ISSN 1857-9973

JOURNAL
OF ECONOMICS

2019

GOCE DELCEV UNIVERSITY OF STIP
FACULTY OF ECONOMICS

www.ugd.edu.mk

The *Journal of Economics* ISSN 1857-9973 is an international, open access, peer reviewed, online journal. The journal focuses on the following areas of publication: Economics (Microeconomics, Macroeconomics, International Economics), Banking and Finance, Accounting and Auditing, Management and Business, Entrepreneurship and Marketing.
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Journal of Economics, 4 (2) 2019 *ISSN* 1857-9973

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Traffic safety promotion and awareness raising campaign: organizational and ecological issues

ISSN 1857-9973

656.1.05:351.811(497.7)
656.1:502(497.4)

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Abstract

Traffic accidents are one of the most difficult problems in human society, followed by human and material losses and a problem that every country in the world faces, regardless of technological progress and traffic culture. International institutions and numerous experts are constantly trying to find an appropriate model that can respond to the problem of everyday vehicle growth in the world, serious and alarming situations with the number of traffic accidents and the harmful consequences that the traffic arises.

Numerous analyzes and statistical surveys are trying to define appropriate scenarios that would give a true answer to the direct causes of accidents, with the minimization of the harmful consequences that inevitably result from them.

In September 2015, amendments to the Law on Road Traffic Safety in the Republic of Macedonia were adopted, which, as an important novelty, determined the maximum allowed speed of vehicles, instead of the previous 60 to be 50 kilometers per hour. At the same time, very severe penalties were adopted for drivers who did not respect this limitation.

The idea of these measures was to create conditions for greater traffic safety, especially for pedestrians and specifically reducing the number of traffic accidents in which pedestrians are often injured. Analyzes show that these amendments, despite of good intentions, caused other difficulties, such as reducing the throughput of the streets in populated areas and adversely affecting environmental conditions, visibly increasing air pollution, increased noise and harmful effects on the urban environment.

In this paper, a cross-section is being made, of the necessary preparations for more effective application of these legal solutions, as well as analyzes of the harmful effects on the environment in the city centers in the Republic of Macedonia.

Keywords: environment, environmental conditions, traffic safety, roads, harmful actions, legal changes, possible solutions.

1. Introduction

According to World Health Organization data, about 1.35 million people die each year as a result of traffic accidents in road traffic. **[1]** The 2030 Sustainable Development agenda set an ambitious goal to halve the global number of deaths and injuries from road accidents compared to 2020. More than half of all deaths in road traffic are among vulnerable road users: pedestrians, cyclists and motorcyclists. 93% of the greatest casualty casualties occur in low- and middle-income countries, although these countries account for approximately 60% of the world's vehicles. Injuries to road traffic are the leading cause of death in children and young people aged 5 to 29 years. Every year, the life of approximately 1.35 million people is shortened as a result of a car accident. Between 20 and 50 million more people suffer from non-fatal injuries, many of whom have permanent disability as a result of their injury.

Traffic accidents cause significant economic losses to individuals, their families and the nations as a whole. These losses result from treatment costs, as well as lost productivity for those killed or disabled from injuries, as well as family members who need to avoid work or school to take care of the injured. The road of road transport consumes most of the countries 3% of their gross domestic product. The increased speed of vehicles undoubtedly increases the likelihood of accidents. There is a strong correlation between the risk of speed and traffic accidents: the general connection has at all speeds and for all roads, but the rate of increase in the risk of accidents varies with the initial speed level and type of route. High speed road differences also increase the likelihood of an accident. In addition, drivers driving much faster than the average driver have a greater risk of accident.

In accordance with the world practices and harmonization with the European legislation, as well as the need to reduce the number of traffic accidents in the past years, several amendments have been made in the Law on Security in the Republic of Macedonia.

