previous section, the proportion of cross- and reverse commuting depends on the travel time from Budapest. Job locations with easy access from the capital have a significant proportion of reverse commuters. 53% of all commuters to Budaörs, for example, commute from Budapest.

Job location	Number of reverse commuters	Total number of in-commuters	Proportion of reverse commuters to in-commuters
Budaörs	5118	9668	53%
Törökbálint	1295	3498	37%
Dunaharaszti	1081	2577	42%
Szentendre	977	2882	34%
Dunakeszi	906	3007	30%
Gödöllő	889	8098	11%
Fót	870	1938	45%
Érd	861	3074	28%
Budakalász	804	1595	50%
Szigetszentmiklós	717	2770	26%
Budakeszi	574	1252	46%
Vecsés	557	2070	27%
Kistarcsa	481	1577	31%
Gyál	455	901	50%
Pomáz	455	1345	34%
Biatorbágy	425	1591	27%
Csömör	356	777	46%
Vác	355	7761	5%
Székesfehérvár	341	28214	1%
Solymár	323	1311	25%

Table 10
Top 20 destinations of reverse commuters from Budapest
(Source: HCSO Census 2001)

I argue that reverse commuting increased between 2001 and 2005 due to a growth of the number of jobs outside Budapest, and owing to the fact that the new economic poles in the proximity of Budapest attract a significant number of reverse-commuters from Budapest. This has been confirmed by examining the number of jobs and total number of commuters to Pest County in 2001 and 2005 (Table 11).

	2001	2005
Number of jobs in Pest County	281999	327147
Total number of commuters to Pest County	101240	139272

Table 11
Change of the number of jobs and in-commuters to Pest County
(Source: HCSO Census 2001 & Microcensus 2005)

5.1.3.4. Educational status of commuters

In the 1970s, commuters were considered to be a disadvantaged group of industrial workers, who were unable to settle in towns and cities where they worked. Their living conditions in the low-profile villages around the cities lacked basic amenities. Their qualifications and income were also lower than the national average (Bőhm & Pál, 1979). Since then, however, the educational status of commuters has changed considerably. The proportion of commuters to Budapest with a college or university degree was only 5% in 1980, but increased to 25.7% in 2005. This change followed the general increase in the educational attainment of the workforce living in Pest County (Fig. 15).

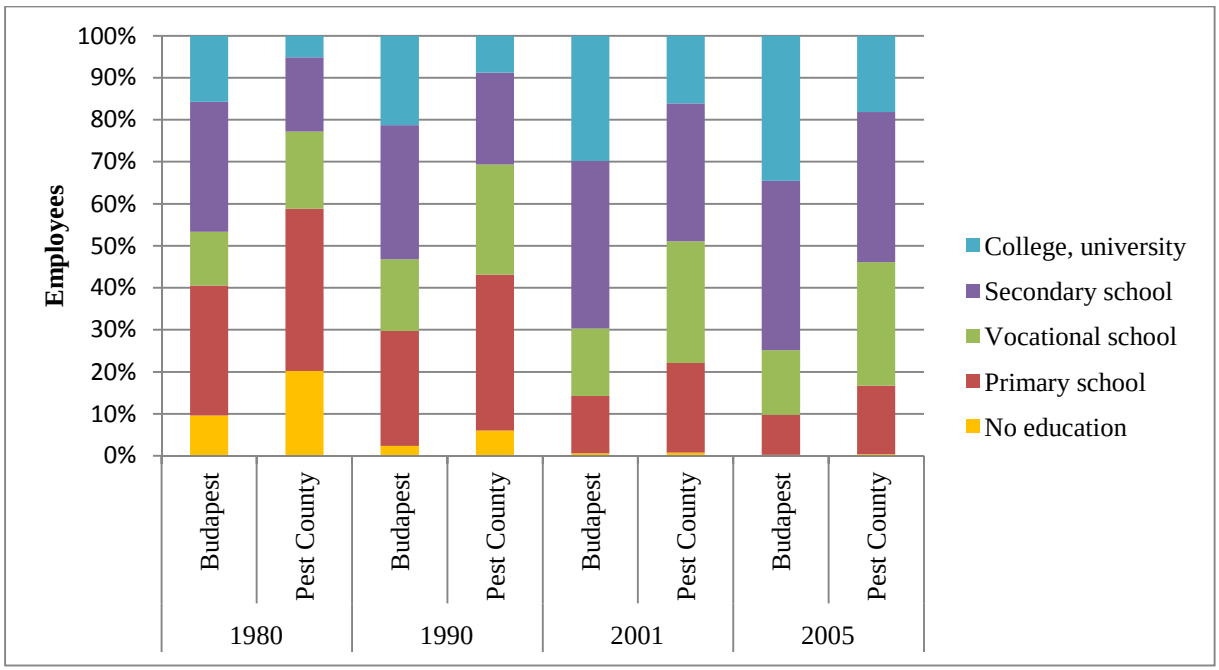


Fig. 15
Distribution of employees living in Budapest and Pest County by highest level of education between 1980-2005
(Source: Own elaboration based on HCSO data)

The profile of reverse commuters from Budapest changed as well. The proportion of reverse commuters with a higher educational degree was relatively high at 22% already in 1980, especially compared to out-commuters from Pest County at 5%. This may reflect the fact that under socialism residents of towns and cities had the highest level of education. At the same time, intellectuals (teachers, doctors, lawyers etc.) commuted from their hometowns to nearby villages where there was a shortage of such professions (Bőhm & Pál, 1985). After 1990, the educational level of reverse commuters stagnated while the proportion of out-commuters from Pest County with a higher education degree saw a fourfold increase from 5% to 19.4%. Between 1990 and 2001, the proportion of commuters with vocational and secondary education increased. This may reflect that during this decade economic development in the FUR was focused on logistics and commercial development requiring skilled labour. By 2005, the proportion of reverse commuters with a higher education degree increased to 31%, which may be the consequence of the accelerated economic development requiring more highly qualified workforce in the FUR after 2000.

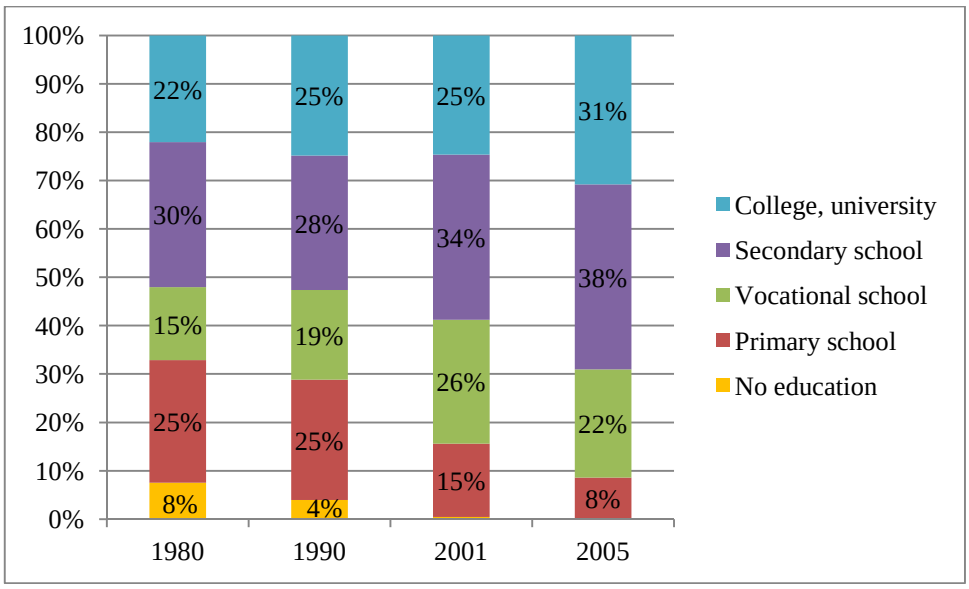


Fig. 16
Educational level of out-commuters from Budapest 1980-2005
(Source: Own calculations from HCSO Census data 1980, 1990, 2001, 2005)

Information about the educational level and occupation of cross-commuters is not available retrospectively. According to the 2001 Census, cross-commuters had the lowest average educational attainment (Fig. 17). This indicates an imbalance between qualifications of the local workforce in Pest County and the requirements of employers. It can be assumed that Budapest still has the highest number of jobs that require highly qualified workforce. Therefore, the majority of residents who have recently moved to the suburbs have to commute to the core city. It could also be an indication of exchange commuting when residents commute from outside Budapest to the capital, while reverse commuters from Budapest fill positions in the outskirts. As Kovács (1999a) remarked, qualified workforce is transported from Budapest to the new industrial, logistics and office developments as there is not enough local workforce with the required qualifications[40].

In order to identify the phenomenon of exchange commuting, the exchange commuting index has been calculated based on Burger et. al. (2011):

$$ECI = IC(cc)/IC(s)+IC(cc)$$

where
ECI: exchange commuting index
IC(cc): number of in-commuters from municipalities of Pest County to Budapest
IC(s): number of out-commuters from Budapest to municipalities in Pest County.

The index can take a value between 0 and 1, where 0 means that there are no out-commuters from the suburban area to the central city, i.e. all commuters come from the central city to the suburb. A value of 0.5 shows an equal number of commuters between the suburb and the central city, whereas 1 suggests that there is only traditional commuting from the suburb to the central city. Values around 0,5 indicate exchange commuting.

[40] Telenor, a major mobile phone company, for example, provides a free bus service to its employees between Budapest and its national headquarters in Törökbálint.

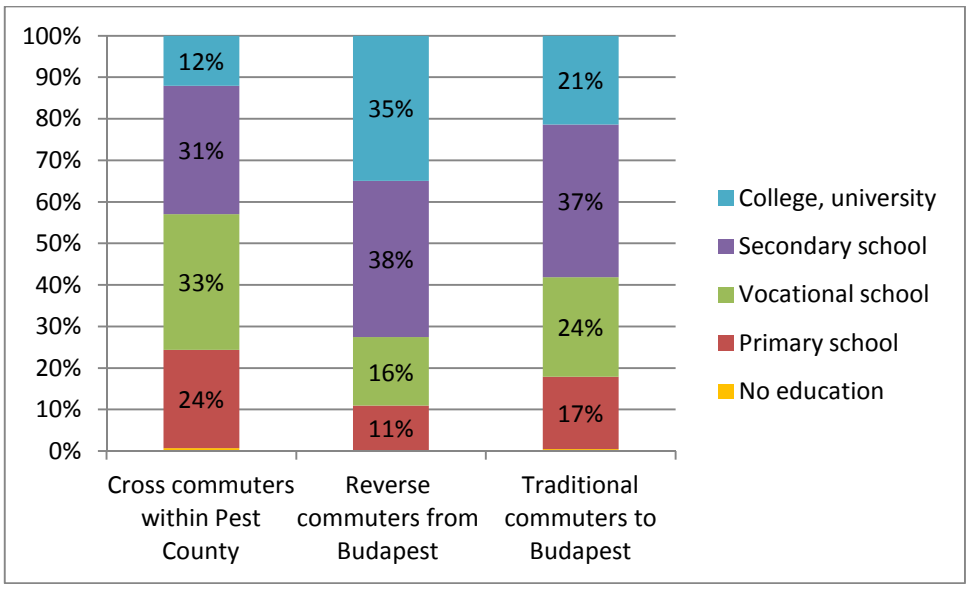


Fig. 17
Educational qualification of commuters, 2001
(Source: Own calculation based on HCSO Census data 2001)
(Reverse commuters include only those with a firm destination)

Based on this index, exchange commuting could only be traced between Budapest and Budaörs from the 2001 Census. The number of commuters from Budapest to Budaörs was roughly identical to the number of those commuting from Budaörs to Budapest (index: 0.5). Further municipalities with a significant number of jobs and a relatively high proportion of in-commuters compared to the number of out-commuters include Törökbálint (index: 0.59), Budakalász (0.7), Dunaharaszti (0.71), Biatorbágy (0.74), Gödöllő (0.77), Szentendre (0.77) and Fót (0.78)[41], all of them were referred to as the new economic poles earlier (except Szentendre). This indicates that in 2001, Budaörs was the only economic pole that could rival the attraction of the core city in terms of commuting.

5.2. Analysis of the household surveys

In order to gain a more detailed picture of the characteristics of commuting trips and commuters in the FUR, disaggregate data from the BKSZ and BKV household surveys (2004 & 2007) were analysed using mathematical statistical methods presented in the previous chapter. Wherever possible, a comparison to Census data from 2001 has been made to identify any changes in commuting patterns. The variables analysed here were identified in Section 3.5.

5.2.1. Characteristics of commuters

5.2.1.1. Net household income

The analysis of data on the household income of commuters has shown that most cross-commuters belong to the medium income category[42] (HUF 130,001-220,000), while the majority of people commuting to Budapest earn more than HUF 160,000 with the category over HUF 220,001 representing the highest proportion of commuters. Reverse commuters are even better-off in the sample than commuters to Budapest as 80% of them have a household income of over HUF 220,001 (Table 12). **A statistically significant, moderately strong**

[41] Only municipalities with at least 100 in- or out-commuters are listed here.
[42] The average national net household income was HUF 189,764 in 2007.

relationship has been found between commuting patterns and net household income (χ^2 (12)=427.488; V= 0.244; *p <0.001)*. The statistical test confirmed that reverse commuters have a significantly higher salary than other commuters and cross-commuters have the lowest proportion in the highest income category. Considering the proportion of salaries over HUF 160,000, reverse commuters are followed by commuters to Budapest, cross-commuters and commuters to outside the FUR.

Net household income (HUF)	Commuting pattern				Total
	Commuting to Budapest	Reverse commuting*	Commuting within the FUR	Commuting outside the FUR	
Under 90,000	4.0%	4.9%	4.3%	1.8%	4.2%
90,001-130,000	11.0%	4.4%	15.4%	25.0%	11.1%
130,001-160,000	16.8%	3.9%	22.2%	18.8%	14.8%
160,001-220,000	27.2%	7.4%	28.5%	24.1%	22.0%
Over 220,001	40.9%	79.4%	29.5%	30.4%	47.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

χ2 (12)=427.488; V= 0.244;p <0.001 N=2389

Table 12
Distribution of commuting trips by household income (in Hungarian Forints)
(1 EUR= approx. 250 HUF as of 01.07.2007)
*** Income data from the BKV household survey (2004) has been adjusted with inflation in order to make it comparable to data from the BKSZ survey (2007)**
(Source: Own calculations based on BKSZ and BKV Household Surveys, 2007/2004)

5.2.1.2. Educational attainment

The educational attainment of commuters shows a distribution similar to that of the household income. Cross-commuters have, in general, lower qualifications than those working in Budapest: 24% of traditional commuters have a Bachelor's or Master's degree, while only 13% of cross-commuters graduated from college or university (Table 13). Employees with primary or vocational school certificates comprise 48% of all cross-commuters, while this group represents only 30% of commuters to Budapest.

Thus, a **statistically significant, moderately strong relationship has been found between commuting patterns and the level of education** (χ^2 (12)=199.383; V= 0.145; *p <0.001*). Similarly to income, the proportion of reverse commuters with high educational attainment is significantly higher than that of the other commuters. Cross-commuters appear to have the lowest educational qualifications together with commuters outside the FUR. This confirms my previous finding based on Census commuting data, i.e. that reverse commuters are characterised by higher educational qualifications.

Educational attainment	Commuting pattern				Total
	Commuting to Budapest	Reverse commuting	Commuting within the FUR	Commuting outside the FUR	
Primary school	7.8%	6.4%	12.8%	14.1%	9.0%
Vocational school	21.9%	20.4%	35.8%	35.9%	25.8%
Secondary school (GCSE)	46.1%	40.9%	38.1%	34.6%	41.9%
Bachelor's degree	16.2%	15.2%	9.2%	9.6%	13.7%
Master's Degree	8.0%	17.0%	4.1%	5.8%	9.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

χ^2 (12)=199.383; V= 0.145;p <0.001 N=3140

Table 13
Distribution of commuting trips by educational level
(Source: Own calculations based on BKSZ and BKV Household Surveys, 2007/2004)

The above results confirmed my findings from aggregate Census data. They suggest that both the income level and the educational attainment of commuters to the core city exceed those of cross-commuters. There are two possible explanations for this. On the one hand, it could be interpreted by Sýkora & Ourednek's (2007) suggestion that the suburbanisation of employment mainly involved retail and logistics facilities employing few high earners, while the suburbanisation of offices employing workforce with higher qualifications has been relatively rare. This differs from the latest experience in Western Europe where the suburbanisation of offices induced high-income and highly educated residents of the suburbs to commute to these job locations(Aguiléra, Wenglenski & Proulhac, 2009).

On the other hand, the very high household income and educational level of reverse commuters contradicts this. It is not a new phenomenon, as it was noted in Section 5.1.3.3. Before 1990, reverse commuters most probably commuted to the towns and villages of the agglomeration because there was a shortage of highly qualified workforce there. It can be assumed that after 1990, managerial positions of the new logistics and retail facilities as well as the few new office jobs have not been taken primarily by the residents of the new suburbs but by reverse commuters from Budapest. Therefore, the considerable difference between the educational status of cross- and reverse commuters can be explained by exchange commuting (see Section 5.1.3.4).

5.2.1.3. Car ownership

The rate of car ownership of households of commuters to Budapest and that of commuters to suburban jobs are similar to each other. About 25% of trips are made by people who live in a household without a car, whilst approximately half of the commuters have one car, and more than a quarter own two or more cars (Table 14). **A statistically significant, weak relationship has been found between the commuting patterns and household car ownership** ($\chi^2(6)=51.412$*; V=0.09; p<0.001; N=3145).* The rate of car ownership is significantly different for commuters to Budapest and cross-commuters. It is more probable for commuters to Budapest to have at least one car in the household than for reverse commuters. This is surprising considering that reverse commuters are characterised by having the highest salaries.

Number of cars in household	Commuting pattern				Total
	Commuting to Budapest	Reverse commuting	Commuting within the FUR	Commuting outside the FUR	
0	20.1%	33.0%	23.1%	27.6%	25.0%
1	54.1%	44.5%	49.2%	48.1%	49.7%
2+	25.8%	22.5%	27.8%	24.4%	25.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

χ^2 (6)=51.412; V= 0.090;p <0.001 N=3145

Table 14
Distribution of commuting trips by the number of cars owned by the household and commuting pattern
(Source: Own calculations based on BKSZ and BKV Household Surveys, 2007/2004)

Car ownership is usually a good indication of the main transport mode used for commuting. As public transport is usually less frequent in the suburban areas in the cross-commuting directions (hence the lower use of public transport compared to commuting to the core city), one would expect that those who commute within the suburban area have a higher probability of owning one or more cars. On the contrary, however, no significant difference has been found between the car ownership of cross-commuters and traditional commuters. The rate of car ownership for commuters living in the FUR is similar irrespective of their commuting patterns. This corresponds to previous research that found no difference between

the rate of car ownership rates of municipalities with better or worse availability of public transport (Keserű, 2004b).

5.2.2. Characteristics of commuting trips

5.2.2.1. Commuting patterns

The comparison of the origins and destinations of commuting trips of the 2001 Census data and those of the 2007 household data has revealed that the proportion of cross-commuting rose from 28.6% to 36% of all commuting from the municipalities studied. At the same time, the significance of the main commuting direction, i.e. Budapest, reduced from 64.8% to 57.1%, while commuting outside the FUR (external commuting) remained approximately the same (Fig. 18). The results confirm the outcome of the aggregate data analysis: after 2001, the proportion of cross-commuting has increased.

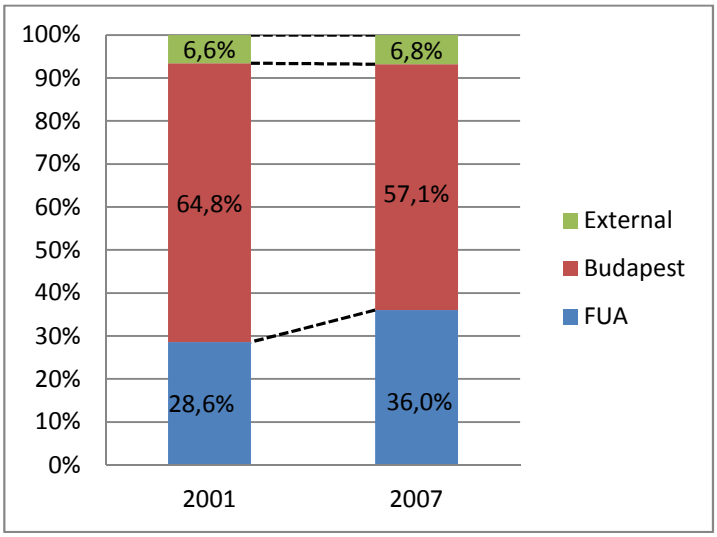


Fig. 18
The distribution of commuters from the study area by commuting direction 2001/2007 (Source: Own calculations based on National Census, 2001 and BKSZ Household Survey, 2007)

5.2.2.2. Modal split[43]

A statistically significant, moderate relationship has been found between commuting patterns and travel mode ($\chi^2(6)=256.317$; V= 0.204; $p<0.001$). According to the household survey, traditional commuting to the core city has the highest percentage of public transport trips. It is only slightly lower than the modal share of public transport for local trips within Budapest (50.3%). Public transport used within the FUR and for reverse commuting from Budapest is significantly lower. Most cross-commuters use their cars to travel to work (65%), while public transport is used by only a little more than a quarter of the commuters. Other means (cycling, walking, special vehicles etc.) are rarely used for trips to Budapest. Their share is significant, however, for trips within the FUR and to job locations outside the FUR (Table 15).

[43] The percentage of travellers using a particular transport mode.

	Commuting direction				
Mode of travel	**Budapest**	**FUR**	**External**	**Reverse**	**All commuting**
Public Transport	50.3%	28.4%	19.9%	28.0%	35.9%
Car	48.1%	65.3%	68.6%	65.0%	58.0%
Other*	1.5%	6.3%	11.5%	6.0%	6.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

$\chi 2(6)=256.317$; V= 0.204; $p<0.001$ N=3065

Table 15
Modal split of commuting trips from and to the study area
(Combined car and public transport journeys are included in the Public Transport category because of the low number of cases in the sample)
(Source: Own calculations based on BTA and BKV Household Surveys 2007/2004)
(* Other modes: cycling, walking, special road vehicles, horse cart etc.)

The modal split of commuting trips is usually influenced by the structure of the transport network. Traditionally, rail-bound transport networks provide the highest capacity and the fastest way of travelling to core cities on radial networks, which is reflected in the higher proportion of public transport trips into the centre of the urban area (Moser, 2007). Similarly, suburban bus networks are oriented towards the core city. At the same time, commuting within suburban areas more often requires a car due to the lack of frequent and fast connections (Keserű, 2010). These characteristics of the suburban transport network are apparent in the distribution of commuting trips by mode of travel in the Budapest FUR indicated by a higher share of public transport for trips to Budapest and the majority of trips made by car within the suburban zone. This finding corresponds with previous results regarding Madrid (García-Palomares, 2010), the USA (Cervero & Wu, 1997) and the Netherlands (Schwanen, Dieleman & Dijst, 2001).

The dominance of car trips in cross- and reverse commuting together with a growing number of these journeys may cause increasing traffic on suburban roads and deteriorating modal split in the metropolitan region (Keserű, 2004b). The proportion of *other* modes (cycling, walking, etc.) is very low for trips to Budapest (1.5%) but eight times higher for those within the FUR and to jobs outside the study area, which is probably the consequence of the difference in travel distance. Commuters within the FUR often travel to the neighbouring municipality for which non-motorised transport is a viable option. In contrast, commuting trips to Budapest are considerably longer, hence the low proportion of alternative transport modes (see below).

