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ROAD SAFETY IN POLAND IN THE YEARS 1998-2011

The paper presents a detailed analysis of the dynamics of the number and impact of road accidents in Poland in recent years. The article also analyzes the seasonality of road accidents, the results of which are interesting from the point of view of optimizing the management of road safety. Finally, it was presented the prediction of the number of accidents and their casualties by the end of 2014, assuming the continuation of the downward trend, estimated on the basis of the data from the years 1998-2011.

1. INTRODUCTION

The purpose of the article is to analyze road safety in Poland in the years 1998-2011. In almost 700 thousand road accidents which occurred during this period, almost 77 thousand people died and nearly 900 thousand were injured. Assuming a very conservative estimate of the western European countries according to which the fatal accident costs about 1 million PLN, due to the past accidents Poland loses about 2-3% of GDP p.a. The issue of road safety, in addition to the obvious social dimension is therefore also of great economic importance.

The issue is so important that in Poland it is made a clear change in the structure of land transport - rail and public road transport for the carriage of passengers are becoming less important. However, it is an increase in the level of freight on Polish roads, and the number of cars has almost tripled in the last few years. According to the estimates prepared by the Ministry of Infrastructure in the period 2005-2030 the car traffic will almost double, and as for semi-trailer trucks it will increase almost two and a half times. At the same time, alternative transportation modes, particularly rail will rise to a much lesser extend [3, pp. 34-40].

In this context, it is worth asking the question of social and economic costs of road accidents, the cost of lost benefits that could be obtained by developing Polish transport infrastructure in a more sustainable way.

To effectively manage road safety it is necessary to take a full description of the factors affecting the frequency of accidents in Poland. In the next parts of the article there will be featured the dynamic changes in the number of accidents and their consequences in an annual comparison, it will be also made the comparison of the threat of accidents in Poland and in other European countries. Based on the monthly data it was made an analysis of accidents seasonality in Poland which is a very clear and stable feature of this phenomenon. The last section provides forecasts on the number of accidents in the years 2012-2014.

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Statistics on the number of accidents and the number of people injured in Poland in the years 1998-2011 are derived from monthly reports published by the Police (the reports are available on the website (www.policja.pl)). International comparisons contained in section three of the paper have been carried out based on the data of the United Nations (www.un.org). Statistical analysis, forecasts, and graphic presentations were prepared with an application of *STATISTICA*.

2. ECONOMIC AND SOCIAL RESULTS OF ROAD ACCIDENTS

Road accidents are obviously undesirable, but their consequences are usually much more severe than it appears. Just after the occurrence of tragic events the most important thing for the relatives of the victims of accidents is the psychological support. The scale of this phenomenon is the fact that within their lifetime, on average, every third inhabitant of the EU will need hospital treatment due to being harmed in an accident [1]. Injuries due to accidents are the leading cause of death in countries highly among people aged 29 [4].

However, in the long term, economic effects become more significant. Accidents have direct and indirect impact on the functioning of the whole community.

In the literature one may find a description of the methodology and a combination of accident costs - both in terms of individual and summary depiction, and in relation to GDP. The problem of estimating the cost of an accident is very complex, as complex are the consequences of any such event. The literature often refers to medical costs and those related to the loss of property (vehicle, load), administrative costs and those more difficult to determine, but considerable in size - the cost of the loss of ability to work, the costs of lost quality of life (both the victims and their intimates). It is worth remembering that some of the consequences of accidents are very stretched in time and their negative effects can affect their participants for many years.

Research Institute of Roads and Bridges, by using different methods of estimating the cost of road accidents, assessed them for 18-65 billion PLN per year [1]. In this context, one should also expect a rapid implementation of the road projects, as it is estimated, it is the poor state of infrastructure which is the main cause of most accidents in Poland. Unfortunately, all signs indicate that a coherent network of safe roads (motorways and expressways) will be ready in no more than a few years. In mid-2012, several investments have stopped which will cause the delay of at least 2-3 years. However, as it results from the above information on the cost of road accidents it is economically proved spending of the amount of 2-3 billion per year, if it would result in a decrease in the number of accidents by 10%. In addition, the effects of deliberate investments are not limited to one year so in fact there are much more cost-effective investments.

