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The Facts Of Young Drivers' Highway Accidents And Fatalities In The United States

Kodrat Wibowo

Department of Economics,
Padjadjaran University

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Center for Economics and Development Studies,
Department of Economics, Padjadjaran University
Jalan Cimandiri no. 6, Bandung, Indonesia.
Phone/Fax: +62-22-4204510
<http://www.lp3e-unpad.org>

**“THE FACTS OF YOUNG DRIVERS’ HIGHWAY ACCIDENTS AND
FATALITIES IN THE UNITED STATES”**

By Kodrat Wibowo

**University Of Oklahoma
Norman
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Abstract

Evidences that young people are the highest risky drivers causing highway deaths and fatalities had made the Congress to pass the Legislation (S 378) to restrict young people driving on the road. The focus of the legislation is how to reduce the alcohol use of young people that is suspected to be one of the most significant factors causes the highway deaths and fatalities. This paper, using the time series and panel data approach shows that it is more efficient to focus the legislation for all people in reducing the highway death and fatality rate. Further, the appropriate policy that should be passed by the Congress is how to limit the speed of vehicles on the road.

Introduction

Motor vehicle deaths have long been among the 10 leading causes of death in the USA. They usually comprise between a third and a half of all accidental deaths. Hence, the highway and motor vehicle safety becomes an important issue that needs to be regulated. The specific role of vehicle and highway safety design came into focus for the first time in the mid-1960's. Several policies have been issued during the last three decades by federal government to improve the highway and motor vehicle safety. Further, they are directed to reduce the level of highway accidents and fatalities. Economists have extensively analyzed the efficacy of those policies. Some of their studies found that these policies significantly reduce highway accidents and fatalities. However in general, regulations that forced improvements in traffic safety brought a steady decline in the rate of traffic fatalities, even as the numbers of licensed drivers and cars on the road increases.

I. BACKGROUND

National Safety Council (1973) shows that between the period 1962 to 1971, on average the youth (age 15-24) was the highest-risky drivers cause the highway accidents and fatalities.

Table 1. Age Distribution of Accidental Death Rates (per million populations)

Age Group	Average 1962-71 Death Rate
15-24	45.4
25-44	27.2
45-64	26.2
65-74	34.2
75 and older	44.0

Source: National Safety County (1973)

Young drivers were represented about three times more frequently than the safest age group (age 50-60). This report also shows that there are strong evidences found a higher than average prevalence of significant blood alcohol concentrations among young drivers in fatal accidents¹. Recent data from Bill Backers cited statistics (1993) strengthen this fact by showing that teenagers, who held only 7.4 percent of all driver's licenses, were responsible for 15.4 percent of all fatal highway accidents and fatalities. National Technical Information Service (1991) also shows the fact that the highest rates of intoxication are found for drivers in their early 20s. Almost 34 per cent of drivers aged 21 through 24 who were involved in fatal accidents were found to be intoxicated. This rate decreases steadily by age to about 6 per cent for drivers aged 65 and older² (see chart below). Saffer and Grossman (1987) support the facts by finding out that drinking age laws significantly reduce the highway mortality rate.

Chart 1. Per cent of drivers in fatal crashes with blood alcohol concentration (BAC) of 0.10 % or greater, 1991

Source: National Technical Information Service, *Alcohol Involvement in Fatal Crashes*, Springfield, VA, 1991

¹ See National Safety Council 1972, p. 52; 1973, p. 152. However, North Carolina Police Department reports indicate that less than 15 percent of drivers in accidents had been drinking (Highway Safety Research Center 1973).

