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THE EFFECTS OF GOVERNMENT REGULATION ON TEENAGE MOTOR VEHICLE MORTALITY

DENNIS C. McCORNAC

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ABSTRACT

This article investigates the impact of a number of policy manipulable variables on the motor vehicle mortality rate of white males between the ages of 15 to 24. Particular emphasis is placed on the role of alcohol. Utilizing data for the time period 1970 to 1975, multivariate equations are estimated for three time periods in order to examine and compare the before, immediate, and longer run (one-year) impact of the changes in these relevant variables on mortality rates.

The results reveal that changes in the minimum legal purchasing age of alcohol has contributed significantly to a higher mortality rate not only in the state instituting the change but in the border states as well.

Dennis C. McCornac
Department of Economics
Manhattan College
Manhattan College Parkway
Riverdale, New York 10471
(212)543-1312

National Bureau of Economic Research
269 Mercer Street, 8th Floor
New York, New York 10003
(212)598-3996

Motor vehicle mortality has long been cited as one of the principal causes of accidental deaths in the United States accounting for over one-half of all such deaths (see National Safety Council Reports). Significantly influencing these statistics is the age of the driver. While comprising less than 23 percent of the total licensed driver population, the fifteen to twenty-four year old age group typically accounts for more than one-third of the fatal motor vehicle accident statistics.[1] For this age group, motor vehicle accidents are also the leading cause of death.

An important factor also affecting the motor vehicle mortality rate is the level of alcohol consumption. Alcohol is the single most important factor yet identified in traffic fatalities [Waller (1979, p. 117)]. The age of the driver together with the consumption of alcohol can prove to be a deadly combination. One of the most frequently cited factors contributing to the relationship between youth, alcohol, and mortality rates is the minimum legal purchasing age of alcohol (MPA).

With the passage of the 26th amendment giving the right to vote to 18 year olds, came the cry for a reduction in the minimum legal purchasing age. Prior to 1970, only five states granted individuals under the age of 21 the right to purchase alcohol publicly. Beginning in September 1970 when Alaska reduced the MPA from 21 to 19 and continuing to the end of 1975, a reduction in the MPA to 20, 19, or 18 became effective in a total of 25 states.[2]

The consequences of such legislation, primarily a higher number of motor vehicle mortalities for drivers between the ages of 15 to 24, soon became a concern. Legislation was introduced in many states to reverse this trend and between 1976 and 1982, 17 states increased the age of legal drinking.

Various studies [Hammond (1973), Cucchiaro et al. (1974), Douglass (1974), Douglass and Filkins (1974), Williams et al. (1975), Zylman (1975), Barsby and Marshall (1977), Fingerman et al. (1977), Wagenaar (1981), Cook and Tauchen (1982)] have been undertaken to examine the effects of changes in the minimum legal purchasing age on motor vehicle mortalities, ceteris paribus. While most of these studies have concluded that a lower MPA increases the number of teenage motor vehicle mortalities (or an increase in the MPA reduces the number of mortalities) the change in the number of teenage motor vehicle mortalities cannot be attributed to one specific factor, such as the minimum legal purchasing age, until alternative explanations are ruled out. Fluctuations in highway safety measures, travel characteristics, and social and economic indicators all may influence the mortality rates. Factors other than the minimum legal purchasing age will affect the amount of alcohol consumption.

The unique aspect of this study is that, with the exception of Cook and Tauchen (1982), it is the first to use data for all states. In addition, as opposed to the Cook and Tauchen study, which employs dummy variables to account for differing state and time effects, this study includes a number of state-specific independent variables, including the MPA, to explain differences in teenage motor vehicle mortality. By focusing on the impact of a number of policy manipulable variables a more specified model is generated.

The objective of this paper is to fill the gap left by previous studies by investigating empirically factors which affect teenage motor vehicle mortality rates. By utilizing data for the time period 1970 to 1975, multivariate equations are estimated for three time periods in order to examine and compare the before, immediate, and longer run (one-year) impact of changes in relevant variables on mortality rates.