It should be noted that the estimation of road accidents costs is done, in aspects, only by an analogy to the values obtained in other countries. In case of Poland one encounters the fact of the lack of access to data related to the costs of treatment (lack of information from the National Health Fund and other insurers), the lack of public access to a detailed database of cases occurred [1, 2, 5].

3. DYNAMICS OF ACCIDENTS NUMBER AND THEIR RESULTS IN THE YEARS 1998-2011

In Poland a number of steps have been taken to improve road safety. There is a special government body - the National Road Safety Council² – whose task is to coordinate and monitor the effects of these actions. These measures are both preventive and educational. In addition, modernization, unfortunately very slowly, is a network of roads which is also reflected in the improvement of the situation on the roads. It seems that the major cause of so many accidents occurring on Polish territory is primarily the accumulation of different types of traffic: pedestrians, cyclists, transit and local roads, most of which are not so intensively adjusted to the use [6, p. 15].

In the years 1998-2011 in Poland there was quite a significant drop in the number of road accidents. Proportionally to the number of accidents has decreased the number of people killed and injured (Table 1).

Table. 1. The number of accidents, people injured and killed in accidents in Poland in the years 1998-2011

Year	Accidents		Fatalities		Injured		Fatalities per 100 accidents
1998	61 855	100	7 080	100	77 560	100	11,4
1999	55 106	89	6 731	95	68 449	88	12,2
2000	57 331	93	6 289	89	71 638	92	11,0
2001	53 799	87	5 534	78	68 194	88	10,3
2002	53 559	87	5 827	82	67 498	87	10,9
2003	51 078	83	5 640	80	63 903	82	11,0
2004	51 069	83	5 712	81	64 661	83	11,2
2005	48 100	78	5 444	77	61 191	79	11,3
2006	46 876	76	5 243	74	59 123	76	11,2
2007	49 536	80	5 583	79	63 224	82	11,3
2008	49 054	79	5 437	77	62 097	80	11,1
2009	44 196	71	4 572	65	56 046	72	10,3
2010	38 025	61	3 759	53	47 800	62	9,9
2011	39 058	63	4 042	57	48 132	62	10,3
Total	698 642		76 893		879 516		11,0

Source: own study based upon the data from the Police (www.policja.pl)

Compared to 1998, the number of accidents over the next 13 years fell by 37% while the number of injuries by 38%. The number of fatalities dropped by 43%. This decrease was the result of a fairly systematic changes as a result of which almost every subsequent year the traffic situation underwent a slow improvement. The exception to this rule was the year 2007 and 2011, when the number of road accidents and their tragic consequences increased³.

Unfortunately, the severity rate of accidents in Poland showing the number of victims of road accidents in 100 accidents is still very high and the decline is almost impercepti-

² Information on the activities of the National Road Safety Council, as well as statistical reports on the number and severity of injuries can be found on www.krbrd.gov.pl.

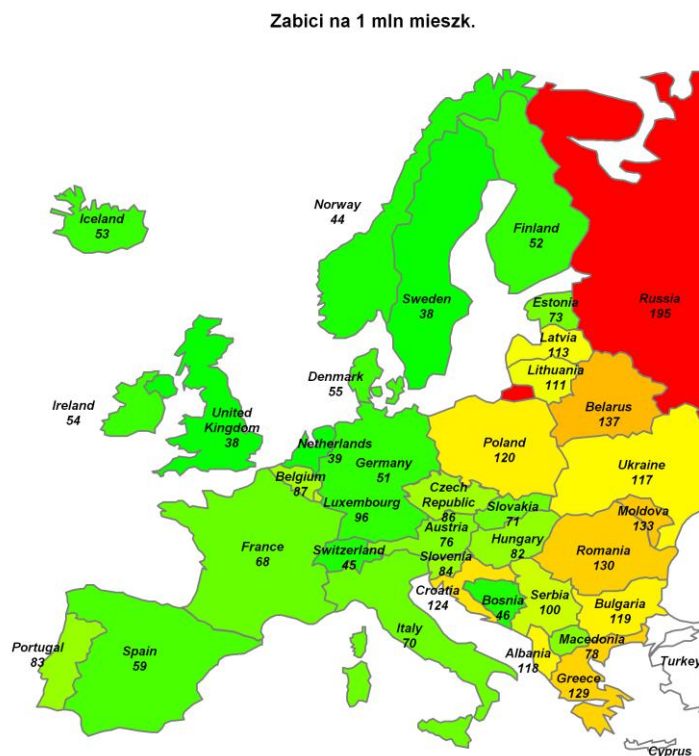
³ Based on data for the first three quarters of 2012 one can talk about a downward trend for all indicators considered. The number of deaths was lower compared to the same period last year by 14%.

ble. It should be noted that it is primarily the value of this ratio which makes that, compared to other countries, Poland is one of the infamous leaders in statistics, in the number of people killed on the roads per million inhabitants.

