

Analysis of integrated transport system influence on the region

M. BOLKOVÁ^a, M. BOLEK^b

^aJan Perner Transport Faculty, University of Pardubice, Studentská 95, 530 09 Pardubice, Czech Republic,

^bAZD Praha, Foreign Marketing & Trade Department, Žitovnická 2, 106 17 Praha 10, Czech Republic
EMAIL: bolekmichal@azd.cz

ABSTRACT

This paper deals with the analysis of the influence of integrated transport systems on the region and on ITS transport services in the Czech Republic and Poland. Available transport statistics contain only the information about particular transport modes; the data of integrated transport systems is not registered. Therefore the basis for the analysis of integrated transport systems and ITS influence on the region is missing. With regard to this, the situation of transport services in regions with an integrated transport system and in regions without it has been analysed. The result is based on the comparison of situation in these regions and in the whole country.

KEYWORDS: integrated transport systems, public transport, region

1. Introduction

The analysis of the influence of integrated transport system on the region is a very complex issue. The main problem is the unavailability of necessary statistical data. Therefore the method of comparing similar regions with an integrated transport system and without it in the same period in different countries has been chosen.

2. Selection of regions for analysis

With regard to the quantity of integrated transport systems (ITS) in the Czech Republic and the amount of data connected with them, it is not possible – considering the size of this paper – to accomplish a detail analysis of the influence of all these systems on the particular regions. For the analysis of the ITS influence on the region and its transport services the analysis of two regions – one with

an operating ITS and one without it – will be performed. A comparison of the development of these regions during particular period and the influence of ITS on this development could be made based on this analysis. Together with these regions the analysis of data for the Czech Republic will be provided for comparison with the whole country development.

Polish ITS KZK GOP was chosen as a suitable region for analysis and comparison with Czech ITS IDS JMK. The comparison with a Polish region without an ITS and with the whole country will be made also in this case.

3. Criteria for the analysis of regions

The following criteria were chosen to analyse the influence of integrated transport systems on the region:

- regional gross domestic product – gross domestic product (GDP) is the market value of all final goods and services made within the borders of a region within a year

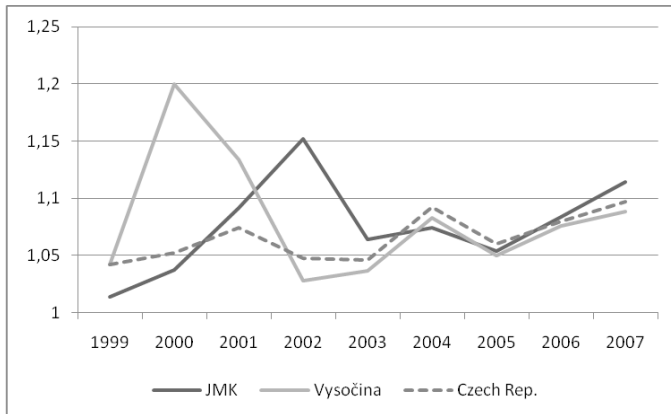


Fig. 1. Annual increments of GDP in the Czech Rep.
Source: [1]

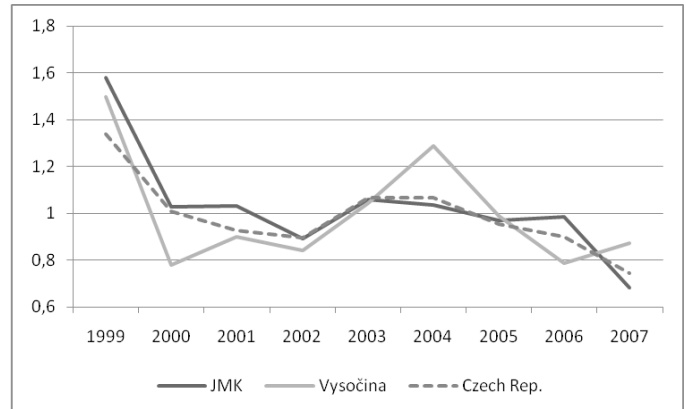


Fig. 2. Annual increments of the unemployment rate in the Czech Rep.
Source: [1]

- unemployment rate, which is defined as the percentage of those in the labour force who are unemployed
- traffic accidents – the number of traffic accidents in a region within a year
- passenger transportation – the number of passengers in the public bus and railway transport within the borders of a region and in the municipal public transport in the area of a region
- connections in a region – the number of railway and bus connections within the borders of a region.

