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The effect of population safety belt usage rates on motor vehicle-related fatalities

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Abstract

The effectiveness of safety belt usage in reducing mortality and morbidity among traffic crash victims has been well established. Population safety belt usage rates have been increasing from 11% in 1980 to 68% in 1995, as measured by observational surveys sponsored by the National Highway Traffic Safety Administration (NHTSA). Safety incentive grants from NHTSA to the States with higher than average usage rates are expected to total $500 million during 1999–2003. In this paper, longitudinal annual motor vehicle-related fatality levels are analyzed by state to estimate the effect of the population safety belt usage rate on traffic fatality rates in the presence of known confounders such as alcohol use and youthful drivers. Consideration of alternative models applied to 14 years of data shows that the population safety belt usage rate (at least, at the current rates) is associated with little or no effect on reducing fatality rates. On the other hand, higher safety belt usage rates arising from states with primary enforcement laws tend to suggest reductions in fatality rates. Such results call into question the NHTSA policy of basing incentive programs on overall safety belt usage rates. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Automobile; Fatalities; Safety belts; Primary enforcement; Alcohol; Auto insurance

1. Introduction

The effectiveness of safety belt usage in reducing mortality among auto accident victims has been subject of several studies in the US (Campbell and Campbell, 1988; Rivara et al., 1999) as well as in foreign countries (Campbell and Campbell, 1986). Estimates of mortality reduction vary from 22 to 75%, but all show a protective and statistically significant reduction in mortality for belted crash victims. Auto safety regulations, including those involving safety belts, are acknowledged to have contributed to decreased fatality rates since 1980 (Zlatoper, 1989). In particular, a National Highway Traffic Safety Administration (NHTSA, 1984) sponsored study concluded that there is a 40–50% reduction in risk of fatal injury with properly used lap and shoulder belts (NHTSA, 1984). More recently, the same agency, and using data from their CODES project from seven states[1] (which merges data from death certificates, hospital discharge, emergency departments or pre-hospital providers, and accident crash reports to create a population-based dataset) found continued support for their original estimates of the size of the favorable effect of safety belts on crash victim mortality (NHTSA, 1996a).

The percentage of motoring population wearing safety belts has grown from 11% in 1980 to 68% in 1995. Installation of safety belts has been mandatory in the new cars sold in the US since 1968 (Rivara et al., 1999). The current US private passenger auto fleet is estimated to have virtually 100% installation of safety belts (NHTSA, Public Affairs Office, personal communication). While safety belts may be installed in the vehicles, crash protection comes only from their active use by drivers and their passengers; and while popula-

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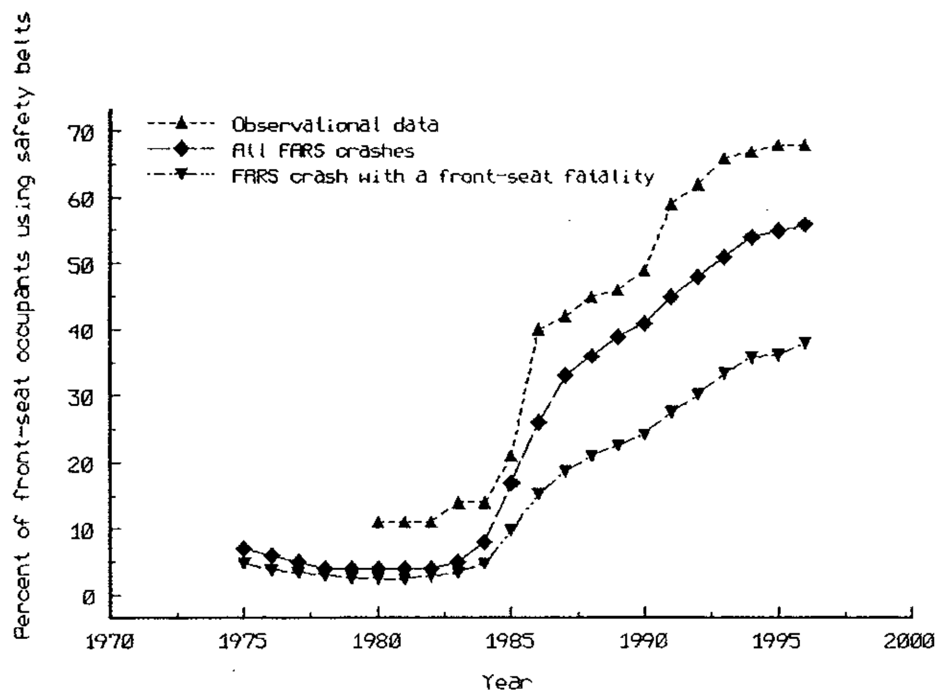

Fig. 1. Safety belt use for front-seat occupants. Observational data and FARS data. Source: Thompson et al., 1999 (reproduced with permission).

tion safety belt usage rates have risen dramatically with the passage of mandatory safety belt laws, the Fatal Accident Reporting System (FARS) data reveal that front seat occupants involved in fatal crashes is still below the 45% rates (Fig. 1) (Thompson et al., 1999).

