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**THE INFLUENCE OF THE CHANGING POPULATION ON THE BUS TRANSPORT  
IN THE AGGLOMERATION OF GYŐR**

**A népességváltozás busz közlekedésre ható tényezőinek vizsgálata Győr agglomerációs  
övezetében**

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**Abstract**

*Environmental, social and economic problems are currently ones of the most important questions of sustainable development. Issues related to agglomerations should get more emphasis now than ever before. Near half of the population lives and works in these areas, moreover the global scale urbanization continues to grow altering villages near to towns. The role of transport in the evolution of the environmental conditions of the agglomeration has been increasing. Herby it is getting more important in township development, consequently optimization of transportation becomes a keystone of sustainable agglomeration. In our study, the bus transport of Győr's agglomeration was investigated. Connections among parameters of the settlements and bus patches were investigated in order to clarify causes of transport preferences of the inhabitants (bus contra motor-car). As a result of our research, it turned out that inhabitants of the rich villages tend to use car instead of busses independently from the time they would spend on the busses. Significant linear correlation is demonstrated between the proportion of the bus users and the distance from Győr independently from the income level of the inhabitants.*

**Összefoglalás**

*Napjaink környezeti, társadalmi és gazdasági problémáinak egyik legjelentősebb alapkérdése a fenntartható fejlődés, a jövő generációk életlehetőségeinek és feltételeinek biztosítása. Ezen belül az agglomerációs övezetekhez kapcsolódó problémáknak nagyobb hangsúlyt kell kapnia a korábbi időszakhoz képest, hiszen a lakosság jelentős része él és dolgozik ezeken a területeken, sőt globális szinten az urbanizáció továbbra is növekszik a városok melletti településeken. Az agglomerációs övezetek környezetállapot alakulásában egyre nagyobb a közlekedés szerepe, ami a településfejlődés egyre jelentősebb részét képezi, ezáltal a közlekedés optimalizálása a fenntartható agglomeráció egyik kulcskérdése. Jelen tanulmány keretében Győr város agglomerációs övezetében lévő települések buszközlekedését vizsgáltuk. A települések és a buszjáratok adatai alapján kerestünk összefüggéseket arra vonatkozóan, hogy milyen paraméterek lehetnek meghatározók abban, hogy az agglomerációban lakók a bejáráshoz személygépkocsit vagy a buszközlekedést preferálják. Kutatásunk során megállapítottuk, hogy a tehetősebb*

*települések lakosai előnyben részesítik a személygépjármű közlekedést függetlenül az autóbuszon töltött időtől. A vizsgált településekről busszal utazók aránya és a települések Győrtől való távolsága között szoros lineáris kapcsolat van, amit a lakosság jövedelmi szintje sem befolyásol.*

**Keywords:** bus, public transport, urban transportation, agglomeration

**JEL kód:** Q53, R41, R42

**Kulcsszavak:** autóbusz, közlekedés, városi agglomeráció

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## Introduction

Public transport plays a key role in mobility within agglomerations, because it aims to meet the needs of citizens for ease of movement, therefore an efficient public transport system is needed. Citizens want to perform some task or satisfy a need, either in their place of work or study or at a leisure venue.

Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. (Bruntaland, 1987) Sustainable development is almost impossible without tackling with transport, as mobility is a basic need of modern humanity. (Holden, 2007)

In its different dimensions; environmental, economic and social, the theme of sustainable development can be regularly found today when the future of urban transport is alluded to. (Nicolas et al. 2003) So public transport system is a key element of improving sustainability in agglomeration areas. One of the most challenging issues in sustainable transport planning, is to develop appropriate indicators to measure the level of sustainability. (Bachok and Ponrahono, 2015)

Indicators have become common elements in transport planning and policy making. So far much research on transport indicators has been concerned with their function as suitable measurement tools for various planning and monitoring tasks. The general assumption seems to be that indicators are necessary, and – if they are also ‘fit for purpose’ – they should be used as parts of the toolbox and thereby have a positive influence on transport decision making. (Gudmundsson and Sørensen, 2013)

Public transport can be divided into various categories of vehicles: busses, subways, trams and trains, (Tavares et al., 2015) however here we focus mainly on busses.