² National Safety Council 1993, p. 59

Moreover, National Safety Council (1993) has estimated that the economic cost of motor-vehicle accidents and fatalities in 1992 was quite high. The average economic cost per death caused by highway accident was \$880,000, while the economic cost per injury was \$29,500.³

Due to this fact, the senate on November 20, 1993 passed legislation aimed at getting young drivers off the road. The legislation (S 738) sponsored by John C. Danforth, R-Mo., offered special grants to prod states to crack down on repeat traffic offenders and drivers 16 to 20 years old. Under the bill, states that granted only provisional licenses to drivers under age 18 were eligible for incentive grants totaling \$100 million over five years, beginning in fiscal 1994. Provisional licenses typically imposed restrictions on the times of day a teenager could drive without adult supervision and required a license holder to maintain a clean record for one year before receiving a permanent license.

Following table shows the requirements over a five-year period that the states had to adopt to win the grants.

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- Establishing a blood alcohol content of 0.02 or less as the measure of intoxication for drivers under age 21 - in effect, a zero tolerance level.
 - Setting a mandatory minimum fine of \$500 for anyone who sold or provided alcohol to minor
 - Requiring all passengers in a car, including those in the back seat, to use seat belts
 - Suspending for at least six months the driver's license of anyone under age 21 convicted of purchasing or possessing alcohol
 - Prohibiting possession of an alcoholic beverage container or consumption of such a beverage in the car
 - Enforcing a minimum penalty for driving through a railroad crossing while the gate was closed
 - Participating in an interstate compact for prompt electronic exchange of information on individual driving records
 - Creating statewide traffic safety enforcement, education and training programs aimed at high-risk drivers
 - Confiscating the vehicles of drivers convicted two or more times in five years of driving under the influence of drugs or alcohol.
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³ There are 5 economic cost components: (a) wage and productivity losses, which include wages, fringe benefits, household production, and traffic delay; (b) medical expenses including emergency service costs; (c) administrative expenses, which include administrative cost of private and public insurance plus police and legal costs; (d) motor-vehicle damage including the value of damage to property; and (e) employer costs for accidents to workers.

Clearly, we can see from table above that alcohol-related restriction for young driver were emphasized (5 of 9 requirements).

The attention for alcohol as accidents-causing factor comes from many cited statistics that imply alcohol consumption in over half of fatal accidents. About 48 per cent of all traffic fatalities in 1991 involved an intoxicated or alcohol-impaired driver, according to studies of the National Highway Traffic Safety (1991). Information from other sources shows that alcohol is also a factor in about 19 per cent of serious injury accidents and 6 per cent of property damage accidents. The estimated cost of all alcohol-related motor-vehicle accidents in 1992 was about \$32.7 billion⁴.

However, the evidence for the efficacy of this bill to reduce the highway accidents and fatalities has not been available yet. Moreover, study from National Technical Information Service (1991) states that alcohol intoxicated involvement in fatal traffic accidents significantly decreased from 1982 through 1991⁵. Intoxicated involvement in fatal traffic was also predicted to always decrease after 1991.

Garbacz (1990) in his study states that 55-mph law has a strong significant negative effect on highway fatality rates, as well as Lave (1997). Ironically, the 55-mph speed limit that had the most dramatic impact on highway safety was actually intended to save gasoline rather than lives. Enacted in 1973 at the height of the Arab oil embargo, it required states to set a maximum speed limit of 55 mph or lose their federal highway aid. The following year saw the nation's biggest single year drop in the rate of highway

⁴ national, safety Council 1993, p. 59;

deaths, from 4.1 per 100 million miles traveled to 3.5⁵. National Academy of Science under arrangement with the U.S. Department of Transportation (1984) concluded that “the magnitude of the decline fatalities” appeared to be far larger than the decline caused by factors other than speed limit (55-mph law). In 1987, Congress authorized the states to raise the speed limits to 65 mph outside urban areas, although the 55-mph limit remained in effect in a number of densely populated in many states.

First objective of this paper is to look at the effect of the 55-mph law (1973) and the 65-mph law (1987) to highway accident and fatality rate of young drivers (age 16-24) and to total highway accident and fatality rate. Regarding the strong evidences of alcohol as a factor causes highway accidents and fatalities, this paper also would like to test whether the restriction of alcohol use to all drivers is more effective to be applied rather than restrict only young people in order to reduce the rate of highway accidents and fatalities.

