

Investigation of the Effect of Economic Factors on the Shadow Price of Road Accidents in Iran

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Abstract: One big challenge every society has to deal with is the problem of road accidents and casualties after them. Many believe that this imposes huge economic costs on the society. Compared with developed countries, developing nations suffer from larger numbers of victims in this crisis that is why road accidents in these countries are known as one of the major causes of death. The aim of this study is to evaluate some economic factors which affect the shadow price of road accidents in Iran's economy. This study analyses the relationship between these factors and the shadow price in the form of ARDL econometric methods during the period 1996-2018. According to the obtained results, it can be claimed that the GDP and shadow price of accidents and traffic correlate with each other. This correlation shows the shadow price in Iran increases along with economic growth, and after reaching a turning point, it begins to decline. In other words, it could be said that the relation between the shadow price of road casualty and GDP in Iran seem to behave similarly to the inverted U-curve of Kuznets. Therefore, it was indicated that the Smeed's law can be applied in Iran.

Keywords: Shadow price of road accidents, Kuznets curve, Gross Domestic Product (GDP).

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Introduction

Nowadays the issue of road accidents, their casualties and high economic and social costs are the most fundamental problems that have caused challenges for specialists and people in charge of transportation and traffic affairs. This is more important for developing countries because of the soaring numbers of road accidents in them. Therefore, their direct and indirect costs are more influential in these countries in comparison with the developed ones (Sanders, 1993). In less developed countries, due to the less efficient supervision by organizations involved with the road accidents, this issue is really deplorable. The inappropriate quality of roads, lack of effective custodians, low revenue, use of worn-out cars for transportation, and many other reasons have intensified road accidents in these countries. On the other hand, with the increase in the number of transportation vehicles, transportation infrastructure has improved. Furthermore, safety standards of vehicles and safeguarding network of passages do not show any sign of a growing trend. This lack of incompatibility between tendency to mechanical urban life and the required infrastructure has led to a growing number of accidents and the entailing casualties in developing countries. Unfortunately, Iran is one of the countries that have the most cases of deaths and injuries of accidents. Studies in our country have indicated that currently more than 25000 of annual death cases and over one hundred thousand casualties are due to vehicle accidents; furthermore, road accident financial losses of road accidents are even more than 4 billion dollars a year which, compared with other countries, shows Iran's critical condition in this regard (Peyvandi, et al., 2005).

The study's results also showed that the rate of investment return in traffic safety is around 360 percent. This rate is so high it that maybe be very difficult to find another investment with such return rate. Therefore, failing to make such an investment and the continuing amount of heavy losses cannot be justified in any way (Ayati, 2008). Furthermore, studies have revealed that 7% of GDP is ruined by the

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damages of road accidents, which is approximately 1 to 2 % in other countries, and no country has recorded such an accident damage rate as of yet (Ayati, 2009). Studies on the economic aspects of accidents and the resulting costs have, hence, rarely been conducted in the country. With respect to what was mentioned, the objectives of this study can be summarized as follows:

- Finding the relationship between GDP with the shadow price of road accidents in Iran
- Evaluation of the impact of investment in transportation infrastructure on the shadow prices of accidents

To achieve these objectives and to provide answers to the related questions, it is necessary to answer the following:

- Does GDP have a significant effect on the shadow price of road accidents in Iran's economy?
- Among the effective variables on shadow price, does investment in transportation infrastructure have maximum impact or not?

Prior to analyzing the issue to come up with a plausible answer, it seems reasonable to first define "accident".

Some of the provided definitions of the accident are as follows:

- Cherns (1962) defines accident as "a mistake with painful consequences". This definition includes causal factors and human costs as well.
- According to the Atkins (1981) "accident may include one or more transportation devices or persons injured in varying degrees."