Amendments to the Law on Road Traffic Safety were adopted in September 2015, and entered into force in October of the same year. **[2]** The changes were made by an urgent procedure, based on the findings from the statistical and media indicators that obviously said that in the settlements, mainly in the bigger cities in the Republic of Macedonia, such as the capital Skopje, then in Bitola, Tetovo, Kumanovo, Strumica, Stip , Prilep - in the short run, many traffic accidents occurred in which there were also injured human casualties (of course, material damage). The analyzes showed that the main reason for the accidents and victims is precisely the fast driving. At that time, in the legal provisions the maximum allowed speed of vehicles in the township was 60 kilometers per hour. On the one hand, irresponsible drivers have often exceeded this speed, and on the other hand, there was an estimate that the speed of 60 km / h. is such that it provides traffic safety disruption and particularly endangers pedestrians (both in marked places such as pedestrian crossings, and in places where there were no pedestrian crossings with markings or are more than 100 meters away from the crossings).

In the procedure, the Ministry of Transport and Communications in the Government of the Republic of Macedonia proposed the maximum allowed speed in settlements to be 50 kilometers per hour. The same proposal has sharpened the penalties for drivers who do not respect the maximum allowed speed by grading the penalties. Thus, if the overdraft is up to 10 km / h. the penalty is 10 euros or 10 negative points in the driver's driver's booklet. If, however, the overdraft is between 10 and 30 km / h. - then the fine has an amount of 45 euros or 25 negative points. For these two situations, no misdemeanor sanction is foreseen.

For speeds more than the permissible between 30 and 50 km / h. the fine is 300 euros or 50 negative points and a driver driving a vehicle for three to 12 months. If the overdraft is more than 50 km / h. the fine is 400 euros or 65 negative points and a ban on driving a vehicle for six to 12 months. **[3]**

The Assembly of the Republic of Macedonia, after a brief procedure, adopted the proposed amendments by the Government of the Republic of Macedonia or the Ministry of Transport and Communications, and later it was shown that necessary and necessary and wider analyzes were necessary for efficient and effective application of this new limitation.

2. Reduce the speed of vehicles - world practices

A large number of studies indicate the linkage of increased speed and the likelihood of traffic accidents. The analyzes indicate that the risk of accidents varies from the originally defined speed level and type of route. The large differences in the speed of road vehicles also increase the likelihood of an accident. In addition, drivers driving much faster than the average driver have a greater risk of accident.

The improper speed of vehicles is one of the key risk factors in road traffic. Inadequate speed is defined as driving at a speed unsuitable for the appropriate road and traffic conditions. Increased and inadequate speed is responsible for a high percentage of mortality and morbidity resulting from road traffic. In high-income countries, speed contributes to about 30% of road deaths, while in some low-income and medium-range countries, speed is estimated as the main contributing factor in about half of all road traffic accidents. Vehicle speed control can prevent the occurrence of traffic accidents and may reduce impact when they occur, reducing the severity of injuries to road traffic victims.

Numerous studies undoubtedly show that acceleration is the most important contributor to deaths, but it also contributes greatly to other types of injuries. Estimates indicate that a 10% reduction in speed can affect the number of victims of road accidents by 37,8%. **[4]**

Table 1 Change in accidents or accident victims as a function of change in speed

	Relative change (%) in the number of accidents or victims					
Accident or injury severity	-15%	-10%	-5%	+5%	+10%	+15%
Fatalities	-52	-38	-21	+25	+54	+88
Serious injuries	-39	-27	-14	+16	+33	+52
Slight injuries	-22	-15	-7	+8	+15	+23
All injured road users	-35	-25	-13	+14	+29	+46
Fatal accidents	-44	-32	-17	+19	+41	+65
Serious injury accidents	-32	-22	-12	+12	+25	+40
Slight injury accidents	-18	-12	-6	+6	+12	+18
All injury accidents						
Property-damage-only accidents						

Source: Elvik R., Christensen, Amundsen A.: Speed and road accident: An evaluation of the Power Model. Oslo, 2004.p. 88.

