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RESEARCH ARTICLE

Analysing the Connection of Hungarian Economy and Traffic Safety

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Abstract
The paper analyses the interaction among economy and traffic safety. In the first chapter the analysis reviews the most researches and previous results. Hereinafter the article focuses on the Economic and transport safety trends in Hungary. The study aims to compare the most significant transport safety factors dependent on economic development distinguished national and international trends. It has been concluded that an intensive traffic development is expected on Hungarian roads, since the slowing pace of traffic development was probably originated in the economic crisis. Robust growth of traffic makes it necessary to react to the situation as soon as possible. Another important conclusion that the permanent improvement of global safety technology is expected to result significant growth of transport safety in Hungary however it has to be based on the premise that the economic growth continues. Finally, it has been concluded that the time when technological development is not able to provide the permanent growth of traffic safety anymore, will makes it necessary for local initiatives like safety programs and training activities to take over the leading part.

Keywords
traffic safety, connection of economy and traffic safety, road safety analysis

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1 Introduction

The economy and mobility are cooperative systems. The economy affects mobility, but, obviously, mobility also influences economy on various levels. Decoupling economic growth from the development of the road transport sector has traditionally been among the objectives of sustainable development (COM/2011/0144), however, as based on the report of EuroStat, these endeavours have not been entirely fulfilled yet (EuroStat, 2009). In line with European tendencies, it can also be stated in case of Hungary, that the GDP (Gross Domestic Product) representing economic growth and the road transport performance estimated relative to the national road network have shown similar trends recently (R^2=0.85).

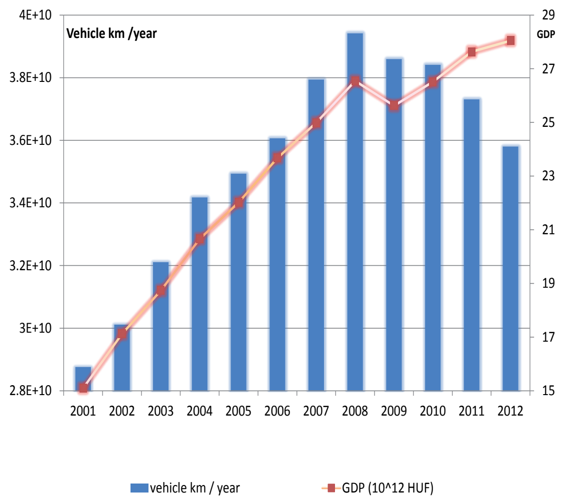

Fig. 1 Time trends of GDP and transport performance in Hungary. Source: Hungarian Central Statistical Office.

Thus, nowadays, economic growth is related to transport demand, and this also influences transport safety, as, simply put, **if traffic on the roads is higher,** then, sadly, **the probability of an accident is also higher**.

Connected to the relationship explained above has Jankó shown that 63% of the variations in the total number of accidents involving personal injuries between 2001 and 2011 could be explained by the changes in the volume index of GDP.

'*This a relatively significant* influencing factor, but the results also imply that 37% of the decrease has been brought about by other factors not covered by the regression analysis, like i.e. the legal background, police control, changes to the infrastructure, other means of prevention, mere chance etc.' (Jankó, 2012)

Besides Hungarian researchers, experts worldwide do also continuously investigate the relationship between the economy and transport safety. Among others relying on data from the period 1975-2011, Yannis, Elvik, proved in an international research covering 27 European states that a decelerating economic growth and the decrease in GDP results in a diminishing fatality rate. (Elvik, 2012; Yannis et al., 2014).

2 Methods

To analyse time series linear regression has been applied, which is the adequate approach to model the connection among a dependent vector variable $\overline{Y}$ and the explanatory variable matrix $\overline{\overline{X}}$. If there are more explanatory variables, the method is called multiple linear regression.

In this statistical approach, data are analysed using linear estimator functions, and other model parameters are predicted from the data. Linear regression is a model in which the average of the conditional distribution of $\overline{Y}$ given $\overline{\overline{X}}$ is expressed as a linear function of $\overline{\overline{X}}$. The matrix form of the linear regression model represents the problem as linear equation system (1):

$$\overline{Y} = \overline{\overline{X}}\overline{B} + \overline{\varepsilon}, \tag{1}$$

where

$\overline{Y} = \begin{pmatrix} y_1 \\ y_2 \\ \cdot \\ \cdot \\ \cdot \\ y_m \end{pmatrix}$ is the dependent variable vector

$\overline{\overline{X}} = \begin{pmatrix} x_{11} & \cdots & x_{1m} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{nm} \end{pmatrix}$ is the explanatory variable matrix

$\overline{B} = \begin{pmatrix} B_1 \\ B_2 \\ \cdot \\ \cdot \\ \cdot \\ B_m \end{pmatrix}$ is the regression coefficient vector, and

$\overline{\varepsilon} = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \cdot \\ \cdot \\ \cdot \\ \varepsilon_m \end{pmatrix}$ is the error vector representing the effect of disturbance term.

