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Case Study on the Relationship between Road Safety and Economy in Hungary

Árpád TÖRÖK*

Centre for Road Safety, KTI Institute for Transport Sciences, Budapest, Hungary
*Corresponding author: torok.arpad@kti.hu

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Abstract The article investigates the highlighted road safety challenges of Hungary, focusing on previous research results. According to the results of the research if the potential for technological development becomes exhausted in the future, local endeavours, transport safety campaigns and education-training needs to become more emphasized in Hungary as well.

Keywords: *road safety, economics*

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1. Introduction

The aim of the paper is to define the most important road safety challenges of Hungary in the next few years. The methodology of the analysis highlights the interdependency of road safety and economy. To describe road safety situation in Hungary the investigation focuses on the main findings of previous researches carried out in the field of safety analysis. In accordance with this the article introduces the interactions between the transport sector and the economy. In the next part of the article the author investigates the basic link among economic crisis and transport safety factors (Vesna R. et al 2014). Afterwards the paper focuses on the economic and the transport safety trends in Hungary (Torok, A. 2013).

The economy and mobility are cooperative and interrelated 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 (Ponti et al., 2013), however, as based on the report of EuroStat, these endeavours have not been entirely fulfilled yet (Cornescu & Adam, 2014). 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 (R2=0.8477).

Thus, nowadays, economic growth is related to transport demand (Figure 1), 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.

Among others, this conclusion has also been drawn by Constantinos Antoniou and George Yannis (Antoniou & Yannis, 2013). Connected to the relationship explained above Jankó has shown (Jankó, 2012) 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.' Besides Hungarian researchers, experts worldwide do also continuously investigate the relationship between the economy and transport safety. Relying on data from the period 1975-2011, Yannis, Papadimitriou and Folla (Yannis et al., 2014) 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, 2010).. Of course, there are many other factors beyond the economic growth, which influences the number of accidents. Some of the researches managed to capture the dynamics of accident related time series providing an overall methodology to describe the changes of accident data in time (Commandeur et al., 2013), however the current paper focuses on the interaction between the economy and road safety.

2. Methods

Basic trends and tendencies of accidents, economic performance, average age of vehicle fleet, number of traffic fatalities and road safety progress are evaluated based on the analysis of time series (Vujanić, M. et al., 2013).

To describe the relationship among GDP and the average age of the vehicle fleet a simple regression model has been built up during the research. The linear regression model is based on a linear predictor function, which estimates average age of the vehicle fleet as unknown model parameters from GDP data, as the explanatory variable.

The current road safety situation of Hungary has been evaluated based on the application of the Kopits-Cropperb method. This method is originated in a linear regression log-log model, where both the dependent variable and independent variables are log-transformed variables.

Following the analysis of the current situation, an international comparison has been carried out based on the Trinca model, which combines in itself both mortality rate (killed/106 population) and fatality rate (killed/104 vehicles), especially considering that it can be misleading, if only the mortality rate is used. Mortality rate in itself is not suitable for independent, objective comparison, because its value can be low not only in the case of high-level road safety, but in the case of low motorization level as well.

The objective of next methodological step is to comprehensively explore the extent to which the EU countries, - especially Hungary - have improved their road safety performance over the period of 2001–2010. In doing so, the result of data envelopment analysis (Yongjun Shen et al., 2013) is introduced, which is a linear programming based technique for measuring the relative performance of organisational units where the presence of multiple inputs and outputs makes the comparisons difficult. In the field of road safety the outputs (e.g. the number of road fatalities) have to be minimized with respect to the level of exposure. Hence in this case the frontier decision making units of the data envelopment analysis are the road safety best-performing countries with minimum output levels.

The DEA-based Malmquist productivity index owns an advantage of being able to be further decomposed into two components, one measuring the change in efficiency and the other measuring the change in the frontier technology. The first term, i.e., change in efficiency, indicates the magnitude of the efficiency change in a given time period. The second one, i.e., the change in the frontier technology, measures the shift in the efficient production frontier between two time periods. Mathematically, the DEA-based Malmquist productivity index is computed as the product of the index measuring the change in efficiency and the index measuring the change in the frontier technology.