The Australian researchers Kloeden, McLean and colleagues invistigated a case control study to compare the risk of speeding and the risk of drink driving. In urban areas with a speed limit of 60 km/h, the researchers determined the speed of accident involved cars preceding the accident as well as the blood alcohol concentration (BAC) of the accident involved drivers. Similarly, they determined the speed and BAC of cars/drivers not involved in accidents, but driving in the same direction, same day of the week, same hour of the day, etc. They also controlled for other potentially confounding variables, such as age and gender. The risk of

sober, non-speeding drivers was the basic risk, set at 1. The risk of speeders and drink drivers was determined relative to this basic risk. They found:

Table 2 Risk of acceleration compared to driving risks

Speed	Relative risk of speeding	Blood Alcohol concentration (g/dl)	Relative risk of Drink driving
60 km/h	1.0	0.00	1.0
65 km/h	2.0	0.05	1.8
70 km/h	4.2	0.08	3.2
75 km/h	10.6	0.12	7.1
80 km/h	31.8	0.21	30.5

Source: Kloeden et al., 1997

https://ec.europa.eu/transport/road_safety/specialist/knowledge/speed/speed_is_a_central_issue_in_road_safety/speed_and_accident_risk_en [06.02.2019] **[5]**

This study shows that overcoming a speed limit of 60 km / h for 5 km / h is comparable to the risk of alcohol blood levels - BAC of 0.05. The risk of exceeding the speed limit of 60 km / h for 10 km / h is greater than driving with (blood alcohol concentration - BAC) of 0.08.

3. Some organizational issues from the application of the limited speed measure

In the framework of the implementation of the legal changes - most obvious is that all the signs / traffic signs communicating / determining the maximum allowed speed for movement of vehicles in settlements were replaced on time and so - where it was marked 60 km / h. - it was noted 50 km / h.

Some of the media soon after the adoption of this measure concluded that drivers rarely adhere to the new limitation, which means they did not comply with the relevant provision and did not eliminate the potential danger of new accidents and everything that follows and can follow from them. Or - safety is not increased at all, nor is the safety of pedestrians. Some media, however, very simply urged traffic police officers to consistently monitor the implementation of this measure and in accordance with the law to impose penalties on irresponsible and reckless drivers. **[6]** There is no research approach that would offer expert opinions, offer ideas and suggestions to achieve the expected effects / results of the new legal solutions. **[7]**

When changing the legal norms, the proposer and the legislator went from the simplest solution - the maximum allowed speed for movement of vehicles in the populated areas is reduced, the penalties for the offenders are increased, signs / boards are placed with which the drivers are informed about the allowed / imprecise speed of movement of vehicles.

Hence, obviously, there are no broader perceptions and analyzes, how and where it affects and causes new behaviors exactly this change.

First, instead of undertaking a package of measures that would increase the security of communication in the settlements, to influence the knowledge and conscience of the perpetrators of legal provisions, initiating public debates, by organizing real and regular controls, involving the civil sector, by organization of trainings and workshops - the most direct solution was removed - new signs, new fines and other penalties.

Also, there was no analysis of how the traffic will take place after the implementation of these norms, and above all the reduction in the maximum allowed speed of vehicles from 60 to 50 km / h.

Almost all cities replaced only boards that now write 50 km / h. Where earlier restrictions were at lower allowed speeds (say 50 km / h or 40 km / h), the same boards with old numbers remained (although, of course, there are reasons why those parts / streets are less permissible speed in relation to the former maximum of 60 km / h, whether it's pedestrians, or special conditions - curves, slippery terrain, other hazards). In this way, partial security, and not security in the overall traffic process in individual city environments, has been obtained.

The bigger problem is that by reducing the maximum permissible speed, the throughput of the roads is reduced (if earlier for a given time some part of the road could pass, for example, 300 vehicles - now, with the application of the legal norm, they can regularly pass around 250 vehicles). People quickly noticed that their time has increased for which they can spend a certain distance (from house / flat to work) in relation to the previous period. And habits, as has been known for a long time, are slowly changing, so disrespect for the new limitation turns out to be a frequently practiced moment.