Time series of these criteria will be analyzed and the influence of ITS introduction in a region on these criteria will be investigated.

For the analysis in Poland the criteria of the number of connections and passenger transportation in the railway transport in a region were not taken into account, because they are not statistically observed there.

4. Analysis of integrated transport system influence on the development of a region in the Czech Republic

For the analysis of the influence of ITS on a region, relative increments of the observed criteria, which could be seen on the following graphs, were used.

The yearly increments of the first observed criterion – gross domestic product – could be seen in Fig. 1. After the period of extremities at the turn of millennium the rate of GDP growth constantly increases. In the second year after the origin of IDS JMK (2005) the relative increment of GDP in the South Moravian region is higher than in the Vysočina region. In the following years, when a gradual enlargement

of the IDS JMK took place, the difference of the GDP growth rate between observed regions increased. The GDP growth in the South Moravian region at the end of period was higher than the GDP growth rate of the Czech Republic.

The trend of unemployment rate increments, which could be seen in Fig. 2, fluctuates in the case of both regions. In particular years the decrease of this criterion is higher (the increase lower, respectively) alternately in both regions and this situation lasts also after the origin of integrated transport system in the South Moravian region. In the whole period the unemployment rate is lower in the Vysočina region, but its trend is not more positive in any of observed regions.

A similar trend of the number of inhabitants in the Vysočina and South Moravia region could be seen in Fig. 3. A higher decrease in the Vysočina region in the year 2000 was followed by a decrease in the South Moravian region in the year 2001. The increase in the number of inhabitants in the South Moravian region in 2005 is caused by the assignation of approx. 30 municipalities from the Vysočina region to the South Moravian region.

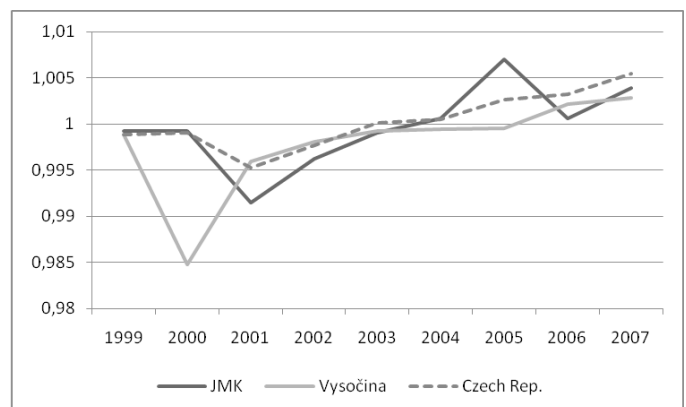


Fig. 3. Annual increments in the number of inhabitants in the Czech Rep
Source: [1]

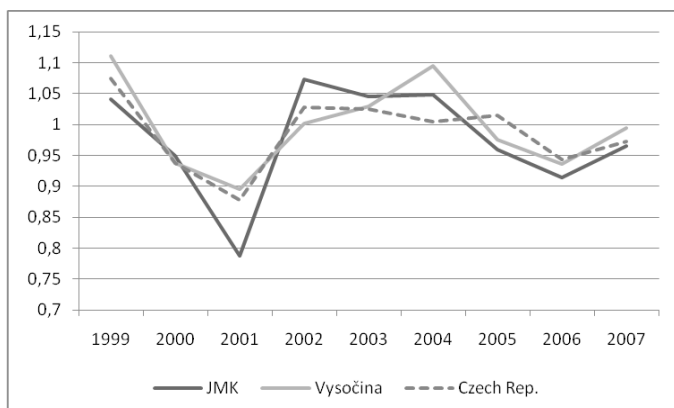


Fig. 4. Annual increments in the number of traffic accidents in the Czech Rep.
Source: [1]

