SUBURBANISATION IN THE VICINITY OF PRAGUE: PUBLIC TRANSPORT ISSUES

Tomáš Paleta¹, Monika Jandová²

¹ Masarykova univerzita, Ekonomicko-správní fakulta, Lipová 41a, 602 00 Brno, Czech Republic
Email: paleta@econ.muni.cz

² Masarykova univerzita, Ekonomicko-správní fakulta, Lipová 41a, 602 00 Brno, Czech Republic
Email: jandová@econ.muni.cz

Abstract: The suburbanisation and desurbanisation are phenomena widespread around big cities. Its significant impact on population distribution generates changes in public transit demand and supply. In this conference paper, we focus on the effect of population change on public transit within the Central Bohemian Region. The aim of the conference paper is to find out if there is any response of public transit supply heading to Prague reflecting the population changes. We test the hypothesis that there will be an increase of number of connections to Prague in municipalities with population increase, and vice versa. Our analysis revealed, that we can observe public transit supply increase in the municipalities with population increase, but rather stagnation in municipalities with population decrease.

Keywords: suburbanisation, public transit, urban mobility, suburban migration, transport policy, desurbanisation.

JEL classification: R11, R41, R23.

1. Introduction

Urbanisation and transport are interrelated concepts which means that cities depend on mobility of inhabitants (Rodrigue et al., 2013). Changes in economy and consequently in wealth are usually a factor determining urban migration. It is usually presented that employees can commute from further distances than before due to a well-developed transportation system (Hosszú, 2009).

In fact, most public transit systems have to be subsidised (Rodrigue et al., 2013). From this point of view we cannot be indifferent to the level of harmonisation between the transport needs of inhabitants and public transport policy.¹ The ambition of this article is to address one of the problems of the urban transportation mentioned in literature – the problem of public transport inadequacy. The question is if the transportation system in the vicinity of Prague is really a well-developed one which in our view means harmonisation of transport needs (measured with a population change) with public transport policy. Lukeš et al. (2014) identified in their study the patterns of transport demand for the Prague suburbs based on the traffic surveys. Their conclusions proved the low competitiveness of public transport from the point of view of travelling speed and transport costs. Our conference paper follows this research and aims to the primary question: does the public transport planning reflect the changes in population?

The aim of the conference paper is to find out if there is any response of public transit supply heading to Prague reflecting the population changes. We test the hypothesis that there will be an increase number of connections to Prague in the municipalities with population increase, and vice versa.

The article is structured as follows:

1) Literature review – desurbanisation generally, impacts on public transport;
2) Suburbanisation/desurbanisation in Prague and the peripheries, suburban parts and adjacent regions;

¹ We use the term “transport policy” in the context mentioned by Rodrigues et al. (2013) who declares that transport policy deals with the “development of a set of constructs and propositions to achieve particular objectives relating to functioning and performance of the transport system”.

-476-
3) Methodology;
4) Results.

2. Literature Review

First of all, it is worth to mention that there is a mismatch of terms regarding “suburban migration”. “Suburbanisation” refers to the “continual development of housing in suburbs sprawling outwards from the outskirts of major cities” which is a response to the desire for affordable housing, advancements in transport technology and infrastructure such as roads and rail, and information technology such as high speed internet and video conferencing (HCR, 2015). The “urban sprawl” is one of the suburbanisation demonstrations. It means building new settlements out of the existing build-up area in the influence area of metropolitan cities, around main transport lines (Šilhánková et al., 2007).

The term “desurbanisation” usually means a process of rural-urban population rate shifts (Bajmócy et al., 2011). On the other hand some authors use the terms at least as an almost synonym, e.g. Šilhánková et al. (2007) defines “suburban migration” as a demanding regular commuting between a place of living and a place of work (or study) that takes place over the city border. This approach does not reject migration to rural areas. In literature, there is a confusion of the term “desurbanisation“ itself as well. Some researchers uses the term “desurbanisation“, others “disurbanisation“ or ,,counterurbanisation/counterurbanization“, “counter-urbanisation“, while some researchers try to avoid the term and refer to “urban-rural migration“, “population turnaround“ or “rural repopulation“ (Hosszú, 2009).

