E C O N O M I C S B U L L E T I N

Traffic accidents: an econometric investigation

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Abstract

Based on a sample of drivers in Brasilia's streets, this article investigates whether distraction explains traffic accidents. A probit model is estimated to determine the predictive power of several variables on traffic accidents. The main conclusion drawn from this study is that the proxies used to measure distraction, such as the use of cell phones and cigarette smoking in a moving vehicle, are significant factors in determining traffic accidents.

We are thankful to an anonymous referee for comments and suggestions.
Citation: Paulo, Loureiro, Adolfo Sachsida, and Tito Moreira, (2004) "Traffic accidents: an econometric investigation." *Economics Bulletin*, Vol. 18, No. 3 pp. 1−7
Submitted: January 28, 2004. **Accepted:** March 22, 2004.
URL: http://www.economicsbulletin.com/2004/volume18/EB−04R40001A.pdf

1. Introduction

Traffic accidents are one of the major causes of violent death in Brazil. According to the Brazilian Institute of Geography and Statistics (IBGE), in the year 2000, 13,747 people died from traffic accidents. Kilsztajn *et alli* (2001) state that 98% of the deaths caused by means of transportation occur by traffic accidents involving motor vehicles. This is not a problem exclusive of Brazil. In the United States, nearly 40,000 people die every year in traffic accidents (Levitt and Porter, 2001). As concerns Great Britain, the estimates of external costs (bottlenecks, search for alternative venues, need to acquire safer vehicles, etc.) resulting from traffic accidents vary from 3 to 26 billion pounds per year [Maddison *et alli* (1996), Pearce (1993), Fowkes *et alli* (1990), Hansson and Marckham (1992)]. In London, the cost has reached 679 million pounds per year for 1991 [Peirson; Skinner and Vickerman (1998)]. In western Australia, traffic accidents impose a yearly cost estimated at 171 million dollars, i.e., US$39,600.00 per accident. In addition, both in the western region as well as in Australia as a whole, traffic accidents are the main cause of death for the population between 17 and 24 years of age (Stevenson and Palamara, 2001)[1].

As meaningful as the financial resources spent on traffic accidents are the losses on human capital. Since most of the fatal accidents victimize a young population, it can be supposed that all investment with education on those people is lost. From the point of view of social welfare, such losses are also significant. After all, the violent death of young people seems to shock society more than that of older citizens. Hence, the costs generated by the traffic accidents seem to be an important variable both for the analysis of transportation projects and for the development and implementation of public policies attempting to minimize the problem.

Among the several causes of traffic accidents, we can mention the poor condition of the roads, the poor condition of some vehicles, the inexpertness of some drivers, distraction, etc. Some researches have addressed the issue of the effect of alcohol in traffic accidents [Levitt and Porter (2001)], others have studied the relation between the flow of traffic and the number of accidents [Dickerson, Peirson and Vickerman (2000)].

Silva e Kilsztajn (2003) analyze the relationship between mortality due traffic accidents, the number of registered motor vehicles, and economic activity in Brazil from 1980 to 1999. The results indicate that the number of deaths in traffic accidents follows economic waves and shows a general tendency to decrease as the number of motor vehicles per capita increases. Kilsztajn *et alli* (2001) and Michelin *et alli* (2001) also analyze the relationship between mortality due traffic accidents and the number of motor vehicles.

Others researches have tried to explain what factors determine the accidents caused by driver distraction [Libbon (1999), Napach (2000), Eisenstein (2001)][2]. This paper shall

[1] Traffic accidents are also the main cause of death for North Americans between 6 and 27 years of age [Levitt and Porter (2001)].

[2] In order to have a more exact idea of the magnitude of these accidents, we have that, according to NHTSA (U.S. National Highway Traffic Safety Administration), driver distraction is responsible for 25% of all annual accidents occurring in the United States.

follow the line proposed by the last of those groups, with the objective of studying whether distraction is a significant factor to explain traffic accidents.

If we understand distraction as a result of illegal behavior on the part of the driver[3] we may use the theoretical model developed by Becker (1968) in our analysis. Becker (1968) argues that the illegal behavior of some individuals is due not to the fact that their basic motivations are different from those of other individuals but to the fact that their earnings and costs are different. Hence, crime is a rational choice of every individual who has more benefits than costs in the act of an illegal activity. Therefore, it is reasonable to assume that individuals break traffic laws on the basis of a rational behavior, also resulting from a cost-benefit relation.

