Development of public transport accessibility in the Czech Republic

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Summary

The convenient system of public transport services belongs to key factors influencing the final decision of public transport use. This paper analyses the development of the level of public transport services, utilising data from Database of Public Transport Connections developed and maintained by the authors. These databases contain regularly updated data about inter-municipality public transport connections since 2007 which are suitable for commuting. The development of public transport accessibility in the Czech Republic is analysed by applying spatial analysis methods. Results indicate more complicated relationships between public transport accessibility and local socioeconomic changes.

KEYWORDS: public transport, accessibility, Czech Republic.

1. Introduction

Public transport has a long history in the Czech Republic and compared to another similar in the central Europe countries (e.g. Poland or Slovenia), high offer of public transport connections still remains also due to financial subsidies by government. This fact caused sufficient level of public transport accessibility to all municipalities what belongs to basic idea of law 194/2010 about public passenger transport services that generally ensures basic transport serviceability of a region but without specific number of bus or train connections. Anyway due to rationalization and short cuts to public transport offer, the level is getting lower. Even so development of modal split in the Czech Republic copies similar development in European countries. The main aspect is stagnant or decreasing share of public transport use (decreased form 17.5% in 1995 to 10.9% in 2013; without city public transport) and increasing number of journeys by cars.

This paper analyses the development of level of public transport services, utilising data from Database of Public Transport Connections developed and maintained by the authors. These databases contain regularly updated data about inter-municipality public transport connections since 2007 which are suitable for daily commuting. The public transport accessibility is interconnected with local socioeconomic situation – public transport system reflects actual human needs and demands and reversely the society is influenced by the public transport accessibility. Such iteration process may quickly increase local disparities if it is not regulated. The development of public transport accessibility in the Czech Republic is analysed by applying methods of spatial analysis of current situation and change since 2007 to 2014. Results indicate more complicated relationships between public transport accessibility and local socioeconomic changes.

2. Database of Public Transport Connections

Czech Republic has the advantage that all time tables are centralized in central information system

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maintained by CHAPS Ltd. Valid time tables together with developed application TRAM are able to search valid public transport connections between all municipalities within 100 kilometres (Euclidean distance) and what creates the database with more than 12.5 million of municipality combinations. Several variables are searched in time tables for each combination of municipalities (e. g. travel time, number of changes, price, and existence of return connection) for five times (to 6, 7, 8, 14 and 22 o'clock). These times define the beginnings of three work shifts. Valid public transport connection must meet defined criterias. Travel time is smaller than 90 minutes, number of changes is smaller than 5, arrival time cannot be earlier than 60 minutes before, and departure time from origin cannot be earlier than 120 minutes before arrival to destination (more in Ivan et al., 2013 or Horák et al., 2014). For purposes of this paper, timetables for trains and buses (no urban transport) valid in March 2007, 2011 and 2014 have been utilized.

3. Development of public transport accessibility

The transport accessibility was assessed mainly using rate of accessible municipalities *RA*, which is defined as the number of accessible municipalities per number of all municipalities tested for existing transport connection (in %) on certain time in case of one-way travelling.

$$RA_{h,i} = \frac{NMA_{h,i}}{NMT_{h,i}} * 100 \qquad (1)$$

where *NMA* is the number of accessible municipalities, *NMT* is the total number of municipalities within a given Euclidean distance (i.e. 100 km), *h* is hour and *i* is the index of municipality.

The map (Fig. 2) shows spatial distribution of public transport accessibility indicator. Potential differs from 0 to 100, where 100 means that there is a possibility to travel to analysed municipality from all municipalities within 100 kilometres, so the ideal destination for commuters from surrounding municipalities. However, many times commuters are using a public transport stop in nearby municipality within walking distance. Therefore spatial filter has been used and final value is equal to the average of potentials of municipalities within 2 kilometres. This distance is considered as maximal walking distance to a public transport stop.

Average municipality in Czechia is accessible for any of analysed five arrival times from 6% of surrounding municipalities within 100 kilometres. Spatial distribution is depicted in the map below (figure 2) and spatial clustering (effect of second order) as well as spatial trend (effect of first order) from west to east are evident in this map. Spatial trend is confirmed by positive and statistically significant ($p = 0.01$) correlation between public transport potential and x coordinate ($R = 0.284$). The more east is the municipality the better is its accessibility. Roads (highways, motorways and first class roads) and railways have influence on public transport potential too. Average of theoretical transport potential of municipalities within 2 kilometres from railway or road network is 6.9%. This is higher than national average. Difference in public transport potential between municipalities within and farther than 2 kilometres from roads and railways (4.9%) has been proved by ANOVA. Bigger influence on average public transport potential is caused by roads with an average equal to 7.5%. Average for railways is smaller 7%.