5.2.2.3. Travel time

In 2007, the average travel time for cross-commuting trips was 35 minutes, while commuters to the core city spent 62 minutes on average with travelling, i.e. almost twice as much as cross-commuters. The average travel time for reverse commuting trips was 48 minutes. If we compare the distribution of trips between different travel time categories, it is apparent that while the travel time of more than half of all cross-commuting trips remains under 30 minutes, 75.5% of trips to Budapest take more than 46 minutes. The above differences have been confirmed by the statistical test as well. **A statistically significant, moderate relationship has been found between commuting patterns and travel time** ($\chi^2(12)=782.743$; V= 0.288; *$p<0.001$)* (Table 16).

Commuting time	Commuting pattern				Total
	Commuting to Budapest	Reverse commuting	Commuting within the FUR	Commuting outside the FUR	
0-15	2.2%	8.1%	21.3%	19.2%	9.8%
16-30	9.3%	28.2%	37.9%	33.3%	23.5%
31-45	13.1%	19.7%	17.7%	23.7%	16.8%
46-60	23.0%	20.4%	12.3%	14.1%	19.0%
61-	52.5%	23.7%	10.8%	9.6%	30.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

$\chi 2(12)=782.743$; V= 0.288; $p<0.001$ N=3065

Table 16
Distribution of commuting trips by commuting pattern and travel time 2007/2004
(Source: Own calculations based on BTA and BKV Household Surveys 2007/2004)

It has been argued that the travel time of cross- and reverse commuting trips is usually shorter than that of traditional commuting (Aguilera, 2005; Moser, 2007). This has also been confirmed in our study, with travel times considerably shorter for trips within the suburban zone, somewhat longer for reverse commuting and the longest for traditional commuting. On the one hand, this is probably partly due to the differences in travel distances, which are considerably shorter for non-traditional commuting directions. On the other hand, congestion may also be a factor that influences travel time as traditional commuting is usually affected by congestion both on the approach roads to the city and within the city, while reverse commuters may experience traffic jams only at the beginning of their journeys in the city, later they use roads that are congested in the opposite direction.

5.2.2.4. Commuting distance

As no route information was available in the surveys for journeys, average commuting distance was calculated in a straight line between origins and destinations using GIS maps. According to the household data, cross-commuters travel the shortest distance. The distance travelled by commuters to Budapest is twice as long as that of commuters within the suburban zone (Table 17).

Commuting direction	Average travel distance (km)
FUR-Budapest	25.6
FUR-FUR	12.7
All commuting	20.6

N=2014

Table 17
Average travel distance measured in a straight line in the different commuting directions from the study area
(Source: Own calculations based on BKSZ Household Survey 2007)

The potential association between travel distance categories and commuting patterns has been tested. **A statistically significant, strong relationship has been detected between commuting patterns and commute distance** ($\chi^2(10)=683{,}605$; V= 0.412; *p <0.001)* (Table 18). This means that traditional commuters travel significantly longer distances than other commuters, while cross-commuters' travel distance tends to be shorter: more than half of the journeys are less than 10 km.

Travel distance (km)	Commuting pattern			Total
	Commuting to Budapest	Commuting within the FUR	Commuting outside the FUR	
0-10	5.7%	56.8%	35.8%	26.5%
11-20	34.7%	27.5%	20.8%	31.2%
21-30	26.6%	10.5%	25.8%	20.6%
31-40	18.1%	2.5%	7.5%	11.7%
41-50	9.8%	1.7%	5.8%	6.6%
51-	5.1%	0.9%	4.2%	3.5%
Total	100.0%	100.0%	100.0%	100.0%

$\chi^{2}(10)=683{,}605$; V= 0.412;p <0.001 N=2014

Table 18
Distribution of commuting trips by commuting pattern and travel distance
(Source: Own calculations based on BKSZ and BKV Household Surveys 2007/2004)

The analysis of journey distance and travel time has made it possible to calculate the average, hypothetical, door-to-door speed of commuting trips[44]. It is the highest for car journeys to the core city (25.5 km/h); car trips within the FUR are only slightly slower (23.6 km/h). The speed of public transport for traditional commuters to Budapest is only slightly lower (20%) than car speed. The difference is much higher (50%) for cross commuters.

	Public transport			Car		
	Travel distance (km)	Travel time (min)	Speed (km/h)	Travel distance (km)	Travel time (min)	Speed (km/h)
FUR-Budapest	27.9	79	21.2	23.0	54	25.5
FUR-FUR	11.8	45	15.7	12.6	32	23.6

N=2003

Table 19
Travel distance, travel time and hypothetical speed of commuting trips from the FUR
(Source: Own calculations based on the BTA Household Survey 2007)

Results on commuting distance correspond to previous findings in Germany, where average commuting distance was discovered to be shorter for commuters to suburban settlements compared to commuting to core cities. Cross-commuting distances were found to be between 14-19 km in Germany as compared to 12.7 km in Budapest, while traditional commuters covered 20-30 km in the German cities similarly to the Hungarian capital (25.6 km) (Siedentop, 2007). Travel speed calculated from travel time and distance revealed that the speed of public transport journeys within the FUR is considerably lower than car and public transport trips to Budapest. This may be due to the fact that there are no fast and frequent public transport services within the suburban area, and rapid rail lines only serve radial routes into the city centre. Public transport is competitive only if it provides a fast connection not affected by road congestion. Suburban railways can provide this advantage if modern infrastructure and vehicles are available. The availability of a rail connection has been shown to improve accessibility significantly compared to bus services (Keserű, 2004a). In the Budaörs Microregion, for example, infrequent bus connections prevent the residents of neighbouring municipalities to travel to work, school or visit relatives by public transport. Connections to neighbouring regions (e.g. Pilisvörösvár) are even worse. Between Zsámbék and Pilisvörösvár, for example, there are only three direct services and only on working days. Until 2009, Páty and Biatorbágy, two suburban municipalities just 6 kilometres from each

[44] The speed is hypothetical, since the exact distance travelled was not available. Thus, the speed is only an estimate.

other were not connected by public transport at all. Today there are 5 connections in the morning and 5 in the afternoon, but an all-day service is not provided (Keserű, Ács & Albert, 2011) (see Appendix 6 for a map of the availability of bus services).This shortcoming also highlights the need for faster transversal public transport connections in order to prevent further modal shift to cars (Keserű, 2005). This can be facilitated by combining the advantages of fast rail services to the city centre and feeder bus lines that connect municipalities without a direct rail connection to the nearest railway station. These bus services have a dual purpose: on the one hand they provide for missing transversal connections within the suburban zone; on the other hand they facilitate access to railway corridors to the city centre. Such a rail-feeder bus system has been suggested for the Budaörs Region in the western part of the agglomeration of Budapest (Keserű & Munkácsy, 2009).

The analysis of travel time and distance of commuters could also contribute to the debate over the co-location hypothesis (see Section 3.6.2). Until, however, the latest data on commuting times and distances from the 2011 Census are available, I can only confirm that cross-commuters spend less time commuting and travel shorter distances than traditional commuters. The co-location hypothesis assumes that employment decentralisation decreases commuting time (Kim, 2008). Whether the shorter commuting times for cross-commuters are a result of employment deconcentration, can only be confirmed if longitudinal data are available and the potential link between the changes in urban structure and commuting time as well as distance can be analysed.

5.3. Chapter conclusions

In this chapter, the results of a two-stage data analysis for commuters to work have been presented and discussed. First, aggregate data have been analysed to explore changes in the demand for jobs and supply in employment in the past two decades. Then the examination of disaggregate household statistics followed in order to test possible associations between commuting patterns, socio-economic characteristics and trip attributes..

The aggregate analysis has revealed that both residential and employment suburbanisation continue to affect population and employment dynamics in Central Hungary. The relocation of residents to the suburbs was on its peak in 2000. Results of the calculation of the suburbanisation index have been presented highlighting that the group of the most dynamically suburbanising municipalities had not changed significantly in comparison to the beginning of the 2000s. They are located in the proximity of Budapest mainly in the southern, western and northern parts of the agglomeration. Due to suburbanisation the demand for jobs in the FUR increased significantly.

Employment has also been shifting from Budapest to its surroundings especially since 2000. This has been demonstrated by the growth of the number of employees and active enterprises in Pest County. The suburbanisation of employment was especially remarkable in the service sector and especially wholesale and retail trade. Financial services, research and development and IT services remained concentrated in Budapest with a slow growth in Pest County. Although the number of white-collar employees increased considerably in Pest County, so did the figures for blue-collar workers. Therefore Pest County remained fundamentally blue-collar. It reflects the growth of economic subsectors that require a large number of blue-collar workers (wholesale and retail trade, manufacturing).

The analysis of aggregate commuting data has proven that cross- and reverse commuting stagnated between 1990 and 2001. A composite commuting index has been proposed and calculated to demonstrate how the direction and intensity of commuting changed between 1990 and 2001. It revealed that the new economic poles had become the main commuting destinations in the FUR. It has been demonstrated that the significance of reverse commuting diminishes the farther we go from Budapest. A strong correlation has been found between the proportion of reverse commuting and the distance from the capital.

More recently, both cross- and reverse commuting was growing between 2001 and 2005. It may be a result of parallel job growth around the capital. The examination of the educational level of commuters has revealed that both traditional and reverse commuters have a relatively high educational status compared to cross-commuters. It may be the result of a mismatch between the qualifications and the salary requirements of suburban residents and suburban jobs. In 2001, there was one town in the FUR where the number of in-commuters exceeded that of the out-commuters. Budaörs, the thriving western gateway to Budapest, has already experienced exchange commuting, while some of the other economic poles have been catching up.

The analysis of the household survey revealed that the educational attainment and income of cross-commuters is significantly lower than that of traditional and reverse commuters. A possible explanation has been offered with reference to the lower requirements of new employment in the FUR (e.g. retail trade). The high socio-economic status of reverse commuters has also been detected, which has been explained by the generally high status of the residents of Budapest some of whom commute to suburban municipalities. No association between car ownership and commuting patterns have been found, however.

The household survey confirmed the findings based on Census data in terms of the intensification of cross-commuting within the FUR. The analysis has also highlighted some of the possible problems that the change in commuting patterns may cause. Cross- and reverse commuters have been found to prefer travelling by car, which is similar to the results of research in Western Europe. If the volume of cross-commuting increases and the modal shift to cars continues, this may lead to congestion in suburban areas and a deterioration of the environment. The modal shift to cars in suburban areas is also accelerated by the insufficient supply of fast public transport services, which would provide an alternative to driving a car. Inadequate public transport can also limit the choice of jobs for people who have no access to a car (Siska & Keserű, 2009).

In terms of journey length and duration, the results have been found to be similar to previous findings in Germany, the Netherlands and Switzerland. Cross-commuting trips tend to be shorter in distance and time than traditional and reverse commuting. The calculation of the hypothetical travel speed revealed that public transport is only competitive for commuters to the core city.

The above results show that post-suburbanisation is still in its early stage. This is indicated by the economic sectors that are affected by the suburbanisation of employment (retail and manufacturing). While there are signs of the suburbanisation of knowledge-based services, they are still largely concentrated in Budapest with a very slow shift to the FUR. The changes in commuting patterns have been slow as well. Only after 2000 did cross- and reverse commuting intensify. It appears that post-suburban development remains fragmented. It is concentrated to some municipalities that could increase especially in the service sector. These new economic poles are expected to become the future post-suburbia.

Socioeconomic change has also been relatively slow and the lack of the suitable job offer prevented high-status suburban residents from becoming cross-commuters. The potential consequences of post-suburban development can, however, already be detected in terms of increasing congestion due to the higher share of car drivers among cross-commuters.

6. Commuting to school

The objective of this chapter is to present and discuss the results of the analysis of data on commuting to school in the Budapest FUR. First, a short introduction about the school system in Hungary and a justification for treating primary and secondary education separately

are given. Then, in Sections 6.2 and 6.3 statistics on commuting to primary and secondary school are provided and analysed. In Section 6.4 the socio-economic background of commuting students, in Section 6.5 the characteristics of commuting trips are studied and discussed. And finally, Section 6.6 highlights some implications of school commuting.

6.1. The education system in Hungary

In Hungary, education is compulsory by law until the age of 18[45]. Pupils between the ages of 6-14 are usually educated in primary schools (*általános iskola*). Secondary education is diversified. There are grammar schools (*gimnázium*) providing general education and the necessary foundations to go on to university; they may also specialise in a certain subject area, for example language or arts. Technical secondary schools (*szakközépiskola*) are similar to grammar schools but they also focus on a special area, such as economics, printing, engineering, nursing etc., providing professional qualifications. Vocational schools (*szakiskola* and previously *szakmunkásképző*) do not allow students to participate in tertiary education but provide them with vocational qualifications (e.g. tailor, carpenter, machinery operator etc.). Vocational schools are not covered by the analysis because commuting data are not available for them at the municipality level.

Commuting to primary and secondary school will be treated separately in the subsequent analysis. It is justified by the difference in the school offer at primary and secondary level, which determines commuting patterns. In case of primary school pupils, commuting is, in most cases, a choice of the parents as there are only six municipalities in the FUR of Budapest, which do not operate a primary school[46]. In contrast, secondary education is highly concentrated, so commuting is more widespread. Only every fourth municipality offers secondary or vocational education. In addition, children aged between 14 and 17 are more independent, hence, they can travel alone. Secondary education is also more specialised than primary schools so the profile of the school can be an important factor in school choice. Besides, secondary schools may select their students through admission tests based on their performance.

Commuting to higher education institutions (college, university) is also a widespread phenomenon. It is, however, difficult to obtain data on this type of student commuting. Many students work and study at the same time, hence they appear in statistics for commuting to work; in addition, university students often follow irregular daily schedules unlike primary and secondary school students, so their commuting patterns may be special. Due to the previously mentioned reasons, this research does not address the commuting of college and university students.

6.2. Commuting to primary school in the FUR

6.2.1. Demand and supply

The supply of education is determined by the spatial distribution, capacity, quality and specialisation of schools. If certain levels of education are not provided in each locality, there is high likelihood that students need to travel daily to another settlement to attend school. Primary school education is normally provided locally in every municipality except for the smallest ones. It is compulsory and a place is guaranteed for every child usually in the nearest 'district school'. If there is no primary education provided in the municipality, free transport is

[45] From 1 September 2012, education is compulsory until the age of 16. As my paper is based on earlier data this change does not affect the current analysis.

[46] The following municipalities did not operate a primary school in 2011: Csörög, Kajászó, Máriahalom, Óbarok, Pócsmegyer, Remeteszőlős

made available to the nearest school in another municipality. Ideally, primary school age children would attend the nearest educational institution and commuting would only occur in a very small number of settlements where there are no schools (6 out of 170 in the FUR). School choice is, however, free; therefore, parents may choose to educate their children at a school which is not the nearest to their homes or it is even in another municipality. The reasons may be manifold: the actual or conceived better quality of education, the ethnic or social composition of pupils, special education (religious, art, languages etc.) or services (e.g. special treatment of disabled students). There is one limitation to the free choice of schools though, i.e. all state schools have a district from which they are obliged to accept students. Children from other districts may only be admitted if there are extra places after the enrolment of all local pupils[47]. Commuters can therefore be divided into two groups: those who *commute out of necessity* because primary education is not provided in the municipality where they live, and those who *commute by choice*.

Residential suburbanisation has affected considerably the age distribution of the population in the FUR. Most new suburban residents who moved out of core cities in CEE countries are characterised by a younger age, an above-the-average income, higher qualifications and are likely to have children of pre-school or school age. This has been shown for Tallin, (Kährik, Leetmaa & Tammaru, 2012), Sofia (Hirt, 2007) and Budapest (Dövényi & Kovács, 1999; Kovács, 1999a; Dövényi & Kovács, 2006; Szirmai *et al.*, 2011). Consequently, suburban areas are characterised by a higher proportion of young residents (0-18 years) (Görgl *et al.*, 2011). As opposed to a dramatic decrease in the number of primary-school age population in Budapest, which is mainly due to the ageing population, municipalities that are targets of residential suburbanisation preserved or increased the size of the population of 6-13 year olds. The number of children in this age group decreased by 6% in the FUR between 1990 and 2010, while nationwide there were one-third fewer children by 2010 than in 1990. In Budapest, the drop was even more dramatic, it reached 45%. In contrast, there were municipalities in the FUR that multiplied their young population (e.g. Telki: 592% growth, Veresegyház 273%, Budajenő 217%), which created an additional demand for primary school education. Commuting data for primary school pupils are only available from 2006 onwards.

6.2.2. Commuting patterns

Information about commuting primary school students is somewhat scarce. HCSO has published the number of in-commuters for each municipality since 2006. The destinations of commuting trips can therefore be identified. Based on the limited longitudinal data available, commuting to primary school increased in Budapest between 2006 and 2010 by 6% and in the FUR by 12%. In 2010, 8.8% of children studying in Budapest were commuters from another municipality (Table 20).

[47] A good example for this is the primary school in *Leányfalu*, a village 25 km north of Budapest, where the number of pupils was decreasing between 1990 and 1997, as the number of students to be admitted was limited due to the lack of space at the school building. This meant that no children living outside the school district (the village) was accepted. After the refurbishment and extension of the school building, however, the number of students started to increase again. Currently, 30% of the pupils commute from other municipalities, despite the fact that all neighbouring villages, except for *Pócsmegyer*, have their own local primary schools (Móricz Zsigmond Általános Iskola és Napköziotthonos Óvoda, 2011).

	Number of in-commuters	Their proportion to the number of schoolchildren at local schools	Number of in-commuters	Their proportion to the number of schoolchildren at local schools
	2006		2010	
Budapest	8920	7,9%	9441	8,8%
FUR	10315	10%	11540	11,5%

Table 20
The number and proportion of in-commuter primary school pupils in the FUR and Budapest 2006/2010
(Source: Own calculation based on HCSO data 2006/2010)

There are, however, no data accessible about where commuters live. Nevertheless, it is possible to estimate the number of out-commuters from a municipality with the following formula:

$$OC = \mathrm{SAP} - \mathrm{LP} + \mathrm{IC}$$

where
OC: the number of out-commuters
SAP: primary school age population (6-13 years) [48]
LP: total number of pupils attending local schools
IC: number of in-commuting pupils

	Number of out-commuters	Proportion to number of 6-13 year olds
Budapest	569	0.5%
FUR	20411	20.9%

Table 21
The number and proportion of out-commuter primary school pupils in the FUR and Budapest in 2007
(Source: Own estimation based on HCSO data 2007)

In total, there were 20,411 out-commuters from municipalities in the FUR, about half of whom commuted to Budapest in 2007 (Table 21). If we look at the number of out-commuters at the municipality level, the ones in the agglomeration belt around Budapest have the highest values (Fig. 19). One of the reasons may be that due to the younger age structure of the population, the proportion of primary school pupils is higher. In addition, if we compare the map in Fig. 19 with the map of the suburbanisation index in Fig. 7 it appears that the area of municipalities with more than 100 out-commuting students extend further away from the border of Budapest in the western, northern and north-eastern agglomeration where suburbanisation is more dynamic.

If we examine in-commuting, the predominance of Budapest is palpable. In Budapest, districts close to the city border and especially the ones on the western side of the Danube (Buda) attract the highest number of in-commuters (Fig. 20). If we compare data on in- and out-commuting, intensive commuting between the municipalities of the Western Agglomeration (Budaörs, Törökbálint, Biatorbágy, Budakeszi) and Buda can be assumed. Outside Budapest, in-commuting is significant into subcentres in the FUR (Vác, Gödöllő, Szentendre, Érd, Százhalombatta, Budaörs).

[48] This method of estimation may be slightly inaccurate as not all six-year olds start the first year of primary school depending on the date of birth and the decision of the parents. Also, there are 14-year olds who are still in primary education due to failed subjects, health reasons, or later start of education. Nonetheless, I think that the inaccuracies in the age group of 6-year olds and 14 year olds offset each other. This presumption is supported by the fact that there is only 1 per cent difference between the number of 6-13 year olds and the number of children attending primary school at national level.

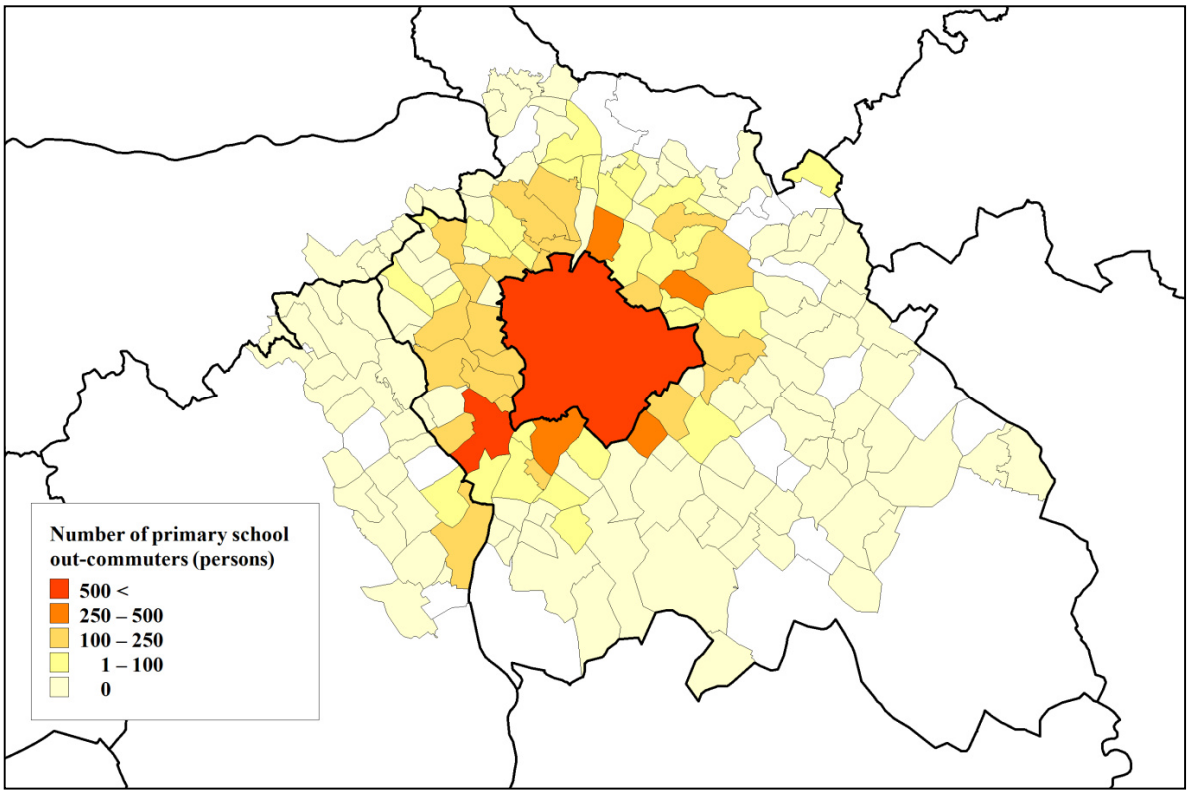


Fig. 19
Outbound commuting of primary school pupils (persons) 2007
(Source: Own elaboration based on HCSO data, 2007)

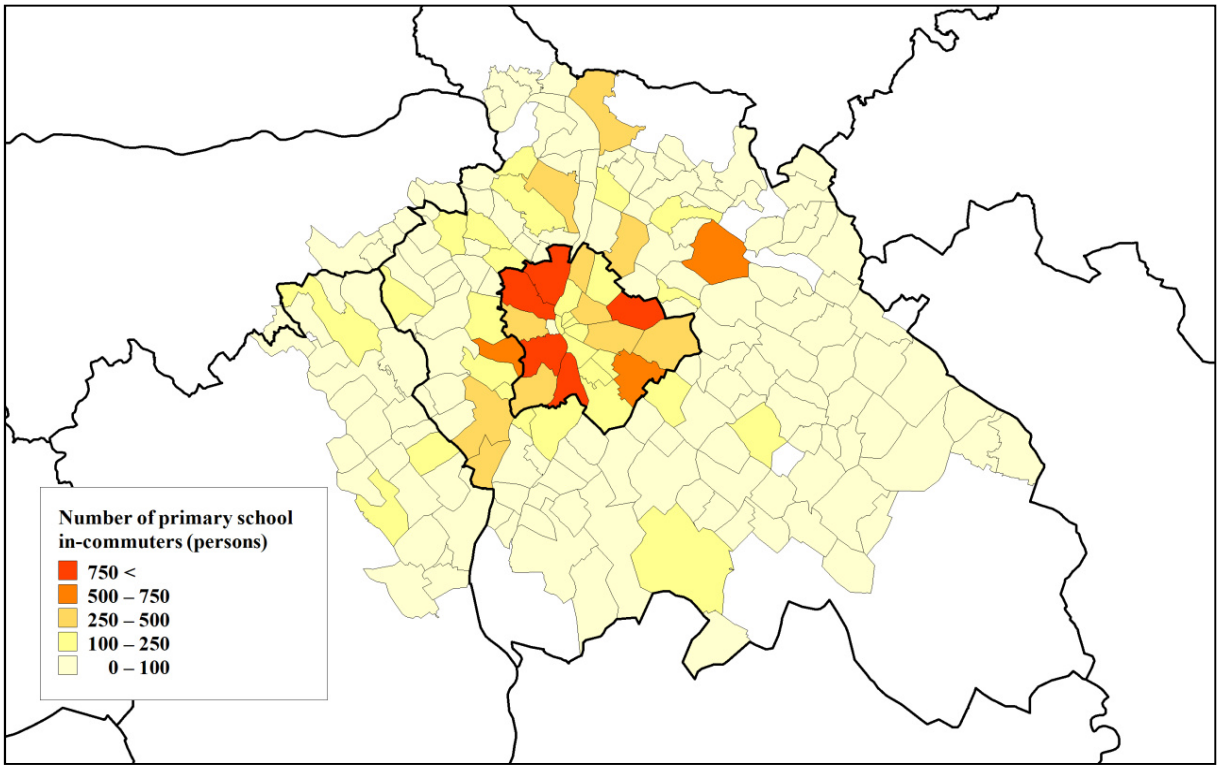


Fig. 20
Inbound commuting of primary school pupils (persons) 2007
(Source: Own elaboration based on HCSO data, 2007)

While the total number of in- and out-commuters is a good indicator of the intensity of commuting, due to the differences between municipalities regarding the number of primary

school age children, they give a somewhat distorted picture. Therefore, I have examined the proportion of commuters as opposed to the number of primary school age population.