When an agent chooses to drive at a speed above the one permitted by law, he reduces his cost with transportation (his transaction cost, since he gets to his destination in less time). When the driver uses a cell phone, in a moving vehicle, he reduces his cost of decision-making, benefiting from access to and dissemination of information (for example, while driving, a speculator can make the decision of buying or selling stocks and receive timely information on the market; otherwise, he could lose millions of dollars).

The choice the agent makes to break traffic laws, in principle, is a generating source of potentially increasing his wealth or even his psychic welfare, or both. On the other hand, by breaking the law, the agent runs the risk of having costs, such as punishment for the traffic infraction (actual value of the fine, of the time spent in jail or of the ensuing psychic disadvantages), or for the bad reputation that his action brings upon him. By intentionally breaking traffic laws, the individual has the objective of maximizing his wealth and/or psychic welfare, while he tries to minimize the risk of incurring in losses of the same nature.

The choice of the manner of driving can be understood as a choice of the level of risk that the driver is willing to take[4]. The driver's attitude of wearing his seat belt[5], or not, using a cell phone, or not, smoking inside his vehicle, or not, all of which, combined with the utilization of several other pieces of equipment that come in modern cars (such as CD players, glass holders, air conditioning dials), or not, are factors that contribute for decreasing or increasing the incidence of traffic accidents.

Within this context, distraction could be considered as a significant determinant of traffic accidents when it results from an illegal activity[6]. From this point of view, some hypotheses are assessed throughout this study as concerns the differences among the types of drivers in their attitudes and behaviors in relation to the risks of traffic accidents. In addition, we shall check whether the individual driver characteristics are determining

[3] It seems reasonable to assume that traffic laws oblige drivers to drive safely, not jeopardizing the lives of others. Consequently, distraction would be a clear violation of that prerogative.
[4] See Deery and Fildes (1999).
[5] See Mock (2000).
[6] The Brazilian parliament has been discussing the possibility of creating a new law to regulate the use, by drivers, of cell phone and/or smoke while driving .

factors in traffic accidents. For that matter, we can verify, for example, if female drivers have risk attitudes different from those of the male drivers.

An aspect which is not frequently examined in the publications on traffic accidents concerns the features that define the profile of drivers as regards to age, sex, married status, number of children, race, schooling, and wage. If those features are determinant to explain traffic accidents, they will certainly be an important contribution not only to public administrators who aim at diminishing the incidence of traffic accidents but also to insurance companies.

The paper is organized as follows: The next section presents the methodological approach and the process of data gathering. In section 3 the results are presented and discussed. Section 4 bears the conclusions drawn.

2. Methodology

A *probit* model will be estimated to check on the predictive power of several variables as regards to traffic accidents. Since the modeling of economic variables making use of *probit* models is usual in economics, we shall abstain from further comments concerning that methodology. However, a more curious reader will find references on the technique in Maddala (1997) and Greene (1998).

The people we selected for this survey were drivers from Brasilia chosen at random during the third quarter of 2001. We interviewed people in shopping centers, universities, public buildings and other public places. Hence, in this study samples of 1,455 observations (subjects) were gathered about traffic accidents in urban venues. From the total of the drivers in the sample, 704 had never been in any kind of traffic accident and the remaining 751 had been in at least one traffic accident. The subjects sampled answered a questionnaire about two basic types of questions:

(a) Questions related to each individual's characteristics, i.e., to the driver's profile, such as age, sex, married status, number of children, race, schooling and wage; and
(b) Questions related to traffic safety as a result of behavioral aspects of the drivers when driving their vehicles, i.e., wearing the seat belt (or not), using a cell phone, type of car and smoking while driving.

We start from the premise that more experienced individuals (older), married and with a higher salary are more averse to taking risks, that is, they are more careful in traffic. We also presuppose that the behavior of the driver while driving his vehicle can contribute to the occurrence of an accident. Individuals who use a cell phone and/or smoke while driving are more prone to becoming distracted in traffic, and that may bring about accidents.

According to Table 1, 51.61% of the people in the sample had already suffered at least one traffic accident. Also 50.44% were men, 22.61% smoked while driving and

57.45% used a cell phone while driving. In addition, 2.33% of the interviewees had elementary schooling and 28.65% had a university degree.

Table 1: Descriptive Statistics

Description of the variables	Mean	Standard-Deviation
Had an accident car	0,5161	0,4999
Male	0,5044	0,5001
Age under 30 years old	0,6261	0,4839
Wage between 1 and 10 minimum wages[a]	0,7876	0,4091
Basic education	0,0233	0,1511
High school	0,4652	0,4989
College	0,2865	0,4523
Marriage	0,4824	0,4998
White (race)	0,4343	0,4958
Kind of vehicle	0,9250	0,2633
Use Seat belt	0,9615	0,1924
Use cellular phone while driving	0,5745	0,4945
Children riding with the driver	0,5285	0,4993
Smoke while driving	0,2261	0,4184

a: at the time of the research this corresponded to a salary between U$80.00 and U$ 800.00.