## Methods of the research

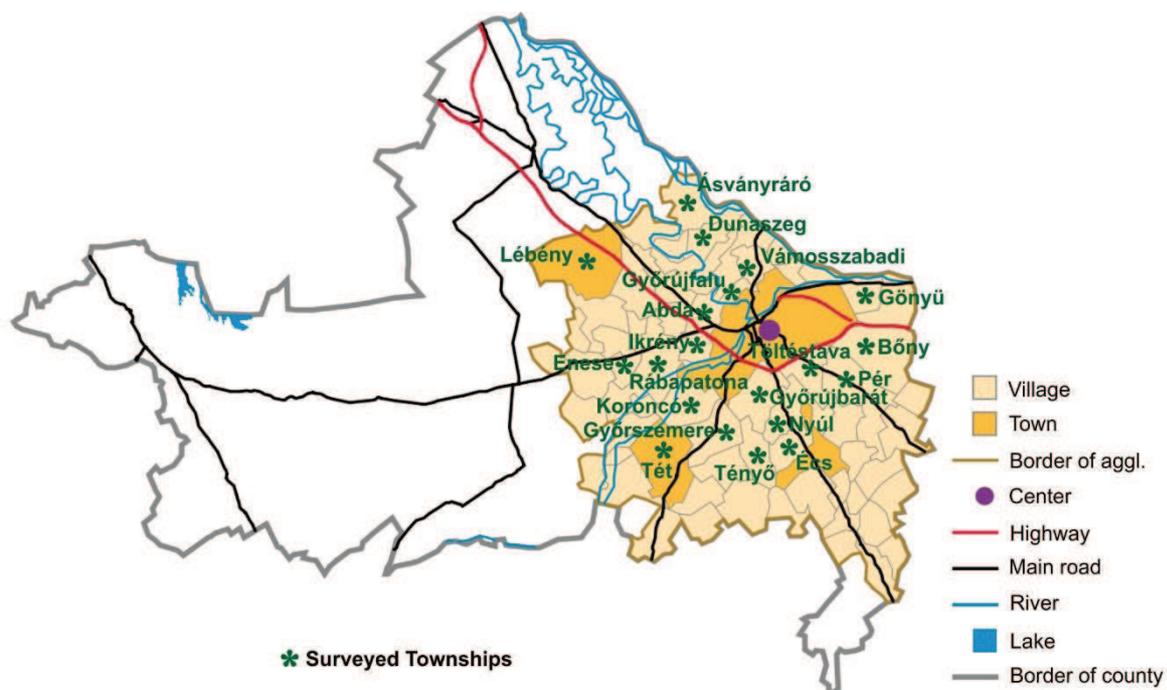
In this study the bus transport of Győr’s agglomeration was investigated. The definition of agglomeration according to the European Union was applied: ‘agglomeration’ shall mean a zone that is a conurbation with a population in excess of 250 000 inhabitants or, where the population is 250 000 inhabitants or less, with a given population density per km<sup>2</sup> to be established by the Member States. (Web-1)

In Hungary ten indicators of changes in agglomeration zones were determined by the Central Statistical Office. Beside Budapest’s agglomeration there are 3 more urban agglomeration in Hungary. To agglomeration of Győr 68 settlements are assigned. This area is 1.607 km<sup>2</sup> and had 227.147 inhabitants in 2014.

We investigated 20 settlements (Figure 1.) in the agglomeration of Győr containing two cities (Tét and Pannonhalma) outside of Győr. In the last decades Győr has become one of the fastest growing city in the country as a result of the industrial investments. The development contributes to strengthen the role of the city in commercial, educational, health, administrative and cultural sectors. (Hidas, 2014)

The urban transport of the region can be considered relatively good in the country. High-performance transportation lines are passing through Győr, connecting Vienna and Budapest by railway line and highway, which provide good accessibility for the region. The structure of transport network is basically radial starting from the centre of Győr. (Hardi and Nárai, 2005). Main roads lead to those settlements which are the prime sources of commuters.

The most dominant ways of the transport are busses and passenger cars. The transport company runs bus-flights to all attracted settlement. Accessibility of Győr by busses is far enough, but connections between the smaller settlements has been problematic. (Hidas (ed.), 2014)