Many of these variables used to explain variations in mortality rates in this study result from government regulations, but some are exogenous to governmental action. By controlling for those exogenous variables, the research in this paper will provide unbiased estimates of the effectiveness of government regulations. As such, it will be a valuable tool for government policy makers in their efforts to reduce motor vehicle mortality rates.

ANALYTICAL FRAMEWORK

To study the determinants of motor vehicle mortality it is assumed that individuals make decisions over two time periods. The individual is concerned with the present period which he is certain to survive, and one future period which he will survive with some probability. His expected utility is given as:

$$E(U) = U(C_1, A) + (1 - \pi)\, U(C_2) \qquad (1)$$

where $E(U)$ is expected lifetime utility; $U(C_1, A)$ is period 1 utility which depends on period 1 consumption of all other goods except alcohol (C_1) and the consumption of alcohol in period 1 (A). $(1 - \pi)$ is the probability of survival to period 2. Thus π is the probability

of not surviving or the probability of mortality. $U(C_2)$ is the utility of period 2 consumption of all goods including alcohol. Alcohol is not separated out here because the analysis is concerned with the effect of the consumption of alcohol in period 1 only. At a level of alcohol consumption of greater than or equal to zero in period 1, the consumer faces a probability π of mortality. The level of alcohol consumption directly affects the probability of mortality since the probability of a fatal motor vehicle accident increases as the level of alcohol consumption increases [Borkenstein et al. (1964)]. Thus:

$$\pi = \pi (A, x) \quad \frac{\partial \pi}{\partial A} > 0 \quad , \tag{2}$$

where x is a vector of additional variables such as gasoline consumption per capita and the ratio of urban to rural highway miles.

Alcohol consumption (A) affects lifetime expected utility in two ways: (1) an effect on period 1 utility via A, which enters directly in equation 1, and (2) an effect on the probability (π) that the individual will not survive to period 2. Maximization of the expected utility function [equation (1)] subject to the budget constraint[3] yields a demand function for alcohol

$$A = A(p, y, x, t) \tag{3}$$

where p is the price of alcohol, y is income, and t is a taste parameter.

Price is defined broadly to incorporate various indirect costs that must be incurred to obtain goods. In general, the total or real price of a good is the sum of the nominal price and the costs that

must be incurred to obtain and consume it. Such examples of these costs are the travel and shopping time required to purchase alcohol. Therefore a youth must sacrifice scarce time as well as scarce resources to acquire alcohol. It is plausible that time costs are smaller in states with a larger number of retail outlets per capita. Moreover, the indirect cost of obtaining alcohol for a person under 21 should be lower in states where the legal drinking age is 18 as opposed to 21. Throughout this study the term availability is used to account for these indirect costs.

Substitution of equation (3) into equation (2) yields a reduced-form probability of mortality equation

$$\pi = f(p, y, x, t) \quad . \qquad (4)$$

The empirical work in this paper will provide estimates of equation (4) using data for the states of the U.S..

Mortality Production Function

A simple linear production for mortality is represented by:

$$D = a_0 + a_1 A + a_2 H + a_3 F + u \quad . \qquad (5)$$

A is the level of alcohol consumption, H is a vector of highway variables (rural-urban highway mix, highway travel density, gasoline consumption, driver's license age, and vehicle inspection requirement), F is a vector of social and economic indicators (educational level, health care, and unemployment) and u is a random error term with the usual properties. The alcohol demand function depends on the

following set of variables:

$$A = b_0 + b_1P + b_2C + b_3I + v \quad . \tag{6}$$

P is actual price, C is a vector of availability factors (minimum legal purchasing age, type of state control, number of establishments, border state price difference and border state age difference), I is personal income, and v is a random error term with the usual properties. Substituting equation (6) into equation (5) yields estimates of the total impact of both policy and non-policy variables on teenage motor vehicle mortality. The reduced form equation actually estimated is:

$$D = a_0 + a_1b_0 + a_1b_1P + a_1b_2C + a_1b_3I + a_2H + a_3F + a_1u + u \quad . \tag{7}$$

The starting point for the empirical work in this paper is the interest in the policy manipulable variables; the minimum legal purchasing age, the minimum driving age, the price of liquor and its availability, etcetera, on teenage motor vehicle mortality. Therefore, the empirical work will provide estimates of the effects of these variables on teenage motor vehicle mortality, and in particular, of (a_1, b_1), (a_1, b_2), (a_1, b_3), a_2 and a_3.