There are two types of suburbanisation theories mentioned in the literature. First, the “natural evolution theory” that assumes that the middle classes tend to live in larger family houses in the suburbs which reinforced by transportation possibilities leads to an increase of the urban area; second explanation for suburbanisation stresses fiscal and social problems of city centres (e.g. crime, congestions and low environmental quality) (Mieszkowski and Mills, 1993). Even if our ambition is not to identify the determinants of suburban migration, in relation with the aim of our paper, we tend to the evolution theory in case of Prague.

Present-day economic development processes have been accompanied by a significant increase in mobility and higher levels of accessibility (Rodrigue et al., 2013) which is due to a better transport services and lower transportation costs (Kupková, 2008). Mobility of inhabitants from urban areas has increased automobile traffic intensity into the suburban locations that has a negative influence on public transport (transit) (Lukeš et al., 2014). Employment zones are located away from residential zones which has caused an increase in the number and length of commuting trips that was absorbed by public transit before suburbanisation, but today the automobile supports the majority of these trips (Rodrigue et al., 2013). As countries become wealthier, they also become more urbanised and more reliant on private cars, but other factors come into account as well – e.g. parking availability, shift to cycling, good access to transit etc. (see Guerra, 2015). The role (or challenge) of transit is to offer transport within the range of acceptability for the majority of passengers and to become the best alternative (Lukeš et al., 2014).

Generally, negative impacts of automobile transport have been reflected into the transport policy formulation. As stated in Schmeider (2010), the problem of suburbanisation is connected with sustainable transport and mobility which is the main topic of the modern transport policy. An effective public transport system is essential. As Rodrigues et al. (2013) declares, public transit (or collective transportation) is almost exclusively an urban transportation mode, particularly in large urban agglomerations because it provides conditions for its efficiency – high density and short distance mobility demands subsidised. Cooperation among public transport modes to provide necessary and efficient transport services is a necessity in the future (Marada et al. 2010). Yet public
transit is the only major alternative to the car in the cities and thus improvements of the public transport systems should make transit more attractive, by improving bus schedules, appearance and comfort of transit vehicles and stations (Rodrigue et al., 2013).

3. Suburbanisation/Desurbanisation of Prague

Even if Prague is a region itself, the city of Prague is a dominant city of the whole Central Bohemian region, and many of the suburban settlements do not behave as traditional municipalities (Lukeš et al., 2014). The trend of suburbanisation in the Czech Republic started in the mid-1990s, in connection with economy structure changes (Schmeidler, 2010). These economy changes in the 1990s have led to an increase of the area of the Prague commuting region which is more apparent in the nearest vicinity of Prague whilst more distant parts of the Central Bohemia have kept their commuting direction in favour of regional and district centres (Marada et al., 2010). What is interesting is the fact that changes of orientation of labour force in favour of Prague have not shown dependence on nearness neither to highways not to railway corridors, but on nearness to large regional capitals (Marada et al., 2010).

The concentration of economic activities in the Central Bohemian region is stated for these settlement lines connected to the city of Prague (Povšík, 2010):
- Prague – Brandýs n. L. – Stará Boleslav – Mladá Boleslav – Mnichovo Hradiště;
- Prague – Nymburk;
- Prague – Beroun – Hořovice/Zebrák;
- Prague – Odolena Voda – Úžice/Kozonín – Kralupy nad Vltavou;
- Prague – Říčany – Benešov.

The regional authority of the Central Bohemian region is aware of the growing importance of transport and consequently the aim for this field is to assure transport infrastructure meeting the transport service increase and the improvement of transport services for regions (Povšík, 2010). Generally, the public service obligation (PSO) emerges from the act no. 194/2010 Coll., on public services in public passenger transport, and no. 129/2000 Coll., on regions. According to the statement of the regional authority the real scope of public transport depends on transport needs of the inhabitants and financial ability of the region (Krajský úřad Středočeského kraje, 2011).

Prague has its own integrated transport system (PID) based on the zone system that takes into account just only radial directions of the public transport to the city of Prague. On the contrary, the Central Bohemian region has its own integrated transport system (SID) based on the gradient in the micro regions. The border of PID and SID is not set by the city border. The Prague PID is extended into five “external zones around Prague in the Central Bohemian region. On the other hand, even if the population change and transport demands would require, other expansion of PID is not possible due to incompatibility of both systems (Krajský úřad Středočeského kraje, 2011).