3. Data

Since an important aim of the study is to analyse road safety related challenges of Hungary in the next years accident data has an important role in the investigation. Beyond the absolute numbers the yearly changes of the total numbers of accidents can help us to explain road safety trends based on social and economic processes. Accordingly Hungarian accident data is analysed during the research with regard to the total number of accidents in Hungary in the past twelve years. Accident data in the past twelve years had a slow decreasing tendency. The biggest reduction took place from 2008 to 2010 after 2010 the reduction started to lower.

To investigate the road safety situation in Hungary in a complex way it is necessary to evaluate social and economic factors as well, since these factors can have crucial effects on the number of accidents. Based on the above introduced approach gross domestic product, transport performance of the national road network and the average age of the vehicle fleet are considered to play an important role in the change of road safety trends. GDP data in the past twelve years had a permanent increasing tendency. The biggest growth took place from 2002 to 2006 after 2009 GDP index started to lower and then stagnate. Vehicle kilometres per year from 2001 to 2010 had a permanent increasing tendency. The biggest growth took place from 2002 to 2004 from 2010 vehicle kilometres per year index started to lower. Average age of the vehicle fleet had a slow reduction from 2001 to 2006. After 2006 average age of the vehicle fleet started to grow and then stagnate.

The economic development of the country is evaluated compared to the following neighbouring countries Germany, Slovakia, Austria. The comparison is based on GDP/per capita data. The basic database of the comparison is presented in the table below. On the one hand the road safety development in the European Union and in Hungary is described by the reduction of the number of fatalities per population. On the other hand to ensure the adequate complexity of the investigation road safety development is also described by the reduction of the number of fatalities per vehicles.

4. Analysis

In Figure 1 it is shown that in the wake of the economic crisis reaching the country, continuous growth of transport demand in Hungary has come to a halt. This might have contributed to the significant improvement in transport safety represented by Figure 2.

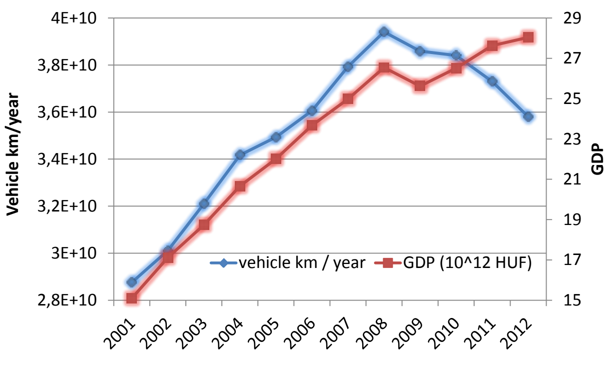

Figure 1. Time trends of GDP and transport performance in Hungary. Source: Hungarian Central Statistical Office, Hungarian Road Management Company

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

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 (Hungarian Central Statistical Office, 2013).

Nevertheless, the relationship between GDP and the number of accidents is not determined by only one factor. For instance, it can be supposed that in countries with more developed economies higher resources can be allocated to police enforcement, with an obvious positive effect on reducing the number of accidents. 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.

Figure 2. Time series of total number of accidents and transport performance in Hungary. Source: Hungarian Roads Management Company, Hungarian Central Statistical Office

The study aiming to compare the most significant transport safety factors dependent on economic development (Beenstock & Gafni, 2000), distinguished national and international trends. It analyses how international transport safety trends, like the improvement of vehicle safety, and local efforts, like increasing the presence of the police force, improving road traffic behaviour or road network safety influence the long term accident trends.

In Hungary, just as in other developing countries, while the vehicle fleet, of which average age can be regarded as even a presently growing one, will turn to be more modern, the effects coupled to these incoming vehicle technologies might bring about significant transport safety improvement.

Figure 3 also indicates that the average age of Hungarian vehicle fleet is growing. It means that individuals change their cars later, so cars are used further in time. Since vehicle fleet is still changing permanently, the inflow of developed vehicle safety technology is continuous however the ratio of new cars is decreasing compared to old cars. Therefore, 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.