There are no objective, systematic and scientifically based analyzes of how this measure (legal change) has positively influenced the traffic flow, the reduction of traffic accidents, nor how many real drivers respect the limitation. The media often report that police punish drivers who are detected / caught driving a vehicle in a township at a speed greater than the maximum permissible. It can easily be established that the traffic participants (drivers, pedestrians, public transport users, taxi drivers and their clients) are basically dissatisfied with the increase in transportation times from one place to another in relation to the previous period.

It turns out that one measure and tougher penalties are not enough. In fact, when the causes of traffic accidents are statistically considered - the speed of movement more than legally permissible and its (in) adaptation to specific situations is only one of the most carriers of road accidents (here, of course, and other reasons such as inattention, driving under the influence of alcohol and other harmful substances, the low / low traffic culture, the insufficiently quality traffic service provided by the city streets, the inadequate system of marking the roads, the unspecified or unrecognizable pedestrian crossings and so on).

4. Impact on the ecological status

Sticking to the definition of the object of analysis, it should be said that the reduced maximum speed for moving cars in residential areas adversely affects the environmental situation in the places themselves and beyond. Cars, that is, in order to pass accurately the same distance for a long time are in active use - engine included and emission of gases, in relation to the previous limitation. Thus, the air is polluted to the detriment of the natural environment and contains substances that are harmful to human health (and that more dimensions - respiratory organs, blood pressure, body hygiene, general mood, stress). It is quite scientifically proven that the cars are either the strongest or among the strongest air pollutants by discharging carbon monoxide from leaks from motor vehicles.

Of course, the problem of air pollution from vehicles is much wider. But it is necessary to say that the polluted air in general and most visible in urban areas, besides harmful effects on human health, has an adverse effect on the environment, such as on grass, greenery, trees, soil, then on public hygiene on the streets and other surfaces. Cars are also very frequent triggers of harmful noise, which is above the permissible strengths and in the regular operation, and when a part of the cars, for various reasons, have a reinforced sound (special exhausts, defective exhaust flows, large vehicles with high noise and the like).

The December 2018 data from the Breathe Life initiative, a Climate and Clean Air Coalition led by the WHO and UN Environment, shows the gravity of the situation. The concentration of

the PM2.5 particles in Skopje is 4.5 times higher than the recommended level of 10 micrograms per cubic meter. According to the same source, the situation is even worse in Tetovo, where the concentration of $PM_{2.5}$ particles is 8.1 times higher than the recommended level.

Air pollution in Macedonia far exceeds international safety levels. In 2016 The WHO (World Health Organization) ranked Skopje as the third worst city in Europe in terms of particulate matter air pollution ($PM_{2.5}$). Skopje's annual mean for 2016 was 40 µg/m3 (40 micrograms per cubic meter), which is 4 times higher than the annual WHO guideline (10 µg/m3), and 60 per cent greater than the official Macedonian target and European guideline (25 µg/m3). **[8]**

Table 3 Registered road motor vehicles and trailers by years, RM and Skopje city - 2017

	Total	motor-cycles	passenger cars	buses	goods vehicles	road tractors	tractors	work vehicles	trailers
REPUBLIC OF MACEDONIA	474516	14129	403316	3188	35912	5778	2707	834	8652
Skopje	169190	5209	144224	953	14534	1578	195	260	2237
Aerodrom	24336	808	22380	20	838	109	11	12	158
Butel	13938	328	11759	33	1375	193	13	8	229
Gazi Baba	23276	599	18815	485	2370	378	80	43	506
Gjorche Petrov	12015	357	10874	26	497	112	6	3	140
Karposh	22790	955	19607	27	1825	122	9	36	209
Kisela Voda	20734	703	17762	30	1644	236	14	16	329
Saraj	7157	44	5845	58	946	109	7	17	131
Centar	29477	1069	23384	217	4043	207	47	119	391
Chair	12622	253	11267	50	803	104	8	5	132
Shuto Orizari	2845	93	2531	7	193	8	-	1	12
Arachinovo	1929	7	1597	4	221	42	2	-	56

