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Examining of correlation between demographic development of population and their travel behaviour

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Abstract

The transport sector makes economic growth, contributes significantly to the functioning of the Slovak economy and individual regions and creating conditions for optimal economic and social potential. The transport sector is influenced by a wide range of external social and economic factors such as demographics, living standards of the population, urban planning, organization of production, structural changes in society and accessibility to transport infrastructure. The article aimed to examining if there is any correlation between demographic development of population and their travel behaviour. For this purpose were used methods of analysis, synthesis, analogy, comparison, data collection and processing and methods of mathematical statistics.

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Keywords: Transport planning; travel behaviour; demography.

1. Introduction

In recent years, there is an accompanying phenomenon of development, such as in developed countries, also in Slovakia, the increase of road transport which is represented by significant growth of negative impacts on the environment, increase congestion in urban areas and the growth of road accidents.

Transport is very important for social, cultural and economic success of each community - from urban centres to remote communities. The traditional interconnection between economic success transport and mobility has shifted in

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the last decade due to:

- recognition of the adverse effects of motorized transport on the environment,
- social exclusion of those who do not own a passenger car,
- rising costs and lack of conventional fuels for transport, or demographic changes.

The current population development in Slovakia is characterized by the same process that took place in the developed Western and Northern Europe from the mid 60s to late 70s. A reflection of the current situation in Slovakia in term of travel behaviour are also significant changes in the demography, such as age, gender, household composition or income of its members.

2. Demographic development in Slovakia and abroad

Demographic development in Slovakia is characterized by a gradual slowing down of population reproduction. The result of that is a deterioration of reproductive rates and age structure of the population. The aging process continues, as demonstrated by the higher average age of the population of both sexes. In terms of individual continents, Europe is the continent with the slowest population growth. In Europe, it showed the smallest population growth the Central Europe, where in some countries, for example in Hungary or Poland there is a decrease in population. Recently, every year there is population declining, also in Romania and Bulgaria and some other countries which are not mentioned in the Table 1 and Figure 1. [1,2]

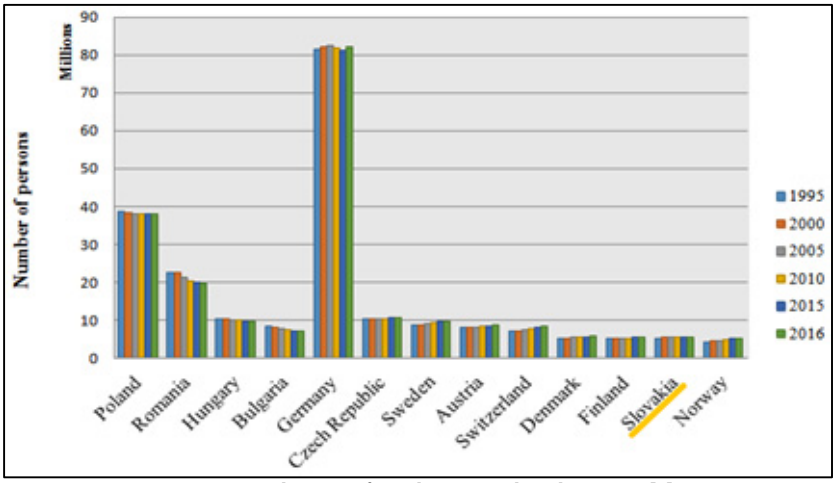

Figure 1. Development of populations in selected countries [3]

Table 1. Development of populations in selected countries [3]

YEAR	1995	2000	2005	2010	2015	2016	Change
COUNTRY			**[Number of persons]**				**[1995-2016]**
Poland	38.580.597	38.263.303	38.173.835	38.022.869	38.005.614	37.967.209	-1,59
Romania	22.712.394	22.455.485	21.382.354	20.294.683	19.870.647	19.759.968	-13,00
Hungary	10.336.700	10.221.644	10.097.549	10.014.324	9.855.571	9.830.485	-4,90
Bulgaria	8.427.418	8.190.876	7.688.573	7.421.766	7.202.198	7.153.784	-15,11
Germany	81.538.603	82.163.475	82.500.849	81.802.257	81.197.537	82.162.000	0,76
Czech Republic	10.333.161	10.278.098	10.198.855	10.462.088	10.538.275	10.553.843	2,14
Sweden	8.816.381	8.861.426	9.011.392	9.340.682	9.747.355	9.851.017	11,74
Austria	7.943.489	8.002.186	8.201.359	8.351.643	8.576.261	8.700.471	9,53
Switzerland	7.019.019	7.164.444	7.415.102	7.785.806	8.237.666	8.325.194	18,61
Denmark	5.215.718	5.330.020	5.411.405	5.534.738	5.659.715	5.707.251	9,42
Finland	5.098.754	5.171.302	5.236.611	5.351.427	5.471.753	5.487.308	7,62
Slovakia	5.356.207	5.398.657	5.372.685	5.390.410	5.421.349	5.426.252	1,31
Norway	4.348.410	4.478.497	4.606.363	4.858.199	5.166.493	5.213.985	19,91