Since safety in its economic aspects is considered as a good product, so with higher revenue, safer situation is expected. That in low-income countries, higher incomes lead to less traffic safety and traffic casualties, is still a confusing topic. In contrast, in countries with high income, that higher income will lead to less traffic deaths is quite understandable. The question that arises here is whether it is possible to analyze the difference. In response to the question why the rate of road fatality is lower in higher income communities, there is some justification:

- 1- The concept of externalities, which determines the responsibility and regulates the external effects in the more advanced stages of economic development and is considered a success factor for institutional capacity
- 2- Competing risks, which in this case is one of the reasonable solutions to road users is the fact that less investment on road safety is in line with the most vulnerable dangers of traffic
- 3- The composition of vehicles: with the economic growth the rate of traffic fatality will spontaneously be lower. Because in this case, the road users will access safer vehicles and instead of hazardous methods of transportation (bicycle motor and double-decker buses), they will utilize safer transportation vehicles.
- 4- Medical technology: to save victims and the injured on the road, a very strong and developed medical system is needed (Bishai, et.al. 2006).

Literature Review and Empirical Research

Among the vital infrastructures of cities and countries for economic development are road system and transportation. Due to the increasing number of accidents, the analysis should be done in such a way that contributing factors are identified. Overall, road safety is checked in the system of "human vehicle, the road and the environment". In 1986, William Haddon introduced transportation and traffic system as a without a plan and program system of "human-machine" and announced that the system needs to be understood and treated systematically (Haddon, 1986). He introduced the matrix, which is known as Haddon' matrix that indicates the interaction of three components: human, vehicles and the environment (road).

Table (1) represents three steps to take about an accident:

- 1- Before an accident
- 2- During an accident

3- After an accident

In the 3 by 3 above interactions above, there would be a matrix with 9 cells. Haddon’s dynamic system model provides the opportunity to figure out which interventions can investigate behavioral factors, those related to the road, and the ones related to vehicles that affect the number and severity of accidents.

Table (1): Haddon’s Matrix

Steps		Factors		
		Human	Equipment and Vehicles	The road and Environment
Before the accident	Prevention of accidents	Education and culture, laws and regulations	Speed management, lights, brakes, good performance, technical inspection	Road design, speed limits, pedestrian facilities
During the accident	Prevention of injuries during an accident	Injuries Control	Protection of passengers, safety equipment, accident prevention plan	Near road equipment for protection against accidental damage
After the accident	Survival	First aid skills and access to health centers	Ease of firefighting	Facilities and rescue routes (aid on road)

Resource: Haddon (1986)

By using this approach and Haddon’s systemic method, major sources of error or design weakness that lead to accidents, casualties and serious injuries can be detected. In order to reduce the corresponding consequences the following steps must be taken into consideration:

- Reducing exposure to risk
- Preventing road accidents
- Reducing the severity of injuries in the event of an accident
- Reducing adverse outcomes and results by improving post-accident care

Evidence shows that in developed countries, considering an integrated approach to road safety has a significant effect on reducing the number of casualties and injuries of accidents (Trinca, 1988; Lonerio, 2002). In general and based on Table 2, the results of different studies show that, road accidents in developing countries increase until they reach a particular threshold level of a revenue and then the rate declines. This relationship is similar to the Kuznets` curve, which states that there is a relationship between non-uniformity income and per capita income. So the evidence shows an inverse U-shaped relationship between income and road mortality.

Table (2): studies in the field of accidents and road fatalities

Researchers	Year	Country of study	Results
Akinyemi	2020	Nigeria	Results showed that in the long-run, both crashes and fatalities decrease while injuries increase with GDP
Huan He, et.al	2015	Russia	The road traffic fatalities rates decreased monotonically over time as GDP per capita increased in 66 studied regions during 2004–2011
Rong Hu,et.al	2012	China	There is an inverted u-shaped relationship between the economic growth and the number of people killed in traffic accidents. The number of death in traffic accidents increases with the development of economy in early stages. However, as the economic develops into a certain level, the mortality rate of traffic accidents starts to decrease, which clearly indicates that the Smeed’s law can also be applied in china.