In the second phase of the research the link among the Hungarian GPD and road safety related factors has been investigated based on the regression model of Kopits and Cropper. The basic model helps to define the turning-point of the fatality trend depending on GDP data. The general model is based on motor vehicle fatality rate, the rate of motorization and fatalities per vehicle.

In the final phase Trinca model (Trinca et. al., 1988) has been applied to evaluate the Hungarian road safety situation based on a combined method which also uses both fatality per inhabitants and fatality per vehicle.

3 Results

Three main inferences can be made from the above introduced investigation.

Since the slowing pace of traffic development can be originated in the economic crisis, when the crisis will be over, an intensive traffic development is expected on Hungarian roads. Robust growth of traffic makes it necessary to react to the situation as soon as possible.

In the future the permanent improvement of safety technology is expected to result significant growth of transport safety in Hungary however it has to be based on the premise that the economic growth continues.

When technological development is not able to provide the permanent growth of traffic safety, local initiatives like safety programs and training activities has to take over the leading part.

4 Discussion

Figure 1 show clearly that in the wake of the crisis reaching the country, continuous **growth of transport demand in Hungary has come to a halt**. Based on Fig. 2 this might have contributed to the significant **improvement in transport safety**.

Comparing the time trends of the Hungarian GDP per capita to those of other EU Member States, it can be seen that the economic growth of Hungary has recently slowed down even in view of the neighbouring economies (Török et. al., 2015). This also supports the presumption that the crisis has had a more severe effect on Hungary than on other countries.

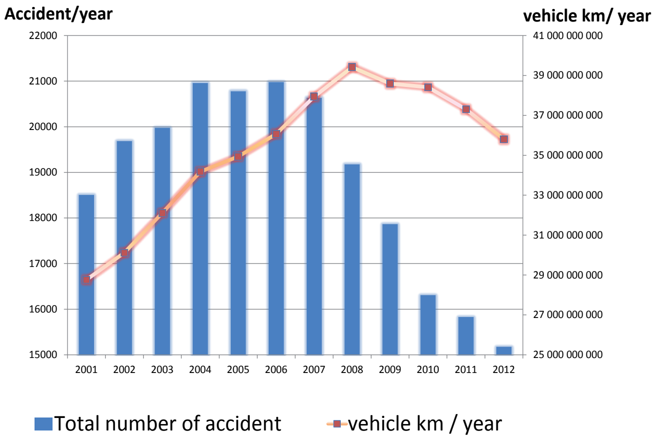

Fig. 2 Time trends of accidents and transport performance in Hungary. Source: Hungarian Roads Management Company, Hungarian Central Statistical Office.

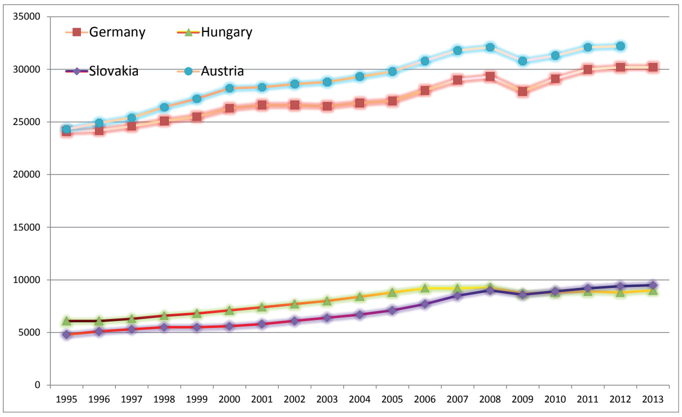

Fig. 3 GDP per capita [EUR] in different countries. Source: Hungarian Central Statistical Office.

These less favourable economic trends as compared to the neighbouring Member States lead us to believe that recession has exerted an influence above the average both on the Hungarian rate of motorization and on the road transport performance; thus also on accident risk.