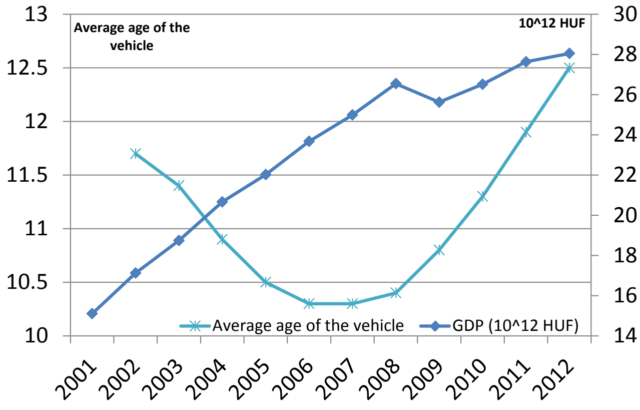

Figure 3. Time series of GDP and of the average age of the vehicle fleet in Hungary. Source: Hungarian Central Statistical Office

Beenstock and Gafni suggested 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 & 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 (Beke et al., 2014).

Investigating long term traffic safety effects of GDP, Kopits and Cropperb 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 & Cropperb, 2005)

The per capita income has not reached $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 discussion 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.

Examining the Hungarian tendencies from an international perspective, it can be stated that the traffic mortality rate (fatalities/population) has slightly been above the EU (Papadimitriou et al., 2013.)

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. 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) (Papadimitriou et al., 2013.)

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 Dr Péter Holló (Holló et al., 2010) and presented in Figures 4 and 5. 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 traffic safety morale and safety considerations.

Further on this complex approach has been validated and applied in many researches to compare and rank countries from a road safety point of view (Gitelman, 2012).

Assessing the road 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. On the other hand some important aspects are still not possible to be analysed in this model, since traffic performance is also an important explanatory factor of accidents, especially considering that the frequency and distance of vehicle usage is an important contributor to the increasing road safety risk.

However there are other approaches, like DEA - data envelopment analysis, which can make the road safety ranking process to be more nuanced.

Applying DEA model, it is possible to consider both efficiency change and technical change together as the total factor productivity change. Accordingly, the overall road safety progress in the 26 EU countries during the last decade are deduced, which is illustrated in the Figure 4 (Shen et al., 2013).

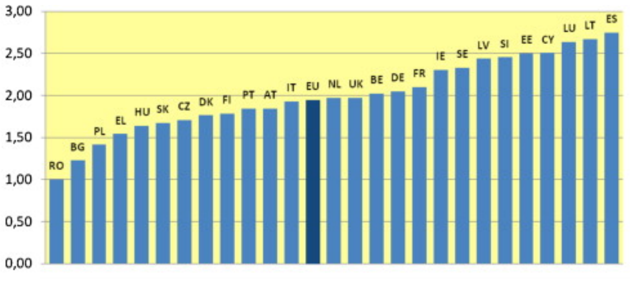

Figure 4. Time series of GDP and of the average age of the vehicle fleet in Hungary. Source: Hungarian Central Statistical Office

Nonetheless, it is to be noted that the two examinations may not be compared, as they rely on different methodologies. One is basically a model using estimates, which draws conclusions regarding transport safety from the level of economic growth; while the other is a comparative classification procedure, which analyses transport safety using special transport safety indicators.

5. Conclusion

Although the available data defines a strong limitation to the performed study the conclusion can be drawn that the improvement of local and international transport safety trends can significantly be accounted for the development of vehicle and infrastructure safety technologies, while these improving tendencies can much less be explained by the success of local efforts. However, the following need to be emphasized regarding this research: the intense technological development seen recently has inherently meant that global factors 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.

Three main conclusions can be drawn from analysing the traffic safety situation in Hungary:

Owing to the crisis, the rhythm of traffic growth has come to a halt and started to decline. However, after the crisis, a dynamic traffic growth may be expected on the Hungarian road network, which necessitates urgent interventions and further measures in the area of prevention and control.

The development of vehicle (Garcia-Castro, A. 2014) and infrastructure safety technology incorporates significant potentials for the growth of transport safety in Hungary. Nevertheless, as based on the results of prior research, these favourable trends can only exert their influence in a competitive and continuously growing economic environment (Kostanjšek, J. et al. 2014).

As the potential for technological development becomes exhausted in the future, local efforts and endeavours (e.g. transport safety campaigns and education-training) need to become more emphasized in Hungary as well (Kiss, O. et al., 2013).

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