Law, et.al	2010	60 countries of the world	The relationship between per capita income and road fatalities is u-shaped (Kuznets). An Increase in the doctor per capita is followed by a decrease in the road fatalities.
Law and Partners	2009	25 countries of the world	Kuznets relationship exists between the loss of motorcycle riders and economic growth. Enforcement of traffic rules reduced the mortality of motorcycle riders.
Traynor	2008	The US (Ohio state)	Per capita income and population density have a significant effect on the road casualty that represents the nonlinear relationship between per capita income and the road casualty.
Paulozzi, et. al	2007	44 countries of the world	In the early stages of economic development, we are faced with increasing rate of deaths of road accidents until they reach a critical point to see a decrease in this rate.
Bishai, et. al	2006	41 countries of the world	In low-income countries, increased traffic deaths and injuries are in a line with economic growth. GDP increasing in rich countries lead to reduce of traffic fatalities.
Ayati, et. al	2008	Iran	In 2004, Iran economy has been damaged more than six thousand billion Rials, as a result of traffic accidents.
Mehregan, et. al	2011	Iran	There exists the Kuznets` inverted U relationship between traffic fatalities and economic growth. The negative relationship has been observed between the Investment in infrastructure of transportation section variable , improvement of recovery medical care and cultural index with the traffic casualty and also direct relationship between the number of vehicles per capita with the level of road fatalities.

Methodology

Kuznets' environmental hypothesis in relation with road accidents

The relationship between economic growth and environmental quality on a long-term basis can be indirectly or reverse be a combination of both. If the related literature of the field is investigated, it becomes clear that in recent decades, two streams of thought have existed in this area that have eventually become a third approach. The first approach is the trade-off between economic growth and preservation of their environmental standards, which means that economic growth is primarily the result of increased production and consumption and inevitably requires more raw materials and energy as the inputs of production, and thus increase production associated with environmental degradation. At the other end of the spectrum is a second approach. It is believed that the improvement of environmental quality is paralleled with economic growth, and in order to improve environmental standards, steps should be taken for economic growth. Basically, the higher level of income, the higher the demand for commodities that use lower levels of raw material, thus, the demand for environmental quality rises as well. This means accepting the norms and standards of environmental protection. The third approach introduced in the early 90s suggests the relationship between economic growth and environmental pollution is in the form of an Inverted U-shape. This is known as Environment Kuznets' Theory. The Kuznets' curve hypothesis claims that in the early stages of economic growth, environmental degradation increases until it reaches its maximum point, and then along with economic growth environmental degradation will decrease. The researches that exist in literature on the relationship between road traffic fatalities and economic growth have come out with mixed results. While some studies discovered a non-linear or u-shape Kuznets curve relationship between traffic fatalities and economic growth, others found a strong linear relationship (Yusuff, 2015).

Along with economic development, growth of motor vehicles usually associated with an increase in road accidents. The investigation of trend of economic growth and traffic fatalities in different countries suggests the relationship between the two variables. This fact puts forwards two main questions. First,

how to detect changes in traffic fatalities with developing countries and in particular the second question is how to identify a model for stating what kind of relationship exists between the growth in per capita income and road fatality (Koptis, 2004).

R. j. Smeed (1949), was the first one who conducted researches in this field. He showed that there is an inverse u-shaped relationship between traffic accident mortality rate and economic growth. The results of experimental studies have shown that road accident in developing countries increases until it reaches a certain threshold level, and then it decreases. This relationship is similar to the Kuznets' curve, which states that there is a relationship between non-uniformity income and per capita income. In order to study the Kuznets' hypothesis, researchers usually consider road accidents as one of the environmental pollution in their research literature. The analysis on the basis of which the relationship between the Kuznets' hypothesis and road accidents is expressed in such a way that communities at low levels of income are less able to allocate resources to the relevant institutions and the development and implementation of safety policies that lead to an increase in accidents and casualties. At the low level of income, the demands for safer roads are low as well. However, in higher levels of income, societies have focused greater attention on road safety, because they have more resources to invest on road safety and efficient supervisors are available too. Therefore, the people of these areas have a higher demand for road safety (Law, et al., 2010).