As I look for possible reasons for commuting other than the lack of local primary school, the analysis should only cover commuting that is carried out *by choice* and not due to the lack of local primary education, i.e. *out of necessity*. Thus, I assumed an ideal situation when each municipality in the FUR have a primary school with 8 classes. Commuters had to be divided into two groups: commuters *out of choice* and *by necessity*.

I examined the availability of primary education in small villages in the FUR by consulting the websites of schools[49]. All municipalities were labelled as 'commuting by necessity' where there was no primary school in 2007 or primary education was limited to 1-4 or 1-6 classes[50]. All further calculations were carried out with the estimated number of 'commuters by choice'.

Distortions resulting from the differences in the number of 6-13 year olds may be avoided by looking at the proportion of in-commuters to the number of students attending the local school; as well as the percentage of out-commuters compared to the primary-school age population. Table 22 shows these proportions aggregated by different territorial units within the FUR. The grouping of settlements makes it possible to assess the effect of the proximity of Budapest.

Area	**Proportion of in-commuting primary school pupils (compared to the number of pupils studying at local schools) (%)**	**Proportion of out-commuting pupils (compared to the primary school age population) (%)**
Agglomeration	11.9	23.6
FUR outside the agglomeration	6.4	9.1
Budapest	8.5	0.5
FUR (without Budapest)	10.2	19.3
FUR (with Budapest)	9.2	11.9
Municipalities bordering Budapest	11.6	26.5

Table 22
The proportion of outbound and inbound commuters in the different sectors of the study area (Source: Own elaboration based on HCSO data, 2007)

The proportion of out-commuters is almost twice and a half as much in the agglomeration than outside of it. At the same time, the difference between the proportion of in-commuters is small, only 5 percentage points. If we consider only municipalities bordering Budapest, the proportion of out-commuters exceeds the average of the agglomeration. These data may indicate that the rate of out-commuting from settlements closer to Budapest is greater. There is a high likelihood that these out-commuters travel to Budapest to school. The high level of attraction of Budapest is also demonstrated by the fact that the proportion of out-commuters from Budapest to the number of in-commuters is very small.

It is highly probable that the proximity of attractive schools in Budapest, good public transport links (many of these settlements are directly connected to Budapest by the services of the Budapest Transport Company), and higher proportion of parents commuting to Budapest and taking their children with them may be the reason for the higher proportion of

[49] The websites had to be consulted because no data were available for 2007 about limited primary education (only classes 1-4 or 1-6).

[50] Out-commuters from these settlements appear in the statistics as in-commuters in municipalities where they attend their district schools, hence this data on in-commuting had to be corrected as well. Commuting data estimated from HCSO data was adjusted for municipalities with *commuters out of necessity* and municipalities where they commuted to.

commuters. The potential relationship between out-commuting of primary students and the level of suburbanisation of their home municipality has been tested by observing the strength of correlation between the suburbanisation index calculated according to the method described in Section 4.2.2 and the proportion of out-commuting at municipality level.

A moderately strong correlation has been found between the suburbanisation index and the proportion of out-commuters compared to the school-age population (r=0.41; $p<0.001$; N=167). Although it does not suggest a causal relationship, it indicates a potential association. Propensity to commuting may be influenced by many factors apart from suburbanisation: proximity to the nearest town or Budapest, transport connections, quality of teaching at local schools etc. This is suggested by examining commuting statics for Érd and Budaörs. Érd is the largest town of the FUR with 65,000 inhabitants 20 km southwest from the centre of Budapest and only 13 km from Budaörs. The proportion of commuters in the primary school age population is 24%, while the percentage of in-commuters is only 8%. In contrast, the primary schools in Budaörs seem to be more attractive for commuters. While Budaörs has a population of about the half of Érd and it is equally close to Budapest, only 13% of the primary school age population commutes from the town, while the proportion of in-commuters is high: 23.6%, three times as much as the percentage of commuters to Érd.

Settlement structure may also have an effect on commuting. The density of settlements is, for example, varies in the different areas of the FUR. In the south-east it is relatively low, which means that commuting between municipalities involves larger distances and higher travel time and cost. In the north-eastern, northern or western parts, however, settlements are close and often attached to each other (e.g. Törökbálint-Budaörs, Pilisvörösvár-Pilisszentiván, Dunakeszi-Fót-Göd). This means that commuting may involve only a short trip across the municipality border. It is also noticeable, that in municipalities bordering Budapest, the proportion of out-commuters is higher.

6.3. Commuting to secondary school

6.3.1. Demand and supply

After 1990, secondary school attendance expanded rapidly due to increasing competition among schools for students in a race to compensate for the drop in school-age population, shrinking financial resources and the decline in demand for vocational schools (Lannert, 2009). This phenomenon occurred in Central Hungary (Budapest and Pest County) even earlier, so this region had a higher proportion of secondary school students compared to the national average already before 1990. Secondary schools also tried to diversify their educational offer by launching new specialisations and forms of education. Grammar schools often started technical classes, while former technical secondary schools introduced grammar school-type education. By the end of the 1990s, the proportion of schools offering solely one type of secondary or vocational education decreased to 30% (Garami, 2003b).

Between 1990 and 1999, the number of secondary schools increased by 40% countrywide, while the number of vocational schools did by 20%. The expansion was above the average in Budapest and Pest County (Garami, 2003b). Since 2001, the number of secondary schools has continued to increase, at a slower rate, though. Between 2001 and 2010 the number of grammar schools[51] increased from 51 to 70 (37%) in the FUR, while the number of grammar schools in Budapest increased from 169 to 183 (8%). The rise of the number of secondary technical schools was more moderate: from 45 to 51 (13%) in the FUR and from 182 to 188 (3%) in Budapest.

[51] The statistics reflect the number of school sites. A school can have several sites in different locations.

Currently, 43 municipalities offer secondary or vocational education in the FUR of Budapest, as opposed to 163 settlements with primary schools. Secondary education is concentrated in Budapest with 183 grammar schools and 188 technical secondary schools[52]. Most schools are concentrated in the inner districts as well as the Buda (western) side (Districts 11 & 12) (Fig. 21). The outer districts in the eastern and southern side of the capital have few secondary schools; District 23, for instance, has only one grammar school. While technical secondary schools are concentrated on the (eastern) Pest side, there are more grammar schools in the districts of the Buda side.

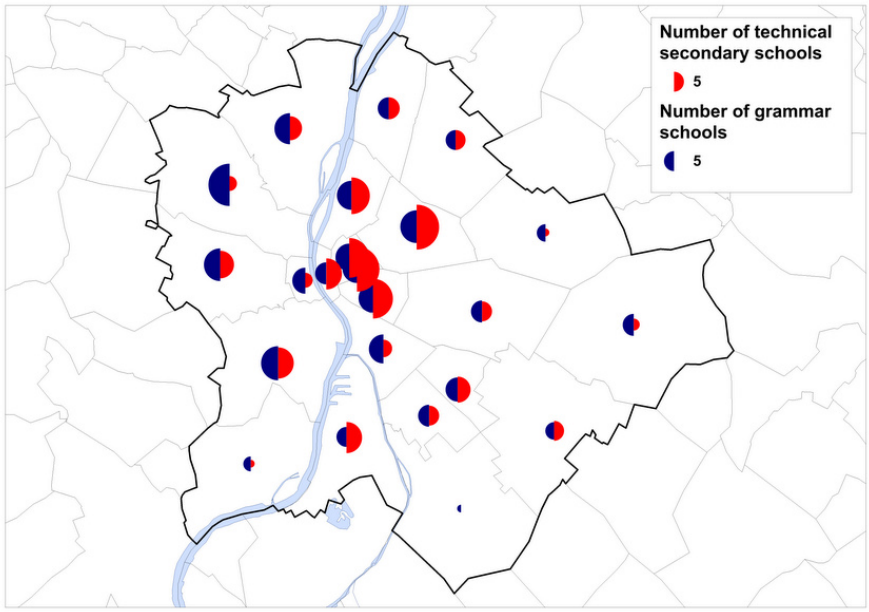


Fig. 21
The distribution of secondary schools in Budapest, 2010
(Source: Own elaboration based on HCSO data)

There are 70 grammar schools and 51 technical secondary schools in the FUR. Larger towns in FUR usually have more than one secondary school (Vác, Gödöllő, Szentendre) (Fig. 22), but there are some smaller towns that became centres for secondary education. Szigetszentmiklós, for example, has a population of 26,662, but it has 36% more secondary school students than Érd with a population of 65,000.

[52] Statistics include all school sites irrespective of the administrative centre of the school as well as all branch institutions that provide full- or part-time education. Some of these branches are very small, and they may only have students in adult education.

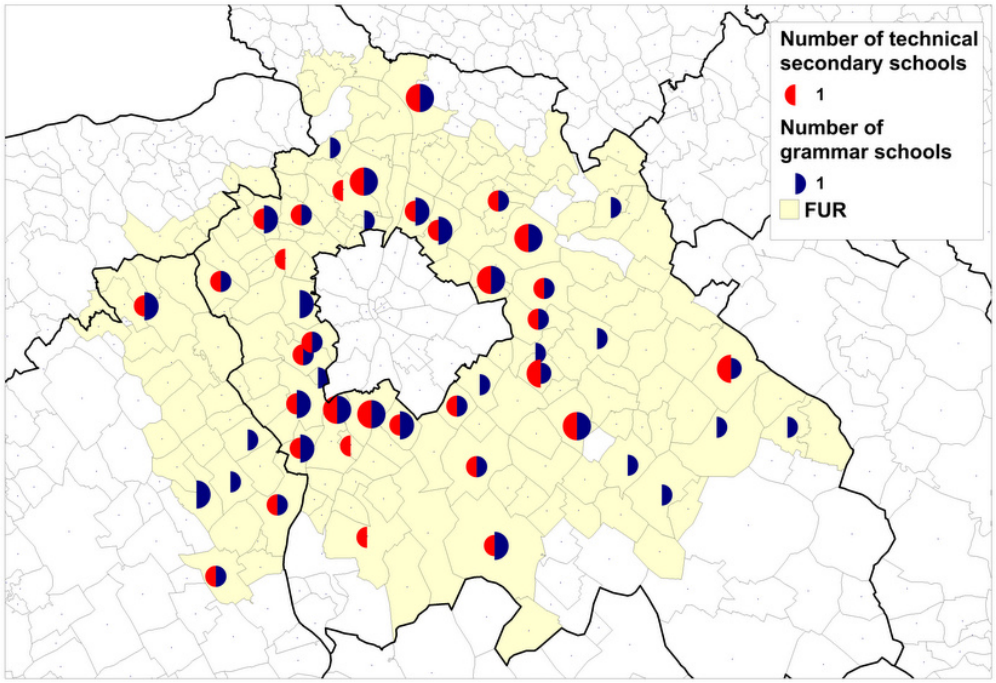


Fig. 22
The distribution of secondary schools in the Budapest FUR, 2010
(Source: Own elaboration based on HCSO data)

Between 1990 and 2010, the number of full-time students[53] attending secondary school in the FUR increased by 114%. The growth was, however, not uniform. Four patterns of change can be identified. Firstly, a significant increase can be detected in the major towns of the FUR, which has established schools that had attracted a significant number of students even before 1990 (Vác, Szentendre, Gödöllő, Monor) (Fig. 23).

Secondly, the number of students also increased considerably in a number of municipalities with smaller or fewer schools. Most schools other than the ones in the above-mentioned major towns had 200-300 students in 1990 which increased to 600-800 by 2010. These municipalities include Szigetszentmiklós (364% growth), Törökbálint (518%), Budakeszi (239%), Pilisvörösvár (204%), Piliscsaba (202%), Fót (116%), Százhalombatta (178%) and Ócsa (119%). The third group of municipalities that increased the number of secondary school students at their schools did not operate a secondary school before 1990 (see shaded areas in Fig. 23). Some of these new schools were opened by the church (Zsámbék); expanded an existing primary school with secondary school classes (Vecsés, Pomáz); were founded by a private organisation (International Christian School of Budapest in Diósd); or a public foundation (*közalapítvány*) that has close ties to the local municipality (Gyömrő, Isaszeg).

[53] Wherever the dataset allows only full-time students are considered as they commute daily to school as opposed to part-time students who usually only commute weekly.

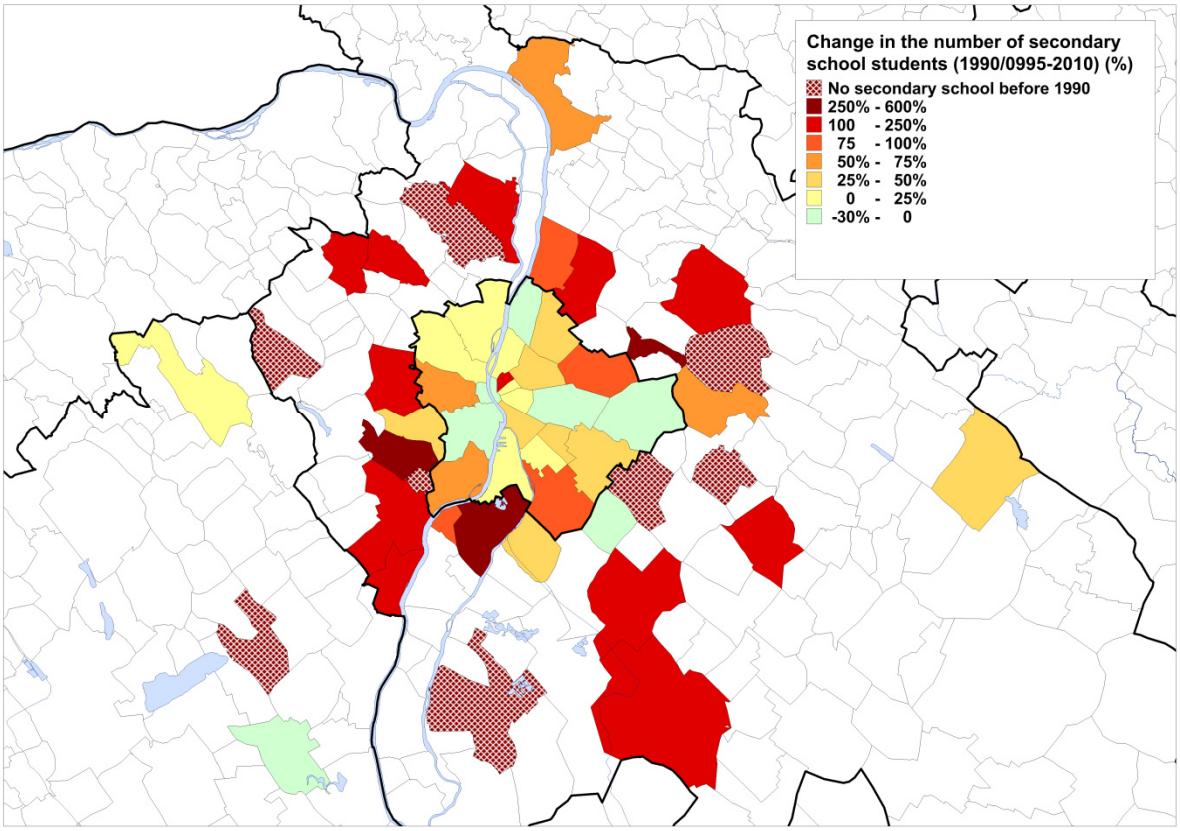


Fig. 23.
The change in the number of full-time secondary school students (percentage) 1990*/1995-2010**
(Source: Own elaboration based on HCSO data)
*** FUR; ** For Budapest data is only available from 1995**

In Hungary, secondary schools are usually operated by the state, municipalities, the church and other non-state organisations (foundations, private entities, private companies etc.). The ownership of the school is often a consideration when choosing a secondary school, because many of the church and private schools focus on elite education. The proportion of non-public schools is relatively low. In 2009, 79% of all secondary school students attended public schools, 9% church schools and 11% other non-state schools in the country. Their proportion is higher in Central-Hungary and especially in Budapest than the national average. The proportion of students attending non-state schools increased by 41% between 2001 and 2009 while the school-age population was shrinking (Balázs 2011). It could mean that a further increase in the number of non-sate schools may also increase the overall rate of commuting.

Since 1989, there has been a proliferation of six and eight-form grammar schools usually within existing secondary schools. They attract 10- and 12-year olds from primary schools whose parents want to ensure that their children get good quality education paving the way to university at an early stage. Better student performance at these schools is indicated by results of competency tests (Neuwirth and Horn, 2007). In 2009, students in 8-form grammar schools performed best in mathematics and reading comprehension, followed by 6-form and 4-form students (Balázs 2011). In 2000, 9,6% of all applicants to secondary schools wished to attend a six or eight-form grammar school. In Budapest and Pest County, the proportion of such applications was higher than the national average (Balázs 2005). In 2009, In Budapest, 10,3% of grammar school students attended 6- or 8-form schools, while in Pest county covering roughly the area of the FUR, the proportion was even higher, 14,5% compared to the national average of 9,4%.

The quality of teaching can also be a determining factor of school choice. There is a significant difference between the attractiveness of different grammar and secondary schools. It is reflected by the results of students measured by a national competence test, the rate of admission to university, inter-school competition results, the number of students with language test certificates and the proportion of students admitted to higher education (Dugasz 2011). Secondary schools often refer to these ratings in their promotional materials to attract the best students.

Students attending schools maintained by the church have the highest rate of admission to university education (63%), well above the national average (42%). Contrary to common belief, schools maintained by public or private foundations are the worst performers with only 30% of students admitted to higher education on average between 2001 and 2006. There is also a difference between school types (grammar school, technical secondary school, mixed school). Grammar schools tend to have the best rates of admission to higher education (66%), followed by mixed schools (39%), and technical secondary schools (24%). Within grammar schools there is a difference between 4-, 6- and 8-form schools with the 6- and 8-form systems having higher admission rates (Neuwirth and Horn, 2007).

The admission rates of schools both in Pest County (41%) and Budapest (37%) are lower than the national average (42%). Schools in Budapest, however, perform much better as regards study competition results; the proportion of students who receive a language certificate until leaving secondary school; the results of written admission tests to higher education; and results in mathematics and reading comprehension on the national competence test (Neuwirth and Horn, 2007). If we examine the ratings of secondary schools, it is obvious that Budapest has the largest number of well-performing schools (Table 23).

	Top rated schools			
	grammar school	technical secondary school	mixed school*	Total
Budapest	20	17	6	43
FUR	4	2	5	11

Table 23
The number of top rated schools in Budapest and the FUA
(Top rated schools are in the best 10% based on admission to higher education, language skills and competition results)
(Data source: Köznevelés 2010)

In the forth group of municipalities, the number of secondary school students decreased between 1990 and 2010. Some institutions even ceased operation. The technical secondary school in Kistarcsa, for example, was closed in 2011 because the local municipality did not have the resources to continue operation[54]. Students were taken over by the nearby schools in Aszód and Gödöllő. Some institutions maintained by public foundations were also closed down in Tök, Nagymaros and Páty. Apart from the secondary school in Kistarcsa, which was attended by 233 students when it ceased operation, the other schools that were closed down were small institutions with a low number of students so their closures did not affect the overall school offer of the FUR significantly.

As opposed to school locations, data about the location of homes of secondary school students are not available. Commuting data published by HCSO only indicate the place of school they attend. As education is compulsory for 6-18 year olds in Hungary, demand for secondary schools is determined by the population of the age group 14-17 typically attending

[54] The closure of the school is not reflected on the maps as the latest statistical data available are from 2010.

secondary education[55]. As 96.6% of primary school pupils go on to secondary or vocational education (Garami, 2003a), the examination of the size of secondary school age population can give us an indication of the demand for secondary education.

Demographic trends and suburbanisation affected the size of secondary-school population similarly to primary school pupils. The number of 14-17 year olds decreased by 24% countrywide between 1990 and 2010. In contrast, the drop was only 10% in the FUR, while Budapest lost more than half of its adolescent population. There were municipalities in the FUR, which even managed to increase their young population; in some cases by more than 50% (e.g. Telki: 261%, Leányfalu 127%, Kisoroszi: 100%).

Fig. 24 highlights the regional differences of the change in population of 14-17 olds. Most municipalities with increasing young population are situated in the western (e.g. Diósd, Páty, Biatorbágy), north-western (e.g. Csobánka, Pilisborosjenő, Solymár, Nagykovácsi, Telki, Budajenő), and northern (e.g. Csömör, Mogyoród, Szada) agglomeration of Budapest. These settlements have been popular targets for suburbanisation (Keserű, 2004b; Bajmócy, 2006). Demographic change itself, i.e. the increasing proportion of the younger generation has been linked to residential suburbanisation (Szirmai *et al.*, 2011).