4. ACCIDENTS IN POLAND IN COMPARISON WITH OTHER COUNTRIES

In this section will be made a brief comparative analysis of the level of road safety in Poland and other European countries.

Fig. 1. The number of road fatalities per million inhabitants in European countries in 2009.



Source: own study based upon the data from the United Nations (www.un.org)

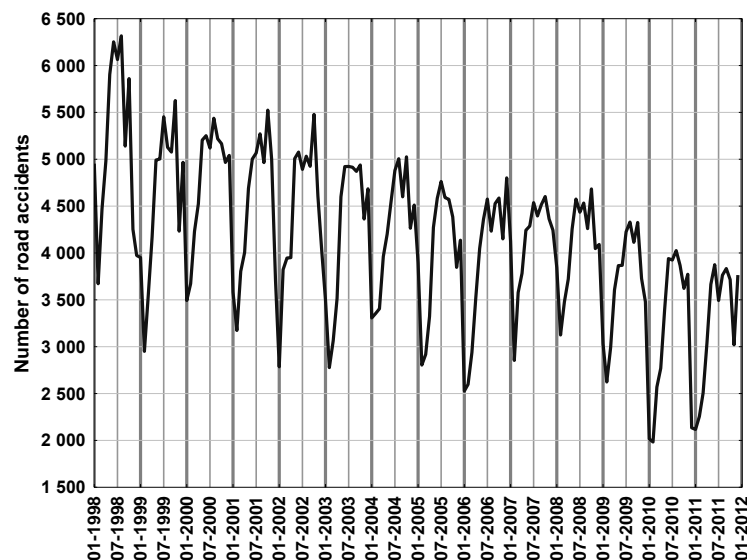
In 2009, the ratio of the number of road fatalities per million inhabitants in European countries ranged from 38 in the UK to almost 200 in Russia (Fig. 1). In Poland, it was also high at 120 deaths per million inhabitants. This indicator is of course very much related to the level of the cost of road accidents in relation to GDP. It can be concluded that the relative low cost of road safety in Poland are 2-3 times higher than in most Western European countries. By analyzing the information contained in the chart above, it is worth paying attention to the clear difference between the post-communist countries, where the risk of traffic accidents is generally much higher than in other countries. These are long-term effects of neglecting on both the level of road infrastructure, as well as emergency medical services, drivers culture, alcohol abuse and other related events. Described in

section two quite a significant drop in the number of tragic accidents in Poland in the years 1998-2011, however, should be considered in a broader context. Unfortunately, against most EU countries the indicators of improvement do not look good. For example, in the years 2001-2010 the number of deaths in accidents in Poland fell by 29%, while in France, Portugal and Spain, it was almost a 50% and across the EU more than 35% [6, p 9].

5. SEASONALITY ANALYSIS

A seasonality analysis on the threat of accidents in Poland was carried out on the basis of the so-called multiplicative seasonal factors. Even in a simple video presentation prepared for the number of traffic accidents on a monthly basis one will see that this phenomenon is highly seasonal (Fig. 2). Seasonality effect is so strong that in spite of a very clear trend, the number of accidents in the summer 2011 is higher than in January or in February several years ago. Of course, such a comparison of values for different times of the year, with no adjustment for seasonality is unauthorized, which is often forgotten.