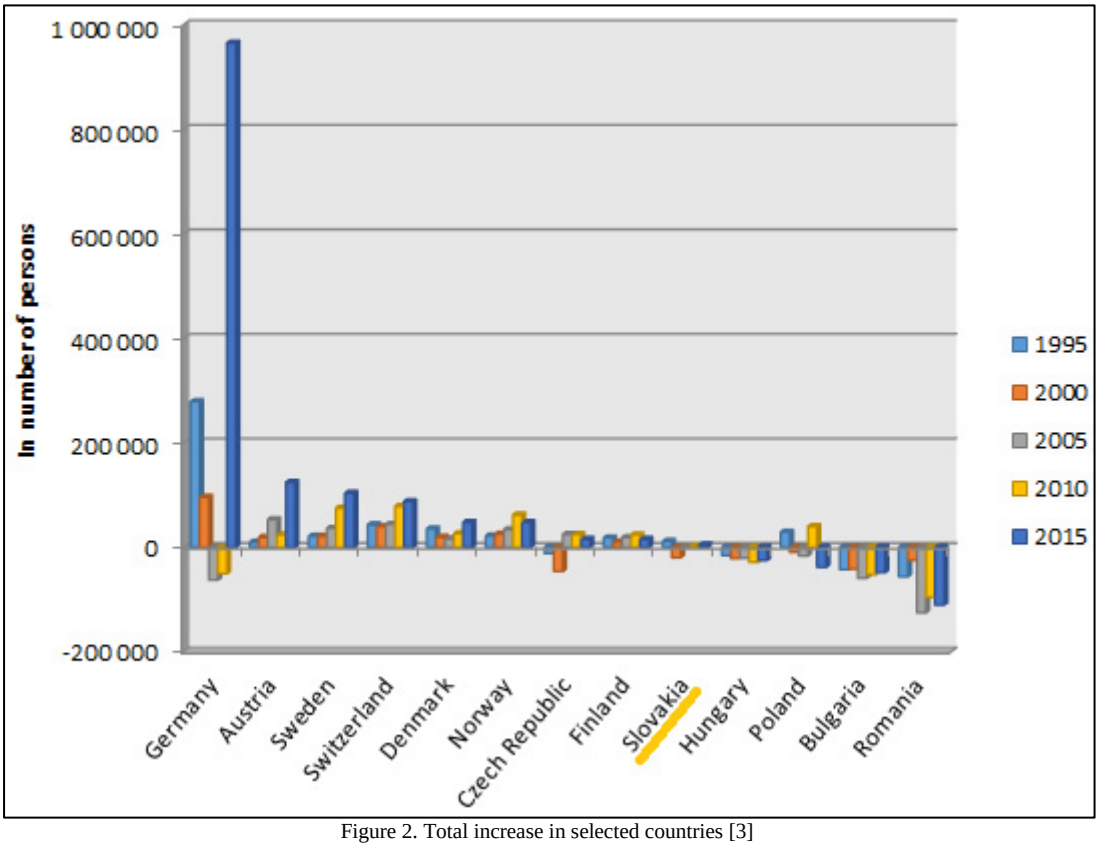

Figure 2. Total increase in selected countries [3]

