Transportation System, Economics and Quality of Life

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Abstract: - The transport system has big influence on national economy as well as on environment and life quality. The modern economy with high level of labour division would not be productive enough without efficient transport systems. Therefore this paper is focused on complex relations beetwen transportation system and quality of life (this concept was formulated first time thirty years ago). There is also very important role of externalities, environment and economic growth. Therefore the paper is finished with relationship between emissions from road transport in 16 European countries and their economic output expressed by the GDP.

Key words: - Externality, transportation system, quality of life, environment, GDP, Kuznets curve

1 Quality of Life - concept

The transport system substantially affects life quality, especially in towns. The life quality is of course very questionable concept, due to many factors (partly highly subjective), affecting finally the resulting life quality. From many approaches and models we can demonstrate the complexity of the problem on the approach of Ruut Veenhoven [1] that divided the life quality on inner and outer one and classified this concept according the following Table 1:

Table 1: The four qualities of life (Veenhoven, 2006)

Four qualities of life	Outer qualities	Inner qualities
Life chances	Liveability of environment	Life-ability of the person
Life results	Utility of life	Appreciation of life

From the indicated approach it unambiguously follows (and other models would confirm it) that the influence of economic factors and other hard ones will be limited and the life quality will be affected by many other, subjective impacts. From the viewpoint of the transport system the link to the first quadrant will be interesting – thus how the transport system influences the environment that

afterwards affects the life quality. The externalities will have a significant influence, whether the negative or positive ones. The relation between the output of the transport system and gross domestic product will be also important. A separate problem will be also the influence of the quality of the actual transport process. If we consider the transport system as a whole (transport quality is usually associated only with public transport), we can also distinct the inner quality that is a set of constituent quality factors, i.e. accessibility, accuracy, comfort, information availability etc. and that can be expressed by the final utility of a passenger.

This inner quality will be limited by the GDP indicator that influences the living standard and indirectly the quality of transport means and infrastructure. As outer quality we will call the influence of the transport system on its neighbourhood and thus also on its indirect users. This influence is represented by externalities. This relationship can be represented in a simplified way by the following scheme in Figure 1.

The negative externalities or external costs are often mentioned in connection with transportation. However it is also important to be concerned with the positive externalities that cause external revenues. Above all we can mention the influence of the

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transport system on the economic output of a territory. This problems have been studied in economy since the improvement of the GDP measuring thus since the half of the 20th century. They are connected mostly with the name of the American economist Simon Kuznets. [2]

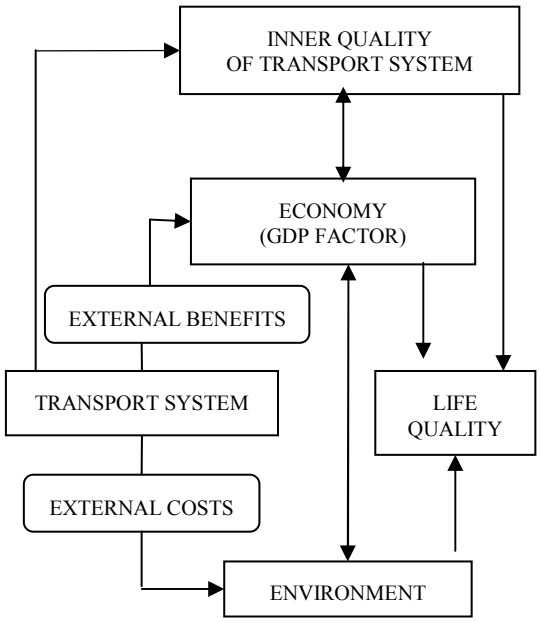

Figure 1: Relation between transport system and life quality (authors)

2 GDP and environment

The environmental Kuznets curve (EKC) was introduced by the economists Grossman and Krueger [3]. It states that the environment begins to improve with the growth of GDP per capita, as e.g. better technologies start to be used after some level of welfare had been reached. Its general shape is shown in Figure 2.