Source:Ministry of Interior

The density of vehicles on city streets created additional problems with air pollution. In the past few years several cities in the Republic of Macedonia have been ranked as the most polluted city centers on a world scale. The maximum permissible concentrations of particles PM_{10} in the ambient air in Skopje are constantly exceeded, but also in other cities in the country, as is the case in Tetovo, Bitola and Kumanovo. The air pollution from the exhaust gases of the vehicles accounts for 20% of all pollutants. The City of Skopje, in cooperation with the Finnish Institute for Meteorology, with the Austrian Environment Agency and the Ministry of Environment and Physical Planning, has developed a comprehensive air quality plan in Skopje. This plan shows that the biggest air pollution in Skopje with particles PM_{10} originates from the warming of households, with 32%. Then, the traffic is 20%, the dust created by the unsettled areas, street dust and dust from construction activities - 19%, industry - 18%, sulphate salts - 7%, nitrate salts - 2%, and transboundary transmission of pollutants - 2 % ".

Here, the so-called bottlenecks should also be considered, most often the central parts of cities, where due to the density of cars they slowly pass certain distances, for a long time, in a small area, emitting large quantities of exhausts. **[9]**

For example, for such parts, for example, Clement Ohridski Street, with many crossroads, Krste Petkov Misirkov Boulevard, also with many intersections, the street network around Bit Pazar, the entrance to the city from Gjorce Petrov and from among Veles and Kumanovo. In

Bitola - the entrances from Prilep and Resen / Ohrid, the center around the hotel Epinal, the lines along the river Dragor. Through Kumanovo high car density is registered on the move from the Bus Station towards the city center and Bajram Shabani Street, then near the Post Office and the court building. In Stip such is the situation around the Bus Station, on the drives of the Otinja River. Strumica has heavy traffic in the center around the shopping facilities and at the entrances to the city.

The weather conditions in urban areas, especially in the winter, due to the mistiness and intensification of wet zones from the sky - clouds with rain, snow, high humidity - have a harmful effect on the air and hence on the health of people and the quality of the environment.

In addition, the picture of the state of the vehicle fleet in the country, from the aspect of the quality of combustion of fuels and the discharge of harmful exhaust gases (very often above the permissible quantities, ie with very harmful substances in them towards the human health and the environment) is more of a worrying.

Table 4 Shares of different types of vehicles of all registered vehicles in Skopje and division of the car fleet to euro classes (Ministry of Interior, 2014).

Share of different types of vehicles		**Share of vehicles in euro classes**	
Passenger cars (petrol)	56.6%	Euro 0 (-1992)	11%
Passenger cars (diesel)	29.2%	Euro 1 (1993 - 1996)	15%
Passenger cars (other)	1.9%	Euro 2 (1997 - 2000)	24%
Light duty vehicles (petrol)	2.4%	Euro 3 (2001 - 2004)	17%
Light duty vehicles (diesel)	4.4%	Euro 4 (2005 - 2010)	26%
Heavy duty vehicles	2.7%	Euro 5 (2011 - 2014)	7%
Buses		0.7%	
Motorcycles		2.1%	
Total number of vehicles		**161 474**	

Source: Finnish Meteorological Institute and Ministry of Environment and Physical Planning Air quality improvement plan for Skopje agglomeration project is funded by the European Union]. Skopje. 5.12.2016. p.13.

One of the key sources of pollutants in the air that is common to most cities is the old one inadequately maintained fleet. On national level, approximately half from passenger cars and buses are old and belong to the category vehicles with high emissions. Traffic congestion or poorly developed public traffic, that is, the absence of public transport worsens the situation. The number of vehicles in the last decade has increased by 15%, the share of diesel fuel vehicles has doubled (as major polluters, which in Western European countries is their complete removal from the traffic), and do not have a treatment device of the disintegrating particles in the exhaust gases, about two-thirds of the vehicles (at the state level) are older than ten years, which means lower quality of combustion and emission of more harmful substances than usual. **[10]**

Of course, the solutions should not be required in increasing the maximum allowed speed of vehicles, although the limit of 60 km / h. could be tolerated. One part of the solutions are already mentioned as a system of activities and measures, to the widest possible extent, to improve traffic safety, especially in urban areas. It would also be to avoid heavy and large vehicles passing through the centers of cities.