**Figure 1. Map of the agglomeration of Győr**  
(Modified from Hidas, 2014)

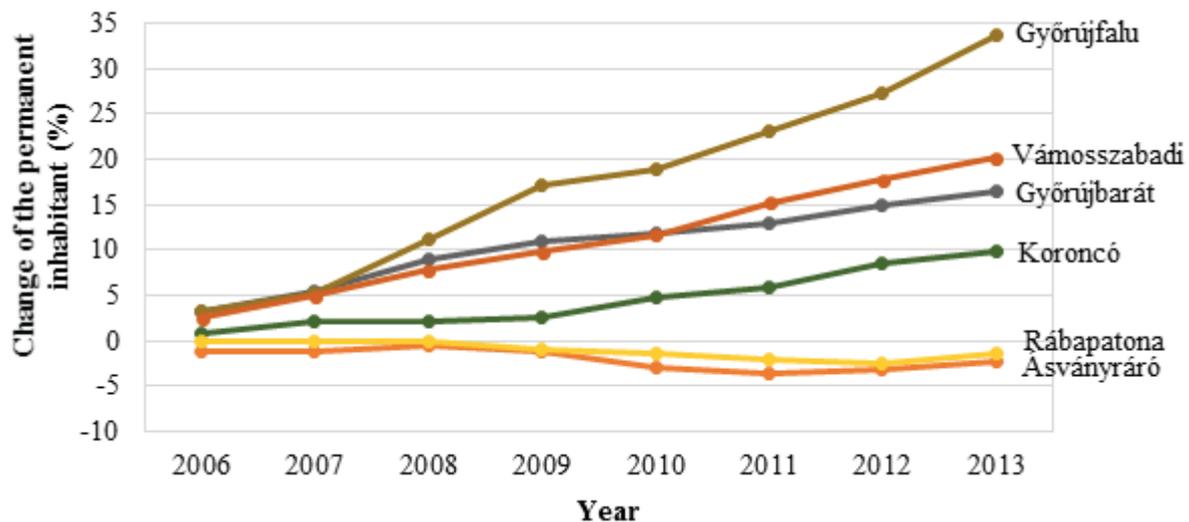
In the course of suburbanization, the population and economic operators were emigrated from the town and it has significantly been enhancing traffic between the town and environs. In general it is true, that for one unit of population who move out generates more than one unit of demand for mobility. So the increase in the number of emigrated people is not directly proportional to the increase in transport demand, as these demands are growing faster. (Hardi and Nárai, 2005) Therefore, the change in the number of people in the agglomeration have to be examined. For the investigation the recent and actual dynamics of the population were essential to know, because population size is a highly important determinant of transport and relative sharing of public transport.

As regards the use of means of transport bus is the dominant mode of transportation. The extra time spent with bus journey (comparing to traveling time by car in percent) was examined, and how it affects the rate of bus users.

The distance of the settlement from the centre of town Győr was an important parameter, such as the income level of the population of the village in determining the ratio of the population and using bus traveling.

## Results

The change in the population size of the settlements was investigated in Győr's agglomeration, because population growth and decrease affect the rate of bus users. The permanent population has been generally growing during the period between 2006 and 2013. The year 2006 was considered as 100% and other years were compared to it. Figure 2 presents the most typical settlements' data.



**Figure 2 Change of the population size in the agglomeration of Győr (100%=2006)**

*Data source: (Hidas (ed.), 2014)*

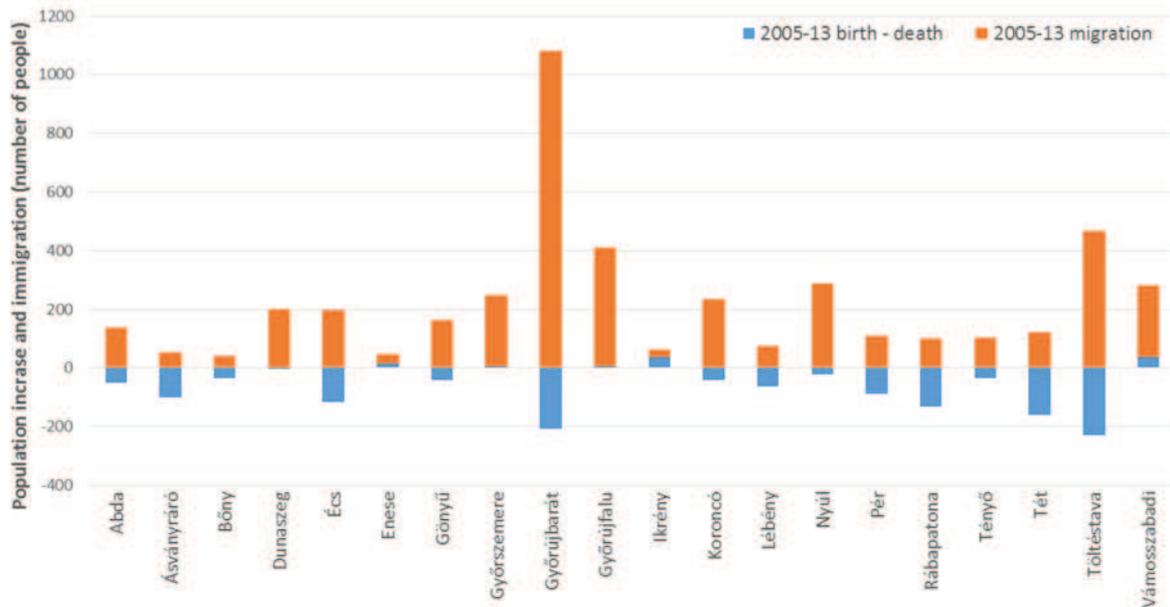
The most remarkable population growth was exhibited by the villages Győrújfalú, Győrújbarát and Vámoszabadi. These settlements are next to Győr and the active population works usually in the centre of Győr, so significant commuting population are living there. As the population of a village is growing, the number of commuters are increasing, consequently the proportion of bus users is also increasing. Ásványráró, Rábapatona and Tét had downward trend in the size of the population, and the growth was getting slower, but in 2013 the population were below the 2006 year.