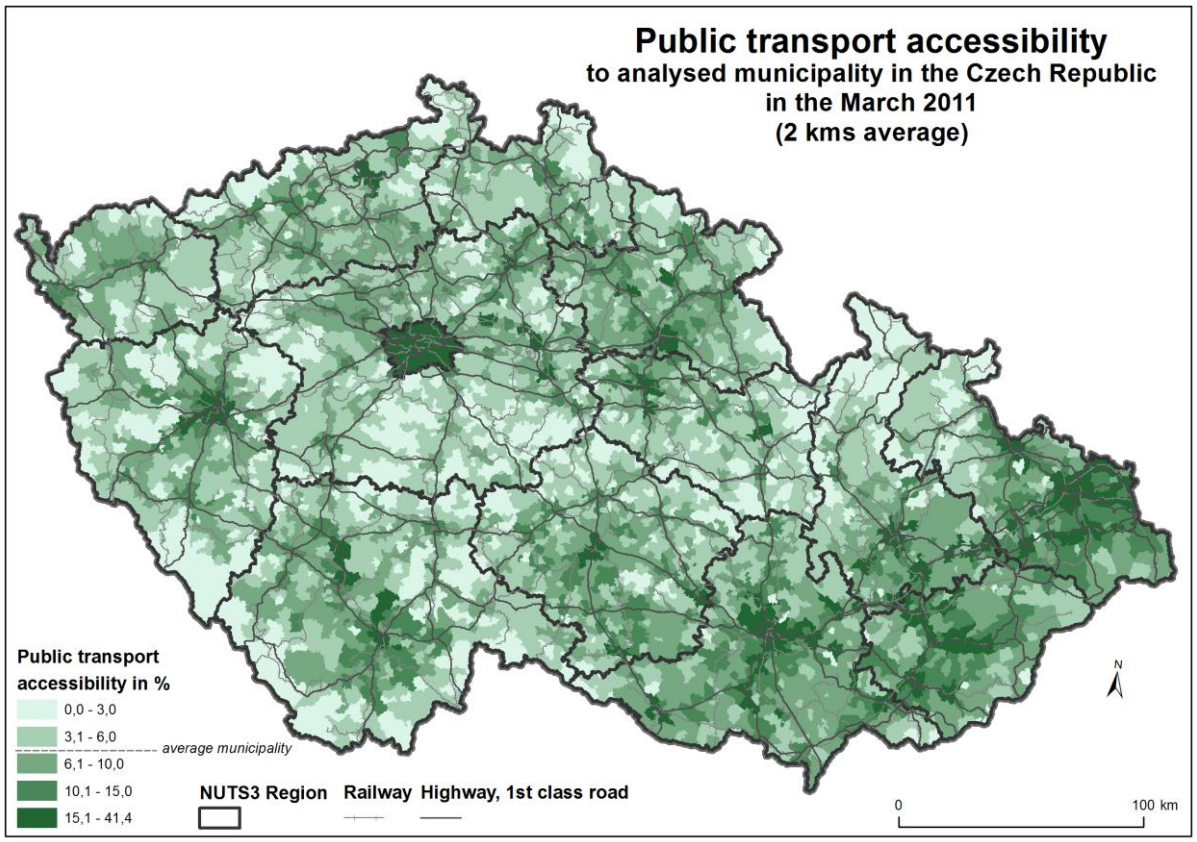

Figure 1 Rate of accessible municipalities in March 2011

Obviously if a municipality has a good public transport accessibility, surrounding municipalities should have higher accessibility too. These municipalities could share the same public transport link. Spatial clustering is analysed using local autocorrelation of public transport accessibility. Moran's I is 0.575 what proves clustering of municipalities with higher or lower accessibility. The map in figure 2 depicts these clusters of municipalities. Red colour characterizes municipalities with higher public transport accessibility surrounded also by municipalities with higher accessibility. These municipalities are concentrated mainly in the eastern parts of Czechia what confirms previous hypothesis about western-eastern trend. On contrary blue colour describes municipalities with low accessibility surrounded by municipalities also with low level. These municipalities create several clusters situated mainly in the western part of Czechia and in the northern part of Moravia (eastern part of Czechia).