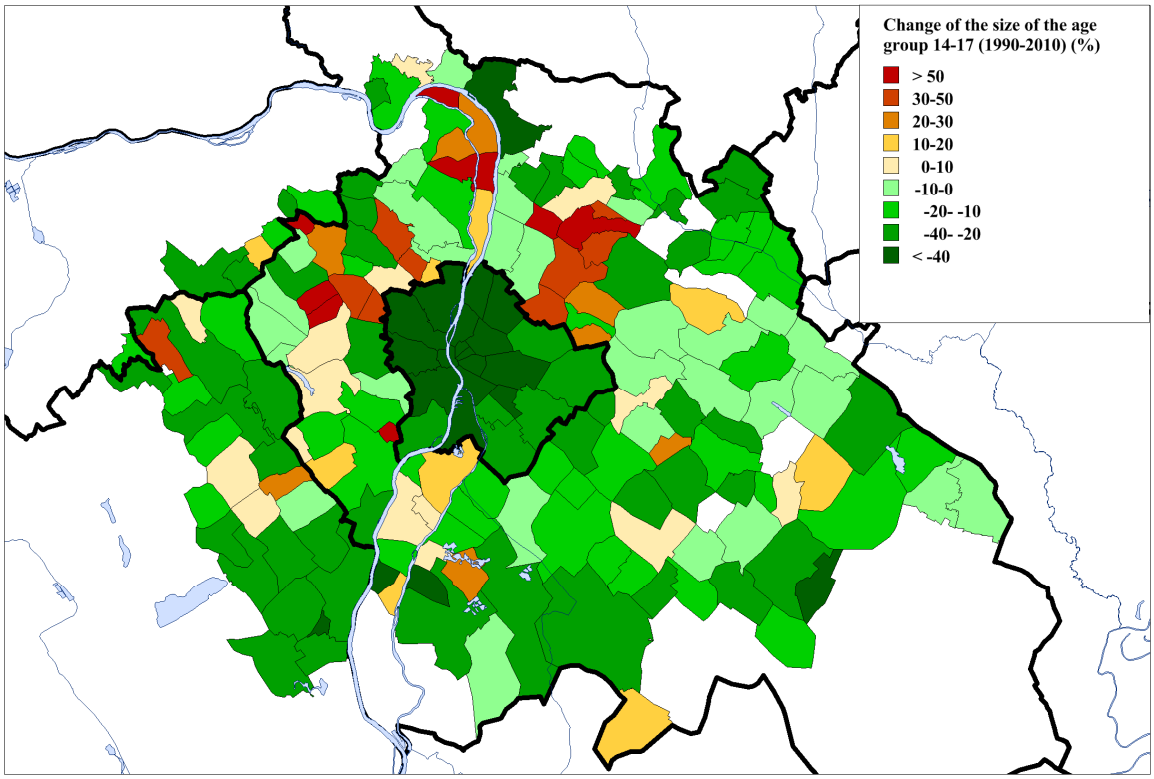


Fig. 24
Change of the size of age group 14-17 between 1990 and 2010
(Source: Own elaboration based on HCSO data)
(In case of Budapest, data are from 1991 and 2010)

The dominant role of Budapest in secondary education has not been challenged. At the same time, schools in the FUR expanded significantly educating 20% of all secondary and vocational students by 2010. While the expansion of secondary schools was continuous in the

[55] According to data available about the age of students for Pest county, the typical age to attend secondary school is 14-18 with a mixture of 14-15 olds in the 9th (typically the first year of secondary education) and 17-18 olds in the 12th classes (typically the last year of secondary education). At least two thirds of secondary school students start secondary education at the age of 14. In addition, detailed population data retrospectively to 1990 is only available for the age group of 14-17. Hence, this group will be used for further analysis.

FUR between 1990 and 2010, the number of students in Budapest had been rising only until 2001 and has been stagnating since then. This indicates that growth in student numbers shifted to the FUR after 2001. Stagnation in case of Budapest is still remarkable in the light of the halving of the secondary school age population in the capital. The phenomenon can be explained by the rise in the number of students commuting to secondary schools in Budapest but living elsewhere.

6.3.2. Secondary school commuting between 1990 and 2010

It is possible to estimate the intensity of commuting in the FUR by analysing data collected by the HCSO about the number of students attending secondary schools in each municipality and the number of in-commuters to these municipalities[56]. In the 20 years between 1990 and 2010, secondary school attendance and commuting underwent considerable changes (Fig. 25).

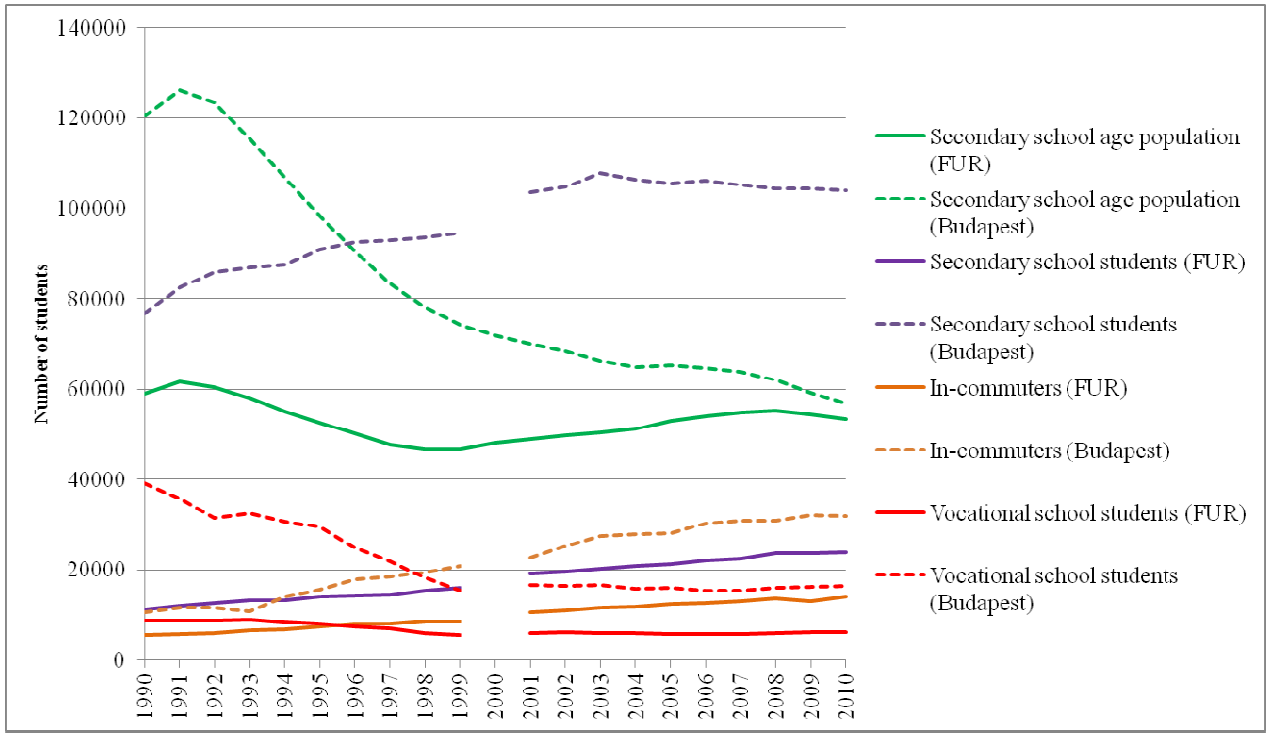


Fig. 25
Number of students attending and commuting to secondary schools and vocational schools in Budapest and the municipalities of the FUR
(Source: Own elaboration based on HCSO data)
(Data for the year 2000 were not published due to inaccuracies in the HCSO database)

If we compare the number of the students[57] with the size of secondary school age population, it is important to highlight that while the number of 14-17 year olds decreased only slightly from 59,087 to 53,362 in the FUR, the number of students attending school there doubled. This could indicate that demand and supply have been levelling off; hence, commuting has decreased. If we examine commuting data in the FUR and Budapest, however, a dramatic intensification of commuting between 1990 and 2010 can be observed.

[56] Commuter data only includes grammar and technical secondary schools and no such commuting data is available for vocational schools.
[57] Since 2001, children attending 6 and 8-form grammar schools from the age of 10 or 12, respectively, are included in the statistics for secondary schools. As here we compared 1990, 2001 and 2010 data and 6 and 8 form grammar schools proliferated after 1990, this did not affect the comparability of the data.

Commuting to Budapest saw a threefold increase rising from 10,588 to 31,974. In 2010, 31% of all secondary school students studying in Budapest were commuters. In the rest of the FUR, the increase was also remarkable, the number of commuters increased from 5,630 to 14,094. It is unlikely that daily commuting to Budapest from outside of the FUR increased significantly during this period due to the long distance. Thus it can be assumed that the intensification of commuting from the FUR to Budapest compensated for the fall in the number of secondary school age population in the capital.

As the data show, local demand for educational services decreased considerably in the central city, while it stagnated in the FUR with growing demand in some suburbanising municipalities. At the same time, the supply of educational services did not keep up with the change of demand in the FUR on the quantitative and qualitative side, which led to increasing commuting to Budapest originating from the FUR. This is an evidence of the mismatch between the transformed socio-economic composition of the society and the spatial distribution of educational institutions. The slow adaptation of the school system is partly due to the fact that it takes decades for a school to create an attractive profile that is very much tied to cities (e.g. high profile secondary schools with long traditions in central Budapest, Vác, Szentendre, and Gödöllő). On the other hand, there are emotional reactions from the local communities to any plans to change the educational system. The combination of tradition and emotion makes it a time-consuming process to implement any changes in the fabric of the school network (Berényi, 1997). If we accept that residential suburbanisation leads to an increase in the school-age population, it can be assumed that there is a link between residential suburbanisation and commuting if the school supply is unable to fulfil the increasing demand in the suburbanising settlements.

In aggregate, between 1990 and 2010, Budapest's dominance on the secondary education market decreased only slightly. In 1990, 87% of all secondary school students in the FUR and Budapest attended schools in Budapest, while by 2010 the proportion fell to 81% (Table 24). During this period, Budapest's proportion of 14-17 year olds within the functional urban area fell considerably from 67% to 52%. This indicates that the discrepancy between demand and supply within the whole FUR (including Budapest) increased. Consequently, the proportion of students commuting to Budapest, however, rose. In 1990, 12% of all students studying in the FUR and Budapest commuted to Budapest, while only 6% to the FUR (cross-commuting). Although the proportion of commuters to municipalities in the FUR increased to 11% by 2010, so did the share of commuters to Budapest (25%). During the past 20 years, commuting intensity increased to both Budapest and the FUR in similar proportions. This indicates that the imbalance between demand for and supply of secondary schools has not been relieved. While a shift from the traditional suburb-city commuting pattern has been detected towards cross-commuting as regards employees, the proportion of secondary school commuters to the core city in fact increased.

	1990		**2001**		**2010**	
	Budapest	**FUR**	**Budapest**	**FUR**	**Budapest**	**FUR**
Proportion of secondary school students	87%	13%	84%	16%	81%	19%
Proportion of commuters to Budapest/FUR	65%	35%	68%	32%	69%	31%
Proportion of 14-17 year olds	67%	33%	59%	41%	52%	48%
Proportion of commuters of all students in the FUR and Budapest commuting to …	12%	6%	18%	9%	25%	11%

Table 24

The distribution of students and commuters within the functional urban area of Budapest (Source: Own calculations based on HCSO data)

The overall growth of the proportion of commuters may have several underlying reasons. It may be caused by a change in the school offer (new schools and specialisations); an increasing qualitative imbalance in secondary school supply and demand (families moving to the suburbs with high income and educational status cannot find suitable high quality schools locally); demographic changes (drop in the number of secondary school age population in the centre of Budapest).

If we examine the inflow of secondary school commuters at municipality level, it is apparent that Budapest has the greatest level of attraction (Fig. 26). As opposed to the commuting of primary school pupils, whose parents tend to choose schools at nearby settlements due to the children's limited independence, secondary school students seem to commute farther. This is especially apparent in Budapest, where the highest number of commuters from outside the capital attend schools in the inner districts (Districts 7, 8, 9, 13). This may also be a reflection of better transport connections into the city centre (railway terminuses, metro network), which may make it easier to reach a school in the centre than in one of the outer districts.

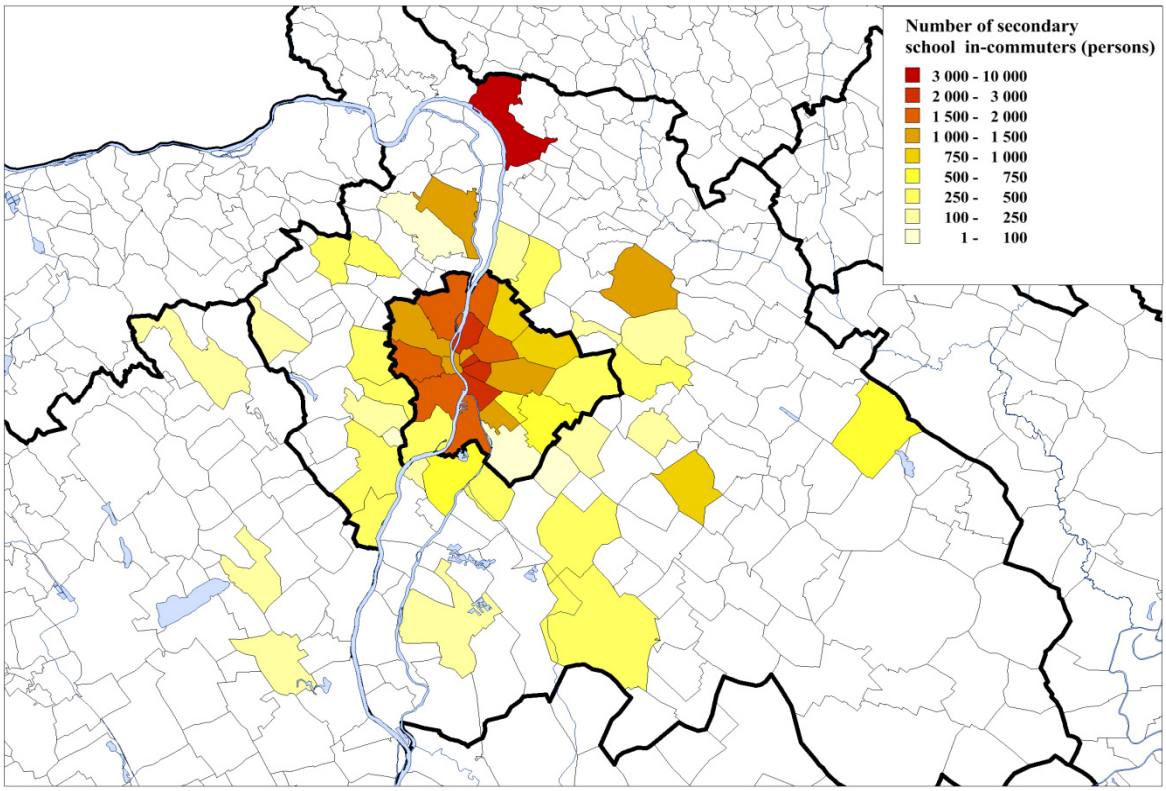


Fig. 26
Number of secondary school commuters in 2010 in the FUR of Budapest
(Source: own elaboration based on HCSO data)

If we examine the change in the number of in-commuters between 1995 and 2010, we should note that in some districts and municipalities, the number of commuters increased by more than 100% (Fig. 27)[58]. It is apparent that growth was concentrated on the outer districts of Budapest (East: 15., 16., 17., West: 22.). Outside of Budapest, the only significant increase occurred in the most suburbanised areas in the Western agglomeration (Pilisvörösvár, Budaörs, Törökbálint, Budakeszi).

[58] In Gyömrő, Piliscsaba, Százhalombatta and in Budapest's District XXIII, new secondary schools were opened in the mid-1990s, hence the growth in the number of students and commuters is not comparable to other municipalities and districts.

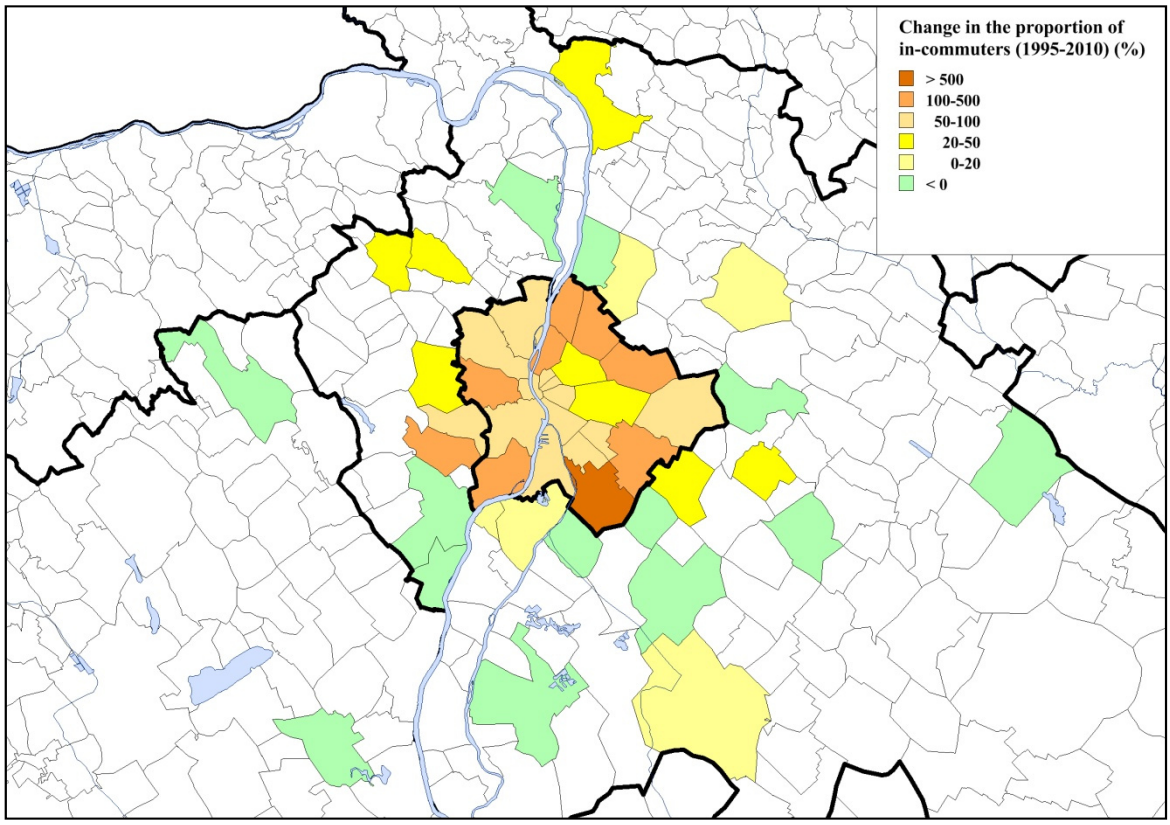


Fig. 27
Change in the number of commuting secondary school students between 1995-2010 in the FUR of Budapest
(Source: own elaboration based on HCSO data)

6.4. Socio-economic background of commuting students

6.4.1. Net household income

School choice is influenced by the cost of commuting (Kertesi & Kézdi, 2005a). As the cost depends primarily on the distance travelled for motorised modes of transport I assumed that families with higher income would be more likely to send their children to a school in another municipality[59]. For primary school pupils, **a statistically significant, moderate relationship has been found between commuting and net household income** (χ^2 *(4)=14.349; V= 0.131;p =0.006 N=837*). For higher income categories (130,001-160,000 and over 220,000) the proportion of commuters is significantly higher (Table 25). For secondary school pupils the results of the cross-tabulation and the statistical test are similar (χ^2 *(4) =14.345; V= 0.168; p =0.006 N=511*).

[59] Due to the low proportion of commuters within the group of primary school pupils, it has not possible to subdivide commuters according to commuting pattern. Therefore primary school pupils have been divided into the subgroups of commuters and non-commuters.

Net household income (HUF)	Commutes to primary school			Commutes to secondary school		
	No	Yes	Total	No	Yes	Total
Under 90,000	7.5%	5.8%	7.3%	7.4%	9.6%	8.6%
90,001- 130,000	17.6%	17.4%	17.6%	19.7%	9.6%	14.1%
130,001 - 160,000	25.7%	9.3%	24.0%	17.9%	20.9%	19.6%
160,001- 220,000	19.8%	24.4%	20.3%	30.1%	26.2%	28.0%
Over 220,000	29.4%	43.0%	30.8%	24.9%	33.7%	29.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

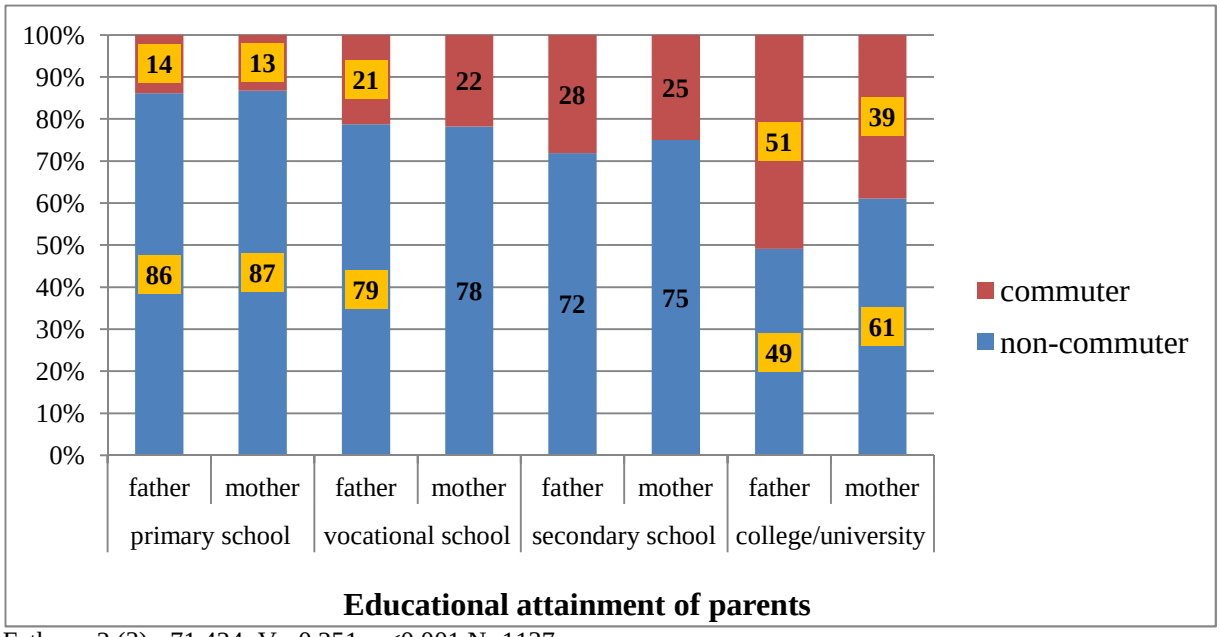
Primary school: χ^2 (4) =14.349; V= 0.131; p=0.006 N=837
Secondary school: χ^2 (4) =14.345; V= 0.168; p=0.006 N=511

Table 25
Proportion of primary and secondary school students according to net family income and the location of the school
Source: Own elaboration based on BKSZ household survey data 2007

6.4.2. Educational level of parents

Higher socio-economic status may also be reflected by the educational attainment of the parents. A relationship between the educational status and the propensity to commute was found by Kertesi and Kézdi (2005b) who analysed national data from 2001. They found that if the father had a degree from higher education, 42% of the children commuted; if the mother had a degree, 37% studied in another municipality compared to the 23% national average.

A similar association has been found by analysing data for the FUR of Budapest. **A statistically significant, moderate relationship has been found between the propensity to commute and the educational attainment of the parents** (Father: $\chi 2$ (3) =71.424; V= 0.251; p<0.001 N=1137; Mother: $\chi 2$ (4) =45.039; V= 0.185; p<0.001 N=1313). Families with parents with higher educational degrees are more likely to send their children to non-local schools (Fig. 28). The proportion is higher than the previous results of Kertesi and Kézdi for fathers (51%) and similar in case of mothers.