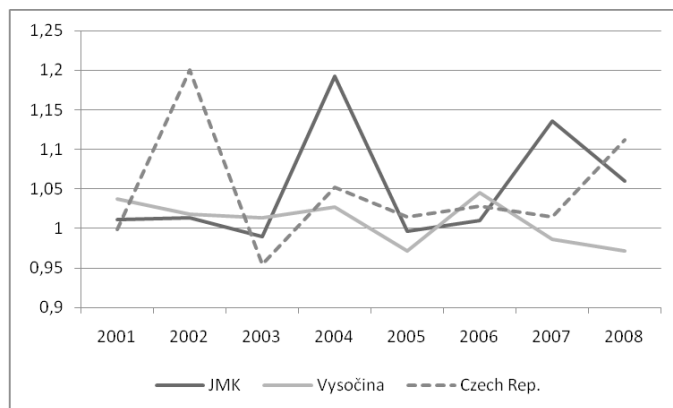


Fig. 6. Annual increments in the number of regional bus connections in the Czech Rep.
Source: [3]

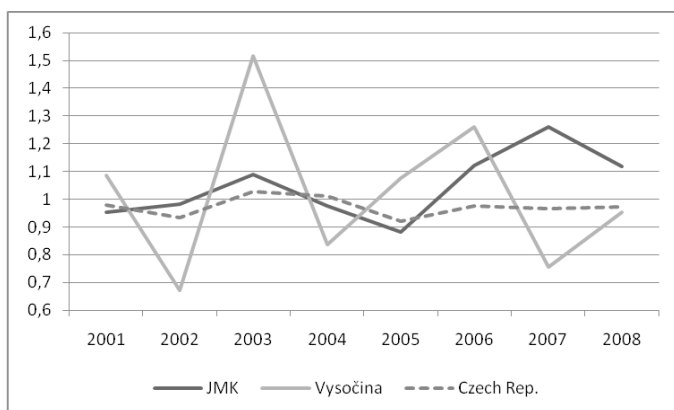


Fig. 5. Annual increments in the number of passengers in the bus transport in the Czech Rep.
Source: [3]

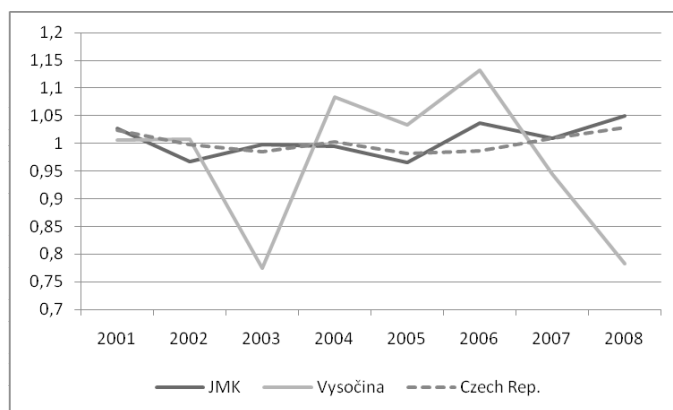


Fig. 7. Annual increments in the number of municipal transport passengers in the Czech Rep.
Source: [3]

The trend in the number of traffic accidents is more positive in the South Moravian region after the origin of ITS than in the Vysočina region. This fact displays Fig. 4.

The yearly alterations in the number of passengers in the bus transport (see Fig. 5) in the Vysočina region are considerably unstable. Therefore it is more suitable to compare the trend in the South Moravian region with the trend in the whole Czech Republic. A constant growth of the number of passengers in the bus transport in the South Moravian region could be seen starting in the year 2006, while in the whole Czech Republic it decreases.

The number of bus connections in the South Moravian region is increasing after the origin of integrated transport system, while in the Vysočina region it decreases except 2006. The yearly alterations of total number of bus connections within the borders of region are displayed in Fig. 6. The difference between observed regions is more significant on Saturdays, Sundays and public holidays.

sion could not be drawn. Generally it could be said, that the number of passengers in municipal public transport is relatively stable. It is caused by the fact that the increasing number of inhabitants in cities, the development of such systems as Park & Ride and participation of many municipal transport systems in the integrated transport systems counteract the increase in individual transport.

The number of passengers in the regional railway transport is statistically monitored just from the year 2003 (see Fig. 8). The trend in the South Moravian region is significantly fluctuating in comparison with the Vysočina region and the Czech Republic. The increase in this criterion in the South Moravian region in 2006 was supposedly caused by the development of integrated transport system IDS JMK (railway in the position of backbone transport, while buses deliver passengers to trains). The trend in the following years corresponds with the trend in the Czech Republic.