Three theories support the EKC hypothesis in relation to the road accidents in experimental studies that are: (1) economic activity scale (2) changes in the composition of economic activity (3) the increasing demand for qualitative environment (safe route) with income growth (Ansuategi, 2002). Revenue growth offers a scale associated with economic growth and road casualty. This problem occurs because economic growth is typically associated with an increase in transfers and more demand for transportation services (Gately and Dargay, 1999). Previous studies have shown that one of the main factors contributing to the increase of road accidents and injuries is the growing number of vehicles per capita (Johnston, 1997 and Bishai, 2006). Therefore, it is expected that as for the impact of scale, road fatalities are a growing linear monotonic function of per capita income.

The second one is the combined effect, which is also called the substitution effect. It refers to the change in the composition of high-risk vehicles threatening pedestrians (motor bicycle, etc.) to low-risk ones (cars, etc.) (Bhalla, et.al, 2007). In the early stages of development, the risk of death will increase because the increase in the number of motor vehicles can cause an increase in pedestrian population threats. However, at higher levels of income, when more than half of the population in traffic is motorists, the increase in the number of motor vehicles leads to a reduction in total mortality. Thus, in relation to the combined effect, it is expected that, traffic fatalities are the non-uniform function (U reverse) of the per capita income.

Efforts to secure the road may be one of the driving forces that reduce the rate of traffic fatalities. On the demand side, low-income people are less able to invest on road safety, even if certain need for improving road safety exists, the more investment is invested for public health risks and material needs. However, with rising of incomes, the demand for improved safety road increases. It is also possible that safer alternative transport methods (replacing cars with motorcycles) are provided for people on the road. On the supply side, in low-income classes, communities are less able to allocate resources to create the necessary social institutions to balance the road safety policy. However, when the economy grows enough, the higher levels of income can increase public demand, that make applicable the road safety policy (compulsory use of helmets for motorcyclists and wearing safety belts for passengers) to reduce road accidents and increase security. (Law et al., 2010)

Investigating the status of Kuznets' Curve in Iran

Figure (1) shows the relationship between the number of road fatalities and Iran GDP. As it is seen, the intersection points of GDP and road fatalities are in a curve shape, which is similar to the Kuznets' environmental curve, and the level of GDP is 450.000 billion (which is consistent with the 2012 level),

which can be considered the beginning point or in fact the fix pint of the road casualties that depends on the adopted approaches and policies to let the trend continue.

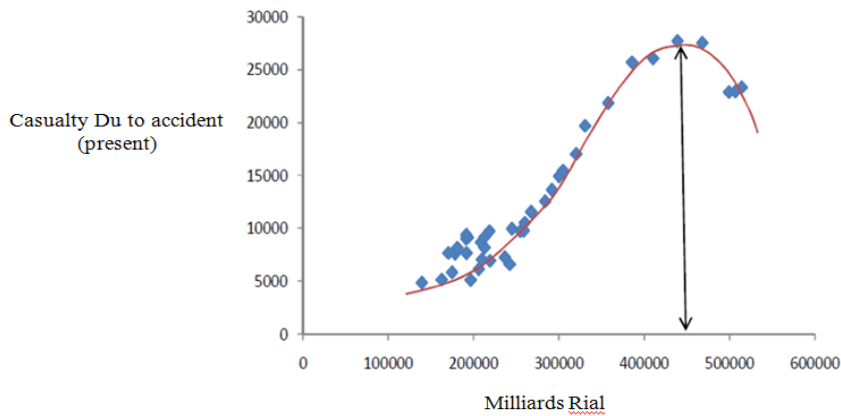


Figure (1): The relationship between GDP and traffic fatalities in Iran

Resource: Statistical Center of Iran and the Central Bank of the Islamic Republic of Iran