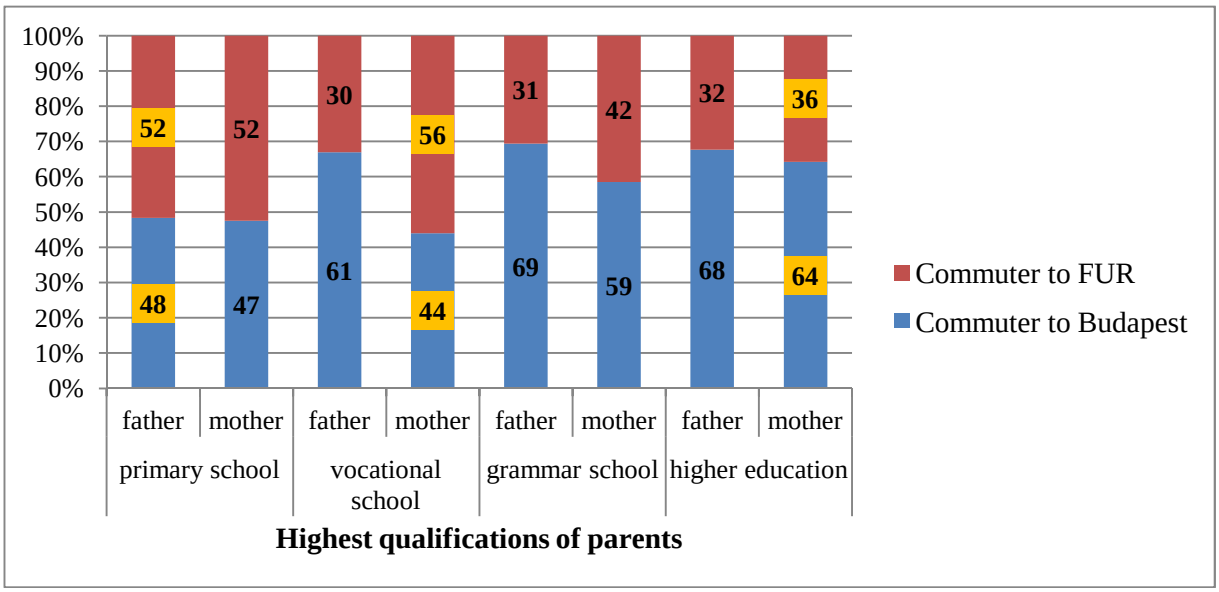


Father: $\chi 2$ (3) =71.424; V= 0.251; p<0.001 N=1137
Mother: $\chi 2$ (3) =45.039; V= 0.185; p<0.001 N=1313

Fig. 28
Proportion of primary-school pupils according to the educational level of the parents and the location of the school
(Source: Own elaboration based on BKSZ household survey data 2007)
(The orange shading indicates a significant difference from the expected values)

In case of secondary school students, it is not feasible to analyse the connection between the tendency to commute and the parents' qualifications, since the number of municipalities that provide secondary education is limited. The potential association between commuting patterns and the educational attainment of the parents was tested instead.

According to the household survey **a statistically significant, moderate relationship has been found between commuting direction and educational attainment of the parents** (*Father: χ2 (3) =8.911; V= 0.141; p=0.031 N=451;Mother: χ2 (3) =10.014; V= 0.15; p<0.018 N=445*). The association is less straightforward than in case of primary school pupils. The proportion of secondary school commuters to Budapest whose parents have higher educational degrees does not differ significantly from the proportion of children with parents who have grammar school qualifications (Fig. 29).



Father: χ2 (3) =8.911; V= 0.141; p=0.031 N=451
Mother: χ2 (3) =10.014; V= 0.15; p<0.018 N=445

Fig. 29
Proportion of secondary-school pupils according to the educational level of the parents and the location of the school
(Source: Own elaboration based on BKSZ household survey data 2007)
(The orange shading indicates a significant difference from the expected values)

6.4.3. Car ownership

Car ownership may exert an effect on the transport mode choice of commuting students In case of primary school children **a statistically significant, moderate relationship has been found between commuting and the number of cars in the family** (*χ^2 (4)=24.289; V= 0.151;p <001 N=1069*). Children who live in families with 2 or more cars are more likely to commute. As car ownership is related to income, we cannot say that there is a causal relationship between the two. We can, however conclude that families with higher income and better availability of a car are more likely to send their children to a non-local school. The proportion of commuting schoolchildren is not significantly different in families without a car or with one car. One reason for this may be that if there is a car in a household, it is used by the family head (usually the father) and children can only be taken to school by car if the school is on the way to the father's workplace. If there are two or more cars available, however, it gives more flexibility to the family and it makes mothers more mobile as it is traditionally her task to escort children to school. This is indicated by a higher proportion of commuting children living in families with 2 or more cars. **For secondary school students the association is weaker but still significant** (*χ^2 (2)=6.402; V= 0.097;p =0.041 N=678*).

For them, the difference between the car ownership of families with commuting and non-commuting students is significant for families with at least two cars available in the household.

Number of cars in household	Commuter to primary school			Commuter to secondary school		
	No	Yes	Total	No	Yes	Total
0	26.3%	13.0%	24.8%	26.4%	20.1%	22.9%
1	58.1%	55.3%	57.8%	57.3%	57.2%	57.2%
2 or more	15.5%	31.7%	17.4%	16.3%	22.7%	19.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

$\chi 2$ (4)=24.289; V= 0.151;p <001 N=1069
$\chi 2$ (2)=6.402; V= 0.097;p =0.041 N=678

Table 26
The distribution of commuting and non-commuting primary and secondary school students by car availability in the household
(Source: Own elaboration based on BKSZ household survey data 2007)

I assumed that there may also be a connection between car ownership and travel mode of students. The more cars the household has, the more probable it is that students commute by car. 6% of one-car households and 24% of students in households with more than one car travel to school as car passengers. I assume that students can only travel to school by car if the school lies on the route to the parent's workplace. The more cars a family owns the higher chance there is for this to happen.

6.5. Characteristics of commuting trips

6.5.1. Commuting patterns

The household survey data have made it possible to examine the distribution of commuting trips according to origin and destination and compare it between school levels. The proportion of commuters among primary school pupils is fairly small. 86.7% of them attend a local school and 13.3% commutes to another municipality. Commuting to Budapest and outside the FUR is relatively uncommon with most pupils who commute travelling to another municipality within the FUR. Similarly to primary school pupils, the largest group of secondary school students is that of the non-commuters. Their proportion is, however, much smaller. Those who commute, do so to Budapest in the largest proportion followed by municipalities in the FUR (Table 27).

Commuting pattern	Primary school pupils	Secondary school students
Does not commute	86.7%	39.5%
Commutes to FUR	8.0%	21.4%
Commutes to Budapest	3.3%	30.0%
Commutes to outside the FUR	2.0%	9.2%
Total	100%	100%

Table 27
Commuting patterns of primary and secondary school students living in the FUR of Budapest
(Source: own calculations based on BKSZ household data, 2007)

6.5.2. Travel mode

As the minimum age for getting a driving licence for cars is 17 years, the majority of school trips are carried out on foot, by bicycle (other category), by public transport and as a passenger in a car usually driven by parents. **A statistically significant, strong relationship**

has been found between commuting patterns of primary school pupils and travel mode ***(χ2(3)=218.970; V= 0.453; p<0.001 N=1069).*** Walking is the predominant mode of transport for non-commuters. Those who commute, travel mainly by public transport, but the percentage of journeys by car is also high (Table 28).

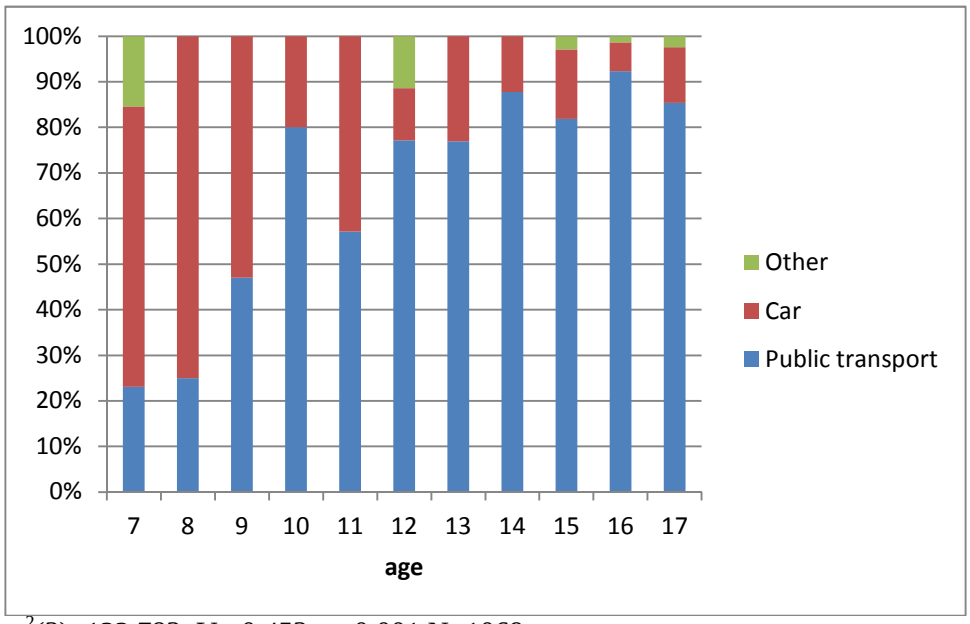
Travel mode	Commuter		Total
	No	Yes	
Public transport	12.1%	56.5%	17.2%
Car	19.0%	38.7%	21.3%
Other	17.8%	3.2%	16.1%
Walking	51.1%	1.6%	45.4%
Total	100.0%	100.0%	100.0%

$\chi^2(3)=218.970$; V= 0.453; p<0.001 N=1069

Table 28

Travel mode of commuting and non-commuting trips of primary school pupils
(Source: Own calculations based on BKSZ household data 2007)

For primary school pupils, age seems to be a determining factor in travel mode choice, as children's independence depends on their age. **A statistically significant, strong relationship has been found between commuting pattern and choice of travel mode** ***(χ²(3)=122.783; V= 0.322; p<0.001 N=593).*** As Fig. 30 shows the higher the age of the pupils is, the more likely they are to travel by public transport instead of being driven by car.



$\chi^2(3)=122.783$; V= 0.453; p<0.001 N=1069

Fig. 30

Travel mode choice of commuting students by age
(Source: Own calculations based on BKSZ household data 2007)

For secondary school students, a statistically significant, very strong relationship has been found between commuting pattern and choice of travel mode (*χ^2 (6)= 387.307; V= 0.509;p <0.001 N=747*). Secondary school students who commute predominantly use public transport. The difference between the car use of commuters to Budapest and to schools in the FUR is not significant. The proportion of car use is similar for cross-commuters and commuters to Budapest (Table 29).

Travel mode	Commuter to Budapest	Commuter to FUR	Commuter to outside the FUR	Does not commute	Total
Public transport	87.1%	83.1%	95.6%	27.1%	63.3%
Car	12.9%	11.9%	4.4%	6.1%	9.2%
Other	0%	5.0%	0%	66.8%	27.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

χ^2 (6)= 387.307; V= 0.509;p <0.001 N=747

Table 29
Modal split of secondary school students' trips to school
(Source: own calculations based on BKSZ household data 2007)

6.5.3. Commuting distance

While primary school pupils attending local schools travel only 1.1 km on average[60], their commuter counterparts travel 9.6 km. Secondary school students' local journeys are also short: 1.4 km, but they travel much farther than primary school pupils with an average journey distance of 18.7 km.

This latter observation has been confirmed by the crosstabulation of travel distance categories and school types (Table 30). **A statistically significant, very strong relationship has been found between school types and commuting distance** (*χ^2 (4)=95.728; V= 0.427;p <0.001 N=525).* The commuting distance of secondary school students is significantly higher than that of primary school pupils.

Commuting distance (km)	School type		Total
	Primary school	Secondary school	
0-10	72.5%	24.4%	35.4%
10-20	16.7%	43.0%	37.0%
20-30	9.2%	17.5%	15.6%
30-40	1.7%	12.3%	9.9%
40-50	0.0%	2.7%	2.1%
Total	100.0%	100.0%	100.0%

χ^2 (4)=95.728; V= 0.427;p <0.001 N=525

Table 30
Commuting distance of primary and secondary school students (not including non-commuters)
(Source: Own calculations based on BKSZ household survey 2007)

For secondary school students, the commuting pattern determines the length of the trips**.** Average trip distance is highest for commuters to Budapest (23.4 km), followed by commuters to outside the FUR (16.3 km), to the FUR (10.8 km) and attending local schools (1.3 km) (Table 31). These results suggest that commuters to primary school travel to neighbouring settlements, while commuters to secondary school travel farther. It has been confirmed by mapping commuting trips for both primary and secondary school students (see Appendix 7 & 8).

A hypothetical journey speed[61] has also been calculated. Primary school pupils who commute to Budapest travel at the highest speed probably because the majority of them are driven by car. The speed of other commuting students is similar, ranges between 13-18 km/h irrespective of commuting pattern, because the majority of them travel by public transport.

[60] As no route information was available in the surveys for journeys, average commuting distance was calculated in a straight line between trip origins and destinations on a GIS map.
[61] It is hypothetical, since the exact distance travelled was not available. Thus, the speed is only an estimate.

	Commuting pattern	Distance (km)	Time (min)	Speed (km/h)
Primary school	Attends local school	1.1	17.3	3.8
	Commutes to FUR	7.1	31.1	13.7
	Commutes to Budapest	14.4	35.5	24.3
Secondary school	Attends local school	1.3	22.0	3.5
	Commutes to FUR	10.8	43.9	14.8
	Commutes to Budapest	23.4	79.0	17.8

Table 31
Average commute distance, time and hypothetical speed of students
(Source: Own calculations based on BKSZ household survey 2007)

6.5.4. Commuting time

The duration of commuting trips is determined by travel distance and mode. According to my data analysis, those who travel farther and by public transport spend the most time on commuting to school. Secondary school students commuting to Budapest have the longest average commuting time with 79 minutes (Table 31). Primary school commuters to Budapest travel approximately half of this on average. This may indicate that primary school commuters that travel to Budapest mostly live close to the capital and/or commute one of the outer districts of the capital.

Primary school students in general spend less time travelling to school. **A statistically significant, very strong relationship has been found between school types and commuting distance** ($\chi 2$ (4)=109.210; V= 0.43;p <0.001 N=590). The proportion of primary school students travelling to school for 0-30 minutes is significantly higher than secondary school students. For journeys longer than 61 minutes, the proportion of secondary school students is significantly higher (Table 32).

Commuting time	School type		Total
	Primary school	Secondary school	
0-15	20.9%	5.8%	9.3%
16-30	36.0%	10.2%	16.3%
31-45	18.7%	19.3%	19.2%
46-60	14.4%	16.4%	15.9%
61-	10.1%	48.3%	39.3%
Total	100.0%	100.0%	100.0%

(χ^2 (4)=109.210; V= 0.43;p <0.001 N=590)

Table 32
One way duration of trips to school by type of school (including only commuters)
(Source: Own calculations based on BKSZ household data, 2007)

6.5.5. Departure time from home

Most primary and secondary schools start classes at 7:30 or 8:00. The departure time of students from home depends on the duration of the journey to school. According to my results, while pupils attending local schools rarely leave before seven, for commuters it is typical to leave between six and seven. Primary school commuters typically leave home between six and eight, while at least one-sixth of secondary school students leave home before six. The median departure time for primary school commuters is 6:52, while for secondary school students it is 6:30 (Table 33).

Departure time from home (hr)	Primary school	Secondary school
4-5	0%	1.1%
5-6	0%	16.4%
6-7	56.2%	64.8%
7-8	43.8%	17.8%

Table 33
The distribution of commuting students by departure time from home
(Source: Own calculations based on BKSZ household data)

6.6. The implications of commuting to school

Commuting to school has several consequences. School choice, the distance from home to school and segregation have been linked by Allen (2007), who found that a higher proportion of students visiting not the closest school increases social segregation. Andersson et al. (2012) examined children's travel to school distances in Sweden and its implications on equality. She argued that the distance travelled to school is a reflection of social inequalities and free choice of schools had led to increased inequality in the Swedish school system. The children of more affluent parents are more likely to have one or more cars available for commuting and therefore it may be easier for them to fund the cost of commuting for school. It means that these families have more choice concerning schools. If higher status people move to the suburbs in the course of residential suburbanisation they may increasingly choose non-local schools as they can afford to send their children to 'better' or 'special' schools. Those who move to a suburb from Budapest may choose to continue to school their children in Budapest especially if they have already started school there[62]. In my analysis, parents with higher educational status have been found to be more prone to send their children to schools outside their home municipalities. It may imply that parents with higher educational attainment may select the schools for their children more carefully contemplating special teaching programmes and specialisations (e.g. languages or sports), the quality of teaching and the infrastructure and the ethnic and social composition of pupils. This may lead to segregation at local schools and an increasing inequality as regards school choice between less and more affluent residents of suburban municipalities.

Primary school pupils can choose to attend a local school in most of the cases if they do not want or cannot afford to commute to another municipality. For those 14-17 year olds, however, who have no access to a car or do not want to live in a hall of residence far from home, public transport provides fundamental accessibility of secondary schools from settlements that do not provide secondary or vocational education. While employees can relatively easily choose individual transport (car) for commuting in case public transport is unavailable or inconvenient (provided they have a car), secondary school students rarely have this choice due to the lack of a driving licence and a second or third car in the family. Therefore school choice for secondary schools may also be limited by the public transport network. Municipalities in the FUR usually have good links to Budapest with frequent services, while cross-suburban connections are usually limited, which also restricts commuting to another municipality in the FUR (Keserű, 2010). Consequently, providing better public transport links to suburban educational institutions may reduce the amount of commuting for secondary school students.

According to Marique et al. (2013) the decentralisation of schools leads to decreased energy consumption and more favourable mode choice by reducing the need for commuting. The conclusions I can draw from my data analysis contradicts this argument. While it can be

[62] This conclusion is valid only if suburbanisation is limited to medium and high-status people.

argued that due to the increase in the number of secondary schools in the FUR, education has been deconcentrating, commuting to both Budapest and the FUR still increased. Marique et. al's argument can only be true in an ideal case, if all children go to the nearest school and free choice of school is restricted. If, however, school choice is free, my analysis shows, that parents with higher socio-economic status tend to choose schools further away from their home municipalities increasing energy consumption and the tendency to choose cars instead of public transport, walking or cycling.

It has been highlighted in this chapter that commuters to school have to travel farther and longer and they have to wake up earlier than their non-commuter counterparts. As commuting students has to spend more time with travelling they have less time for out-of-school activities. It may have adverse consequences for the study performance and well-being of children. It has been pointed out that a high proportion of commuting students and extracurricular activities due to the need to travel to and from school (Balázs, 2005). Due to the early rising and travelling often with several transfers they have to cope with daily stress (Mayer, 2003; Mayer & Singer, 2003). Hence they may be subject to weaker study performance. Consequently, they may require a different approach from teachers as they have less time to study (Balázs, 2005). Time spent on public transport vehicles is very often wasted in short of suitable circumstances (lighting, proper seat) for studying (Mayer, 2005). Although it has also been argued that travelling together with their fellow-commuters provides a chance for social interaction and new friendships (Mayer & Singer, 2003).

As commuting usually involves some motorised form of transport, it can contribute to an unhealthy lifestyle (Cooper *et al.*, 2003; McMillan, 2007). Those pupils who walk to school have been found to have a higher physical activity level (Alexander, 2005). Lack of regular exercise can lead to illnesses, fatigue, stress and obesity (Hillman, 1997). Children who travel to school by car are also less independent (Morris, Wang & Lilja, 2001).

My results have highlighted another important aspect of commuting. The choice of transport mode and the distance travelled impact on environmental pollution and road congestion (Morris, Wang & Lilja, 2001). In the United States, for example, the proportion of children driven to school by car increased from 16% to 55% between 1969 and 2005 while walking and cycling decreased from 42% to 13% (McDonald, 2005). In the United Kingdom, at 8:50 on weekdays one-fifth of the cars on urban roads are transporting children to school (Derek Halden Consultancy, 2002). Besides increasing traffic at the urban level, local congestion may also become an problem around schools as the school run is usually at the same time, and there is limited parking around schools (Morris, Wang & Lilja, 2001). According to my analysis, children in families with higher income have been found to be more likely to travel to school in their parents' car. If more families can afford taking their children to school by car, traffic congestion may increase on the suburban road network.

Another consequence of the increasing number of student commuters is the higher compensation the state has to pay to public transport operators[63]. I have calculated the state compensation paid by the state every year for student passes bought by primary school pupils based on the commuting data in the previous analysis. It is estimated that approximately 100 million HUF is paid a year to this end[64]. Should the proportion of children commuting to school increased by 10%, the compensation would have to be increased by 6.5 million HUF each month. In case of primary school pupils, parents are not obliged to educate their children

[63] Public transport tickets and passes are subsidised for students by the state. The state compensates public transport operators for tickets and passes sold to students with a discount of 50% (any trips within the country) or 90% (for monthly passes between the municipality of the student's home and school).

[64] The calculation is based on the average travel distance of commuters to primary schools (10%) and the proportion of public transport users (64%). The 2012 price of a student pass for 10 km was taken into consideration which includes 90% discount over the full price pass. I need t emphasize that this is merely a rough estimate, but it is, I think, suitable to demonstrate the magnitude of compensation.

in the municipality where they live. Free choice of schools is guaranteed by law. As a consequence, the state funds local primary schools and supports the commuting of primary school students with travel discounts to schools simultaneously. At the same time, as suburbanising settlements show higher car ownership rates (Keserű, 2004b), we can also assume that if the number of cars per family grows, the probability of pupils commuting to school by car will increase and consequently, the proportion of public transport passengers will drop.

6.7. Chapter conclusions

This chapter has presented and discussed the results of the data analysis on commuting to primary and secondary school. It has been shown that the demand for both primary and secondary education has increased in the suburban areas of the FUR with a simultaneous sharp decline in Budapest due to residential suburbanisation. At the same time, commuting intensity for both school types has increased in past decade.

Although primary education is largely decentralised and there are fewer differences between schools in terms of specialisations, commuting to primary school still affects 20% of all primary-school age children living in the FUR. Commuting to primary school has been found to be more significant from suburbanising settlements in the western, northern, and north-eastern agglomeration of Budapest. The distance of a municipality from Budapest appears to play an important role. A moderately strong relationship between the suburbanisation index of municipalities and the proportion of out-commuters to primary school has been found.

In comparison to primary schools, commuting to secondary school is even more widespread, due to the concentration of secondary schools in larger towns and especially in Budapest. It is estimated that at least 50% of 14-17 year olds living in the FUR commute. Despite the sharp drop in local demand in Budapest, and the opening of new schools in the FUR, the capital's dominance on the secondary education market has been unaltered. Commuting intensity increased to both Budapest and the FUR in similar proportions. As opposed to employment commuting where cross- and reverse commuting have increased significantly over the past decade, commuting to secondary school has remained monocentric and the proportion of secondary school commuters to the core city increased. While a slow deconcentration of secondary schools in the FUR has been detected it cannot be confirmed that it has reduced commuting. These results confirm previous findings of Burgmanis (2012) and Bajerski (2010), who concluded that education remained largely monocentric in CEE urban areas and it does not show trends of decentralisation.

By analysing disaggregate commuting characteristics, it has been pointed out that the propensity to commuting for both primary and secondary school students is associated with net household income, the educational attainment of parents and car ownership. Primary school children whose parents have a degree from higher education and/or high income are more likely to commute to another municipality. In case of secondary school students, only the household income has been found to affect the propensity to commute. Children living in households with two or more cars are more likely to commute to school as car passengers.

The analysis of trip characteristics confirmed the findings of the aggregate data analysis: a significantly higher proportion of secondary school students commute and their main destination is Budapest. The students who commute have been found to use predominantly public transport, but car use was relatively high for primary school pupils, especially in the younger age groups. The analysis of commuting distance and duration revealed that secondary school students travel farther and longer than primary school pupils. The longest journeys are made by secondary students commuting to Budapest and they have to leave home early. Finally, the potential consequences of the increasing proportion of car use, long commuting

journeys and early morning departure from home on traffic congestion, children's physical and mental health and inequality of access to education have been highlighted.