The trend in the number of train connections, which could be seen in Fig. 9, is similar in both observed regions

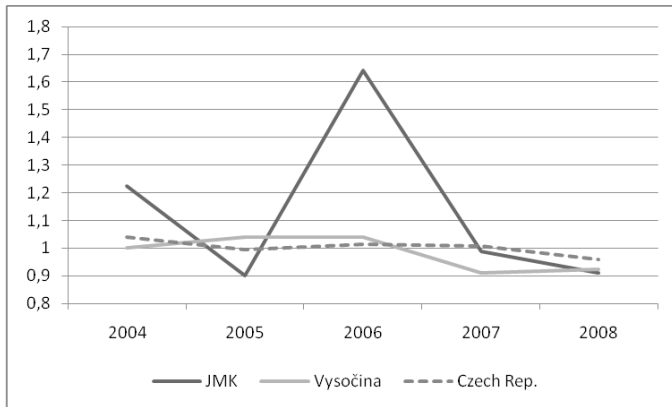


Fig. 8. Annual increments in the numbers of railway transport passengers in the Czech Rep.
Source: [3]

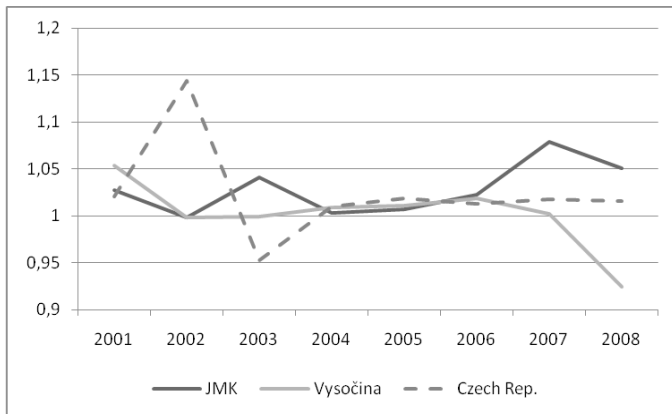


Fig. 9. Annual increments in the number of train connections in the Czech Rep..
Source: [3]

up to the year 2006. In the following years the number of train connections in the South Moravian region increased significantly. This fact is related to the emphasis on the railway transport as a backbone transport in IDS JMK. The difference between observed regions is higher on Saturdays, Sundays and public holidays.

5. Analysis of integrated transport system influence on the development of a region in Poland

For the analysis of the influence of ITS on a region, relative increments of observed criteria, which could be seen on the following graphs, were used as in the case of the Czech Republic.

The gross domestic product trend, which could be seen in Fig. 10, is significantly unstable in all observed

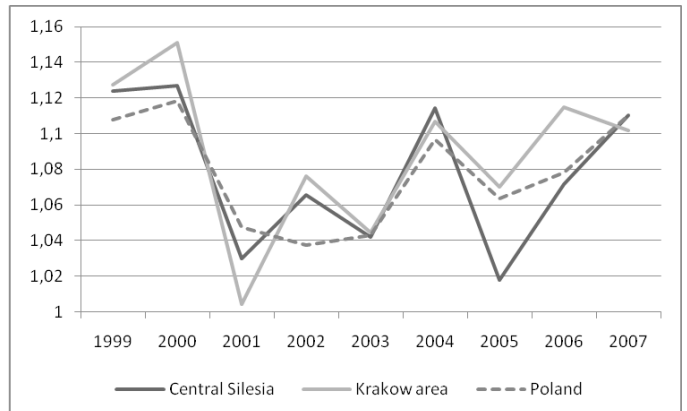


Fig. 10. Annual increments in GDP in Poland
Source: [2]