As already mentioned, suburbanisation refers to movement from the city centre towards the periphery of the agglomeration. According to Regulation No. 561/2006 Coll., the Prague agglomeration covers these cities and municipalities: the city of Prague, Bořanovice, Černošice, Čestlice, Dobřejovice, Dolní Břežany, Drahelčice, Horoměřice, Hostivice, Hovorčovice, Husinec, Chrášťany, Chýně, Jeneč, Jesenice, Jinočany, Jiný, Klecany, Kněževy, Květnice, Libeznice, Měšice, Modletice, Náčer, Napaky, Ořech, Průhonice, Psáry, Roztoky, Rudná, Říčany, Sibřina, Šestajovice, Tuchoměřice, Únětice, Úvaly, Vestec, Zbraslav, Zdíkovec and Zlatníky-Hodkovice. As we can see from the following maps (Fig.1 and Fig.2), the density and increase of population is greatest

---

2 With exception of the D1 highway (Prague to Brno) and the R4 high-speed road (Prague to Příbram).
3 As declared in Duchoň and Dvořáková (2013), especially in the case of Prague and Říčany, Neratovice and Kladno there is a systematic increase of number of connections reflecting transport needs of commuters.
in the geographic circle around Prague (and in case of density also in the county towns of the Central Bohemian region), but it covers larger area than the agglomeration. The population dynamics around Prague can be described as a mix of suburbanisation and desurbanisation.

Fig. 1. Population density (2014)

Source: data CZSO, own created in ARC GIS

As could be seen from the map above, the population density of the Prague vicinity is higher than in rural areas and the density corresponds to the level typical for smaller cities, even if they are villages. This could create the transport problem during peak hours, leading to congestions and longer transport time.
Figure 2 shows the population increase. The sprawl from the city of Prague to its vicinity is apparent and quite strong, despite a quite short period analysed. The increase is visualised as a circle around Prague, with stronger expansion to southeast, with a good accessibility to the D1 highway. There could be lower impact towards the public transport changes, because according to the survey of Marada et al. (2010) the highest share of individual transport proved to be on the western part of the D1 highway which could be caused by the population size of the settlements not exceeding 500 inhabitants. The periphery exhibits a reverse tendency – the decrease of population. This could be caused by either the movement to Prague (plus its vicinity, strengthening the effect of Prague suburbanisation), or out of the Central Bohemian region closer to another regional capitals. It can be assumed, that the movement towards Prague is stronger.

Figure 3 represents the spatial clusters weighted be the population changes using the Getis-Ord Gi statistic. We can see, that the statistically significant clusters of increase are concentrated around Prague and to some degree around Mladá Boleslav. The opposite side of the spectrum, the decrease clusters are located at the periphery of the region. This stylized facts support the evidence from the raw data, that the target of migration is located adjacent to Prague, at the expense of the periphery and the centre of Prague (not included in map) as well.
Fig. 3. Population change – optimised (between 2014 and 2008)

Source: own created in ARC GIS

From the analysis of the population dynamics, we can select those municipalities that have the highest increase and decrease of population and examine the effect of the population change on the public transit supply.

4. Methodology

As mentioned above, we focused our attention to municipalities with the highest increase and the highest decrease of population in the period of 2008 to 2014. We considered both a relative change (in percent) and an absolute change within the examined period. Then, we tested the change in a number of connections from the particular municipality towards the first stop in Prague.

For the testing purposes, and due to a very demanding data mining, we limited the first research to 30 municipalities with the highest and the lowest values from each category as we assumed that the effect will be strongest in these extreme cases. We examined the number of connections from each municipality in working day with the latest arrival in Prague at 9:00 a.m. In our conference paper, we just focus on the city of Prague that is the most important absorber of the labour force and we abstract from other economic centres mentioned above. Since the most municipalities are located rather
further from the city of Prague, Prague may not be the natural centre of economic activity for them. We assume, for now, that Prague is the centre for the whole region, which should be confirmed by the highest wages, lowest unemployment rate and its role as the country capital. This assumption should be reflected by commuting to Prague, the economic centre of the whole country and the most of the Central Bohemian region. Our aim was to find out, if there is any significant shift of public transit supply to Prague reflecting the changes of population. Our primary hypothesis was, that with increasing population there will be an increasing supply of public transit, and vice versa.