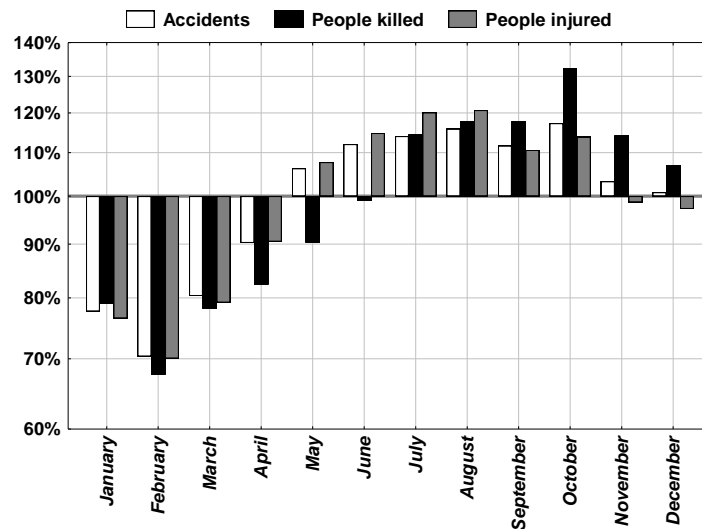
Fig. 2. Number of road accidents in Poland on a monthly basis in the years 1998-2011



Source: own study

Seasonal factors were determined both for the number of accidents and the number of killed and injured. The results are summarized graphically in Figure 3. The ability to interpret the seasonal factors allows to monitor the level of road safety because on this basis it can be compared to the actual number of cases in each subsequent month with the expectations resulting from accidents in the previous months, adjusted by seasonal effect.

Figure 3. Seasonal factors of accidents, the number of people injured and killed in accidents in Poland - calculations based on data from the years 1998-2011



Source: own study

The strongest seasonality has a number of people killed in road accidents. In some months not only does increase the number of accidents, but also their severity. This is particularly true in the summer and early autumn season. The most dangerous month is October in which the number of accidents increases by 17% and the number of deaths is as much as 32% higher than the average annual level. The least accidents occur in winter, especially in February, in which the number of fatalities is more than 30% lower than the annual average, and as compared to October, these tragic events are almost twice lower. According to the detailed analysis, seasonal factors calculated on the basis of data from the years 1998-2011 in a detailed way reflect the relationship between the number of accidents in each month for almost every year. The least stable is the month of December in which the number of accidents strongly depends on weather conditions. For instance, in December of 2010 on Polish roads died 172 people, while at the same period of 2011-440. It was due to difficult road conditions in 2010 and completely not winter aura of the following year. Paradoxically, the risk of an accident is the highest during good weather.

6. FORECASTS ON THE NUMBER OF ACCIDENTS FOR THE YEARS 2012-2014

There are many factors affecting the number of accidents and their consequences. In an attempt to forecast the number of the long-term ones, there should be considered various scenarios which play a vital role for the following conditions:

- The development of road infrastructure;
- The level of motorization;
- Volume of traffic;

- Traffic regulations and their enforcement by the relevant departments.

Each of these factors is very variable and even to some extent random. Many of them depend on economic conditions, fuel prices and even the demographic issues (in view of the predicted significant decline of the Polish population in the next few years, prediction of the traffic growth may be strongly overestimated).

In the paper it was adopted a different concept of prediction which assumes that all external factors are reflected in the changes of the size of the test in the past, which allows for the use of one-dimensional methods of analysis of time series. Of course, this estimate cannot look into the future too much.

Table. 2. Forecast on the number of accidents, the injured and killed in Poland in 2012-2014

Month	2012			2013			2014		
	A	K	I	A	K	I	A	K	I
January	2 470	261	3 005	2 357	245	2 861	2 243	230	2 716
February	2 229	222	2 741	2 126	209	2 609	2 023	195	2 477
March	2 535	255	3 085	2 417	240	2 936	2 300	225	2 787
April	2 837	268	3 512	2 705	252	3 342	2 573	236	3 171
May	3 327	292	4 164	3 172	274	3 961	3 016	257	3 757
June	3 495	318	4 419	3 331	299	4 202	3 167	279	3 986
July	3 543	366	4 604	3 376	343	4 377	3 210	321	4 150
August	3 585	374	4 609	3 416	351	4 381	3 246	328	4 154
September	3 442	372	4 206	3 278	350	3 998	3 115	327	3 789
October	3 602	417	4 310	3 431	391	4 095	3 259	365	3 881
November	3 159	357	3 720	3 008	335	3 534	2 857	313	3 348
December	3 072	333	3 651	2 924	313	3 467	2 777	292	3 284
TOTAL	37 294	3 835	46 026	35 540	3 601	43 762	33 787	3 367	41 499
Change %^{a)}	-5%	-5%	-4%	-9%	-11%	-9%	-13%	-17%	-14%

^{a)} percentage change in relation to the year 2011; A – accidents, K – people killed, I – the injured

Source: own study

The estimates (Table 2) were obtained by exponential smoothing models. In each of these models it was taken into account the multiplicative effect of seasonality and the occurrence of trend (linear, exponential, or dying). By using optimization procedures available in *STATISTICA*, there were searched the models giving the smallest absolute value of the percentage error. For each of the considered quantity the best results gave the models with a trend line, with a mean absolute percentage error of the forecast of 3-5%. The predicted values of the number of accidents, the number of people injured and killed in 2012-2014 are presented on a monthly basis as well as globally each year.