7. Conclusions

The two preceding chapters have presented and discussed the findings of the data analysis. This ultimate chapter now seeks to summarise the results of the research. In Section 7.1, the research findings are interpreted in relation to the specific research questions set out in Chapter 1. Then, in Section 7.2 the theoretical and methodological contributions of this research are presented. Subsequently, reference to the limitations of the results will be made followed by recommendations for further research and policy making.

7.1. Research findings

In Chapter 1 the research gap was identified and the research questions were formulated. After clarifying the definitions of the main concepts used in this research in Chapter 2, I confirmed that the Budapest FUR is indeed affected by the dual influence of suburban and post-suburban development (Chapter 3). In Chapter 4, the methodology of the quantitative analysis was introduced, which was then applied to aggregate and disaggregate data pertaining to commuting to work in Chapter 5 and commuting to school in Chapter 6. The findings of the research are presented in a structure that follows the research questions, which are repeated below.

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

This research found evidence for post-suburban development in the functional urban area of Budapest. Based on a literature review, urban forms indicating post-suburban development have been identified. The emergence of new suburban employment centres (growth poles) in the western, and northern periphery of Budapest (Burdack, Kovács & Dövényi, 2004; Dövényi & Kovács, 2006); the emergence of a polycentric urban fabric with the edge-city like development in Budaörs-Törökbálint (Izsák, 2001; Burdack, Kovács & Dövényi, 2004; Dövényi & Kovács, 2006); economic development around the international airport (Dövényi & Kovács, 2006); company headquarters relocating to suburban locations; services, high tech industries, research and development centres dominating new business development in the suburbs (Kovács, Sági & Dövényi, 2001; Koós, 2004; Nagy & Nagy, 2009); the emergence of suburban entertainment centres and gated communities (Hegedűs, 2011); and the construction of a postmodern artificial edge-city (Tópark) have been identified as the indications of post-suburban development.

Additional evidence has been provided for post-suburbanisation by analysing data pertaining to the labour market of the FUR. It has been revealed that job growth in the suburban areas surpassed the rise of employment in Budapest between 2000 and 2010. There was a significant increase in service employment as well. As these are considered as indications of post-suburban development (Burdack, 2002), they provide further evidence for post-suburban transformation.

The fact that post-suburban forms and processes can be detected around Budapest as well as the increasing suburbanisation of jobs indicates that post-suburbanisation affects the development of the urban structure of the functional urban area of Budapest.

Post-suburbanisation is still in its early stage. The suburbanisation of jobs is still largely limited to manufacturing and retail services. Post-suburban development is also fragmented.

The new economic poles that emerged in the FUR during the past 20 years are may become the future nodes of post-suburbanisation as the example of Budaörs shows.

B. Is post-suburban restructuring reflected in the changes in commuting patterns in the Budapest functional urban region?

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 (Van der Laan, 1996; Sohn, 2005). The analysis of aggregate commuting statistics showed that both cross-commuting and reverse commuting increased between 2001 and 2005, most probably because of accelerated job growth in Pest County. The results suggest that while commuting in general stagnated between 1990 and 2001 in the FUR, a significant reconfiguration of commuting destinations took place. While traditional sub-centres lost their significance, the new economic poles around Budapest became the main destinations for cross- and reverse commuting. The distribution of cross- and reverse commuters was found to be influenced by average travel time by car from Budapest. Municipalities which can be reached in a shorter time from Budapest attract a higher proportion of reverse-commuters.

The fact that the new economic nodes restructured commuting patterns and attract a high proportion of cross- and reverse commuters is considered as an additional evidence of post-suburban development. Hence it can be expected that further economic development in the suburban zone would increase both reverse- and cross-commuting.

Exchange commuting – when residents of a suburb commute to the core city, while people living in the core city commute to the suburb exchanging workforce – could also indicate post-suburban restructuring (Schwanen, Dieleman & Dijst, 2004). It was detected in the relationship between the town of Budaörs and Budapest, where the number of reverse commuters exceeded the number of traditional commuters already in 2001. It is expected for additional economic poles (Törökbálint, Budakalász, Dunaharaszti, Gödöllő, Fót) to develop exchange commuting as well.

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

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 (Van Ommeren, 2000). 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 (Berényi, 2003). My analysis shows that there is an imbalance in the demand and supply of secondary education in the Budapest FUR and it led to increased commuting of students within the Budapest FUR.

My results suggest that residential suburbanisation may influence the above-mentioned balance of demand and supply. Suburbanisation shifts demand for primary and secondary education from Budapest to its suburban zone through increasing the size of the school-age population. As a consequence, both commuting to primary and secondary school has intensified. 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 1990-2001.

Another major difference between commuting to work and school is that the 'actors' (i.e. the commuters) are less independent in their decisions about school choice and commuting

characteristics (e.g. travel mode). Decisions are most often made by their parents, whose socio-economic characteristics have been found to influence children's propensity to commute. Flexibility in the choice of school is also constrained by the limited independence of children in terms of travel by public transport and availability of cars in the household.

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

The data analysis demonstrated that socio-economic characteristics of commuters influence their commuting patterns. 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. 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 residents of new suburban communities cannot find jobs in the suburbs and commute to the core city, while jobs requiring higher educational levels are taken by reverse commuters from Budapest (exchange commuting).

As regards commuting to school the relationship between the socio-economic status of parents and the likelihood of children commuting to school to another municipality has been confirmed. Both net household income and the educational attainment of parents, and especially that of the father have been 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?

My results suggest that cross- and reverse commuters to work are more likely to use a car to go to work than commuters to Budapest. 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 in suburb-to-city corridors and intra-suburban trips by calculating the theoretical travel speed. It was significantly higher for commuters to Budapest compared commuters within the FUR.

Cross-commuters have been found to spend half the time with travelling to or from work than traditional commuters. A similar difference has been shown in travel distance as well. Journeys by public transport have been found to be longer in duration than car trips. The advantage of the car in traditional commuting, however, was small compared to cross-commuting, most probably due to the fast rail-bound connections to the city centre providing a competitive alternative to the car.

Commuting students primarily use public transport, but a high proportion of primary school pupils are driven to school especially in younger age groups. Secondary school students are driven to school to a significantly less extent, possibly because they are more independent, especially compared to very young children (ages 6-10). In addition, an association between mode choice and household income was also found: children living in families with lower income are less likely to travel to school by car.

Commuting distance and time of secondary school students are significantly higher than those of primary school pupils. Similarly, secondary school students have to leave home earlier to get to school on time. It has been 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.

After answering the sub questions of this research the main question *to what extent is post-suburbanisation in the Budapest functional urban region different compared to western countries with respect to changing commuting patterns* is answered.

In different stages of this research, results were compared to previous findings from the USA, Western Europe and other post-socialist countries in order to trace any unique features of urban transformation and especially commuting. The objective was to contribute to the debate over the existence of a unique post-socialist development path.

The results of the analysis of migration and labour market data over a period of the past 20 years revealed that the suburbanisation of residents and jobs in the Budapest FUR overlap. While intensive residential suburbanisation has been occurring since the beginning of the 1990s, a boom of the suburbanisation of employment could only be detected from the beginning of the 2000s. This provides further evidence for the stages of urban development overlapping in post-socialist countries (Hirt, 2006). It is, however, still uncertain how the current economic crisis affects the trend of suburbanisation.

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.

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. It reflects the concentration of highly educated population in Budapest and a shortage of them in the agglomeration. While this could be considered as a legacy effect of socialism (Tammaru, 2005), changes in commuting trends since 1990 indicate that the socio-economic status of commuters has reflected residential suburbanisation. While the proportion of reverse commuters with a degree changed only by 5 percentage points between 1990 and 2005, the proportion of commuters to Budapest educated to degree level increased by 500%. Consequently, I think this legacy effect has been neutralised.

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 case of students' commuting, differences can also be explained by the differences in regulatory frameworks between countries. Free choice of schools, for example, is fundamental in determining the commuting patterns of students.

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 is still in the early phase of post-suburbanisation.

7.2. Theoretical and methodological contributions

In Chapter 1, I highlighted a clear gap in existing knowledge pertaining to post-suburbanisation in the context of changing commuting patterns. Few empirical studies have been carried out to investigate how the interplay between suburbanisation and post-suburbanisation affects commuting patterns in Central and Eastern Europe. In addition, I pointed out that most of previous research had considered only the commuting of employees while other groups of the society, like students had received significantly less attention.

One of the main contributions of this research to the body of urban geography is an attempt to link forms and processes identified with post-suburban transformation in the USA and Western Europe in the literature with urban change in metropolitan areas in post-socialist countries and specifically the functional urban region of Budapest. The catalogue of post-suburban forms and proposed in Chapter 3 processes (based on Borsdorf, 2004, 2009; Knox and Pinch, 2009; Leber, 2010) can help to identify whether a certain urban region is undergoing post-suburban transformation. The application of this method has provided evidence for post-suburban development trends around Budapest.

Another important theoretical contribution is the attempt to extend the focus of geographic research to the linkage between urban change and daily spatial mobility to social groups other than employees. This research has extended the study of the relationship between commuting and urban transformation to primary and secondary school students. A justification for extending the concept of commuting to include students' daily travel to school was suggested based on the fundamental similarities of the daily movements of employees and students.

Notwithstanding the similarities, important differences between commuting to work and school were also identified. In case of commuting to school only one end of the commuting trip is determined by 'free choice' or demand, i.e. the location of homes. The location of the school is – in most of the cases – determined is 'given' (existing schools) and any changes in school locations and the educational system relies mostly on state and municipality policy and interventions.

I applied a multi-level research methodology on commuting (Schwanen, Dieleman & Dijst, 2004) using aggregate (FUR and municipality) and disaggregate (household) data that made it possible to examine commuting characteristics at different geographical scales. This approach has not previously been applied in geographical research on commuting in Hungary and provides a more in-depth analysis of commuting patterns.

As a methodological contribution, I introduced a composite commuting index by improving Guth et. al.'s (2010) measure of commuting intensity. My index has made it possible to indicate the magnitude and direction of changes in commuting patterns. The use of this index has been demonstrated by calculating it for commuting into municipalities in Pest County in 1990 and 2001.

A method for the calculation of the index of residential suburbanisation has been proposed partly based on Bajmócy (2003, 2006). It accounts for the definition of suburbanisation as a deconcentration process but limiting it to the deconcentration of higher status population for the purposes of this study.

As regards the commuting of primary school pupils I proposed that commuters should be distinguished by their reasons for commuting. The terms 'commuting by choice' (if primary education is available locally) and 'commuting by necessity' (if primary education is not available locally) have been introduced. This distinction makes it possible to investigate the relationship between suburbanisation and commuting of primary school pupils as it was demonstrated earlier.

7.3. Limitations of the findings

Although the analysis has been carried out at three different geographical scales (functional urban area, municipality, individual), inferences could only be made at the level of the FUR due to the nature of the dataset available. Consequently, the way local agents, (e.g. commuters, business owners, school principals and municipality leaders) experience and influence urban change have been left out of the analysis completely.

Another methodological limitation inherent to the restrictions applied to the definition of residential suburbanisation is that only the deconcentration of people with higher socio-economic status has been considered as suburbanisation. Therefore those who may have moved from Budapest to one of the less affluent suburbs have not been taken into account. As most of the associations between variables are related to higher socio-economic status, I think, this restriction has not affected the validity of findings.

The link between commuting and suburbanisation could only be investigated through proxies in this research. None of the databases that I used provided information whether the individuals were 'suburbanites' or long-time residents. Therefore socio-economic status was used as a proxy for suburbanisation at the individual level, and the suburbanisation index at municipality level. Although there is likelihood that these proxies are not fully reliable, the fact that they are based on previous research ensures that they reflect suburbanisation as much as possible.

A number of limitations are related to the unavailability of current or recent data. The latest municipality level commuting and employment statistics, for example, is more than 10 years old. While an effort has been made to use more up-to-date aggregate county-level figures to reflect recent trends, these may have concealed changes at the level of municipalities and below. It must also be noted that due to the unavailability of data for the FUR, statistics for several different administrative and spatial units were used. Although most of them (e.g. Pest County) largely overlap with the FUR, the results are not directly transferable between them. Some data I needed was missing from HCSO statistics and had to be estimated (e.g. the number of out-commuters to primary school). As these calculations included some assumptions, they may not reflect reality to a full extent. Another limitation arises from the fact that the research covered a period of 20 years and some of the longitudinal statistics were not comparable to earlier periods due to the changes in data collection methodology at HCSO (e.g. number of primary school pupils, number of employees). This issue has been addressed by comparing data only within periods for which data were available in the same quality. Comparisons were also made between Census data from 2001 and Microcensus data from 2005. These results, however, need to be confirmed by analysing the latest Census data as soon as they become available, as data from 2005 are based on a sample of 2% of households.

Another limitation of the methodology has been that the study area (FUR) was delimited using solely a commuting threshold based on 2001 Census data, while other relationships (education, transport, administration) have not been taken into account. The application of a more complex method would have, however, been beyond the scope of this research.

Most of the findings of the household survey are limited by the use of a cross sectional design. As data from previous similar household surveys was not available at the time of the research, no comparisons could be made with previous datasets. Where comparisons were made with the 2001 Census data, the differences in sampling may have affected the reliability of the findings. In addition, the results of the household survey can only be generalised to the FUR, because of the limited sample size. It was therefore not possible to carry out more detailed analysis at regional and municipality level.

7.4. Recommendations for further research

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 can be proposed.

The scope of this analysis did not permit a detailed exploration of post-suburban forms and processes in Section 3.1. It would be interesting to identify post-suburban development in a systematic way and extend the 'catalogue' of post-suburban forms and processes suggested in this research.

It was also not possible to investigate the validity of the co-location hypothesis (see in Section 3.6.2) in the post-socialist context. While it has been tested in the USA and many Western European countries, no research has been carried out in CEE countries. An in-depth study could help to forecast if further decentralisation of jobs would lead to shorter journeys. As soon as the results of the 2011 Census have been published, the characteristics of commuting trips can be compared over a period of 20 years, which can contribute to the better understanding of this issue.

Although potential explanations for the significant difference between the socio-economic status of cross- and reverse commuters has been suggested, further empirical research should confirm if the main reason is exchange commuting. In addition, the underlying reasons for exchange commuting could be investigated using qualitative methods.

The fact that the role of local agents in urban change has not been addressed warrants further research using qualitative methods, too. Interviews with commuters, schoolteachers, company representatives could contribute to a better understanding how these agents view commuting in the FUR. Case studies of specific municipalities and employees would greatly expand our knowledge.

One of the major consequences of increasing cross-commuting is the deteriorating modal split and increasing traffic on suburban roads. It would be interesting to investigate what the reasons for the preference for the car are for cross-commuters. This could help to influence relevant policy to avoid future traffic congestion and increasing environmental pollution.

It has been suggested in this study that the access to suburban job locations may depend on car availability. This has implications for equal opportunities of mobility. Further research should be carried out to investigate how the equality of suburban residents with and without access to car transport differs and how transport policy (e.g. the development of suburban public transport) can tackle this issue.

A similar issue has been referred to with regard to school commuting. As a consequence of free choice of schools, families that have access to one or more cars have better opportunities to reach schools that would be inaccessible without a car. At the same time, local schools may be deserted by suburbanites who have recently moved to a village and prefer to take their children to a town school or to Budapest. The issues of accessibility and segregation seem to be linked to the propensity and ability to commute. The relationship and the extent of the phenomenon are, however, not clear and hence it could be the subject of further empirical research.

Similarly, we know little about the impact of commuting to school by car on local traffic congestion around schools especially during the daily school run. Empirical studies could address this issue by observing and counting traffic around schools and carrying out questionnaire and quantitative surveys among schoolchildren and their parents.

While this research has hinted at a potential relationship between suburbanisation and the propensity to commuting to school, it has also been noted that besides suburbanisation several other factors may influence school choice (e.g. attractiveness of individual schools,

specialisations, settlement density, transport connections). A complex investigation of these factors is needed to explain their potential influence.

As it was noted in Section 6.1 this research did not address the commuting patterns of university students. Their commuting is likely to be significantly different from that of primary and secondary school students due to their irregular study timetables, independence, access to car and the limited availability of higher educational institutions.

In addition, the administrative and legal framework of education is changing constantly. A major restructuring of the education system at all levels has been introduced in 2013. Whether these changes may have consequences pertaining to commuting could also be the subject of further research.

7.5. Relevance to policy making

The potential consequences of changes in commuting characteristics presented above have been reviewed based on previous research. Changing socio-economic status and trip characteristics of commuters may have several consequences pertaining to traffic, environment, health, equity and transport provision, which need to be addressed by transport, regional and education policy.

Increasing cross-commuting may trigger rising car use since cross-commuters have been found to be more likely to use cars. If the volume of cross-commuting increases and the modal shift to cars continues, it may lead to congestion in suburban areas and a deterioration of the environment (Gordon, Richardson & Kumar, 1989; Gordon, Richardson & Jun, 1991; Sultana, 2002) .

Cars being 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 lead to inequality in access to jobs (McLafferty, 1997; Cervero *et al.*, 2002; Ohnmacht, Maksim & Bergman, 2009).

Student commuting has been found to be associated with the socio-economic status of parents. If municipalities around Budapest 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 (Andersson, Malmberg & Östh, 2012). 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 (Morris, Wang & Lilja, 2001; Rhoulac, 2005; McMillan, 2007; Wilson *et al.*, 2010). Increasing intensity of student commuting can have a negative impact on their health (Cooper *et al.*, 2003; McMillan, 2007) and study performance (Mayer & Singer, 2003; Mayer, 2003; Balázs, 2005; Mayer, 2005). I also indicated that increasing commuting of students may increase the compensation paid by the state for students' travel discounts, while local primary schools are also maintained.

8. Magyar nyelvű összefoglaló (Summary in Hungarian)

Jelen értekezés célja az ingázási irányok vizsgálata a posztszuburbanizáció összefüggésében egy 'poszt-szocialista' metropoliszban, a budapesti funkcionális várostérséget használva vizsgálati területként. A tanulmány hozzájárul a volt szocialista országok nagyvárosaiban tapasztalható városi átalakulás megértéséhez, illetve a lakóhelyi és a munkahelyi szuburbanizáció kettős hatásának értékeléséhez. Emellett a kutatás rámutat az

ingázási irányok átalakulásának lehetséges mozgatórugóira és a potenciális következményekre is.

A dolgozat első fejezete röviden bemutatja a témával kapcsolatos korábbi kutatások hiányosságait. Máig le nem zárult vita folyik arról, hogy ez a nagyvárosi átalakulás mennyire sajátos. A kutatók egyik tábora szerint a szocialista örökség és a posztmodern globális társadalmi-gazdasági hatások eredményeként egy sajátos városszerkezet jön létre. Mások úgy vélik, hogy ezek a folyamatok alapvetően hasonlóak a Nyugat-Európában zajlókhoz. Miközben a dzsentrifikációra és a lakóhelyi szuburbanizációra vonatkozóan viszonylag sok kutatási eredmény áll rendelkezésre, addig kevés kutatás foglalkozott azzal, hogy a posztszuburbán fejlődés – amennyiben kimutatható – sajátos formákat és folyamatokat hoz-e létre Kelet-Közép-Európa nagyvárosi terekben. Még kevesebbet tudunk az ingázási irányok átalakulásáról ezekben a térségekben. Mivel a posztszuburbanizáció elsősorban a nagyvárosi térségekre jellemző, ezért várhatóan a kelet-közép-európai országokban is ott jelent meg először. Éppen ezért, úgy vélem, hogy egy olyan nagyváros, mint Budapest körüli empirikus vizsgálat hozzájárulhat a fent említett elméleti vitához.

Miközben a munkahelyre való ingázásra vonatkozóan nagy számban készültek kutatások, viszonylag keveset tudunk a foglalkoztatottakon kívül más társadalmi csoportok ingázásáról. A társadalomnak számos más rétege különíthető el nem, kor, társadalmi-gazdasági helyzet vagy éppen etnikum alapján. A gyermekek napi utazása az iskolába, például, Magyarországon a harmadik legfontosabb utazási indok. Mégis a diákok ingázására vonatkozóan azonban csak kevés kutatás született és hiányoznak azok a munkák, amelyek az iskolai ingázás és a városszerkezet átalakulásának kapcsolatát vizsgálják.

A kutatás fő kérdése hogy *a nyugati országokkal összevetve mennyiben tekinthető sajátosnak a posztszuburbanizáció az ingázási irányok átalakulásának tükrében Budapest funkcionális várostérségében?* A kérdés megválaszolása érdekében kétlépcsős kutatási módszertant alkalmaztam. Abból következően, hogy a posztszuburbán fejlődési jegyek budapesti megjelenéséről eddig nem végeztek kutatást a munka első része feltáró jellegű. Célja a posztszuburbanizáció jelenségének kimutatása Budapest körül, illetve ez alapján az empirikus kutatás részkérdéseinek megfogalmazása volt elsősorban másodlagos forrásokra alapozva. A második fázisban kvantitatív módszerek széles skáláját alkalmaztam több adatforrást felhasználva mivel a korábbi kutatások között kevés volt a kvantitatív jellegű. Az empirikus kutatás során aggregált statisztikai adatokat valamint két háztartásfelvétel egyénekre és háztartásokra vonatkozó adatait elemeztem matematikai statisztikai módszerekkel. Így összevethetővé váltak a korábbi nyugati országokban lefolytatott hasonló vizsgálatok eredményei és megválaszolható volt a fő kutatási kérdés.

A kutatás vizsgálati területe Budapest funkcionális várostérsége, amelyet a széles körben használt munkaerő-vonzáskörzet alapján határoltam le. Azok a települések tartoznak ide, amelyekről a 2001-es népszámlálás szerint a helyben lakó foglalkoztatottak legalább 15%-a Budapestre ingázott.

A dolgozat második fejezetében a kutatás során használt legfontosabb fogalmakat értelmeztem. Az ingázás fogalmát a meglévő hasonlóságok alapján kiterjesztettem az iskolásokra is. Ez alapján az általam használt ingázás definíció a lakóhely és a munkahely vagy iskola közötti rendszeres, napi szintű utazást jelenti, abban az esetben, ha a lakóhely és a munkahely vagy az iskola eltérő településen van. Meghatároztam emellett a dolgozatban használt ingázási irányokat is: keresztingázáson az elővárosi övezeten belüli, de a nagyvárost nem érintő ingázást értem, míg elleningázáson a nagyvárosból az elővárosi munkahelyre történő ingázást. Definiáltam emellett a csereingázást is, amikor a nagyváros és az elővárosi település munkaereje napi szinten kicserélődik. A szuburbanizáció definíciók közül elfogadtam Timár J. (1999) meghatározását, ami egy decentralizációs és dekoncentrációs folyamatnak tekinti a szuburbanizációt. A kutatás céljából következően azonban egy megszorítást tettem. A budapesti funkcionális várostérségben csak a közép- és felsőbb osztályok szuburbanizációjával foglalkoztam, a szegényekével nem.

A kutatás feltáró fázisának részkérdése a következő volt: *A: Felismerhetők-e a posztszuburbán átalakulás jelei Budapest funkcionális várostérségében, ami indokolhatja a jelenség részletesebb vizsgálatát?* A harmadik fejezetben az irodalomelemzés módszerével feltártam a posztfordi városok jellemző átalakulási folyamatait különös tekintettel a posztszuburbanizációra. Bemutattam a posztszuburbanizáció illeszkedését az urbanizáció ciklusaira vonatkozó elméletbe. Ennek alapján a posztszuburbán folyamatok a negyedik ciklusra (a globalizáció urbanizációja) jellemzőek. Bemutattam, hogy a posztszuburbanizáció létezését a kelet-közép-európai nagyvárosok környékén, s különösen Budapesten csak kevesen vizsgálták.