The data used in this study are time series, the shadow price of road accidents, the real GDP, investment in transport infrastructure, and the number of motor vehicles during the period 1996-2018. No study so far has investigated the factors affecting the shadow price of accidents and road fatalities over Iran's economy, but a number of studies have examined the impact of accidents and traffic fatalities on the economy. Among them Law, Traynor and Mehregan's studies can be noted. Variables that are used in most of these studies are road fatalities, the gross domestic product, the number of motor vehicles, and investment in the infrastructure of transportation, health care, population, and education levels. In this study, the shadow price of road accidents as the dependent variable and the GDP, the square of GDP, investment in transport infrastructure and the number of motor vehicles are all used as explanatory variables. Operational definitions of these variables are as follows:

1. Shadow Price of accidents and road deaths (P): Shadow price can be calculated by multiplying the number of deaths due to accidents by the rate of compensation payments.
2. The real gross domestic product (GDP): An increase in GDP as well as economic growth can, on the one hand, lead to a rise in road accidents because of building more and longer roads, and on the other hand, it may end in an improvement in the quality of roads that can result in fatal road accidents. Thus, it seems its effect on reducing road accident is ambiguous.
3. Investment in transport infrastructure sector (I): Improving road infrastructure through increasing investment in this sector is normally considered as a technique to reduce injuries caused by accidents. Improving infrastructure means constructing and improving highway systems, establishing network engineering standards and generally less curvature on the road, putting wide lines, and establishing more lines for travelers.
4. The number of motor vehicles (V): The number of vehicles is a major cause of road accidents. Apparently, there exists a direct positive relationship between road accidents and the number of vehicles with an increase in the number of vehicles, the number of the accidents may also increase.

Model and Empirical Results

In this study, in order to investigate the effect of economic factors affecting the shadow price of road accidents in the economy of Iran, annual statistics period (1996-2018) and econometric model ARDL were used. In order to investigate the effect of the economic factors affecting the shadow price of accidents, the following model is used:

$$\text{LnP}_t = \alpha_1 + \beta_1 \text{LnGDP}_t + \beta_2 (\text{LnGDP}_t)^2 + \beta_3 \text{LnI}_t + \beta_4 \text{LnV}_t + \varepsilon_t \quad (1)$$

In this model: LnP_t : Logarithm of the shadow price of road accidents in the year t

LnGDP_t : Logarithm of the real GDP in year t
 (LnGDP_t)² : The square of the logarithm of GDP in the year t
 LnI_t: Logarithm of the investment in infrastructure in the transport sector of the year t
 LnV_t : Logarithm of the number of motor vehicles in the year t
 As a first step, the used variables in the model must be tested in terms of stability.

Table (3): Results of Augmented Dickey-Fuller test for variables (without intercept and trend)

Variable	Augmented Dickey-Fuller test	MacKinnon critical values			Lag
		1%	5%	10%	
LnP	-6.557	-2.699	-1.961	-1.606	1
LnGDP	-8.251	-2.685	-1.959	-1.607	0
(Lngdp) ²	-8.330	-2.685	-1.959	-1.607	0
LnI	-5.876	-2.692	-1.960	-1.607	1
LnV	-3.078	-2.717	-1.964	-1.605	0

Source: The authors' findings

(Zero means stationary at the level and one means stationary in the first area differences.)

As the unit root test results in Table (3) show, all the variables studied in this research, were I (0) and I (1), and this means that the ARDL is a good way to analyze short-term and long-term behavior of this study's variables. Short-term results of the Autoregressive distributed lag (ARDL) are provided in table (4):

Table (4): The results of ARDL Model (The dependent variable of shadow price of road deaths)

Dependent Variable: Ln P			
Regressors	Coefficient	Standard error	T-Ratio
Ln p(-1)	-0.28238	0.17386	-1.62424
Ln GDP	145.9333	25.6894	5.6807
Ln GDP(-1)	60.7938	31.9277	1.9041
(Ln GDP) ²	-4.2360	0.86340	-4.9062
(Ln GDP) ² (-1)	-3.3214	1.2627	-2.6304
Ln I	-1.6923	0.68042	-2.4871
Ln V	1.2454	0.45105	2.7612
C	-1389.4	328.4622	-4.2300
T	-0.46369	0.23510	-1.9723
R-Bar- Squared: 0.72			
R-Squared: 0.84			
Durbin's h -Statistic: -2.03			