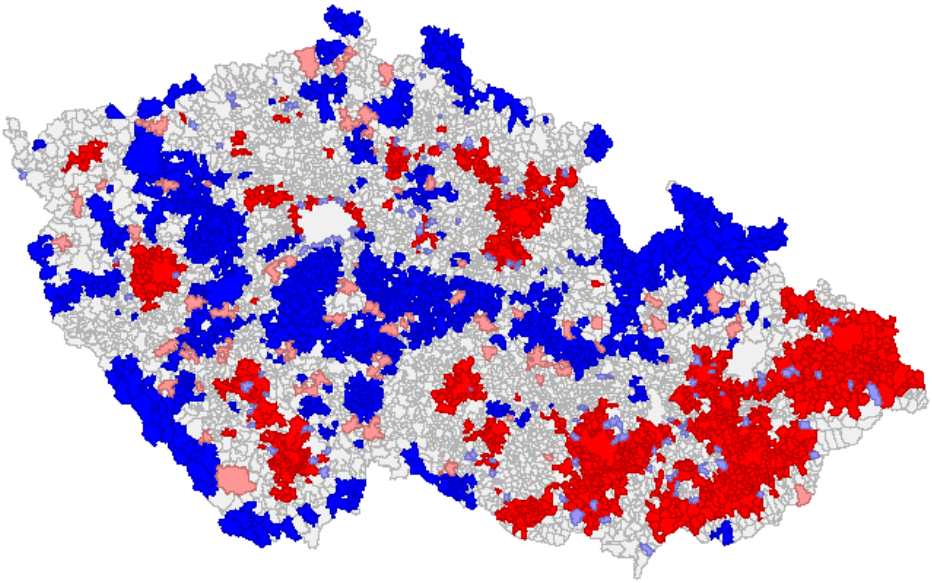

Figure 2 Cluster map of public transport potential

Two maps below describe the development of public transport accessibility on the municipality level represented by rate of accessible municipalities. The time series covers development since 2008 to 2014 and was divided into two periods – 2008–2011 and 2011–2014. While during the first period there is more significant increase of RA with mean value +2.27%, with maximal increase above 10%, with maximal decrease higher than 6%, in the second period the development is more stagnant with small decrease (mean value -0.54).

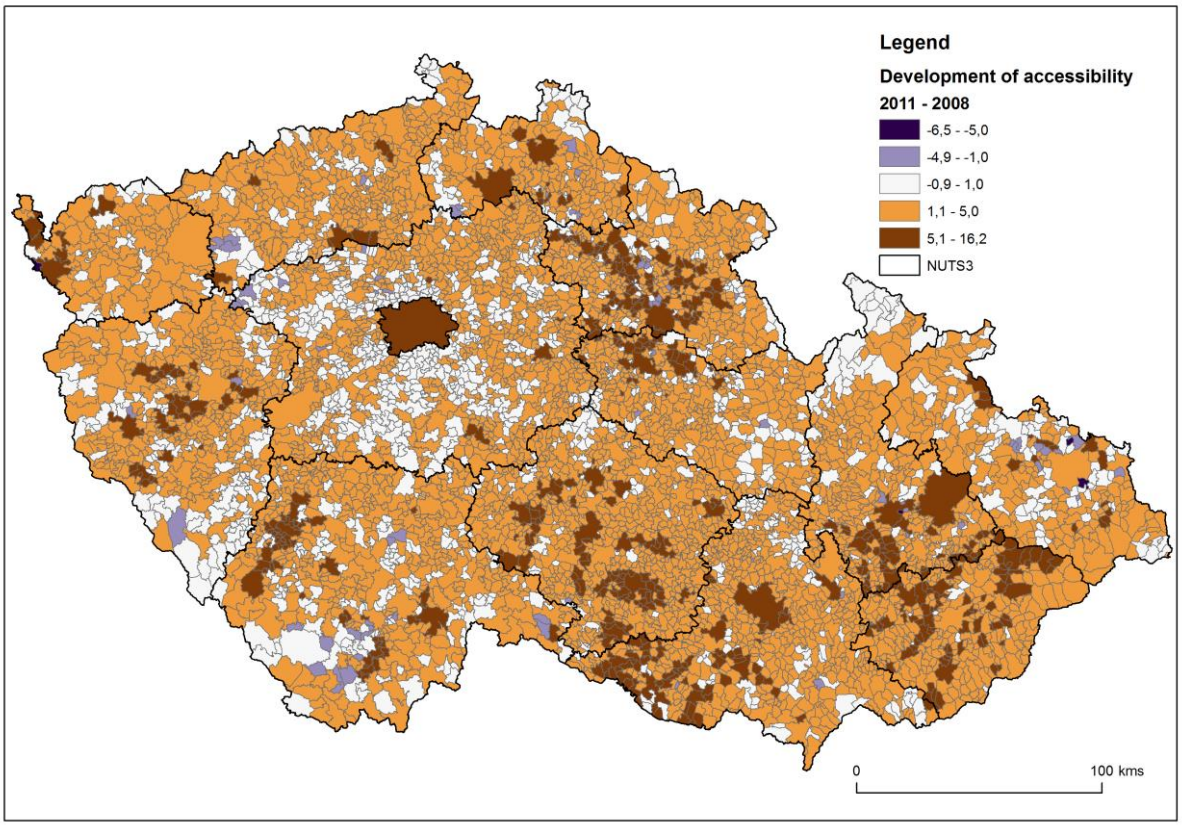

Figure 3 Change of RA (2008 – 2011)