The paper is organized as follows. Section 2 presents the econometric models. The Section also includes a brief explanation of variables used in the models, and describes some previous related studies of highway accidents and fatalities. Section 3 presents the results. The last section will be the conclusion.

⁵ National Technical Information Service, *Alcohol Involvement in Fatal Crashes*, Springfield, VA, 1991

⁶ Congress Quarterly Almanac, 1993, p. 223

II. MODEL AND TECHNIQUES

To answer the first objective of this paper, this paper uses a simple model of the demand for auto accidents for motor-vehicle drivers which is adapted and modified from Peltzman's model (1975)⁷, Kelly (1987), Loeb (1989) and Garbarcz's model (1990). Of course, all of the articles are different in the estimated form of the models. This paper estimates the model in linear form and using time series analysis.

Refers to Merrel, Poitras, and Sutter (1998) conclusion, it is assumed that during the period of observations, safety inspection do not have effect in reducing the fatality rate among young drivers, and then will be excluded from the models. It is also supported by Crain (1980) Garbarcz and Kelly (1987), Garbarcz (1990), and Fowles and Loeb (1995). Additionally, using pooled data approach, Leigh (1994) generates evidence against the efficacy of inspection. It is also assumed that other factors that should be correlated to income and affect the driver demand safety such as: vehicle maintenance, car insurance rate, private demand and supply of vehicle's safety features can be represented by secular trend. Further, Merrel, Poitras, and Sutter (1998) suggest that engineering improvements in roads can also be represented by secular trend. Because it might creates a downward trend in accidents. Garbarcz (1990) supports this assumption with the argument that we expect permanent income to lead to continued safety improvements and therefore to exhibit a long term negative effect. The parameters of the model will be estimated from time-series data between period 1963 and 1993, period when the bill (S 738) was launched.

The empirical model in this paper takes the form:

$$(1) \quad R_t = a_1 + a_2 Y_t + a_3 T_t + a_4 A_t + a_5 S_t + a_6 M_t + a_7 Y_o_t + a_8 D73 + a_9 D87 + e_t$$

where:

R= Fatality rate (per vehicle mile);

Y = income;

T = secular trend;

A = alcohol consumption;

S = driving speed;

D73 = 55 mph speed limit;

D87 = 65 mph speed limit;

M = percentage of male of total population;

Yo = percentage of young drivers of total drivers; and

u = Error term.

The expected derivatives are $\partial R/\partial Y > 0$, $\partial R/\partial T < 0$, $\partial R/\partial A > 0$, $\partial R/\partial S > 0$, $\partial R/\partial D73 < 0$, $\partial R/\partial D87 (?)$; $\partial R/\partial M > 0$, $\partial R/\partial Y_o > 0$.

Definition of independent variables:

1. Accidents and fatality rate, R each are some measures of fatality divided by vehicle miles driven. The specific numerators employed are TDR, the total death rate-all motor vehicle deaths in the United States in the year (source: National Safety Council, *Accident Facts*, 1993 edition and National Highway and Traffic Safety

⁷ The effects of Automobile Safety Regulation, Chicago Studies in Political Economy, p. 349 - 403

Administration, *Highway Statistics*, various years); and YDR, young people-16-24 years old death rate. (Source: see TDR)

2. We define Income, Y as real disposable income per capita in 1987. Income increases accidents by stimulating the increase of demand for driving “intensity” (heedlessness and speed)⁸. Peltzman (1975) finds that the intensity effect dominates (fatalities increase with income) in time series regression. This has been interpreted that income is a measure of the value of time, not the value of live (source: U.S. Bureau of the Census, *Survey of Current Business*, various issues).
3. T represents time trend.
4. Per capita alcohol consumption, A, is measured by total consumption of liquor and beer (in billion US \$) divided by population above age 16. (U.S. Bureau of the Census, *Statistical Abstract*, various years)
5. Vehicle speed, S, is the estimated average speed on rural highway at off-peak hours (source: Administration, *Highway Statistics*, various years)
6. 55-mph speed limit, D73, 55-mph law, or an embargo dummy variable: before 1973 = 0, after 1973 = 1).
7. 65 mph speed limit, D87, dummy variable: before 1987 = 0, after 1987 = 1)
8. The percentage of males among registered drivers, M, is the proxy of high-speed driver and possible variation in preferences toward risk or driving intensity. (Source: National Highway and Traffic Safety Administration, *Highway Statistics*, various years).