Nevertheless, the relationship between GDP and the number of accidents is not only determined by one factor, since, for instance, it can be supposed that in countries with **more developed economies** higher resources can be allocated to police control. This may have a positive effect on the number of accidents by **increasing the probability of revealing the infringements**. Apart from this, countries with economies on a higher level of development may be supposed to possess **safer road networks** and, newer, **more modern car fleets**. These influence the number of accidents in a positive direction by way of decreasing the probability and severity of accidents. Contrary to the effect of GDP on road transport performance, **these factors** rather have a mid- and **long term positive influence on the number of accidents**.

In the next phase of the study the most significant transport safety factors depending on economic development (Beenstock and Gafni, 2000) have been compared, distinguishing national and international trends. It analysed how international transport safety trends, like the improvement of vehicle safety, and local efforts, like increasing the presence of the police force, improving transport behaviour or road network safety influence the long term accident trends. The **results of this research indicate** that the **improvement** of local and international **transport safety trends can be accounted for by the development of vehicle and infrastructure safety technologies**, while these improving tendencies can **much less be explained by the success of local campaigns**. However, the following need to be emphasized regarding this research: the **intense technological development seen recently** has inherently meant that global factors (Jurecki et al. 2014; Levulytė et al., 2014; Žuraulis et al., 2014) must have played a more significant role in improving transport safety. Whereas, as the potentials for technological development in the developed countries become exhausted, **local efforts and endeavours** are to be assigned a **gradually increasing role**. In Hungary, just as in other developing countries, while the vehicle fleet, which can be regarded as even a presently aging one, will turn to be more modern, the effects coupled to these incoming **vehicle technologies** might bring about **significant transport safety improvement**.

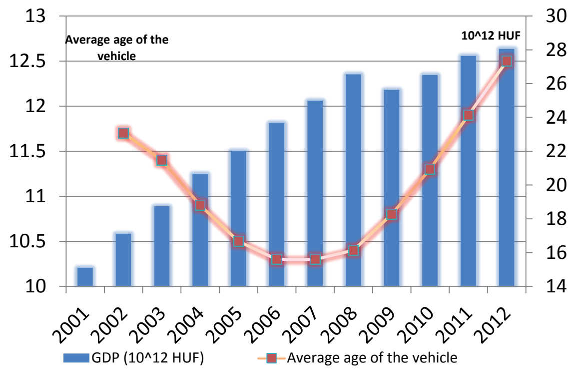

Fig. 4 Time trends of GDP and of the average age of the vehicle fleet in Hungary. Source: Hungarian Central Statistical Office.

The figure above also indicates that while the Hungarian vehicle fleet is not becoming newer as based on its average age, by the withdrawal of older vehicles, the safety level of vehicle equipment will probably show an improving tendency. This in itself will mitigate the severity of accidents.

Due to the **increase in the average age of the vehicle fleet**, that is, the slowing pace of vehicle fleet modernisation, it may be presumed that the development of vehicle safety technology has **only contributed in a small extent to the improvement of the accident severity in Hungary**. Thus it may be assumed, that in Hungary it has not primarily been the development of vehicle technology which has brought about the decrease in accident risk and accident severity (Vujanić et al. 2014).

Beenstock and Gafni suppose that vehicle safety parameters are directly determined by the earnings level of the vehicle owner, considering that the individuals disposing of higher earnings may presumably afford safer vehicles (Beenstock and Gafni, 2000). In connection with this, it needs to be emphasized that, anticipating an economic growth, the modernisation of the vehicle fleet may be expected, thus, **the effects related to the rollout of up-to-date vehicle safety technologies incorporate a significant transport safety potential in Hungary**.

Investigating long term traffic safety effects of GDP, Kopits and Cropper analysed data from 88 countries. The aim of research was to describe the relationship between the increase in the per capita income and the decline of the road death rate experienced during economic growth. The authors explain the relationship between the per capita income growth and the decrease of fatality rate among others with the development of vehicle and infrastructure safety. In the research the authors have shown that traffic fatality risk (fatalities/population) has started to show a steadily decreasing tendency in the 88 countries investigated, when, in the course of economic growth, the per capita income has reached $8,600. (Kopits and Cropper, 2005)

*The per capita income has not reache*d $8,600 in Hungary yet. The average gross income was 1,234,646 HUF per capita in 2012, which is $5,487 at the average 2012 exchange rate. Taking into account that the authors have determined the $8,600 value at the 1985 price level, it is reasonable to consider the income level of 2012 at the value discounted to 1985. This correction may be executed using the real wage value index available from the website of the Hungarian Central Statistical Office. Thus, the average gross income per capita in Hungary becomes $6,250 at the price level of 1985.