Spatial trends are evident also in case of development. In the first period, three main areas are typical due to higher increases and two by significant decreases. Some of these drops can be explained by changes in financial subsidies in public transport by regional authorities (even they officially announced something different). Situation in the second period is partly reacting on the previous development. Thus while the RA has increased in some of these areas, the RA has decreased in areas with increases for 2008–2011 period. Finally some regions exist that experienced an increase for both periods.

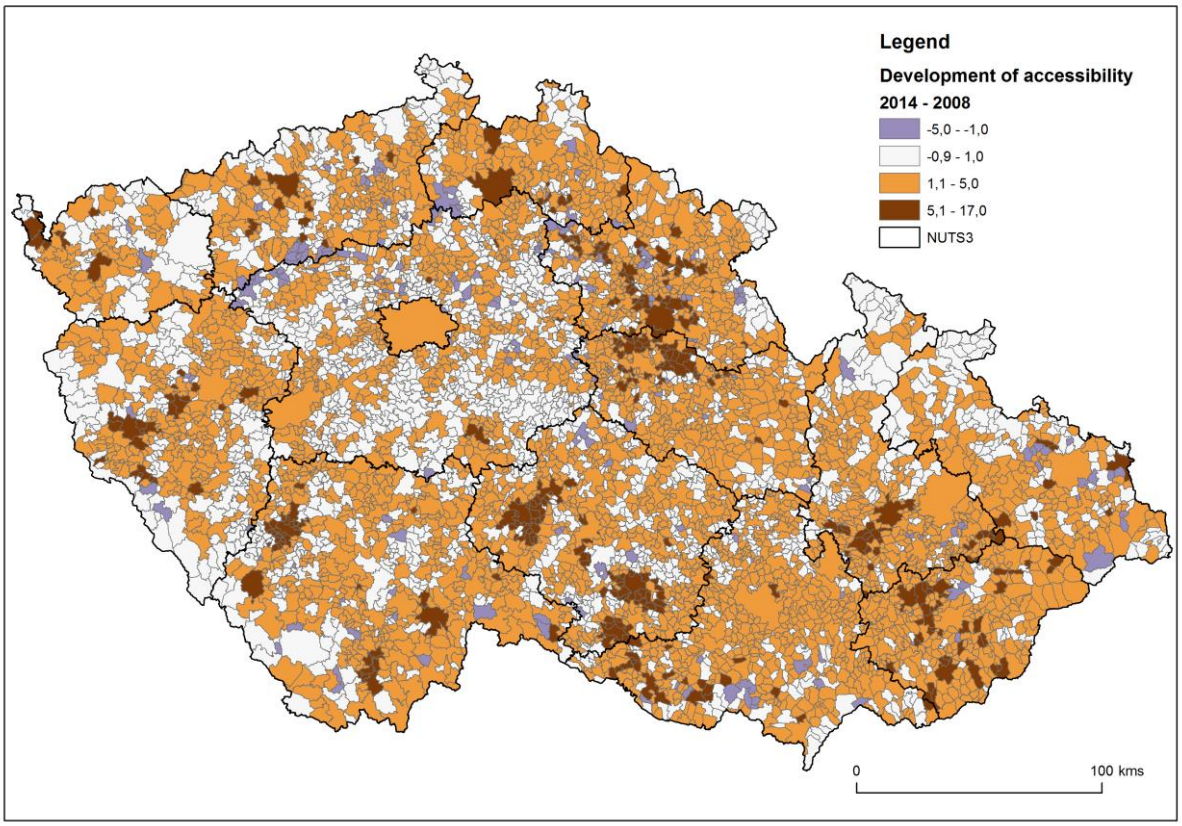

Figure 4 Change of RA (2011 – 2014)

4. Acknowledgements

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5. Biography

Igor Ivan – He defended his PhD thesis focused on public transport accessibility and door-to-door accessibility in 2010. His main research activities deal with spatial analysis at micro-geographical scale, analysis of individual data, and transport analysis related mainly to public transport.

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