EMPIRICAL IMPLEMENTATION

Equation (7) is estimated for white males between the ages of fifteen to twenty-four who reside in 49 of the 50 states in the United States plus the District of Columbia.[4] The dependent variable, the motor vehicle mortality rate, is defined as the number of deaths per 1,000 population per year for this group in each jurisdiction (MRWM). The justification for the use of a dependent variable that is race and sex specific is as follows. Male death rates are much higher than female death rates and white death rates are much higher than those of non whites.[5] Thus, pooling is inappropriate. In addition, preliminary results revealed significant race differences in slope coefficients which supported the use of race specific data.[6] By concentrating on the white male group factors that affect the exceedingly large mortality rate for this group can be identified.

Although the highest minimum legal purchasing age is 21, mortality data for the 21 to 24 year old age group is included for two reasons. First, it accounts for fatalities that are caused by drivers under the age of 21 to those passengers who are in the 21-24 year old group. Secondly, the effects of other policy manipulable variables on this older age group can be examined.

The time period chosen is the years 1970 through 1975. During this period an important change occurred in one of the independent variables commonly believed to have a significant impact on the motor vehicle mortality rate for this specific age group. As discussed earlier, between 1970 and 1975, many states reduced the minimum legal purchasing age to below 21 for distilled spirits. A majority of these

changes were concentrated in the years 1972 and 1973 (3 between 1970 and 1971, 21 between 1972 and 1973, and 1 between 1974 and 1975). To control for the possibility of a difference between the short-run and longer-run response to changes in the MPA separate regressions are run for three time periods: 1970-71, 1972-73, 1974-75 which are termed Period 1, Period 2, and Period 3, respectively. Period 1 will examine the effect of the independent variables on mortality rates prior to MPA law changes; Period 2 will examine the short-run impact; and Period 3 the longer (one-year or more) impact. The advantage of this method is that it allows for the possibility of a lagged effect of a change in the MPA on teenage motor vehicle mortality. Previous studies have not examined both the short-run and longer-run effects.

The dependent and independent variables are two-year averages, whenever possible. Two-year averages were taken to attenuate random elements in the variables that were obtained at the state level. Table 1 contains definitions, means, and standard deviations for all the dependent and independent variables for the three time periods. The headings indicate how these variables relate to the theoretical factors appearing in equation (7).

Measurement of Independent Variables

The independent variables in this study can be characterized as availability variables, highway variables, and socioeconomic variables. Most of the variables are adequately described in Table 1 and need no further elaboration. Those variables that need additional explanation are discussed in this section.

TABLE 1
Definition of Variables

Variable Name	Source[a]	Definition	Mean, Standard Deviation[b] 1970-71		1972-73		1974-75	
Dependent Variable								
MRWM	1,2	Number of motor-vehicle mortalities per 1,000 population per year for white male 15-24 year old age group	.8125 (.7660)[c]	.246 (.102)	.7964 (.7631)	.215 (.101)	.6798 (.6482)	.148 (.088)
Availability Variables								
LIQPR	3	Price including tax of four-fifth quart of Seagram 7 Crown deflated by state-specific C.P.I. (in dollars)[d]	4.383	.499	4.149	.504	3.572	.437
NLIS	3	Number of on, off or on and off premise licenses to sell liquor per capita	1.515	.715	1.178	.71	1.25	.77
AGE	3	Minimum legal purchasing age of alcohol (in years)	20.76	.654	20.03	1.134	19.61	1.433
TYPCON	3	Dummy variable that equals one if state is a license state (sale of liquor by private stores)	.660	.479	.660	.479	.660	.479