⁸ Sam Peltzman (1975), “*The Effect of Automobile Safety Regulation*”, Chicago Studies on Political Economy, p. 349 - 403

9. The ratio of young drivers to total drivers, Yo . It is a proxy for inexperienced youthful drivers who tend to be involved in a much higher proportion of serious accident. (Source: National Highway and Traffic Safety Administration, *Highway Statistics*, various years).

This paper also constructs a panel data set to decide what kind of driver should be emphasized by the regulation of alcohol use restriction. The other purpose of panel data is to test the structural stability of regressions model since I believe that the behavior of highway death and fatalities for young driver differs from the total driver. The form of panel data model is not different to the one we use to answer the first objective in the part of their dependent variable. The different is now we set the data to two panels, which are total licensed driver and young driver. The specification model will be also different since now, we have to put the dummy variable $D1$ ⁹. The panel data model takes the form:

$$(2) R_{it} = a_1 + a_2 Y_{it} + a_3 T_{it} + a_4 A_{it} + a_5 S_{it} + a_6 M_{it} + a_7 Yo_{it} + a_8 D73 + a_9 D87 + a_{10} D1_{it} + u_{it}$$

where $D1_{1t} = 1$ for observations on total driver and 0 otherwise. I assume that the error term in the pooled regression has the usual OLS properties across time series and cross section observation that is the two error terms are normally distributed with the same (homoscedastic) variance σ^2 , and u_{1t} and u_{2t} are independently distributed. Thus if a_{10} in model 2 is statistically significant, it would mean that the intercept value of the total driver function is different from that of the young driver function. I also will do the Chow-Test and dummy variable test to find out whether there is a structural change in

⁹ To estimate the regression, stack the observations for the two panels. That is, the first 31 observations belong to total driver, and the last 31 to young driver. Create the dummy variable and give it a value of 1 for all total driver observations and a value of 0 for all young driver observations.

highway deaths and fatalities rate function between the two panels and to pinpoint the source(s) of difference between two panels. As soon as we know the differences, we can suggest on which panel the regulation of alcohol use restriction should be emphasized.

III. RESULTS

Table 2. contains the results of the model 1. The first variable of interest is income, Y. Both total and young models have coefficients that are positive and significant. The positive sign indicates that as it has been expected, income is a measure of the value of time. The higher the income, the more intensity to drive and finally the higher the possibility to get accident.

Three control variables, which are Yo, M and Speed, have positive and significant estimated coefficients in both total and young model (except variable M in total model). The positive sign indicates that the higher of all of the control variables tend to increase the fatality rate.

One of the key variables in this paper is A. Both total and young models have positive coefficients but somewhat is smaller in young model. Moreover, the estimated coefficient of A is only statistically significant in total model. The smaller number of and insignificant coefficient in young model indicate that for young driver, the alcohol use is not quite the main factor for the possibility of having fatality accident. (*note*: The validity of this result will also be examined in panel data regression in model 2 and is also tested by Chow and Dummy variable test.)