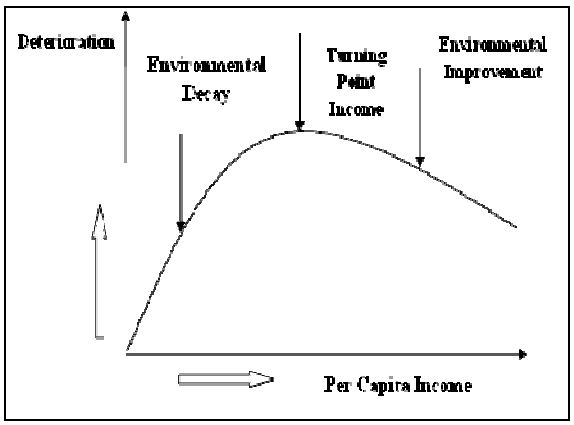

Figure 2: Environmental Kuznets curve [3],[4]

Such function can be is modeled by a maximum third degree polynomial in the regression

$$z_{it} = \beta_0 + \beta_1 y_{it} + \beta_2 y_{it}^2 + \beta_3 y_{it}^3 + \beta \cdot X_{it} + \varepsilon_{it} \quad (1)$$

with emissions per capita z_{it} in locality i at time t, coefficients β_i, independent variable average GDP per capita y_{it}, other explaining factors X_{it} and error term ε_{it}.

Various empirical studies verify the applicability of the EKC (Bhattarai & Vijayaraghavan, & Yandle, 2004), but it is necessary to interpret this dependence and to look for the reasons why the environmental deterioration decreases with the economic growth. These reasons can be divided into 5 groups:

- The transition from agricultural character of the society to the industrial one during the industrial revolution was followed by the increased environmental deterioration. This is the explanation of the growing part of the EKC. This development can be today observed in the developing countries like China and India.

- The decreasing shape of the EKC can be explained by technological changes. Innovation has usually been decreasing the energy consumption rate as well as emission factors.

- The demand for better environment has been increasing with the growing wealth. People that had satisfied their basic needs (Maslow's pyramid) have been increasing the pressure on producers to get environmentally cleaner products.

- More wealthy society has been asserting through its public representatives more strict environmental legislation and incentives (of economic character, i. e. consumption and environmental taxes etc.) towards behavior less harming the environment.

- The last reason relates to the transfer of production to poorer countries with lower

labour cost, more wealthy countries have been concentrating to the production of services that damage less the environment. This is of course only the case of a local transfer among countries that does not decrease the total environmental damage.

3 EKC in Road Transport – statistic data for European countries

For the verification of the EKC in road transport we have analysed the emissions as function of the GDP of 16 countries of the European Union (Bulgaria, Czech Republic, Slovakia, Slovenia, Hungary, Estonia, Lithuania, Latvia, Belgium, France, Germany, Netherlands, Portugal, Austria, Sweden and UK). The emissions are averaged (per capita) in population for the purpose of comparison and the use of data from various countries.

Carbon dioxide emissions show in general (regardless the source activity) a strong linear correlation with GDP [5]. Some authors state that the EKC concept may be inappropriate to describe the relationship between economic growth and carbon dioxide emissions [6]. The reason can be that carbon dioxide has been considered as a pollutant recently in connection with the problems of global warming.

In the road transport, the emissions of the carbon dioxide also show an almost linear growth with GDP per capita, as shown in Figure 3.

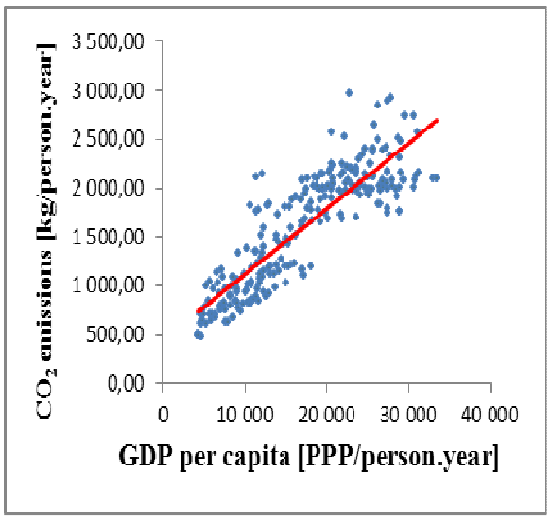

Figure 3: Road transport CO2 emissions as function of GDP per capita (source: Eurostat)

The situation of emissions of nitrogen oxides is more interesting. A final regression with a quadratic function was used that corresponds to the theoretical shape of the EKC. The graph is shown in Figure 4.