(continued on next page)

TABLE 1 (continued)

Variable Name	Source[a]	Definition	Mean, Standard Deviation[b] 1970-71		1972-73		1974-75	
Availability Variables (continued)								
APDR	See text	Difference of price of alcohol in given state and border state price times percentage of population that live in counties that border given state. Value of zero if border state price higher. Deflated by C.P.I (in dollars)[d]	.006	.020	.0076	.019	.019	.027
AMD	See text	Difference of given state MPA and border state MPA if border age lower times percentage of population that lives in counties that border given state (in years)	.239	.485	.247	.464	.225	.492
Highway Variables								
GCPC	5	Number of gallons of gasoline consumed per capita per year by state (in hundreds)	447.18	66.01	489.42	75.64	477.21	69.55

(continued on next page)

TABLE 1 (continued)

Variable Name	Source[a]	Definition	Mean, Standard Deviation					
			1970-71		1972-73		1974-75	
Highway Variables (continued)								
DL	5	Age at which youth is able to obtain drivers license (in years)	16.60	.70	16.60	.70	16.60	.70
MUNHT	5	Number of vehicle miles traveled per mile of municipal highway (in millions)	2034.66	813.87	2235.19	944.16	2328.89	113.96
RURHT	5	Number of vehicle miles traveled per mile of rural highway (in millions)	621.59	954.38	714.60	1129.33	297.49	1012.27
INSP	5	Dummy variable that equals one if state requires vehicle inspection	.60	.495	.60	.495	.60	.495
URR	5	Number of miles of municipal highway miles per number of miles of rural highway	.382	.78	.409	.868	.364	.730

(continued on next page)

TABLE 1 (concluded)

Variable Name	Source[a]	Definition	Mean, Standard Deviation 1970-71		1972-73		1974-75	
Socio-Economic Variables								
INCR	6	Per capita personal income per year deflated by C.P.I. (in dollars)	3334.76	363.38	3664.29	377.71	3365.67	356.25
HOSP	7	Number of hospitals per capita	.0487	.062	.0474	.060	.0464	.060
WME	7	Medium number of years of school completed by population 25 years old and over in 1970	12.014	.75	12.014	.75	12.014	.75
UN	7	Unemployment rate by state	5.209	1.48	5.104	1.49	7.009	1.682

Notes to TABLE 1

[a]The sources are:

1 = Enhanced Mortality Files, Applied Management Inc.
2 = Area Resource File, Applied Management Inc.
3 = Liquor Handbook, Gavin-Jobson Inc.
4 = Facts and Figures on Government Finance, Tax Foundation Inc.
5 = Highway Statistics, U.S. Federal Highway Administration
6 = Survey of Current Business, U.S. Department of Commerce
7 = Statistical Abstract of the United States, U.S. Bureau of the Census

[b]All means and standard deviations are two-year averages: For two-year periods, n = 50.

[c]The means and standard deviations in parentheses are weighted. The weight is

$$\frac{n_j}{n}$$

where

n_j = state specific population

n = population of United States.

[d]The two price measures and per capita income are deflated by a state-specific cost-of-living index developed for the year 1967 by Victor R. Fuchs, Robert T. Michael, and Sharon R. Scott. Cross-sectional price indexes for years other than 1967 will be computed by assuming that year-to-year percentage changes for each state equal the year-to-year percentage change in the Bureau of Labor Statistics' Consumer Index for the U.S. as a whole.

With regard to the availability variables, the price variable for distilled spirits is the retail selling price including tax of a four-fifth quart of Seagram 7 Crown. This price is selected because Seagram 7 Crown is the leading brand of liquor in the United States, and its price is commonly used as a standard in the liquor industry.[7] The own price of liquor is deflated by a state and time-specific cost-of-living index to obtain the own relative price of this variable (LIQPR). The interstate price index was developed for the year 1967 by Fuchs, Michael, and Scott (1979). Cross-sectional price indexes for years other than 1967 are developed by assuming that year-to-year percentage changes for each state equal the year-to-year percentage change in the Bureau of Labor Statistics' Consumer Price Index for the U.S. as a whole.