The coefficient of determination of the model is 0.72 that shows the explanatory power of the model, and states that 0.72 percent of the dependent variable can be explained by the independent variables. As dependent variables emerged, with the interval model in the model, Durbin-Watson test cannot be an appropriate criterion to evaluate the presence or absence of correlation, so in such circumstances, the Durbin-Watson test of h should be used. Durbin's h-statistic indicates that the model did not have autocorrelation problem. In order to investigate other classic assumptions, the relevant goodness of fit tests has been used. The goodness of fit tests results are presented in the following table:

Table (5): The results of goodness of fit tests

Test	Statistics	
	LM	F
Serial Correlation	4.1920 (0.041)	2.5478 (0.145)
Normality	0.12540 (0.939)	Not application
Heteroscedasticity	1.8819 (0.170)	1.8689 (0.189)

Source: The authors' findings

The results show that the model does not have any problems in terms of classical assumptions. This means that there is neither autocorrelation nor heteroscedasticity, and the estimation errors have a normal distribution.

To evaluate the long-term relationship, t statistic is calculated as follows:

$$t = \frac{-0.282-1}{0.173} = -7.410$$

Since the t-statistic is more than the obtained t in terms of absolute value, which was provided by Banerjee, Duladu and Master (1992) at the 99% confidence level that equals to -5.79 , the null hypothesis that states that there is no long-term relationship is rejected; therefore, it can be concluded that a long-term equilibrium relationship exists between the variables of the model. The results of long-term relationship are provided in table (6):

As can be seen in the above table, the positive GDP rate shows an increase in GDP logarithm makes the shadow price of road fatalities increase, which suggests that economic growth is basically in a line with roads death and, as a result, more shadow prices on the road. This index suggests that due to increased investment in infrastructure and public services, the economic growth in the later stages reduced road casualty. As a result, the shadow price will also drop because of the losses. Therefore, Kuznets' inverted U hypothesis, which states that there is a relationship between the road deaths and income, is confirmed in Iran. Iran is in the preliminary steps of economic growth; therefore, it is expected that in the future, economic growth will lead to road deaths and its resulting costs, which are really stressful matters. It means that by increasing the number of vehicles, road accidents and, as a result, the shadow price of fatalities increases as well. Results of previous studies also confirm the hypothesis of Kuznets for two groups of countries: developed as well as developing. This represents a U-shaped relationship between economic growth and road deaths. Due to the fact that Iran is among the developing countries, the previous studies confirm the results of the present study. The results of the long-term relationship show that there is a significant positive relationship between the variable logarithms of the numbers of vehicles with the shadow price of road accidents. The reason can be traced to the rising rate of motorization in recent years that not only wasn't in line with a conventional process of economic growth but it has also been a jump. Therefore, if the process of motorization is not accompanied with economic growth, it can be very dangerous because if the safety necessary platform is not provided for these vehicles, certainly a tragedy of road will entail. On the whole, it is understandable that an increasing number of vehicles on the roads of a country increase road accidents. However, according to theories, the combination of means of transportation shouldn't be neglected because it involves the safety level of vehicles and worn out vehicles which makes the situation even worse and can be considered as another reason of the importance of vehicles variable in the model. For example, heavy vehicles such as Mack, White, and still working in Iran fleet of road transportation belong to the 30's. Keeping such vehicles in the fleet of road vehicles, not only has increased the number of vehicles on the road, but it has also made an old unsafe fleet, which increases traffic and its losses.