Nyugati kutatások alapján összegyűjtöttem a posztszuburbanizációt jellemző urbanisztikai formák és folyamatokat. Ezek létezését Budapesten is megvizsgálva bizonyítékot találtam arra, hogy Budapest funkcionális városövezetében posztszuburbán fejlődés jelei tapasztalhatók. A következő posztszuburbán indikátorok azonosíthatóak Budapest környékén: új szuburbán gazdasági pólusok megjelenése Budapest nyugati és északi agglomerációjában; a policentrikus városszövet kezdeményeinek megjelenése Budaörs-Törökbálint térségében *edge-city* jellegű fejlődéssel; munkahelyek számának növekedése a nemzetközi repülőtér körül; vállalati központok megjelenése a szuburbán térségben; a szolgáltatások, csúcstechnológiai ipar és kutatás-fejlesztés megerősödése az új gazdasági pólusokban; szuburbán szórakoztató és szabadidős központok létesítése; zárt lakóparkok megjelenése a szuburbán településeken; és egy posztmodern *edge-city* jellegű önálló település (TóPark) építésének megkezdése.

Miután az eredményeim alapján valószínű, hogy Budapesten is tapasztalható posztszuburbanizáció, megalapozottnak láttam a posztszuburbanizáció és az ingázási irányok közötti kapcsolat vizsgálatát, ami további bizonyítékkal szolgálhat a posztszuburbanizáció létezésére. Ennek kapcsán feltártam a nagyvárosi átalakulás és az ingázási irányok közötti kapcsolatokra vonatkozó bőséges nyugati és szűkebb kelet-közép-európai irodalmat. Ez alapján egyértelműnek tűnik, hogy a posztszuburbán átalakulás az ingázási irányok átalakulását okozza. Felhívtam a figyelmet arra, hogy az iskolai ingázás és a városszerkezet átalakulásának kapcsolatára vonatkozó közép-kelet-európai és magyar kutatások rendkívül hiányosak.

Az irodalomelemzés alapján arra a következtetésre jutottam, hogy a városszerkezet átalakulása és különösen az ingázási irányok megváltozására vonatkozóan csak korlátozott kutatási eredmények állnak rendelkezésre, ami indokolja a dolgozat célkitűzését, illetve a részletesebb vizsgálatokat.

A kutatás első, feltáró fázisának zárásaként pedig megvizsgáltam, hogy az ingázási irányok átalakulását milyen lehetséges változókkal hozták eddig összefüggésbe. Az amerikai és nyugat-európai kutatások alapján meghatároztam az ingázók azon legfontosabb jellemzőit (jövedelem, iskolai végzettség, személygépkocsi ellátottság) amelyek hatással lehetnek az ingázás irányára; valamint az ingázás indokú utazások azon jellemzőit (utazás módja, távolsága, időtartama), amelyekre az ingázási irányoknak hatása lehet.

A kutatás első fázisa elősegítette a kutatási célként kijelölt kérdés megválaszolásához szükséges részkérdések megfogalmazását. Így a kutatás második részében az empirikus elemzés a következő részkérdésekre kereste a választ:

B. Az ingázási irányok változása tükröződik-e a posztszuburbán átalakulás a munkába járók ingázási szokásaiban Budapest funkcionális várostérségében?

C. Mennyiben különböznek az általános és középiskolás diákok ingázási szokásai a foglalkoztatottakétól különös tekintettel a városi átalakulással való kapcsolatra?

D. Mennyiben befolyásolja az ingázási irányokat az ingázók társadalmi-gazdasági státusza?

E. Az ingázási irányok milyen mértékben függnek össze az ingázási indokú utazások jellemzőivel (utazási mód, távolság és idő)?

Az empirikus elemzések során használt adatbázisokat és az alkalmazott kvantitatív módszereket a negyedik fejezet mutatja be.

Aggregált szinten a népszámlálásokból (1980, 1990, 2001) származó lakossági, foglalkoztatotti és ingázási adatokkal dolgoztam. A népszámlálási adatokat a 2005-ös mikrocenzusból és az évente elvégzett munkaerő-felmérésből (1992–2010) származó adatokkal egészítettem ki. Az iskolai ingázást a KSH által publikált bejáró általános iskolásokra (2006-2010) és középiskolásokra (1990–2010) vonatkozó települési adatok feldolgozásával vizsgáltam.

A diszaggregált szinten két korábbi, reprezentatív háztartásfelvétel adatait dolgoztam fel. A 2004-ben Budapesten 30258 háztartásban elvégzett háztartásfelvétel a Budapesten lakó foglalkoztatottak munkanapi utazásairól szolgáltatott adatokat, amit a visszaingázás vizsgálatához használtam fel. A 2007-ben a Budapesti Közlekedési Szövetség területén 9000 háztartásban lebonyolított háztartásfelvétel pedig a kereszt- és hagyományos ingázásról szolgáltatott adatokat. A háztartáskikérdezések adatai lehetőséget nyújtottak az egyének és háztartások társadalmi-gazdasági státuszának (jövedelem, iskolai végzettség, személygépkocsi ellátottság), valamint az ingázás indokú utazások jellemzőinek (közlekedési mód, utazási távolság, időtartam és indulási idő) mint független változóknak a vizsgálatára.

Az összevont adatokat leíró statisztikai módszerekkel (arányok, számtani átlag, medián) és a Pearson féle szorzatmomentum korrelációs együtthatóval vizsgáltam, ami két változó közötti lineáris kapcsolat erősségét mutatja meg. Az ingázási adatok elemzéséhez javaslatot tettem egy összevont ingázási indexre, amely megmutatja az ingázás jellemző irányát (eljárás vagy bejárás) és felhasználható annak megállapítására, hogyan változott az ingázás intenzitása két időpont között. Az index számítási módja a következő:

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

ahol *CCI*: összevont ingázási index; *OC*: eljárók száma; *IC*: bejárók száma; *LE*: helyben lakó foglalkoztatottak száma a településen; *LJ*: helyben dolgozó foglalkoztatottak száma a településen.

Emellett kiszámoltam a csereingázási indexet a 2001-es népszámlálás ingázási adatai felhasználásával Burger et al. (2011) alapján (az adott településre Budapestről bejárók és Budapestre eljárók aránya). Ez a munkaerő nappali kicserélődésének intenzitását mutatja meg a nagyváros és egy szuburbán település között.

A véletlen mintavétellel elvégzett reprezentatív háztartásfelvételek adatait részben leíró statisztikai módszerekkel (keresztтábla, számtani átlag, gyakoriság és medián), részben pedig következtetéses matematikai statisztikai módszerrel (chi-négyzet próba és Cramer-féle V mutató) vizsgáltam a változók közötti kapcsolatok felderítése céljából, 95%-os konfidencia intervallummal.

A lakossági szuburbanizáció és az iskolai ingázás közötti kapcsolat feltárása érdekében – részben Bajmócyra (2003, 2006) alapozva – egy szuburbanizációs indexet alkottam. Az index figyelembe veszi, hogy a szuburbanizáció egy dekoncentrációs folyamat, ezért csak olyan mutatókat alkalmaztam, amelyek folyamatot és változást fejeznek ki. Emellett a konkrét empirikus elemzések érdekében a szuburbanizáció értelmezését a magasabb státusú

népességre korlátoztam, mivel korábbi, Budapest környékére vonatkozó kutatások összefüggést mutattak ki a család jövedelme, a szülők iskolai végzettsége és a gyermekek ingázása között.

Az empirikus elemzés két nagy egységre oszlik. Az ötödik fejezet a munkavállalókra, míg a hatodik fejezet az általános és középiskolás ingázókra vonatkozó elemzések eredményeit mutatja be. Mindkét fejezet először az aggregált KSH adatokat, majd pedig a háztartásfelvételek diszaggregált adatainak elemzését veszi sorra. Az alábbiakban a kvantitatív elemzések legfontosabb eredményeit emelem ki a fenti részkérdések szerinti szerkezetben.

B. Tükröződik-e a posztszuburbán átalakulás a munkába járók ingázási jellemzőiben Budapest funkcionális városövezetében?

A kereszt- és elleningázók arányának növekedése a poszt-szuburbanizáció egyik indikátora. Eredményeim azt mutatják, hogy míg 1990 és 2001 között összességében stagnált az ingázók száma a Budapestet és Pest megyét magában foglaló Közép-Magyarországon, az ingázási célpontok jelentősen átalakultak. A hagyományos alközpontok (pl. Vác, Dunakeszi, Szentendre) veszítettek jelentőségükből, míg az új gazdasági pólusok (pl. Budaörs-Törökbálint, Érd, Dunaharaszti, Fót, Vecsés) megerősödtek. Statisztikailag szignifikáns kapcsolatot találtam a Pest megyei településekre bejáró kereszt- és elleningázók aránya és Budapest közúti elérhetőségi ideje között. Minél hosszabb idő alatt érhető el egy település Budapesttől, annál kisebb az elleningázó és nagyobb a keresztingázók aránya.

Az aggregált ingázási adatok vizsgálata azt mutatta, hogy Budapest és Pest megye viszonylatában 2001 és 2005 között nőtt mind a keresztingázók, mind pedig az elleningázók aránya. Ez valószínűsíthetően a munkahelyek Pest megyében tapasztalható dinamikus növekedésének volt az eredménye.

A kereszt- és elleningázás növekedését, valamint fő célpontjaik áttevődését az új gazdasági pólusokba a posztszuburbán átalakulás további indikátorának tartom. Úgy vélem, hogy a szuburbán zóna további gazdasági fejlődése a monocentrikus városszerkezet oldódását, egy leendő policentrikus térség új központjainak kialakulását, valamint az ezekbe irányuló kereszt- és elleningázás növekedését vonhatja maga után.

A csereingázók magas aránya – amikor egy előváros lakói a nagyvárosba ingáznak, míg a nagyvárosból nagy számban ingáznak ugyanebbe az elővárosba mintegy kicserélve a két település között a munkaerőt – szintén jelezheti a posztszuburbán átalakulást. A Pest megye településeire kiszámított csereingázási index alapján Budapest és Budaörs között tártam fel csereingázást. Emellett több település (Törökbálint, Budakalász, Dunaharaszti, Gödöllő, Fót) esetében is az elleningázók hagyományos ingázókhoz viszonyított relatíve magas aránya arra utal, hogy itt is hamarosan kialakulhat (vagy már azóta kialakult) a csereingázás.

C. Mennyiben különböznek az általános és középiskolás diákok ingázási jellemzői a foglalkoztatottakétól, különös tekintettel a nagyvárosi átalakulással való kapcsolatra?

Eredményeim azt sugallják, hogy a munkahelyi és az iskolai ingázás meghatározó tényezői között alapvető különbség van. A munkahelyre való ingázás jellemzőit a lakóhely és a munkahely elhelyezkedése határozza meg; mindkettő viszonylag rugalmasan változtatható. A diákok esetében azonban az ingázás célpontjának (iskola) megválasztását korlátozhatja az iskolák regionális eloszlása és elérhetősége, az iskolák profilja, az oktatás szintje (alap- vagy középfok) és az iskolák vélt vagy valós vonzereje (tanítás minősége, felszereltség). Miközben a lakóhelyek és a munkahelyek elhelyezkedése dinamikusan változik a nagyvárosi átstrukturálódás során, az iskolák elhelyezkedését elsősorban az állami és önkormányzati oktatáspolitika, valamint a finanszírozás határozza meg. Ezért az iskolai ellátás gyakran késve alkalmazkodik a városszerkezet, a népesség és az igények változásához. Elemzésemben kimutattam, hogy Budapest funkcionális városövezetében nincs egyensúlyban az iskolák iránti igény (iskoláskorúak száma) és az ellátás (iskolai férőhelyek típusa és száma), ami jelentős ingázáshoz vezet.

Eredményeim azt is sugallják, hogy a lakóhelyi szuburbanizáció befolyásolhatja a fenti egyensúlyt az igények és az ellátottság között. Mérsékelten erős korrelációt találtam ugyanis a szuburbanizációs index és egy adott településről eljáró általános iskolások aránya között. A szuburbanizáció következtében az igények eltolódnak a szuburbán övezet felé, növelve az elővárosok népességén belül az iskoláskorúak arányát. Ennek következtében mind az általános mind pedig a középiskolások ingázása intenzívebb lett az elmúlt évtizedben.

További különbség az iskolai és munkahelyi ingázás között, hogy míg a munkavállalók esetében az ingázási adatok arra utalnak, hogy oldódik a funkcionális várostérség monocentrikussága, addig a középiskolás diákok esetében az ingázás erősen monocentrikus maradt Budapest célponttal annak ellenére, hogy az elmúlt két évtizedben nőtt a főváros körüli középiskolai férőhelyek száma.

D. Mennyiben befolyásolja az ingázási irányokat az ingázók társadalmi-gazdasági státusza?

A posztszuburbanizációt Nyugat-Európában általában a kereszt- és elleningázók társadalmi státuszának növekedése jelzi. Az adatok elemzése azt mutatta, hogy Budapesten szignifikáns különbség van a különböző irányokba ingázók (hagyományos, kereszt- és elleningázók) társadalmi-gazdasági státusza között. Míg Nyugat-Európában és az USA-ban a keresztingázók általában magas iskolai végzettséggel és jövedelemmel rendelkeznek, addig Budapest környékén éppen a keresztingázók között legmagasabb az alacsonyabb státuszúak aránya és közöttük a legkisebb a tercier *szektorban* dolgozók aránya. Ezzel szemben a fővárosba és onnan kifelé ingázók között nagy a magas jövedelemmel és iskolai végzettséggel rendelkezők aránya. Ez azt jelezheti, hogy a szuburbán területekre költözött magasabb státuszú lakosság elsősorban a fővárosban talál munkát magának, míg a magasabb végzettséget igénylő elővárosi munkahelyekre elsősorban fővárosiak ingáznak. Úgy tűnik, hogy a szuburbán területeken létesült munkahelyek nem tudják kielégíteni az ott élő lakosság átalakuló igényeit.

Az iskolai ingázást tekintve az elemzésem megerősítette, hogy statisztikailag szignifikáns összefüggés van a szülők társadalmi-gazdasági státusza és annak valószínűsége között, hogy a gyermek másik településre ingázik-e. Mind a háztartás magasabb nettó jövedelme, mind pedig a szülők – és elsősorban az apa – magasabb iskolai végzettsége esetén nagyobb a gyermekek ingázásának valószínűsége.

E. Az ingázási irányok milyen mértékben függnek össze az ingázási indokú utazások jellemzőivel (utazási mód, távolság és idő)?

Eredményeim azt mutatják, hogy a kereszt- és elleningázók szignifikánsan nagyobb valószínűséggel használnak autót munkába járáshoz, mint a Budapestre ingázók. Úgy vélem, ennek egyik lehetséges magyarázata, a közösségi közlekedési hálózat struktúrájában és szolgáltatási színvonalában keresendő. Mivel gyors és gyakori közösségi közlekedési szolgáltatást tulajdonképpen csak a sugárirányú vasútvonalak nyújtanak, a közösségi közlekedés elsősorban a Budapestre ingázók számára reális alternatíva. Másrészt az elővárosi övezetben hiányoznak, vagy lassúak és ritka követési idejűek a keresztirányú közösségi közlekedési kapcsolatok. Ezt mutatja a háztartásfelvétel adatai alapján kiszámolt átlagos utazási sebesség is, ami az előváros belüli utazásoknál a közösségi közlekedési eszközök használata esetén feleakkora, mint a személygépkocsié.

Az ingázó diákok többségében közösségi közlekedési eszközöket használnak iskolába járásra, de az általános iskolások esetén viszonylag magas a személygépkocsi használat. Az életkor és a közlekedési mód választása között statisztikailag szignifikáns kapcsolatot mutattam ki: a fiatalabb korosztályban (6–10 évesek) magasabb azok aránya, akiket személygépkocsival visznek iskolába. Ugyancsak összefüggést találtam a gyermekek személyautóval való iskolába járása és a család nettó jövedelme között. Azok a gyerekek, akik alacsony jövedelmű családban élnek kevéssé valószínű, hogy autóval járnak iskolába.

Az ingázó iskolások utazásainak vizsgálata kimutatta, hogy a középiskolások átlagos utazási távolsága és ideje közel kétszerese az általános iskolásokénak. Ebből következően a

középiskolásoknak korábban kell otthonról elindulniuk, mint az általános iskolásoknak. Az ingázási távolságok közötti különbségek kapcsán vizsgálataim megerősítették, hogy az ingázó általános iskolások többsége a szomszédos településre jár át, míg a középiskolások távolabbra, valamelyik városba vagy Budapestre ingáznak, ami a középiskolák koncentrált területi elhelyezkedéséből adódik.

A fent ismertetett eredmények összegzésével lehetővé vált a dolgozat fő kérdésének megválaszolása: *mennyiben tekinthető sajátosnak a posztszuburbanizáció a budapesti funkcionális város térségben a nyugat országokkal összevetve az ingázási irányok átalakulásának tükrében?*

A kutatás különböző fázisaiban az eredményeket összevetettem korábbi nyugat-európai és más posztszocialista országokból származó eredményekkel, annak érdekében, hogy megvizsgáljam, hogy felfedezhetők-e a "különutas" posztszocialista városfejlődésre utaló jegyek.

Az elmúlt húsz év vándorlásra és alkalmazottakra vonatkozó adatai alapján arra a következtetésre jutottam, hogy a lakóhelyi szuburbanizáció ugyan a kilencvenes évek végén elérte eddigi csúcspontját, de 2000 után is folytatódott. Ezzel párhuzamosan 2000 óta felerősödött a munkahelyi szuburbanizáció is, így azóta párhuzamosan zajlik a kétféle szuburbanizáció Budapest térségében. Ez úgy is értelmezhető, hogy a klasszikus szuburbanizáció s a posztszuburbanizáció egymást átfedve folynak. Ez azt a feltételezést erősíti, hogy az urbanizáció ciklusai a posztszocialista országokban időben összetömörítve és átlapolva jelennek meg (Hirt, 2006). Az azonban még nem látszik tisztán, hogy a gazdasági válságnak milyen hatása lesz ezekre a folyamatokra, s a lakóhelyi szuburbanizáció 2008 utáni visszaesése, illetve a gazdasági szuburbanizáció stagnálása tartós lesz-e.

Több hasonlóságot azonosítottam az ingázás kapcsán a budapesti funkcionális várostérség és nyugati metropoliszok jellegzetességei között: a kereszt- és elleningázás jelentőségének növekedése; a keresztingázók utazási távolságának és idejének kisebb hossza a hagyományos ingázókhoz viszonyítva és a magasabb autóhasználat a keresztingázók körében.

Néhány eltérésre is rámutattam. A keresztingázók nyugatinál alacsonyabb társadalmi-gazdasági státusza abból adódhat, hogy Budapest még csak a posztszuburbán fejlődés elején jár, amikor olyan munkahelyek települnek az elővárosi övezetbe, amelyek alacsonyabb képzettséget igényelnek. Így az elővárosokba kiköltözött magasabb státuszú népesség kénytelen a fővárosba ingázni. Az elleningázók átlagos státusza ezzel szemben magas, eléri a hagyományos ingázókét. Ez abból adódhat, hogy Budapest lakosságának társadalmi-gazdasági státusza magas, s gyakran az elővárosi településeken hiányzó magas kvalifikációjú munkaerőt a fővárosból pótolják.

Az ingázási irányokat tekintve az ingázók tulajdonságai és az utazások jellemzői alapvetően megfelelnek a nyugat-európai eredményeknek. A meglévő különbségek, úgy vélem elsősorban az eltérő gazdasági fejlettségi szintből adódnak, illetve ország- vagy szabályozási rendszer specifikusak (pl. az általános iskolások ingázása szabad iskolaválasztás nélkül nem lehetne jelentős).

A dolgozat eredményeinek ismertetése után a városszerkezet és az ingázás, valamint az ingázók társadalmi-gazdasági státusza közötti összefüggések alapján, korábbi kutatások eredményeit szintetizálva felvázoltam az ingázási irányok megváltozásának lehetséges következményeit a közlekedésre, a környezetre, az egészségre, az egyenlőségre és a közlekedési szolgáltatások finanszírozására vonatkozóan.

Mivel vizsgálataim szerint a keresztingázók körében magas az autóhasználat, a keresztingázás növekedésével a közlekedési módok közötti munkamegosztás romlására lehet számítani. Ez együtt járhat az elővárosi utak zsúfoltságnak növekedésével és a környezeti károk fokozódásával.

Az új szuburbán munkahelyek elérhetősége azok számára korlátozott lehet, akik nem rendelkeznek személygépkocsival a közösségi közlekedési kapcsolatok hiányosságai miatt. Ez felveti a munkahelyekhez való egyenlő hozzáférés problémáját.

Eredményeim szerint a diákok ingázása összefüggésben áll a szülők társadalmi-gazdasági státuszával. Amennyiben tovább folytatódik a Budapest környéki települések szuburbanizációja, az újonnan betelepülő, magasabb státuszú lakosok elképzelhető, hogy nem a helyi, hanem Budapest vagy valamelyik másik település iskolájába íratják gyermeküket a "jobb" oktatás reményében. Ebből adódóan a lakóhelyi szuburbanizáció végső soron erősítheti az iskolai szegregációt. Emellett a diákok megnövekedett ingázása hozzájárulhat az iskolák környékén kialakuló torlódásokhoz és általában a városi utak zsúfoltságához, miközben növeli a környezetszennyezést. Az ingázás továbbá negatív hatással lehet a gyermekek egészségére és tanulmányi eredményeire is. Emellett a közösségi közlekedési eszközökkel ingázó diákok számának növekedése nagyobb terhet ró az államra is, hiszen az a diákbérletek után kompenzációt fizet a közlekedési szolgáltatóknak.

A fentiek alapján ez a kutatás érveket sorakoztatott fel a szuburbán területeket összekötő közösségi közlekedés színvonalának javítása, a közösségi közlekedési elérhetőséget előtérbe helyező integrált területi és települési tervezés, valamint az iskolai ingázás és a szabad iskolaválasztás szabályozásának és támogatásának átértékelése mellett.

Mivel a kutatás részben feltáró jellegű volt, számos olyan kérdés merült fel, amire jelen értekezés keretein belül nem volt módom választ adni. Éppen ezért számos olyan kutatási irányt és témát javasoltam, amelyek hozzásegíthetnek a posztszocialista országok nagyvárosaiban, illetve Budapesten zajló folyamatok jobb megértéséhez. Ilyen kutatási irány lehet a posztszuburbán formák részletesebb feltárása esettanulmányokon keresztül; a helyi szereplők viselkedésének és véleményének megismerése kvalitatív módszerekkel; a keresztingázók autóhasználattal kapcsolatos preferenciáinak feltárása; a munkahelyek és iskolák elérhetőségének egyenlőségi kérdései; és az ingázás közúti forgalomra kifejtett hatásának felmérése az összforgalmat tekintve és az iskolák környékén.