The forecast was constructed assuming the decrease trend in accidents, people injured and killed. The values obtained allow to predict a decrease in the number of people killed in road accidents in the years 2012-2014 compared to the data of the year 2011, respectively by: 5%, 11% and 17%. For these values one should approach with caution as the action in the field of road safety in Poland in this period may be less effective than in previous years, both because of the delays in terms of their implementation and some design faults.

7. CONCLUSIONS

The number of victims in Poland systematically decreases, however, as seen from the EUROSTAT, at the rate much lower than in most European countries. In terms of the rate of road deaths per million inhabitants, Poland is unfortunately at the forefront of the European Union countries. Even while maintaining positive in the short term direction of change that was apparent in the last few years, the predicted decline in the number of accidents will be till the year 2014 only about 13%. A little more fall can be seen in the number of accident victims - here the predicted decline is 17%. However, in absolute terms, on the Polish roads will die every year more than 3.5 thousand people. In addition to psychological and social dimensions, such a large number of accidents has a negative impact on the functioning of the entire state. It is worth mentioning that according to conservative estimates, the cost of accidents in Poland is equal to or even higher than the budget deficit. In this situation it should be considered changing the concept of transport logistics in Poland, which at the moment is based on the absolute dominance of road transport. In addition, in case of passenger services the increasingly irrelevant is public transport, thus the car traffic increases. As for the activities for road safety, especially the control system should be subjected to the change which is currently focused on the criminalization of mass and often minor offenses, while the penalty incurred by the actual perpetrators of accidents are of too low social perception. Studies on the dynamics and structure of events in Poland will be continued in the following publications where will be discussed, inter alia, the issue of regional disparities of road safety.

REFERENCES

- [1] Breńska U., Kretkiewicz B., Jażdżik-Osmólska A., *Szacunek kosztów wypadków drogowych w Polsce i próba ich internalizacji w ramach prac badawczych IBDiM w Warszawie*, Instytut Badawczy Dróg i Mostów, Warszawa 2012
- [2] Czapski R., *Relacja między PKB a kosztami ofiar wypadków drogowych czyli jak efektywnie inwestować w bezpieczeństwo drogowe*, Poprawa Bezpieczeństwa Ruchu Drogowego jako Wynik Synergii Podejmowanych Działań – Międzynarodowy Kongres Bezpieczeństwa Ruchu Drogowego, Toruń 2011
- [3] *Master plan dla transportu kolejowego w Polsce do 2030 roku*, Ministerstwo Infrastruktury, Warszawa 2008
- [4] *Ocalmy miliony istnień. Dekada działań na rzecz bezpieczeństwa ruchu drogowego*, WHO, 2012
- [5] Serbeńska A., *Szacowanie kosztów wypadków drogowych*, www.edroga.pl, 25.05.2012
- [6] *Stan bezpieczeństwa ruchu drogowego. Działania realizowane w zakresie bezpieczeństwa ruchu drogowego w 2010 r. oraz rekomendacje na rok 2011*, Krajowa Rada Bezpieczeństwa Ruchu Drogowego, Warszawa 2011

BEZPIECZEŃSTWO RUCHU DROGOWEGO W POLSCE W LATACH 1998-2011

W opracowaniu przedstawiono szczegółową analizę dynamiki liczby i skutków wypadków drogowych w Polsce w ostatnich kilkunastu latach. W artykule dokonano także analizy sezonowości wypadków drogowych, której wyniki są interesujące z punktu widzenia optymalizacji zarządzania bezpieczeństwem ruchu drogowego. Na zakończenie przedstawiono prognozę liczby wypadków i ich ofiar do roku 2014, przyjmując założenie kontynuacji trendu spadkowego, oszacowanego na podstawie danych z lat 1998-2011.

DOI: 10.7862/rz.2012.zim.28