Although the number of fatalities have started to decrease significantly after 2006, the results above indicate that the decline of the accident rate is in a larger extent due to the consequences of short term economic effects, and only in a smaller extent to the technological development resulting from continuous technological development (Soltani and Askari, 2014).

Examining the Hungarian tendencies from an international perspective, it can be stated that the traffic fatality rate (fatalities/population) has slightly been above the EU average.

The number of fatalities per vehicle shows a much more unfavourable picture of Hungary, as this value takes into account the rate of motorization as well (see Figure below). This number in Hungary is more than double than that of the countries in the region with a higher rate of motorization (e.g. IT, AT, SI).

Are we to assess the traffic safety position of a certain country as based on the two indicators described above, we might reach ambiguous conclusions, as, for instance, Hungary is not badly ranked considering the fatalities per population rate. However, regarding traffic fatalities per vehicles, a much gloomier picture emerges.

This contradiction may be resolved by the methodology introduced by Trinca et al., adapted for Hungary by Prof. Dr. Péter Holló D.Sc. Using this method, and employing both indicators simultaneously, road transport safety may be characterized in a more sophisticated way, clustering the countries as based on their transport morale and safety considerations.

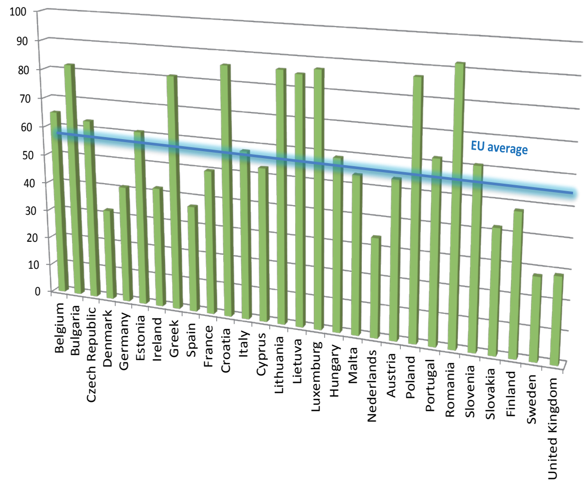

Fig. 5 Number of traffic fatalities per one million inhabitants. Source: IRTAD.

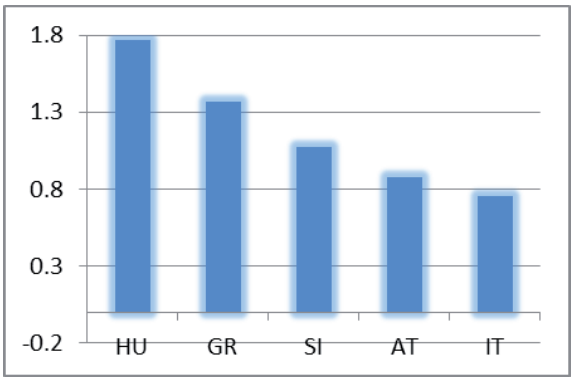

Fig. 6 The number of fatalities per 10 thousand vehicles. Source: IRTAD.

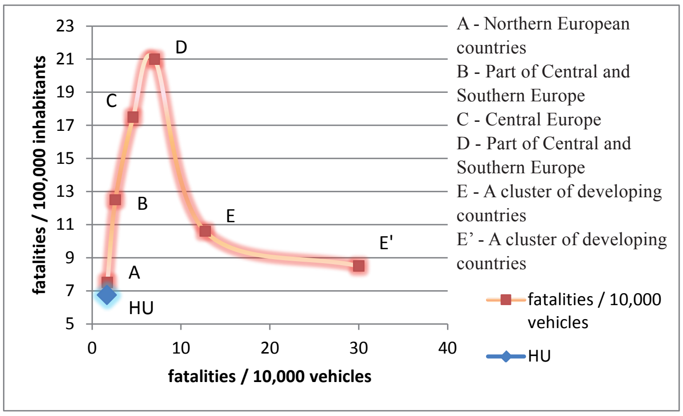

Fig. 7 Relationship between traffic safety and individual safety (theoretical model) and present position of Hungary in the Trinca model (2010-2011). Source: Holló, 2013; Trinca et al., 1988.

Assessing the transport safety position of Hungary as based on the Trinca model indicates that the country is already at the stage of continuous development. This result shows Hungary in a better light than the estimates based on real wage per capita values, according to which Hungarian transport safety has not entered the phase of continuous development yet.

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