The reason of tendencies can be found in the distance of the settlements from Győr and the lack of employment. In case of Koroncó there was a little recoil in the number of population but the land prices has been also significantly cheap and consequently people moved there.

The change of population was studied, what influences the transport in the agglomeration of Győr. The dynamic of population usually has two main reasons: the population increase (i. e. the difference between births and deaths) and the immigration. The population increase and the immigration is compared on Figure 3. It can be seen, that the population is growing in

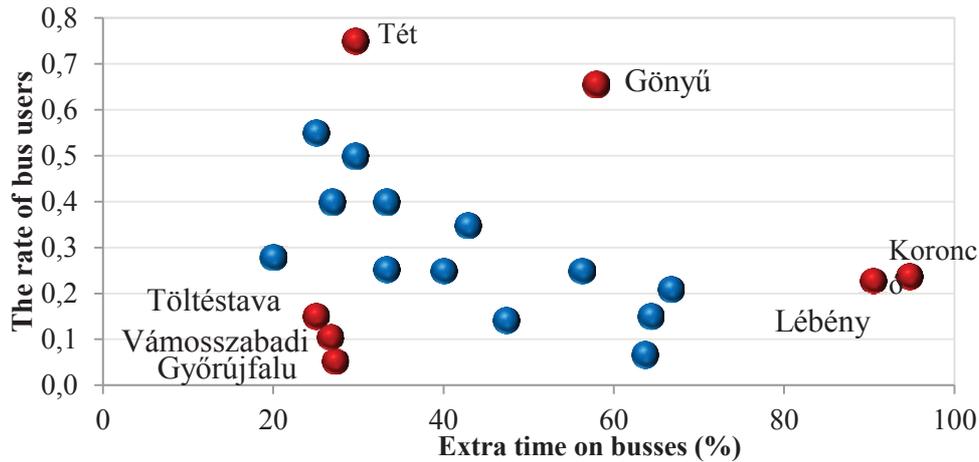
case of almost all settlements, beside that the number of deaths was more than births in some villages. The root of the paradox is the aging society. For further investigation the age structure should be included as well.

People's age determines their traveling habits and the type of means of transport used. Győrújbarát is the most popular target of immigration in the agglomeration after Győr. In case of Vámoszabadi, Győrújfalú and Ikrény settlements have growing population. It is positive, because young couples were moved 5-10 years ago there and the number of births are increased.



**Figure 3 The population increase and the immigration in the agglomeration of Győr**  
Data source: (Hidas (ed.), 2014)

It was also investigated, that how much extra time have to spend passengers on the busses relative to the car users travelling time. There are trade-offs between some examined indicators. However, some settlements are exceptional. The rate of bus users is high compared to the extra time on the bus in case of Gönyű. In Lébény the the proportion of the bus users is small, because there are many people travelling by train to Győr. In case of Töltéstava, Vámoszabadi and Győrújfalú the rate of bus travels is small, because this villages are near to Győr and we count into walking time bus stop, waiting, take-off, landing, walking to the target, it causes very high the access to Győr end back. Between Tét and Győr 90 busses travel daily, that is very high, because very many people travel by bus.