The independent variable generally considered and cited as an important determinant of teenage motor vehicle mortality rates is the minimum legal purchasing age. Each state has direct control of the age at which alcohol can be purchased. Typically, the same minimum purchasing age is imposed on the consumption of liquor, wine, and beer. However, a few states have two minimum purchasing ages. One is for distilled spirits and a lower one is imposed on the consumption of beer and wine. In addition, the maximum alcohol content of beer and wine is specified for the lower age group. Typically the alcohol content of beer is limited to 3.2 percent and for wine 14 percent. Since there is a high correlation between changes in the liquor and beer purchasing ages, the minimum age for liquor (AGE) is chosen.

Lewit and Coate (forthcoming) in a study of cigarette consumption have pointed out that it is difficult to define the relevant price

variable due to the purchase, by those individuals in a high price area, of cigarettes in a lower priced border area. This problem presents itself in two ways regarding alcohol consumption. Not only may the price variable be lower, but the minimum purchasing age may be lower in a border state. This problem is dealt with via the following method.

The incentive to travel to a lower price and/or age border state is higher the greater the difference between own price and lower border state price as well as own age and lower border state age. Increased travel distance will affect the probability of mortality. To control for the border phenomenon (out-of-state purchases) the difference between own price and lower border state price and the difference between own state and border state minimum purchasing age are obtained. The difference variables are not available on an individual basis, but on a state-specific basis. The difference variable will only be relevant for the percentage of the population that lives within a certain distance of a border state. The estimate of the relevant population is obtained by aggregating the population of counties that border a lower age and/or price state. The percentage of the border county population total to the state total is then multiplied by the difference variables to obtain weighted price and age differences. The weighted price difference and weighted age difference are entered as separate independent variables in the regressions. An increase in the difference variables should provide an incentive to travel to a border state.

The variable for the difference between own price and lower border state price is also divided by the state-specific cost-of-living index

to obtain the relative price difference (APDR). The difference between the own state age and border state age is denominated in years (AMD).

The availability measures are subject to government regulation. By including these variables, the effect of government regulation on teenage motor vehicle mortality can be measured.

The highway measures are for the most part self-explanatory. The effect of density and the urban-rural driving mix, however is somewhat complex. To account for urban-rural death rate differences, the ratio of urban to rural highway mileage is entered as an independent variable (URR). States which are characterized by a large percentage of rural highways should have increased distance to be traveled to places at which alcohol is available. In addition to the urban-rural mix, rural and urban densities (MUNHT, RURHT) are employed. These densities are the amount of vehicle miles per respective highway miles. Increased density is generally expected to increase the probability of an accident at a given speed and thereby the risk of death [see Peltzman (1975, p. 710)]. Increased density, however, may force the average speed to be lower and can result in fewer deaths. Rural mortality rates are typically higher than urban rates for the population as a whole. The speed limit is not taken into account directly, since data on vehicle speed are not available on a state specific basis. The inclusion of the three variables (URR, MUNHT, RURHT) should provide an indirect estimate of the effects of speed.

The socioeconomic characteristics of youths in each state are represented by four variables. The first, the state per capita personal income, is an indication of the adolescent's command over

resources. Money income is deflated by the state Consumer Price Incex to obtain real income (INCR). The number of hospitals with emergency rooms per capita (HOSP) serves as a proxy for the availability of medical resources to an accident victim. A sex and race specific education variable is entered to account for possible differences in the ability to read road signs, pay attention to safety and other factors. The final variable is the state unemployment rate (UN). Though a higher unemployment rate may reduce the command over resources to purchase alcohol, gasoline, etcetera, it will also provide more leisure time available for alcohol consumption and driving. Unemployment could have psychological effects that may lead to increased alcohol consumption.