The street network of cities requires organizational and technical efforts that will increase the throughput of streets and roads in general, somewhere with the determination of one-way traffic, elsewhere by reaching three pavements (from the current two) and by removing those obstacles that slow them down the movement of vehicles.

For environmental issues, in spite of the faster flow, it is important to improve the quality of combustion of motor vehicles from vehicles, to create safety and vehicle free zones, to hike and use of non-combustion transport (bicycles, wheelchairs with human energy and other).

Amendments to the vehicle law envisage the introduction of environmental labels, subsidies for electric and hybrid vehicles, in order to have a positive impact on the reduction of ambient air pollution and the health of citizens. With the proposed amendments to the Law on Vehicles, the competent institutions strive to catch up with modern world practices that include coordinated and integrated action in the fight for a healthy environment and dealing with air pollution, where urban transport is an important segment.

According to the European environmental standards and good practices, with the proposed amendments to the Law on vehicles, environmental labeling for vehicles is introduced, which will be divided into three ecological categories depending on the European emission standards (EURO 1, EURO 2, EURO 3, EURO 4, EURO 5 and EURO 6) and from the propulsion of the vehicle engine, (liquefied petroleum gas or compressed earth gas, electric drive or hybrid vehicle).

The next measure that seeks to apply is the granting of subsidies when purchasing a vehicle on an electric drive or returning part of the assets of natural or legal persons who will buy an electric vehicle or hybrid vehicle.

With the Program for subsidizing the purchase of new hybrid and electric vehicles, subsidies of five thousand euros in MKD equivalent for procurement of electric vehicles are envisaged, and three thousand euros in denar equivalent for the purchase of a hybrid vehicle.

5. Conclusion

According the road safety strategies and action plans in the EU the Safe System approach should be seen as a vision based on an ethical foundation, creating and supporting a totally new perspective, a paradigm shift, on the road safety problem and how to solve it.

With the amendments and supplements to the Law on Road Traffic Safety, adopted in September 2015 and entered into force in October of the same year, the maximum allowed speed of vehicles in settlements in the Republic of Macedonia decreased from the previous 60 km / h . at 50 km / h. At the same time, the penalties for exceeding the allowed speed increased. The general perception is that these legal changes were made without prior knowledge of their expected and unexpected effects.

There are no objective, systematic and scientifically based analyzes of how this measure (legal change) has positively influenced the traffic flow, the reduction of traffic accidents, nor how many real drivers respect the limitation. The media often report that police punish drivers who are detected / caught driving a vehicle in a township at a speed greater than the maximum permissible. It can easily be established that the traffic participants (drivers, pedestrians, public transport users, taxi drivers and their clients) are basically dissatisfied with the increase in transportation times from one place to another in relation to the previous period.

It turns out that one measure and tougher penalties are not enough. Regarding the environmental issue examined, it should be said that the reduced maximum speed for driving cars in settlements negatively affects the ecological situation in the places and wider. Cars to pass accurately the same distance for a long time are in active use - a powered engine and emission of gases, compared to the previous limitation. With this, air is more often polluted by such motor vehicle operation.

It is logical that wider solutions should be sought in order to reduce air pollution in the big cities in the Republic of Macedonia in the part that causes the reasons from the traffic.

Thus, the street network of cities requires organizational and technical activities that will increase the throughput of streets and roads in general, somewhere with the determination of one-way traffic, elsewhere by reaching three pavements (from the current two) and by removing those obstacles which slow down the movement of vehicles.

For environmental issues, in spite of the faster flow, it is important to improve the quality of combustion of motor vehicles from vehicles, to create safety and vehicle free zones, to hike and use of non-combustion transport (bicycles, wheelchairs with human energy and other).

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