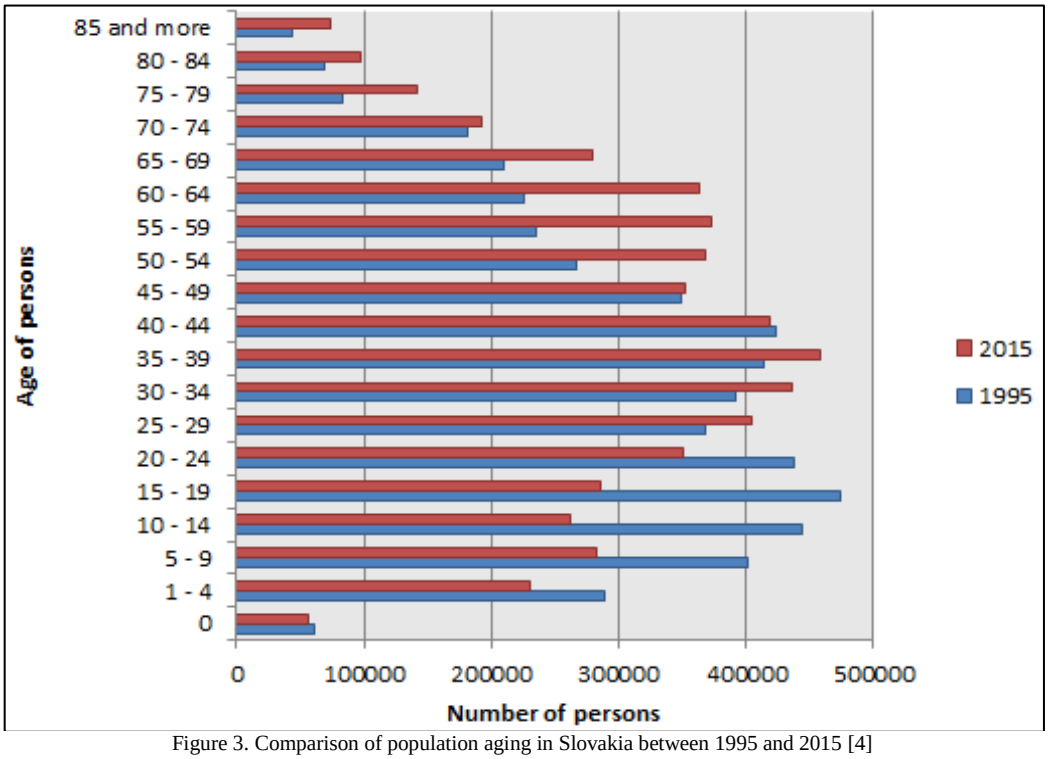

Figure 3. Comparison of population aging in Slovakia between 1995 and 2015 [4]

3. Travel behavior of population in Slovakia and abroad

Travel behaviour focuses mainly on issues such as when and where people travel and how people use the transportation. On this basis it is possible to obtain the concrete idea of how people react to changes in transport systems and policies. Generally, travel behaviour depends on three main factors, which include other variables (Table 2).

Table 2. The main factors affecting travel behaviour of the population

Travel Components	External factors: Policy, economic, physical environment while people are travelling	Internal factors: Characteristics of travellers
Trip purpose	Built environment	Income
Travel mode choice	Infrastructure	Car ownership
Travel time	Transit service quality	Possession of drivers‘ licence
Travel cost	Transport policy	Working status
Travel distance	Economic situation	Gender
Trip frequency		Age group
		Household composition
		Level of education
		Attitudes
		Personality type

A large amount of works have studied the impact of socio-demographic variables on travel behaviour and found a significant relationship between travel behaviour and variables such as age, gender, household composition, household income and so on. [5,6,7]

Household income level is an important variable that affects the travel behaviour of population. Many studies show that low income of people or households allocates fewer funds for travelling, compared to people with high income. That means that people or households with high income can travel more often and longer because they are able to spend more money. [7,8] Statistics also show that income level has an effect on the car ownership. High income allows people to own a car, but this argument is debatable, because some experts have found that the level of income has a negative correlation to the car ownership. Car ownership is then influenced by other factors such as household size, cultural habits and so on. [9]

Another factor that has an impact on travel behaviour is age. According to several studies and statistics, there are differences in the travel behaviour of children, young people, adults and older people. These differences occur because they are interested in different types of activities. Children are primarily interested in educational and playing activities, young people mainly in educational and social activities, adults in work-related activities and the pensioners are primarily interested in social and leisure activities. These activities influence their travel distance. For example, children’s activities are generally concentrated in a small area. Therefore children travel on short distances, because their goals such as primary-secondary schools and parks are usually concentrated not far from their homes. It is different for adults. Their activities are scattered. Their job can be located at different distances from home, they can socialize in parks and restaurants or they can carry out other activities in different parts of the city. [10,11]

Another important factor is the working status. The above mentioned studies show that people who work part-time usually travel more than those who work full-time, because they are involved in more than one activity, for example shopping, supervising children to school or escorting pensioners. [12]

The gender also has a considerable impact on travel behaviour of people. Women can travel more frequently than men, but the total distance of travelling is much less for women. Some researchers have found that it is natural for the female lead in the home. Their tasks mostly involve shopping, supervising children to school, that makes them travel more frequently (they carry out more trips per day) that men, because these targets are mostly close to home. The study is coming from Germany and it also explains that women are less likely to use a car than men. [6,13]

4. Relationship between demographic development of the population and travel behavior in the city of Martin

Travel behaviour is the outcome of complex decision-making process, besides socio-economics impacts include some other individual factors such as perception, social customs or identity of that person. From the used literature it is possible to summarize the factors and their potential impacts (Table 3).