EMPIRICAL RESULTS

The ordinary least-squares regressions of white male motor vehicle mortality rates for the three time periods are presented in Table 2. These regressions are unweighted.[8] The regressions contain the full set of independent variables that estimate the effect of alcohol availability, highway, and socioeconomic factors on motor vehicle mortality rate outcomes.

The results pertaining to the minimum legal purchasing age are strong. A decrease in the minimum legal purchasing age is generally cited as the principal cause of increased mortality rates for this group and has been changed as a direct result of state legislation. For white males the age variable has the expected negative sign for all time periods, and reaches a significant level in the third period. In this period AGE becomes significant at the 1 percent level.

TABLE 2

Regression Coefficients -- Mortality Rates White Males

Ordinary Least Squares -- All Variables Linear

	1970-71 Period 1 (n=50)		1972-73 Period 2 (n=50)		1974-75 Period 3 (n=50)	
Independent Variable	Regression Coefficient	t-Ratio	Regression Coefficient	t-Ratio	Regression Coefficient	t-Ratio
LIQPR	.056	1.06	.125	2.93	.046	1.36
APDR	-1.55	-1.40	-.077	-.089	.665	1.50
AGE	-.036	-1.01	-.011	-.725	-.024	-2.89
AMD	.092	1.85	.027	.718	.042	1.68
NLIS	.077	2.16	.069	2.33	.026	1.47
TYPCON	-.133	-2.68	-.088	-2.38	-.064	-2.58
MUNHT	-.907-04	-2.88	-.357-04	-1.96	-.210-04	-1.99
URR	-.067	-1.99	-.033	-1.53	-.049	-2.76
GCPC	.190-02	4.57	.143-02	5.13	.137-02	6.69
DL	-.060	-1.65	.026	1.027	.027	1.56
INSP	-.003	-.063	-.052	-1.53	-.018	-.802
INCR	.174-04	.200	-.692-04	-1.32	.105-04	.277
HOSP	.385	1.09	.128	.472	-.007	-.031
UN	.004	.024	-.023	-1.84	.004	.057
WME	-.104	-2.88	-.092	-3.55	-.051	-2.68
Constant	2.8159		.9421		.5120	
Adj. R^2	.733		.791		.792	
F*	9.96		13.396		13.467	

*F-ratios are significant at 1 percent level. The critical t-ratio is 1.679 at 5 percent level for a one-tailed test.

An important implication of the significant sign of the AGE variable for white males in the third period is that a lag exists between the implementation of the law reducing the MPA and the consequences thereof. Thus, studies undertaken to examine changes in both consumption and mortality immediately succeeding an age change may not accurately state the full impact of law changes.

Before estimating the full impact of a change in the minimum legal purchasing age the significance of the border phenomenon (the traveling to border states to purchase and/or consume alcohol because of a difference in the legal drinking age) will be explored. The variable AMD, measuring the difference between the own state minimum purchasing age and the border state minimum purchasing age was entered as an independent variable. The coefficient of the age difference variable (AMD) is positive and significant for two of the three time periods.

As the results show, the border problem (crossing state lines to obtain alcohol) is clearly relevant with regard to the age effects for white males. The significance of the value of the border age difference (AMD), indicates that those states which have on their border states with a lower drinking age can expect to have a higher motor vehicle mortality rate. If the incentive to search for sources of alcohol requires increased travel distance and results in driving back to the higher age state while under the influence of alcohol the cost of this search (in terms of lives) is clearly evident.

The significance of the above results is that it addresses the issue put forth by both Wagenaar (1981) and Cook and Tauchen (1982)

as to the need to consider the border problem.[9] The results suggest that studies which have concentrated on variations in mortality rates in a single state only after reductions in the MPA may understate the true cost of such legislation.