Table 2. Time series models of fatality rate, 1963 – 1993 total and young death rate

	TOTAL	YOUNG
Constant	-97.60** (50.14)	-589.3* (206.5)
Y	0.0044** (0.0017)	0.009* (0.002)
A	131.64* (46.94)	24.34 (42.70)
S	0.8251*** (0.4103)	0.1475 (0.5018)
M	0.2761 (0.4541)	8.015** (3.014)
Yo	1.0356* (0.4053)*	4.048* (1.371)
D73	-4.778** (1.752)	-4.782*** (2.632)
D87	4.089** (2.285)	1.238 (2.740)
T	-3.1455* (0.5439)	0.035 (1.175)
R²	0.987	0.869
DW	1.26	1.81

Note: * significant at the 0.05 level; ** significant at the 0.10 level; *** significant at the 0.20 level

The other two key variables are dummy variables D73 and D87. The 55-mph law significantly reduces the fatality rate after 1973. Holding all other factors constant, the

level of fatality rate is expected to be less by about 4.7 per cent after 55-mph law than those before 55-mph law in both total and young model. On the other hand, raising the speed limit to 65 mph significantly increases fatality rate in total model by 4.1 per cent and insignificantly increases fatality rate in young model after 1987. Generally, these two variables are more likely to affect the fatality rate in both total and young models directly rather than alcohol use. This result supports what Hubbard (1997) concluded.

Using panel data set model we obtain the following results:

$$\begin{aligned}
 R_{it} = & -319.01 + 0.008024Y_{it} + 175.83A_{it} + 1.0865S_{it} + 3.238M_{it} + 2.0396Yo_{it} - 3.921D73 \\
 & t = (-3.96) \quad (2.49) \quad (2.46) \quad (1.60) \quad (4.15) \quad (2.54) \quad (-1.26) \\
 & + 6.579 D87 - 3.1524T + 6.055DI_{it} \\
 & (1.73) \quad (-3.54) \quad (5.29)
 \end{aligned}$$

$$R^2 = 83.7\%; DW = 0.53$$

As these results show, since the coefficient of D1 (so called the differential intercept dummy) is statistically significant, we can conclude that the total driver and young driver highway deaths and fatalities functions have statistically different intercept. The fact that the Durbin-Watson statistic is low suggests that probably there are specification errors in the model.

The result from Chow-test shows that we can accept the null hypothesis that function in two panels is the same. It happens since F value produced by the calculation of Chow formula exceeds the critical value¹⁰. In the other words, it is true that the functions of highway deaths and fatalities in the two panels are different. Furthermore, the dummy

¹⁰ $F = \frac{S_5 / k}{S_4 / (n_1 + n_2 - 2k)}$ where S_4 and S_5 are the SSE obtained from the models, while n and k are number of observations and number of parameters estimated in the models.

variable tests¹¹ also support the result by adding that besides having the different intercept, there are also different slopes for variable Y, Y₀ and M. While the rest variables including per capita alcohol consumption have similar slope in both of the panels. These results imply that to restrict the alcohol use to all people is better rather than only to young people in reducing the highway deaths and fatality rate.

IV. CONCLUSION

The results of this study suggest that Congress grossly overestimate the effectiveness of mandated alcohol use restrictions for young people in reducing the highway fatality rate. The restrictions of alcohol use for young people will only work indirectly to reduce the fatality rate and may not be cost effective. The results also recommend Congress to restrict the alcohol use to all people, not only to young people. There is still not enough evidence that young people consume alcohol more than the older one.

Hence, the most effective policy suggested by this paper to reduce the highway deaths is speed limit law. However, if Congress and society treat income as a measure of the value of time (which is shown by positive sign for Y variable in our models), it will be hard to apply this law. This paper also recommends that the studies for this topic should be more strengthened considering that there are just a few studies concerning about the role of young drivers in highway death and fatality rate and its relation with the alcohol use.

¹¹ What we do in this test is pool all the n_1 and n_2 observations together and estimate the following regression $Y_{it} = a_1 + a_2D_{it} + a_3X1_{it} + a_4X2_{it} + \dots + a_5Xn_{it} + a_6(D_{it}X1_{it}) + a_7(D_{it}X2_{it}) + \dots + a_8D_{it}Xn_{it} + u_{it}$ where X's are the explanatory variables; $D_{it} = 0$ for observations in the first panel and 1 for observations in the second panel.

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