5. Results

The most municipalities with the highest percentage increase are located within the close circle around Prague, laying in the 1st or 2nd zone of Prague integrated transport system (PID), with the exception of area south-eastward to Prague, where the increase is significant also in the 3rd zone of PID. With some exception there are villages that were very small about twenty years ago, and then have become the target of suburban movement of the Prague mid-class, and have increased their size even by hundreds of percent. For example, the municipality of Herink increased its size by 590% in the examined period.

Regarding the impact on public transit supply, the results are mixed. In case of the highest percentage increase, there were 18 occurrences of transit supply increase and 7 cases of decrease, in the rest of sample the supply stagnated (see Table 1).

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Pop. change (%)</th>
<th>No. of connections 2008</th>
<th>Travel time 2008 (minutes)</th>
<th>No. of connections 2014</th>
<th>Travel time 2014 (minutes)</th>
<th>No. of connections change</th>
<th>Time saved (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Herink</td>
<td>590.0</td>
<td>1</td>
<td>66</td>
<td>8</td>
<td>22</td>
<td>7</td>
<td>44</td>
</tr>
<tr>
<td>2. Nupaky</td>
<td>339.0</td>
<td>8</td>
<td>26</td>
<td>10</td>
<td>15</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>3. Nová Ves</td>
<td>278.1</td>
<td>9</td>
<td>27</td>
<td>11</td>
<td>28</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>4. Svémyslice</td>
<td>172.5</td>
<td>5</td>
<td>22</td>
<td>6</td>
<td>22</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5. Zlatá</td>
<td>165.0</td>
<td>6</td>
<td>21</td>
<td>8</td>
<td>23</td>
<td>2</td>
<td>-2</td>
</tr>
<tr>
<td>6. Trnová</td>
<td>163.9</td>
<td>17</td>
<td>19</td>
<td>20</td>
<td>18</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28. Kunice</td>
<td>59.5</td>
<td>9</td>
<td>44</td>
<td>11</td>
<td>42</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>29. Okoř</td>
<td>59.1</td>
<td>8</td>
<td>20</td>
<td>9</td>
<td>20</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>30. Líbeznice</td>
<td>59.0</td>
<td>40</td>
<td>15</td>
<td>49</td>
<td>6</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Average 122.5 12.0 31.4 14.2 32.7 2.4 3.0

Table 1. Changes in population and public transport (between 2008 and 2014)

Source: own calculations based on IDOS timetables and CZSO

The municipalities with the highest percentage decrease are generally at the periphery of the Central Bohemian region, and the commuting to Prague was difficult even at the beginning of the evaluated period. Moreover, these villages are very small and there is not too much space for reduction of public transit supply. The population and transport development is summarised in Table 2.

-482-
When focused on absolute changes, the picture remains, in case of increase, almost the same. The highest values are often rather in the smaller municipalities, and at the doorstep of Prague (see Table 3).

Regarding the decrease of population, county towns of Kladno, Příbram, Kutná Hora and even Mladá Boleslav are the most affected, despite the fact that they are generally considered as the prosperous city, due to the significant and advanced automotive industry.
Table 4. Changes in population and public transport (between 2008 and 2014)

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Pop. change (%)</th>
<th>No. of connections 2008</th>
<th>Travel time 2008 (minutes)</th>
<th>No. of connections 2014</th>
<th>Travel time 2014 (minutes)</th>
<th>No. of connections change</th>
<th>Time saved (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kladno</td>
<td>-1156</td>
<td>88</td>
<td>21</td>
<td>97</td>
<td>21</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>2. Příbram</td>
<td>-1141</td>
<td>37</td>
<td>45</td>
<td>34</td>
<td>45</td>
<td>-3</td>
<td>0</td>
</tr>
<tr>
<td>3. Kutná Hora</td>
<td>-1095</td>
<td>16</td>
<td>66</td>
<td>14</td>
<td>58</td>
<td>-2</td>
<td>8</td>
</tr>
<tr>
<td>4. Mladá Boleslav</td>
<td>-330</td>
<td>28</td>
<td>45</td>
<td>28</td>
<td>40</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>5. Vlašim</td>
<td>-294</td>
<td>14</td>
<td>65</td>
<td>15</td>
<td>65</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6. Sedlčany</td>
<td>-290</td>
<td>8</td>
<td>80</td>
<td>7</td>
<td>75</td>
<td>-1</td>
<td>5</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28. Sovínky</td>
<td>-47</td>
<td>2</td>
<td>64</td>
<td>2</td>
<td>69</td>
<td>0</td>
<td>-5</td>
</tr>
<tr>
<td>29. Beřovice</td>
<td>-46</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30. Neratovice</td>
<td>-42</td>
<td>53</td>
<td>21</td>
<td>49</td>
<td>21</td>
<td>-4</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>-231.6</td>
<td>12.1</td>
<td>73.8</td>
<td>12.5</td>
<td>80.6</td>
<td>0.33</td>
<td>2.95</td>
</tr>
</tbody>
</table>