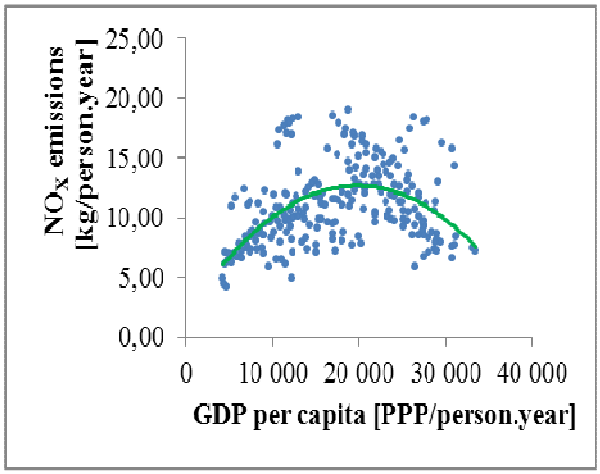

Figure 4: Road transport NOx emissions as function of GDP per capita (source: Eurostat)

The consumption of energy in road transportation (in the same group of countries) is almost proportional to GDP per capita, as shown in Figure 5.

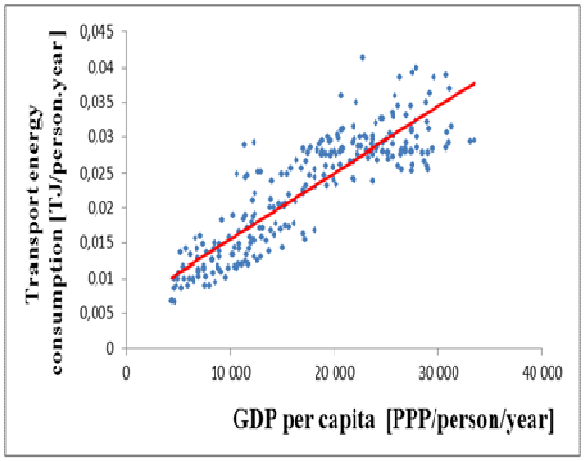

Figure 5: Road transport energy consumption as function of GDP per capita (source: Eurostat)

4 Conclusion

The main goal of this paper was to show the importance of the transport for the mankind with respect to its negative externalities in form of e. g. exhaust emissions. The transportation has an important influence on the national economy and on the creation of national wealth. As the best example we can

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mention the industrial revolution, that by supplying of unthougt production possibilities forced at the same time the higher efficiency of the transport system (as for the transport means, transport infrastructure or the use of other energy resources). The transportation system strongly influences the economy, the environment as well as the human life quality. The economy with high level of labor division requires efficient logistics and transport system, but it needs increasing transport capacity and impacts more the environment and power supply of the country. It is a proved fact, that countries with more liberal economy are economically stronger (the relation between the index of economic freedom and the gross domestic product).

The presented data from the European countries show that for carbon dioxide the environmental Kuznets curve is not valid. But in the case of the emissions of nitrogen oxides (and some other pollutants), our findings are that their emissions per capita from road transport decrease with the growing wealth of society (expressedy by the GDP per capita), i.e. the environmental Kuznets curve could be valid for these type of emissions from road transport. According to our simple analysis the explanation could be only the successful control of emissions, e.g. by the EURO standards and (regular compulsory) emission controls of vehicles. Other important factors like lower consumption vehicles, better transport technologies etc. seem not to contribute at the total to this decrease, because the road transport energy intensity of GDP seems to be constant. However the problem is more complicated and needs futher work.

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