Table 3. The main factors and their potential impacts on the travel behaviour

Socio-economic and demographic factors	Travel Pattern
Household Income ↑	Travel frequency ↑ Travel distance ↑ Proportion of car journey ↑ Transport energy consumption ↑
Car ownership ↑	Trip frequency ↑ [14] Trip frequency → [15] Travel distance ↑ Proportion of car journey ↑
Possession of driver's licenses per household ↑	Using car ↑
Workers per household ↑	Trip frequency ↑ Travel time ↑
Gender	Trip frequency →
Age ↑	Trip frequency → Proportion of car journey Transport energy consumption ↑
Household size ↑	Trip frequency ↑ Travel time ↑ Transport energy consumption ↑
Level of education ↑	Proportion of car journey ↑ Proportion of public transport use ↑

Note: „↑" stands for increasing the number of amount, speed or percentage and „→" stands for remaining the same.

In my study I deal with a number of selected factors that impact on travel behaviour of the population. The study used the data obtained from the travel behaviour survey, which was carried out during the formation of general transport plan for the city of Martin (in 2012). Travel behaviour survey was attended by 2185 residents of the city of Martin, who performed with 5733 trips. I worked with the groups of people who are divided into the Table 4.

Table 4. Groups of people

Groups of people	Number of persons	Number of trips	Mobility
Economically active with a car	803	2047	2,55
Economically active without a car	372	995	2,67
Economically inactive with a car	24	75	3,13
Economically inactive without a car	56	166	2,96
Preschoolers	15	41	2,73
Students	575	1487	2,59
Pensioners	340	922	2,71
Overall	2185	5733	
Average			2,76

Is there a correlation between the number of trips and the number of people belonging to different age groups?

Table 5. Groups of people

Groups of people	Number of persons	Number of trips
Preschoolers and students	590	1528
Economically active and inactive	1255	3283
Pensioners	340	922

The correlation is a statistical dependence of two or more variables. The correlation coefficient takes values from <-1, 1>. If r -1, then between the X and the Y there is a negative correlation (strongly contradictory relationship). For great values of the character X small values of character Y are corresponding and vice versa. In the linear independence of the coefficient of correlation is $r = 0$. The values of characters X and Y in this case are dispersed independently of each other. The values of the correlation coefficient can be equal to 0 even if between the characters X and Y there is other than a linear statistical correlation. Other values of correlation coefficients can be interpreted as follows:

If it is:

- r = 0,0 – 0,3, between the characters X and Y there is zero degree of binding,
- r = 0,3 – 0,5, between the characters X and Y there is a moderate degree of binding,

- r = 0,5 – 0,7, between the characters *X* and *Y* there is a distinguished degree of binding,
- r = 0,7 – 0,9, we talk about the high degree of binding between the characters *X* and *Y*,
- r = 0,9 –1,0, between the characters *X* and *Y* there are very close links. [16,17]

For the calculation of the correlation the PEARSON function in MS Excel was used. The Pearson correlation coefficient *r* is calculated as follows:

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

where $\bar{x}$ and $\bar{y}$ are the sample means of *X* and *Y*, and s_x and s_y are the sample standard deviations of *X* and *Y*. [18]

In my case, the value of the correlation coefficient takes the value 0,999842. The correlation coefficient belongs to the category *r* = 0,9 - 1,0 according to the above scale. This means that between characters *X* and *Y* there are very close links. It can be deduced that the number of such trips is influenced by the number of people who made these trips, which may be a different age group.

5. Conclusion

Rising car ownership, income growth and the declining real cost of using cars have been identified as the key factors that have shaped personal travel patterns around the world. The consequence has been a reduction in the demand for public transport modes and an increasing average trip length. This is not only an issue for the developed countries but also for fast developing countries. As a sustainable and environmentally sensitive alternative to car travel, public transport and cycling have received renewed attention in the world. This has led to a diverse range of transport and land use planning strategies supporting and promoting public transport and cycling. Understanding the differences in travel behaviour and the possible explanations for these differences can help travel demand modelling, and finding policies best suited to meeting the travel needs of all population groups.

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