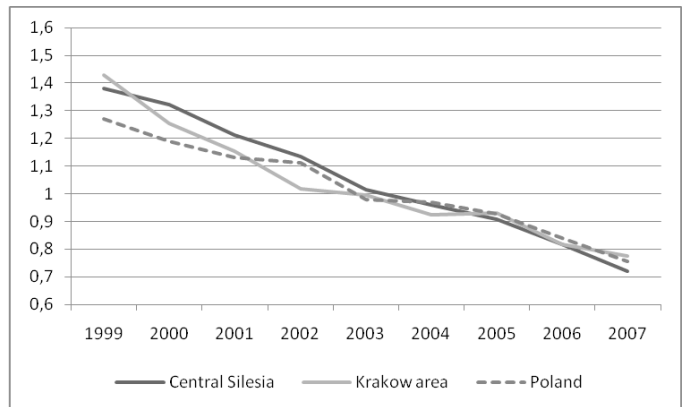


Fig. 11. Annual increments in the unemployment rate in Poland
Source: [2]

regions, however the lowest average growth of GDP is registered in the Central Silesian region, where the KZK GOP integrated transport system is operated. This fact could be explained by the industrial character of the region.

The trend of unemployment rate is displayed in Fig. 11. The unemployment increased more in the Central Silesia than in the Krakow region up to the year 2004. Then the trend was similar in both regions. Just in the last year a higher decrease of unemployment was recorded in the Central Silesia.

The yearly changes in the number of inhabitants in Poland could be seen in Fig. 12. In the Central Silesia the decrease of the number of inhabitants is recorded in the whole period, while in the Krakow region except for 2002 the number of inhabitants slightly grows.

In the case of the number of traffic accidents the trend, which is displayed in Fig. 13, is similar in both regions. However, a higher fluctuation could be seen in the region of Central Silesia than in Krakow region.

The number of passengers in the bus transport (see Fig. 14) is regionally monitored just from the year 2003.

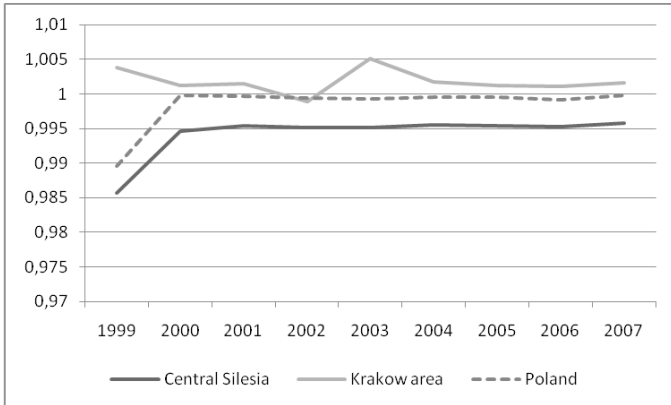


Fig. 12. Annual increments in the number of inhabitants in Poland
Source: [2]

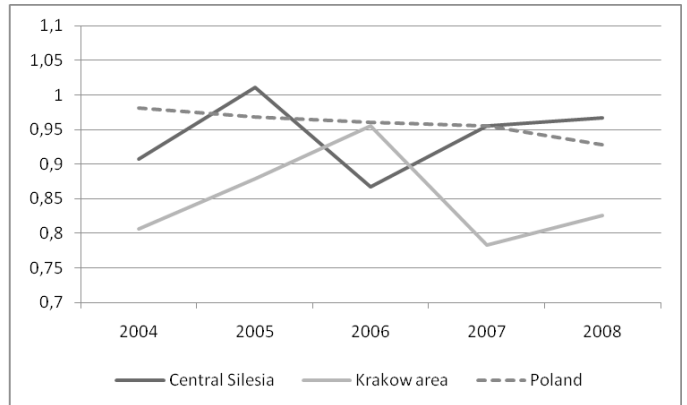


Fig. 14. Annual increments in the number of bus transport passengers in Poland
Source: [2]

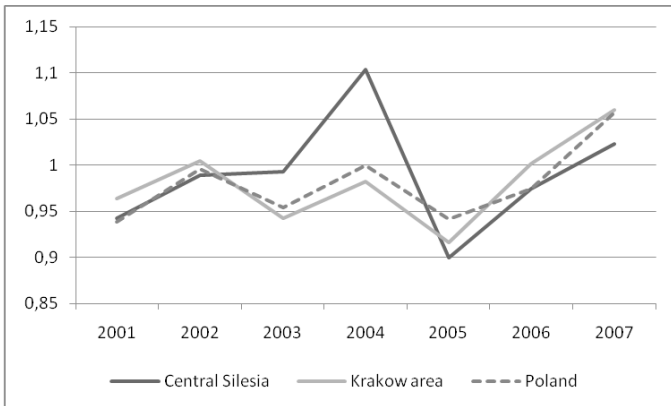


Fig. 13. Annual increments in the number of traffic accidents in Poland
Source: [2]