Source: own calculations based on IDOS timetables and CZSO

To summarise the results, we can say, that there is a significant increase number of connections to Prague from the municipalities with highest absolute and also percentage increase of population. But the link is not straightforward and the correlation between the population increase and transport supply increase is “only” 0.2 in case of relative increase of population or 0.1 in case of absolute increase. But in average, the increase number of connections to Prague in a working day with arrival before 9:00 a.m. is about 2.5 in case of the relative increase and almost 8 in case of the absolute increase.

The municipalities with the greatest decrease of population do not exhibit anticipated results in the full extend. In general, we can describe the situation as a stagnation with some minor and one major exception. The major exception is the county town of Kladno, where the greatest absolute decrease of population was linked with the increase of connection to Prague by 9 connections. The explanation should be, that there is a strong momentum towards Prague, and while a lot of people decided to move closer to Prague, significant and growing part still prefer to commute, generating increasing demand, and consequently supply of public transfer. The stagnation is a natural response to the situation with low default status of connection numbers. The decrease of population could be a result of social exclusion. Small settlements in the region could suffer from social exclusion in terms of accessibility since they are more dependent on individual transport (Marada et al., 2010).

The side effect observed in all groups is a decrease of the shortest possible travel time by a few minutes. This decrease of travel time is generally bigger in case of further municipalities, with the exception of Herink. Herink is close to Prague, but with the enormous increase of population, the travel time decrease significantly (by 44 minutes).

6. Conclusion

In this conference paper we took the first step to test the suburbanisation impact on the public transit supply in the Central Bohemian region. We examined the population changes between 2008 and 2014 and related changes of connection from the particular municipality to the city of Prague.

We took 30 municipalities from both sides of the spectrum and tested the hypothesis that increase of population will be reflected in an increase number of connections to Prague, and vice versa. We confirmed, that the increase of population is generally connected with increase of supply of connection to Prague.
But we cannot confirm the second part of the hypothesis, that the decrease of population will be accompanied by the reduction of connections. In case of smaller villages, the reason for the unpredicted development can be the low (if any) number of connections to Prague which means that there is almost no possibility to decrease. In case of bigger cities, we can see both a decrease of population and the decrease of connection supply (Příbram), and a decrease of population linked with the increase of connection supply (Kladno). The case of Kladno may be explained by the stronger momentum towards Prague in terms of both, relocation and commuting. Definitely, there is a lot of possibilities for further research, like including the local economic centres to the commuting pattern, considering economic variables and other means of transport, especially car. This paper revealed, that even in the short time span, there are not inconsiderable changes of public transit supply reflecting the movement of population around Prague. Last but not least, in this stage we left the industrial zones at the Prague periphery out of the account and assumed the city of Prague as a „black box“. In the further research it could be interesting to take account of the distribution of industrial areas both in Prague and the Central Bohemian region.

Our results show both the process of suburbanisation within the Prague agglomeration but desurbanisation as well whilst the biggest increase is also in the further settlements from Prague. In our results, we can see mostly stagnation or decrease of traveling time, which could be also attributed to improvement of transport infrastructure. Considering the increasing number of travellers, without improvements, the travel time would be increasing.

7. Acknowledgement
This research was financially supported by the Masaryk University Specific Research Grant (MUNI/A/1203/2014).

References
bsluznost-stredoceskeho-kraje--1292271.
http://www.vodochody.cz/obrazky/web/Středočeský
kraj/DOPRAVNI_PLAN_STREDOCESKEHO_KRAJE.pdf.