The total impact of a change in the minimum legal purchasing age can now be evaluated. A change in the MPA in one state will not only increase mortality in the state instituting the law change, but this change may also affect mortality in the border state. An important implication of the above is that a rise in the minimum legal purchasing age to 21 in all states will significantly reduce the number of teenage motor vehicle mortalities. The findings of this paper suggest that an increase in the MPA to 21 in all states would result in decrease in the mortality rate of 15-24 year-old white males by 4 per 100,000 population.[10] Thus, it can be approximated that over 700 lives per year would have been saved for this age-race group.

The results regarding the remaining independent variables are now discussed.

The coefficients of LIQPR show that the liquor price variable never has a significant negative impact on mortality. The price difference variable has the "wrong" sign, but is never significant. These results may be due to the exclusion of an appropriate price variable for beer since beer tends to be the most popular alcoholic beverage for this age group.[11]

The coefficient of the availability measure, NLIS is positive and significant for two out of the three time periods. A larger

number of licenses per capita implies increased access and lowers the cost of obtainment. While increased access may also require less travel and a possible lower probability of mortality, the positive sign of the coefficient of NLIS provides support to the contention that increased availability of alcohol adds to increases in consumption and mortality.

With regard to the availability measure TYPCON, a dichotomous variable that equals one if the state is a license state (privately-owned liquor stores) and zero if the state is a control state (state monopoly of liquor stores), the coefficient is significant for white males in all three time periods. In each time period, however, the coefficient has the "wrong" sign.

Additional analysis revealed that when TYPCON was dropped from the regression equation the license variable (NLIS) was no longer significant in the second or third periods. Thus, the impacts of NLIS must be interpreted with caution.[12]

Turning now to the highway variables, the effect of gasoline consumption per capita (GCPC) on motor vehicle mortality is clearly evident. The sign of GCPC is positive and significant for all time periods. A look back at the means of the mortality rates and gasoline consumption per capita shows the decline in both over time. This is attributed to both the higher gasoline prices which occurred in the 1970's and the reduction in the speed limit to a maximum of 55 miles per hour at the end of 1974 (see National Safety Council Reports, 1974-1975). The results indicate that the positive effect of a decline in gasoline consumption has been lower mortality rates.

The interpretation of the highway variables reflecting both driving density (MUNHT, RURHT) and the urban-rural highway mix (URR) is difficult. The variable RURHT was dropped from the analysis due to a high correlation with MUNHT. Variations in mortality rates for white males, however, can be explained by the two above variables (MUNHT, URR). For white males these highway variables (MUNHT, URR) are significant five out of six times. These results show that while increased density may increase the probability of an accident, and thereby death, the discouragement of faster driving due to this density appears to dominate. This helps to explain the persistent excess of rural over urban death rates.

The last two highway variables, DL and INSP, are not significant in any of the time periods. For the inspection variable the negative sign is consistent with the findings of Fuchs and Leveson (1967, p. 659) in their analysis of the effectiveness of vehicle inspection in reducing mortality for all age groups.

The socioeconomic variables (INCR, HOSP, WME, UN) are now briefly discussed. The effect of income is not significant for the white male group. Differences in income do not contribute to differences in mortality rates among states. The variable used as a proxy for the availability of health care (HOSP) varies in sign but is never significant. The unemployment variable (UN) is only significant in the second time period.

The education measure has a significant negative effect in all time periods. The negative sign of WME is as was expected. Higher educational levels may imply increased awareness of the dangers associated with drinking and driving.

CONCLUSIONS

The purpose of this study has been to examine the effects of government regulations on the 15 to 24 year old white male motor vehicle mortality rate. Particular emphasis was placed on the role of alcohol availability variables such as the minimum legal purchasing age in the jurisdictions under consideration.

The effects of a change in the MPA is consistent with that found by previous studies. The findings of this study, however, revealed that two additional factors must be considered when changing the MPA. Not only may changes in motor vehicle mortality be subject to a lag, but as a result of individuals crossing state borders to obtain alcohol in lower MPA states a higher probability of mortality can be expected. The implementation of a nationally mandated minimum purchasing age of 21 could significantly reduce the number of teenage motor vehicle mortalities. However, before such policy decisions are made the significant role of the highway variables as well as the unexpected results of many of the availability variables must be considered. Alternative policy changes such as increased enforcement of drunk driving, stiffer penalties for driving under the influence of alcohol, or a change in factors that affect the availability of alcohol (other than the MPA) may achieve the desired results.