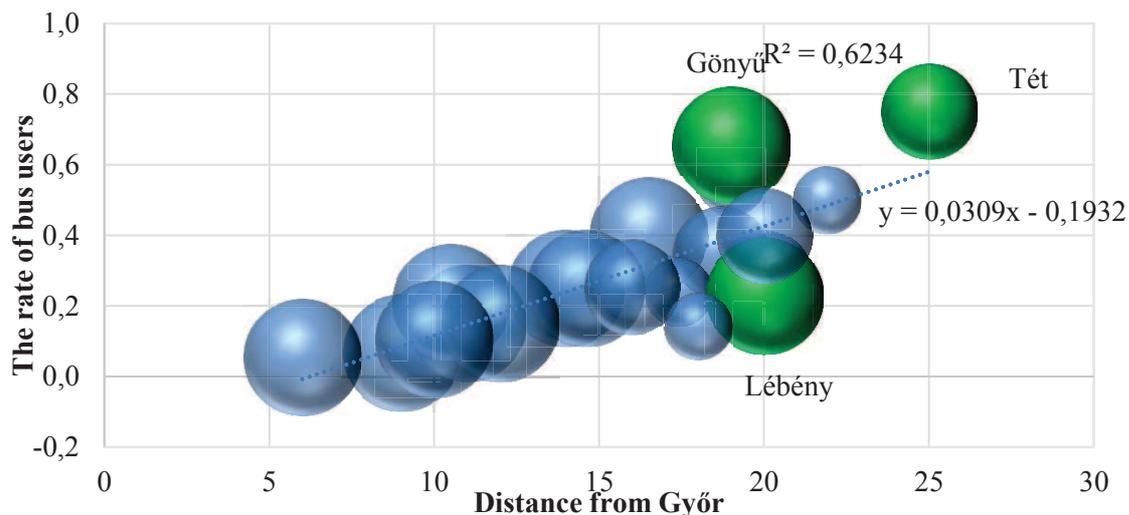
**Figure 4** Possible trade-off between the extra time spent on buses and the rate of bus users

Data source: (FŐMTERV-ENVECOM, 2013)

We investigated the relationship between the distance from the town Győr, the number of bus passengers and the income level of the population. The correlation between the proportion of bus users and the distance of the village was visible.

Correlation between the two parameters is significant, and the calculated the correlation coefficient is  $r^2 = 0,6234$ . As the distance grows, the rate of bus users increases too (Figure 5).

The radius of the bubbles is proportional to the income level of the population in each villages. Inhabitants having high level of income usually live within 15 km distance from Győr. Three settlements; Gönyű, Tét and Lébény are not fitting well to the line. To reveal causes in case of Gönyű needs further investigation. In case of Lébény, the proportion of bus passengers is smaller than expected from the fitted line, because a considerable part of the passengers travel by train. Overall travelling by bus is a very popular way of commuting because of its accuracy and reliability.



**Figure 5** Relationship between the distance from the Győr, the ratio of bus passengers and the income level of the population of villagers

Data source: (FŐMTERV-ENVECOM, 2013), (Hidas (ed.), 2014)

## Conclusions

The growth of population is continuing in Győr's agglomeration, it is increasing the number of voyages. In case of more than three-quarter of the analysed settlements high level of immigration was observed. Immigration is contributed to increase the population of the agglomeration. In general it is true, if the extra time spending on busses is longer, then the proportion of bus users is smaller. There is a linear correlation between the distance from Győr and the proportion of travellers to Győr. This rule is not effected by the income of the residents.

The people arriving from the fastest growing suburban areas (highway of 82, 83 and 14) have to go through bridges on way to the city centre. The capacity these getting insufficient, and the vehicles arriving from outer parts of the city also increase the traffic. So a major traffic jams are formed on the bridges and tracking roads. The regional transport cannot be addressed without investigating urban transport. The transport from the region is increasing the traffic of the city, and the travelling time in heavy traffic within the city is often takes a major part of the whole journey. The bottleneck of the traffic is bridges. (Hardi and Nárai, 2005)

Alternatives of car in transport should be offered in a sufficiently attractive way in order to reduce traffic based on congestion and to obtain derived benefits like road safety and lower atmospheric and noise pollution. (Ibeas, dell'Olio L. and et al., 2010) Travelling time turned to be an important parameter in deciding for public transport.

This study was only a start, deeper investigations should continue this work. The examination of the more accurate modes of transport is determined by the age pyramid too. The number of the examined parameters, indicators and settlements need to be increased. The next step can be the investigation of economic, social and environmental parameters by cluster analysis.

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