Safety belt usage rates are affected by the passage (and repeal) of mandatory safety belt laws with either primary or secondary enforcement (NHTSA, 1996b; Rivara et al., 1999). Fig. 2 shows a pattern of increased belt use in States with primary enforcement of the mandatory safety belt laws (NHTSA, 1994, 1996a).

In an effort to further increase safety belt use and decrease the number of motor vehicle fatalities, NHTSA provides incentive grants to states that document higher than average population safety belt observed usage rates. Only during 1999–2003 and under the TEA-21 funding, a total of $500 million will be distributed (NHTSA, 1999). In order to characterize their population safety belt use, states have been using NHTSA-sponsored grants since 1981. States use statistical sampling methods in observational studies of cars on roadways to estimate usage rates by type of occupant. Data from these observations studies are available from all 50 states since 1991. For example, in Massachusetts, the 1998 observational survey estimated 51% of drivers and front seat passengers were belted (Hingson et al., 1998). These studies have an estimated direct cost of $40 000 per year per state.

In the technical literature, simple empirical or univariable model relationships of population safety belt usage rates and motor vehicle crash fatalities have been used to project lives saved (or lost) by increased (decreased) safety belt usage in the vehicle occupant population (Evans, 1987; Hingson et al., 1998). For example, in the 1998 Massachusetts study (Hingson et al., 1998), it was noted that were Massachusetts to increase its belt use from 51% of front seat occupants to meet the national average of 62%, an additional 10–15 deaths would be prevented per year.

Although the effectiveness of safety belt use in reducing the probability of death in a crash seems unquestionable, the effect of population safety belt use on fatality rates is not that clear, since the people who first choose to use a safety belt may, indeed, be the ones with the lowest likelihood of being in a severe crash. For example, Venezian (1980) documents a separation of 'good' from 'bad' drivers, with an accident frequency differential of about one to five, and Evans (1987) reports a severe crash incident rate 50% higher for unbelted drivers. It could actually be the case that there is a non-significant relation of population safety belt usage rates to fatalities due to the failure of many states to achieve sufficiently high levels of usage. The finding by Rivara et al. (1999) that primary enforcement laws are effective at reducing fatalities while secondary laws are not, points to this hypothesis.

In reality, the number of occupant fatalities in the US crashes depends not only on safety belt use, but on an array of other factors known to influence the likelihood of: (a) being in a crash; (b) the severity of the crash once a crash happens; and/or (c) the severity of the injuries sustained by the occupants; and (d) timely and appropriate health care provided to the injured.