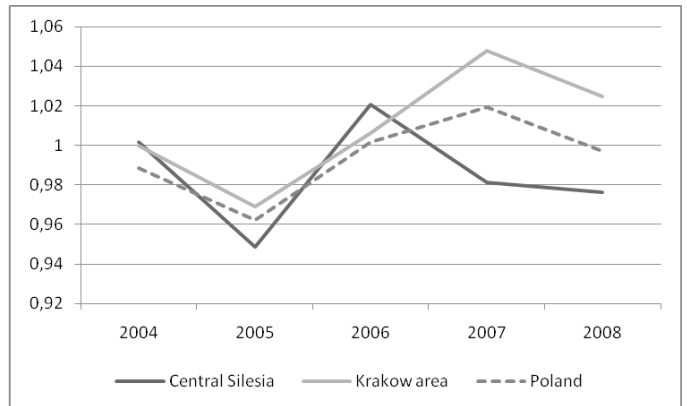


Fig. 15. Annual increments in the number of municipal transport passengers in Poland
Source: [2]

A clear fluctuation in the number of bus transport passengers in both regions could be seen, while the trend in the whole country is stable. A higher decrease of the number of bus transport passengers could be seen in the case of the Krakow region than in the Central Silesian region.

The trend in the number of passengers in municipal public transport could be seen in Fig. 15. In the region of Central Silesia the decrease of the number of passengers is generally higher than in the Krakow region. This fact has to be read in connection with the decrease of the number of inhabitants in the Central Silesia region.

6. Comparison of analysis results in the Czech Republic and Poland

The generally considered target of the integrated transport system development is the growth of the number of

passengers in the public transport. Therefore a correlation analysis was used to analyse the influence of integrated transport system on the region. The Pearson correlation coefficient was used for calculations:

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}} \quad (1)$$

where: r – Pearson correlation coefficient,
 X, Y – sets of data compared,
 x_i – element of set X ,
 y_i – element of set Y ,
 \bar{x} – arithmetic mean of set X ,
 \bar{y} – arithmetic mean of set Y .

The calculated correlation coefficients of the number of public transport passengers with the gross domestic product, the unemployment rate, the number of

Table 1. Correlation coefficients of the number of passengers and selected criteria

Criterion	South Moravia	Vysočina region	Czech Republic
Gross domestic product	0.692	0.395	-0.844
Unemployment rate	-0.763	-0.412	0.690
Number of inhabitants	0.437	0.246	-0.187
Number of traffic accidents	-0.761	-0.545	0.673
Criterion	Central Silesia	Krakov region	Poland
Gross domestic product	-0.875	-0.650	-0.815
Unemployment rate	0.876	0.572	0.689
Number of inhabitants	0.944	-0.726	0.900
Number of traffic accidents	0.577	0.967	0.971

inhabitants and the number of traffic accidents could be seen in Table 1.

The presented values of correlation coefficient are not similar in all regions in the case of any criterion. Actually, some region could be seen, where the value of coefficient for certain criterion is significantly positive (positive linear relationship), and another region, where the value of coefficient is significantly negative (decreasing linear relationship). A higher consistency of the results

of correlation analysis could be seen in the case of Poland, where the same type of relationship (positive / negative) could be found for all criteria except the number of inhabitants.

7. Conclusions

Based on the correlation analysis performed it has to be declared that in the case of the Czech Republic a linear relationship of any observed criterion with the number of passengers in public transport was not proven.

In the case of Poland it is possible to state based on the results of analysis that the number of passengers in public transport decreases in relation to the increase in the gross domestic product and increases in relation to the increase in the unemployment rate (while a linear relationship between the gross domestic product and unemployment rate was not proven). This relationship is independent of the existence of integrated transport system in the region.

Bibliography:

- [1] Czech Statistical Office. <http://www.czso.cz>
- [2] Central Statistical Office of Poland <http://www.stat.gov.pl>
- [3] Transport Statistics of the Czech Republic. <http://www.sydos.cz>