3. Results

As previously described in the methodology, a *probit* model was estimated to verify the impact of the several variables used in this study on the probability of an individual becoming involved in a traffic accident. The results can be observed in Table 2. Two Probit models are described. One contains all the variables of the study and the other contains only the statistically significant variables. As clearly observable, the results are not sensitive to the removal of variables. It is behooving to stress that White's procedure (1978)[7] to correct heteroscedasticity was applied to both *probi*t models.

In accordance with Table 2 and contrary to the opinion of some, the fact that the driver is male increases the probability that he will become involved in traffic accidents. On the other hand, people with an average salary between one and ten minimum wages have a reduced probability of getting involved in a traffic accident. Intuitively, it may be argued that those people have an extremely high cost in becoming involved in an accident. After all, the costs involved in an accident may be superior to their wages, resulting in serious financial complications to them. Hence, it is to be expected that people that earn until ten

[7] See Heckman (1979) and (1990) and Johnston and DiNardi (1997).

minimum wages will be more careful in traffic. Another bit of interesting information is that person's race does not interfere with his/her probability of having accidents.

For the purpose of this paper, the truly important variables are the last three in Table 2. After all, they are the ones that were adopted as *proxies* for traffic distraction. All have confirmed the initial hypothesis, that is, that distraction is a significant determinant of traffic accidents. As it can easily be perceived, the fact that the drivers use cell phones while driving increases their probability of becoming involved in a traffic accident. The same is true for the drivers who smoke while driving. Whereas drivers with children, they frequently have to divert attention from the traffic to care for their children. In fact, people can be distracted by talking to other people (not only children) present in the car while driving. Any conversation inside the car can distract the driver. But, we consider one case more specific. When kids ride in the back seat, the drivers are generally more worried about the behavior of the children. This is especially true when the drivers are the parents. The parents (drivers) usually turn around to reprove the children's behavior and this influences the probability of traffic accidents. Therefore, it can be perceived that the variables adopted as traffic distraction proxies were significant to explain traffic accidents.

Table 2: Results of the Probit Model

Descriptions of the variables	Probit (2)[a]	Probit (3)[a]
Constant	0,0477	-0,1371***
Male	0,1399***	0,1398***
Age under 30 years old	-0,0218	-
Wage between 1 and 10 minimum wages [b]	-0,1012***	-0,0998***
Basic education	-0,1323	-
High school	-0,0902**	-0,0661**
College	-0,0482	-
Marriage	0,0161	-
White (race)	-0,0023	-
Kind of vehicle	-0,0725	-
Use Seat belt	-0,0804	-
Use cellular phone while driving	0,1209***	0,1125***
Children riding with the driver	0,1389***	0,1547***
Smoke while driving	0,2051***	0,2088***

Note: (*), (**) and (***) means that the variable is significant at 10%, 5% and 1% level, respectively.
a: the coefficients represent the marginal effects
b: at the time of the research this corresponded to a salary between U$80.00 and U$ 800.00.

We can note that the use of cellular phones implies an increment of about 12% in the probability of an individual causing a traffic accident. In the same vein, the driver that smokes while driving and the children riding with the driver imply an increase of about 20% and 14% respectively. Hence, the results of the probit model show that distraction is a significant determinant factor of traffic accidents. In addition, public policies prohibiting the use of cell phones and cigarette smoking while driving tend to reduce the number of traffic accidents.

4. Conclusions

This paper is based upon a sample research carried out in the city of Brasilia, D.F., during the third quarter of 2001, with 1,455 drivers. The questionnaire consisted of two types of questions: a) related to the individual characteristics of every subject, i.e., with the driver's profile; and b) related to traffic safety resulting from behavioral aspects of the drivers while driving.

A probit model was estimated and demonstrated that the several variables used as proxies of traffic distraction are important determinants of traffic accidents. Hence, drivers that use cell phones or that smoke while driving seem more prone to being involved in traffic accidents. In addition, when children ride with the driver the probability of traffic accidents occurring also increases. The intuitive explanation for that is that the drivers are made to pay partial attention in the care of their children, rather than dedicating full attention to the traffic.

The results of the probit model show that distraction is a significant determinant of traffic accidents. As a result, we may infer that public policies that prohibit the use of cell phones and cigarette smoking by drivers, while driving, tend to reduce the number of traffic accidents.

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