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Appendices

Appendix 1: The questionnaires of the BKSZ household survey (2007)

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Appendix 1. The questionnaires of the BKSZ household survey (2007) (only the questions used in the analysis are reproduced here) (Source: Közlekedés Kft. - BKSZ)

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Appendix 3. NACE (TEÁOR) codes
Since 2008 **(Source: European Commission - http://ec.europa.eu/competition/mergers/cases/index/nace_all.html)**

A - Agriculture, forestry and fishing
B - Mining and quarrying
C - Manufacturing
D - Electricity, gas, steam and air conditioning supply
E - Water supply; sewerage; waste managment and remediation activities
F - Construction
G - Wholesale and retail trade; repair of motor vehicles and motorcycles
H - Transporting and storage
I - Accommodation and food service activities
J - Information and communication
K - Financial and insurance activities
L - Real estate activities
M - Professional, scientific and technical activities
N - Administrative and support service activities
O - Public administration and defence; compulsory social security
P - Education
Q - Human health and social work activities
R - Arts, entertainment and recreation
S - Other services activities
T - Activities of households as employers; undifferentiated goods - and services - producing activities of households for own use
U - Activities of extraterritorial organisations and bodies

Before 2008 **(Source: NACE Rev. 1, Eurostat. 1996, http://datalib.chass.utoronto.ca/other/E0032_en.pdf)**
A - Agriculture, hunting and forestry
B - Fishing
C - Mining and quarrying
D - Manufacturing
E - Electricity, gas, steam and air conditioning supply
F - Construction
G - Wholesale and retail trade; repair of motor vehicles and motorcycles personal and household goods
H - Hotels and restaurants
I - Transport, storage and communication
J - Financial intermediation
K - Real estate, renting and business activities
L - Public administration and defence; compulsory social security
M - Education
N - Health and social work
O - Other community, social and personal service activities
P - Private households with employed persons
Q - Extra-territorial organizations and bodies

Appendix 4. Suburbanisation index of municipalities of the FUR (2010)

Municipality	Suburbanisation index
Telki	67.91
Veresegyház	51.40
Érd	49.77
Dunakeszi	46.90
Szigetszentmiklós	44.04
Üröm	39.10
Budajenő	39.10
Diósd	35.91
Biatorbágy	33.18
Szigethalom	31.92
Budaörs	30.75
Csomád	30.10
Szada	29.49
Pócsmegyer	29.17
Nagykovácsi	29.09
Leányfalu	27.87
Mogyoród	26.95
Pilisjászfalu	26.56
Göd	26.49
Dunaharaszti	26.25
Csobánka	26.05
Szentendre	25.79
Csömör	25.74
Őrbottyán	25.49
Erdőkertes	25.39
Solymár	24.42
Herceghalom	24.38
Páty	24.14
Pomáz	24.14
Tárnok	23.81
Törökbálint	23.69
Fót	23.60
Maglód	23.55
Gyál	23.38
Piliscsaba	22.53
Pécel	22.07
Gyömrő	22.00
Tököl	21.65
Halásztelek	21.14
Sződ	20.96
Pilisborosjenő	20.91
Pusztazámor	20.90
Kerepes	20.66
Gödöllő	20.66
Budakalász	20.64
Kisoroszi	20.09
Délegyháza	19.74
Dunavarsány	19.51
Szigetmonostor	19.43
Nagytarcsa	19.14
Tahitótfalu	18.91
Kistarcsa	18.89
Etyek	18.43
Üllő	17.66
Budakeszi	17.07
Vecsés	16.97
Tordas	16.92
Felcsút	16.50
Inárcs	16.36
Százhalombatta	16.31
Máriahalom	16.16
Zsámbék	16.09
Újhartyán	15.98
Pilisszentiván	15.80
Újlengyel	15.73
Iklad	15.65
Felsőpakony	15.41
Pilisvörösvár	15.36
Szigetszentmárton	15.28
Pilis	15.25
Kápolnásnyék	15.23
Majosháza	15.14
Zebegény	14.99
Martonvásár	14.88
Alsónémedi	14.87
Albertirsa	14.85
Sülysáp	14.73
Gyúró	14.65
Szárliget	14.39
Monor	14.20
Ecser	14.19
Verőce	14.14
Dabas	14.11
Galgahévíz	14.05
Isaszeg	14.04
Váckisújfalu	13.95
Taksony	13.84
Apaj	13.81
Sződliget	13.71

Pilisszentlászló	13.62
Vácegres	13.58
Bugyi	13.56
Csévharaszt	13.51
Szár	13.49
Tinnye	13.43
Tök	13.02
Vasad	12.94
Káva	12.81
Leányvár	12.74
Péteri	12.73
Kismaros	12.58
Dunabogdány	12.51
Hévízgyörk	12.51
Galgamácsa	12.21
Pilisszántó	12.15
Piliscsév	12.08
Pilisszentkereszt	11.94
Vác	11.90
Vácrátót	11.87
Kiskunlacháza	11.86
Pázmánd	11.84
Kartal	11.62
Mány	11.61
Áporka	11.54
Kóka	11.48
Szentmártonkáta	11.38
Szigetcsép	11.33
Csabdi	11.12
Ócsa	11.06
Tabajd	10.96
Dány	10.96
Váchartyán	10.96
Sóskút	10.92
Tápiószentmárton	10.86
Úny	10.85
Mikebuda	10.78
Gomba	10.76
Tóalmás	10.64
Kakucs	10.61

Nyáregyháza	10.53
Vál	10.48
Nagymaros	10.44
Iváncsa	10.29
Bag	10.26
Kajászó	10.06
Tápiószecső	9.95
Alcsútdoboz	9.91
Farmos	9.87
Szigetújfalu	9.84
Tápiószele	9.81
Vereb	9.71
Dánszentmiklós	9.63
Mende	9.62
Gyermely	9.48
Tápiógyörgye	9.48
Baracska	9.36
Tápióbicske	9.35
Bicske	9.34
Zsámbok	9.33
Verseg	9.16
Bénye	9.00
Nagykáta	8.93
Ceglédbercel	8.81
Úri	8.76
Tura	8.75
Ráckeresztúr	8.59
Tápióság	8.59
Pusztaszabolcs	7.95
Ercsi	7.91
Szomor	7.65
Kisnémedi	7.58
Perbál	7.57
Valkó	7.25
Pánd	6.13
Tatárszentgyörgy	5.77
Besnyő	5.59
Beloiannisz	5.05
Mean	16.86

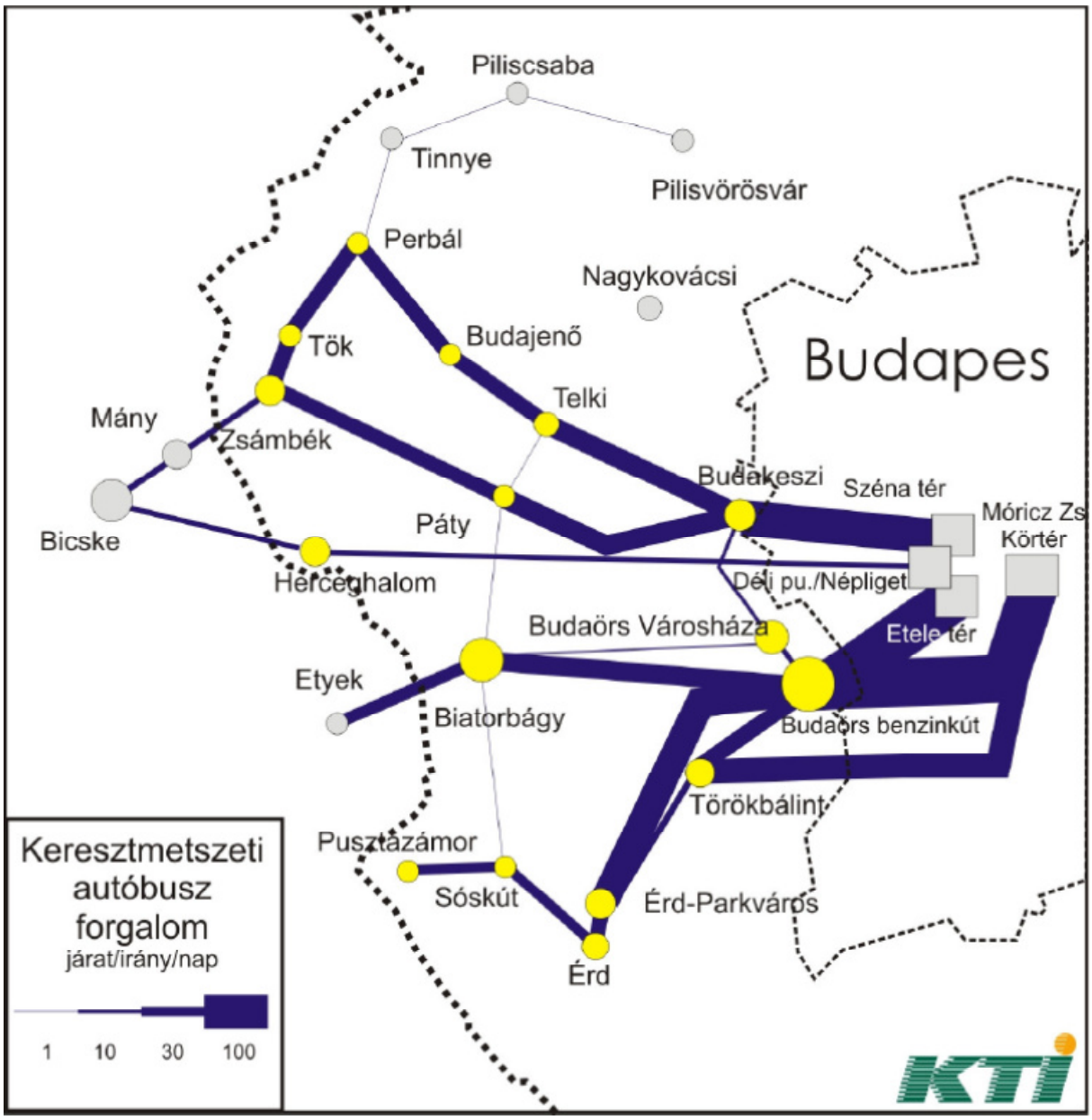
Appendix 5. Combined commuting index of the municipalities of the FUR in 1990 and 2001 (Source: Own calculations based on KSH Census data 1990, 2001)

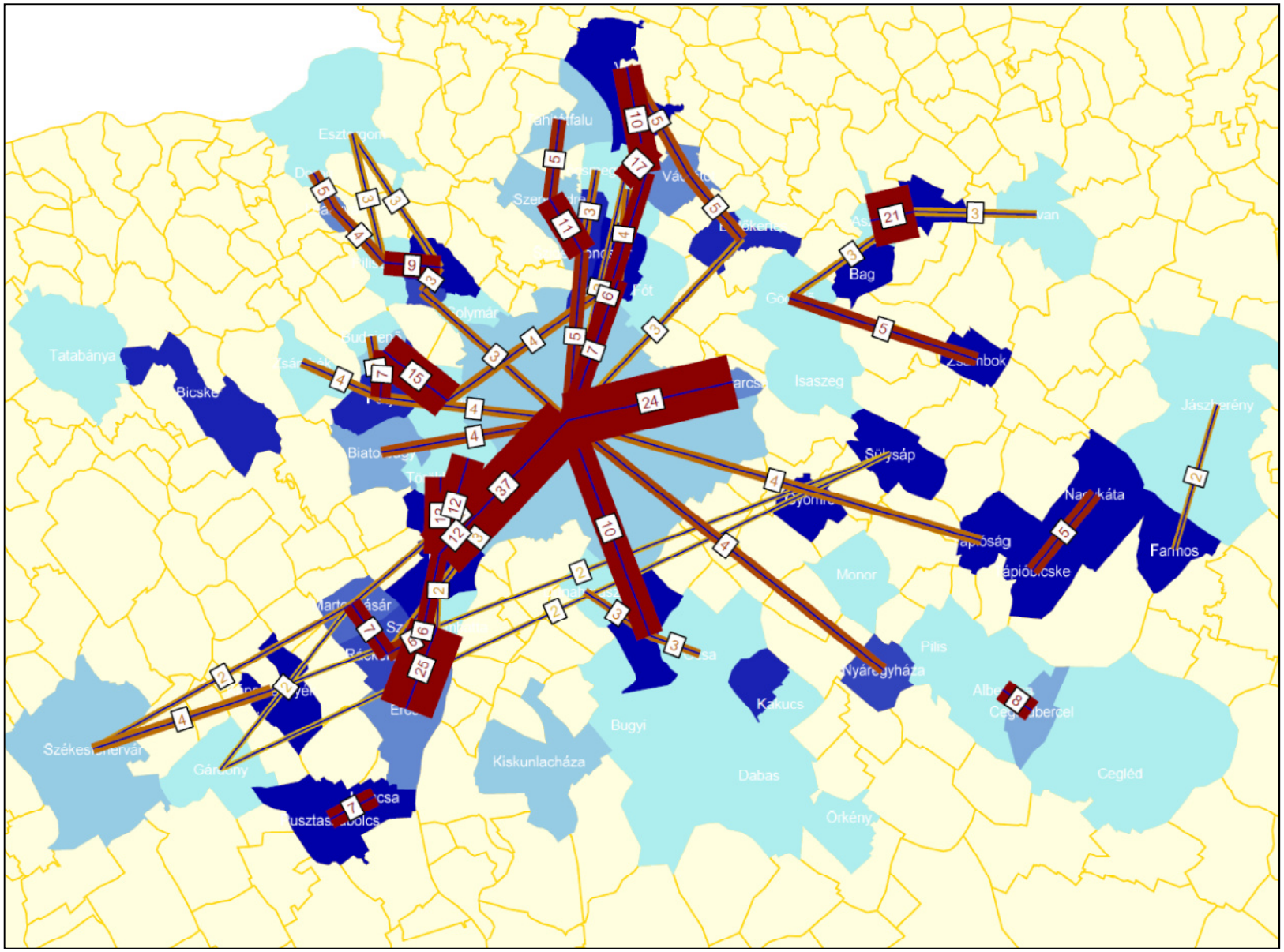
Municipality	CCI 1990	CCI 2001	Difference
Albertirsa	-41%	-42%	-1%
Alsónémedi	-27%	-7%	20%
Apaj	-1%	-49%	-48%
Áporka	-47%	-46%	1%
Bag	-36%	-44%	-8%
Bénye	-50%	-51%	-1%
Biatorbágy	-53%	-6%	47%
Budajenő	-27%	-39%	-12%
Budakalász	-17%	-12%	5%
Budakeszi	-35%	-27%	8%
Budaörs	1%	10%	8%
Bugyi	-16%	-14%	2%
Ceglédbercel	-56%	-62%	-6%
Csévharaszt	-14%	-23%	-10%
Csobánka	-32%	-46%	-14%
Csomád	-39%	-42%	-3%
Csömör	-39%	-23%	16%
Dabas	-14%	-20%	-6%
Dánszentmiklós	-10%	-41%	-30%
Dány	-43%	-58%	-16%
Délegyháza	-10%	-40%	-30%
Diósd	-4%	-7%	-3%
Dunabogdány	-26%	-36%	-10%
Dunaharaszti	-32%	-8%	24%
Dunakeszi	-20%	-23%	-3%
Dunavarsány	-17%	-34%	-17%
Ecser	-36%	-30%	7%
Érd	-41%	-37%	4%
Erdőkertes	-45%	-52%	-7%
Farmos	-47%	-57%	-10%
Felsőpakony	-30%	-48%	-17%
Fót	-28%	-19%	9%
Galgahévíz	-51%	-45%	5%
Galgamácsa	-10%	-39%	-29%
Gomba	-25%	-60%	-35%
Göd	-27%	-37%	-10%
Gödöllő	10%	13%	2%
Gyál	-45%	-41%	3%
Gyömrő	-50%	-45%	5%
Halásztelek	-36%	-34%	2%
Herceghalom	19%	4%	-14%
Hévízgyörk	-56%	-51%	5%

Iklad	26%	3%	-23%
Inárcs	-49%	-40%	9%
Isaszeg	-54%	-53%	1%
Kakucs	-34%	-50%	-16%
Kartal	-54%	-50%	5%
Káva	-55%	-41%	13%
Kiskunlacháza	0%	-18%	-18%
Kismaros	-38%	-39%	-1%
Kisnémedi	-15%	-47%	-32%
Kisoroszi	-41%	-42%	-1%
Kóka	-51%	-49%	2%
Leányfalu	-12%	-22%	-10%
Maglód	-50%	-50%	1%
Majosháza	-41%	-37%	4%
Mende	-51%	-46%	6%
Mikebuda	-14%	-16%	-2%
Mogyoród	-45%	-40%	5%
Monor	-21%	-30%	-10%
Nagykáta	-9%	-7%	2%
Nagykovácsi	-48%	-40%	8%
Nagymaros	-23%	-40%	-17%
Nagytarcsa	-26%	-41%	-14%
Nyáregyháza	-67%	-60%	7%
Ócsa	-15%	-27%	-12%
Őrbottyán	-42%	-45%	-3%
Pánd	-56%	-59%	-2%
Páty	-46%	-43%	3%
Pécel	-39%	-39%	1%
Perbál	-41%	-15%	26%
Péteri	-58%	-50%	8%
Pilis	-46%	-54%	-8%
Pilisborosjenő	-35%	-31%	5%
Piliscsaba	-31%	-12%	19%
Pilisvörösvár	-34%	-19%	15%
Pilisszántó	-41%	-49%	-8%
Pilisszentiván	-25%	-5%	21%
Pilisszentkereszt	-37%	-41%	-4%
Pilisszentlászló	-49%	-54%	-5%
Pócsmegyer	-33%	-49%	-16%
Pomáz	-22%	-24%	-2%
Pusztazámor	-55%	-32%	23%
Solymár	1%	-15%	-16%
Sóskút	-38%	-37%	1%
Sülysáp	-21%	-27%	-7%
Szada	-48%	-20%	28%
Százhalombatta	2%	3%	1%

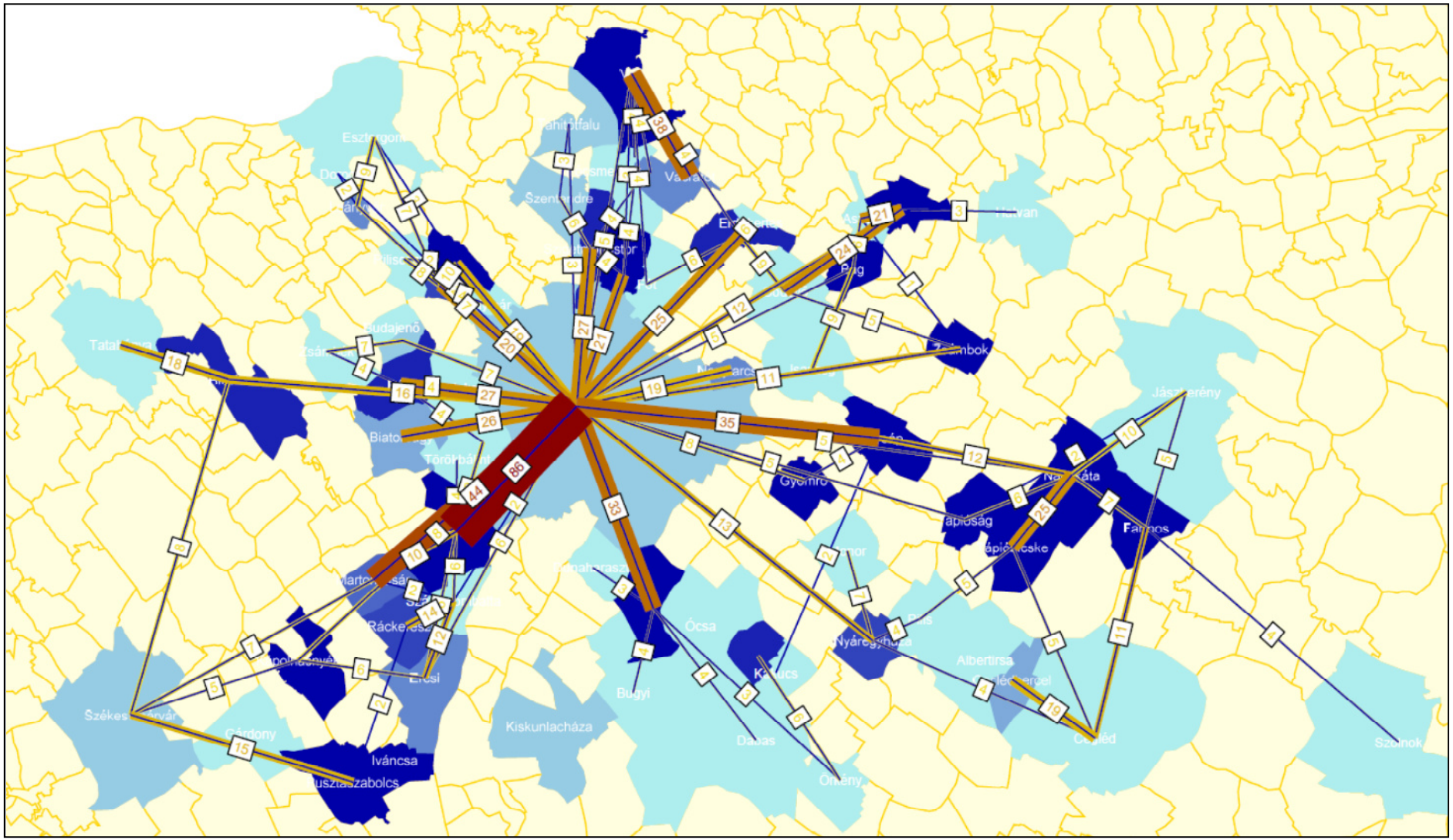
Szentendre	-3%	-12%	-9%
Szentmártonkáta	-25%	-54%	-29%
Szigetcsép	-14%	-33%	-19%
Szigethalom	-6%	-37%	-31%
Szigetmonostor	-21%	-32%	-11%
Szigetszentmárton	-25%	-35%	-11%
Szigetszentmiklós	-4%	-17%	-14%
Szigetújfalu	-50%	-47%	3%
Sződ	-36%	-52%	-17%
Sződliget	-34%	-38%	-5%
Tahitótfalu	-31%	-41%	-9%
Taksony	-35%	-19%	16%
Tápióbicske	-25%	-49%	-24%
Tápiógyörgye	-35%	-44%	-8%
Tápiság	-63%	-36%	27%
Tápiószecső	-37%	-36%	1%
Tápiószele	-13%	-19%	-5%
Tápiószentmárton	-50%	-46%	4%
Tárnok	-49%	-46%	3%
Tatárszentgyörgy	-34%	-36%	-2%
Telki	-28%	-30%	-2%
Tinnye	-51%	-45%	6%
Tóalmás	-50%	-47%	2%
Tök	-3%	-27%	-24%
Tököl	-17%	-17%	0%
Törökbálint	-7%	5%	11%
Tura	-40%	-49%	-8%
Újhartyán	-27%	-17%	9%
Újlengyel	-51%	-46%	4%
Úri	-60%	-49%	11%
Üllő	-54%	-32%	22%
Üröm	-33%	-40%	-7%
Vác	20%	15%	-5%
Vácegres	-39%	-60%	-21%
Váchartyán	-19%	-45%	-26%
Vácrátót	-37%	-42%	-5%
Valkó	-34%	-40%	-6%
Vasad	-12%	-20%	-8%
Vecsés	-42%	-19%	23%
Veresegyház	-33%	-17%	16%
Verőce	-21%	-30%	-9%
Verseg	-33%	-40%	-7%
Zebegény	-15%	-36%	-22%
Zsámbék	2%	-10%	-12%
Zsámbok	-42%	-50%	-7%

Appendix 6. Number and distribution of bus services in the Budaörs Microregion (2008) Source: Berényi *et al.*, 2008





Appendix 7. Origins and destinations of commuting trips to primary school from the BKSZ household survey
(Data source: own elaboration based on the BKSZ survey, 2007; cartography by Tamás Marczingós)
(The numbers represent the number of trips between the municipalities. As only trips from the sample are displayed here, the values cannot be generalised to the municipalities, they only serve to illustrate the general patterns of commuting.)



Appendix 8. Origins and destinations of commuting trips to secondary school from the BKSZ household survey
(Data source: own elaboration based on the BKSZ survey, 2007; cartography by Tamás Marczingós)
(The numbers represent the number of trips between the municipalities. As only trips from the sample are displayed here, the values cannot be generalised to the municipalities, they only serve to illustrate the general patterns of commuting.)