The results of this study will serve as a useful reference tool for policy makers in evaluating the cost and benefits of alternative decisions in their efforts to reduce teenage motor vehicle mortality.

FOOTNOTES

*This paper is based on my dissertation research at the City University of New York Graduate School. The author wishes to thank Michael Grossman for his generous and helpful comments.

[1]The total number of licensed drivers in the United States was 125,426,582. For the 15-24 age group the number was 28,186,104. A state-by-state breakdown is presented in any edition of Highway Statistics.

[2]The minimum legal purchasing age is defined for the purchase of distilled spirits only.

[3]Suppose that y_1 is endowed income in period 1, y_2 is endowed income in period 2, the rate of interest is zero, p is the price of alcohol, the prices of c_1 and c_2 equal \$1.00, and $y = y_1 + y_2$. Then the income or wealth constraint is

$$y = pR + c_1 + c_2 \quad .$$

[4]Wyoming was dropped from the analysis due to data problems.

[5]In 1973 motor vehicle accident mortality rates of persons between the ages of 15 and 24 were as follows: 74.8 deaths per 100,000 population for white males, 22.3 for white females, 54.5 for nonwhite males, and 16.2 for nonwhite females [National Center for Health Statistics (1973)].

[6]A Chow test was conducted to determine the equality of the regression coefficients for the two race groups. The computed F-test rejected the hypothesis of the equality of the two sets of regression coefficients.

[7]Simon (1966) also adopted this methodology in his study of the price elasticity of liquor.

[8]The Goldfeld-Quandt (1965) test was applied to the regressions. In all cases the F-statistic calculated on the residuals was not significant. Thus, homoscedasticity of the error terms was assumed and unweighted analysis is appropriate.

[9]Cook and Tauchen (1982) consider the border problem by incorporating an age variable weighted by the percentage of the population that lives within a certain distance of a lower MPA state. These results, however, were unsatisfactory.

[10]This result was obtained from the following model.

$$D = a_0 + a_1 A_0 + a_2 k(A_0 - A_b) \quad \text{where}$$

A_0 = own state MPA

A_b = border state MPA

k = percentage of population living in counties that border a given state

At the sample mean:

$$\bar{D} = a_0 + a_1 \bar{A}_0 + a_2 \bar{Z}$$

where $\bar{Z} = \bar{k}(\bar{A}_0 - \bar{A}_b)$.

If A_0 were 21 in all states;

$$D' = a_0 + a_1 21 \quad .$$

To evaluate the effect of an increase in the MPA to 21 in all states:

$$D' - \overline{D} = a_1 (21 - \overline{A}_0) - a_2 \overline{Z} \quad .$$

From Table 1 in Period 3

$$\overline{A}_0 = 19.61 \qquad \overline{Z} = .225$$

$$D' - \overline{D} = (1.39)\ (-.024) - (.042)\ (.225) = .043$$

This is a 6 percent reduction in the mortality rate.

[11]Beer and wine tax rates were used as a proxy for price, but were later dropped from the analysis due to a high correlation with the liquor price variable. In preliminary work the coefficients of these variables were not significant.

The positive sign of the liquor price variable may also be due to substitution effects. Although the variable for beer price was not significant in any of the regressions both beer and illegal drugs are substitutes for distilled spirits. A higher price for liquor can result in a substituion towards beer and illegal drugs. The consumption of beer and drugs impedes the ability to drive and thus may increase the probability of mortality. The unavailability of price data for illegal drugs, however, does not enable this conclusion to be confirmed.

[12]When NLIS was dropped from the analysis the variable TYPCON was negative and significant at the 1 percent level in periods 1 and 3 and at the 10 percent level in period 2. Additional analysis on license states (n = 33) revealed that the NLIS was only significant in the second period.

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