Due to the negative ratio of investment logarithm in transport infrastructure sector, it has been found out this variable is inversely correlated with the amount of road fatalities. The analysis of accident statistics also shows that the road deficiency is the main reason of about 22% of accidents on roads. 37.8% of fatal accidents are due to the narrow width of the road (Kashani, Askari, and Dadash zadeh, 2005). Indeed, most accident and death prone roads are the ones in which often less investment has been made. The main features of these roads are that they are narrow, have non-standard turns, lack proper signs and markings, and are two-way. For example, in high-traffic roads such as the north road or Saveh - Hamedan, Semnan - Shahrood, and Jiroft- Bandar Abbas, which are known as the roads of death, the largest numbers of deaths occur. It's worth mentioning that the construction of these roads dates back to more than four decades ago, and they haven't been reconstructed or reinvested yet. Thus, by allocating appropriate investments, traffic fatalities can be reduced.

Table (6): Results of long-term estimates (dependent variable of shadow price of road accidents)

Dependent Variable: LnP			
Regressor	Coefficient	Standard error	T-Ratio
LnGDP	161.206	33.993	5.038
LnGDP) ² (5-.893	1.163	-5.066
LnI	-1.319	0.527	2-.501
LnV	0.971	0.326	2.971
C	-1083.5	219.210	-4.942
T	-0.361	0.190	-1.902

Source: The authors' findings

To evaluate how the short-term adjustment of imbalances in shadow price of road accidents changes to the long-run balance, a model named ECM was used. The important part in ECM model is a variable factor of ECM (-1). This coefficient shows in any period, what percentage of the short-term imbalance percentage of the shadow price of road accidents is adjusted to reach the long-term balance. The error correction coefficient obtained is -0.28, which means that in each period, 28 percent of imbalance in shadow price of road accidents is adjusted and is closer to its long-term trend.

Table (7): Results of the estimation of error correction model (dependent variable of shadow price of road accidents)

Dependent Variable: dLnP			
Regressor	Coefficient	Standard error	T-Ratio
DLnGDP	145.933	25.689	-5.680
(dLnGDP) ²	-4.236	0.863	-4.906
DLnI	-1.692	0.680	-2.487
DLnV	1.245	0.451	2.761
Dc	-1389.4	328.462	-4.230
Dt	-0.463	0.235	-1.972
ECM(-1)	-0.28	0.178	-7.376
$ecm=LnP - 161.2064*LnGDP + 5.8933*(LnGDP)^2 + 1.3197*LnI - 0.97118*LnV + 1083.05*C + 0.36158*T$			

Source: The authors' findings

Conclusion

Road accidents in Iran are the second leading cause of death following heart disease (Hatami, Razavi, and Eftekhari Ardebili, 2009). Therefore, the factors affecting road accidents and their shadow price are important to be investigated, and this importance is due to the social problems and huge economic burdens caused by them. So with respect to the stated issues, the aim of this study is to investigate the economic factors affecting the shadow price of road accidents. The results of this study suggest that it can be claimed that the economic growth and shadow price of road casualties have a relationship with each other, and this relationship is in such a way that with economic growth, the shadow price of road accidents will increase, and it continues to increase until it reaches a turning point, then a decrease in traffic casualties of shadow price will occur. In other words, its behavior is similar to that of the Kuznets' inverted - U relationship, which is related to traffic fatalities, shadow prices and the real GDP in Iran. Hence, the first hypothesis of this study - "significant effect of GDP on shadow prices of road accidents" - cannot be rejected. The other obtained result of this study is the negatively correlated variable of investment in transportation infrastructure with a shadow price of traffic casualties. However, considering that this variable does not have the greatest effect on shadow price, the second hypothesis is rejected. Results also indicate a direct relationship between the numbers of vehicles with the shadow price. Based on the results of this research, the following recommendations can be given in order to decrease the damages resulting from road accidents.

- ❖ An increase in investments on constructing safe road and upgrading safety of roads by erecting proper traffic signs will definitely minimize the level of road accidents and costs that they will impose on any community.

- ❖ Moreover, population growth will inevitably end in the use of more vehicles; a rise in the number of vehicles, hence, can maximize the probability of road accidents. Use of safer vehicles and upgrading the nation's knowledge of traffic and transportation the costs of road accidents can be lowered, despite the rise in the number of vehicles.

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