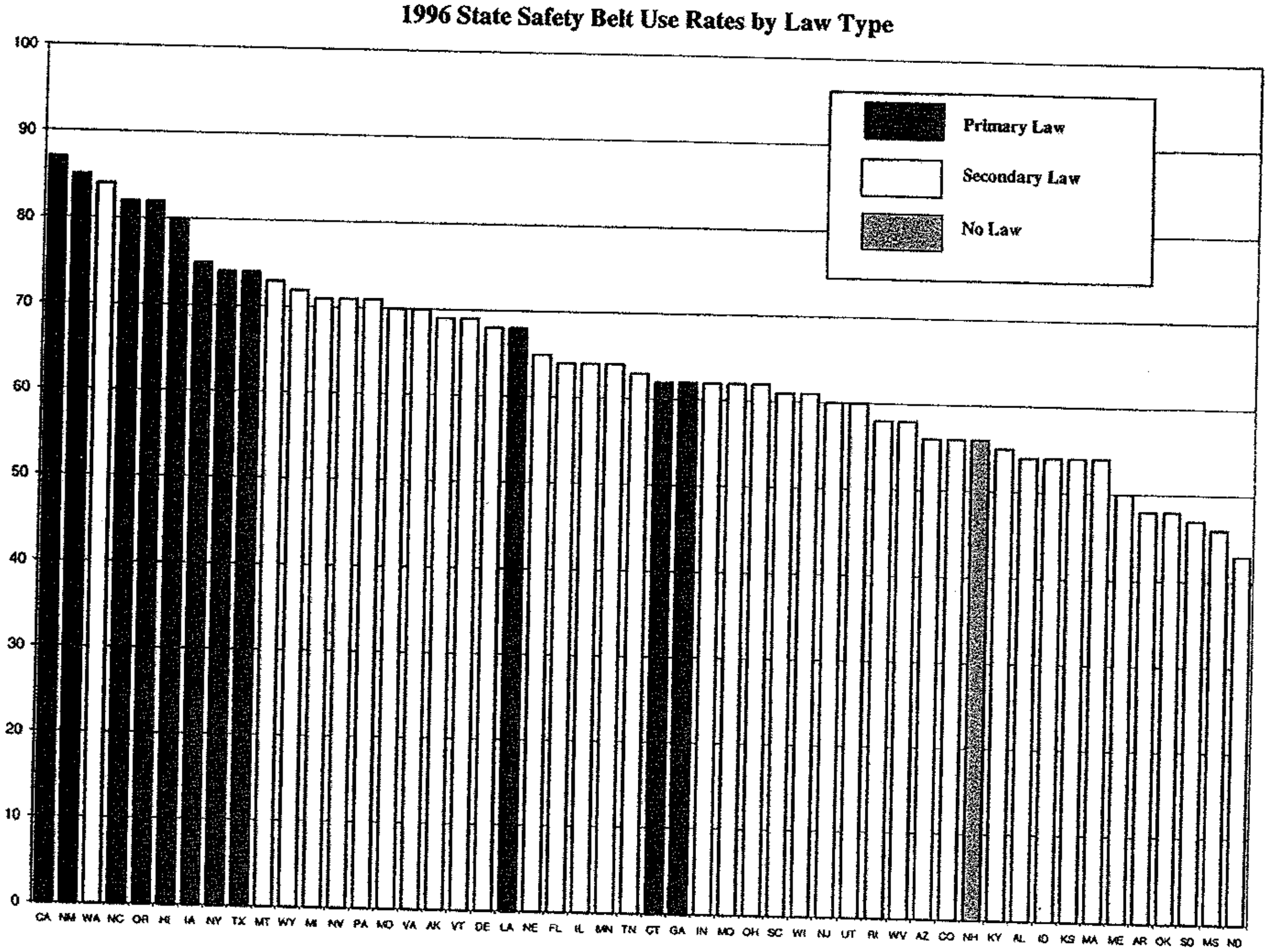

Fig. 2. 1996 State safety belt use rates by law types. Source: NHTSA, Presidential initiative for increasing seat belt use nationwide, 1996. * Primary law in Georgia passed in 1996–97.

Some of the factors associated with one or several of these stages (besides use of safety belts) include: vehicle miles traveled, type of roads (e.g. urban vs. rural), alcohol use, age, educational and income status, availability of trauma medical centers, weather and insurance type and status (Zlatoper, 1989; Dewees et al., 1996; Hu et al., 1998; Cummins and Weiss, 1999; Devlin, 1999).

A wide variety of functional forms relating fatalities and fatality rates to potential explanatory variables have been studied (Zlatoper, 1989). While it is clear that a simple fatality/safety belt usage univariable functional relationship, such as Evans (1987), is inadequate, a precise functional relationship may be difficult to support absent a complete model of automobile accident consequences. Furthermore, simultaneous equations or instrumental variables may be needed when variables exhibiting endogeneity are used (e.g. if evaluating the effect of insurance type on the fatality rates) (Cummins and Weiss, 1999).

In this study, we wanted to evaluate how general population safety belt use rates translate into changes in motor vehicle occupant fatality rates while controlling for possible confounders. Also, one wanted to evaluate the differences in findings associated with alternative proxies for the possible risky behavior incentives of the auto insurance system. Finally, one wanted to evaluate whether the NHTSA Traffic Safety Incentive program's dependence on statewide safety belt usage rates is warranted.

2. Data and methods

A panel (i.e., pooled cross-sectional) dataset of demographic, socioeconomic, political, insurance, and roadway variables was collected on all 50 US states over a 14-year period (1983–1996) for a potential total of 700 state-years.[2] The outcomes of interest were the rates[3] of

[2] A portion of the data was provided by J. David Cummins and Mary A. Weiss (Cummins and Weiss, 1999).

Table 1
Distribution of selected variable by state year[a]

	Mean	S.D.	Min	Max
Motor vehicle occupant fatalities (*N*)	600.37	584.22	34	3433
Fatality rate per VMT (10 billions)	150.95	37.17	50.74	267.35
Fatality rate per population (millions)	132.11	39.96	36.24	309.33
Roadside observational safety belts use (%)	52.27	17.16	9.5	87
Safety belt primary enforcement (0/1)	0.2	0.4	0	1
No-fault insurance (%)	28	44.93	0	100
Total population (*N* in millions)	4.97	5.37	0.45	31.78
Population between 18 and 24 years old (%)	10.88	1.24	8.01	14.07
Population over 65 years old (%)	12.26	2.17	2.87	18.55
Population living in metropolitan areas (%)	66.37	21.61	21.92	100
Population with college degree or higher (%)	20.4	4.36	9.06	33.3
Real Income per capita (1982 US$)	13064.36	2175.95	8111.43	20898.49
Alcohol consumption per capita (gallons)	2.45	0.6	1.24	5.22
Hospitals cost per day (US$)	480.58	132.5	236.41	887.81
Precipitation (in.)	36.37	15.08	7	81
Traffic density (VMT/TRM)	0.59	0.43	0.06	1.99
VMT or vehicle miles traveled (in 10 billions)	4.16	4.34	0.34	27.8
TRM or total roadway miles	77 747	50 237	3939	305 951
Democratic governor in 1974 (%)	72	45	0	100
Democratic governor in 1992 (%)	40	49	0	100

[a] $N = 700$ or 50 states per 14 years (1983–1996). Note: Observational safety belts use data exists for only 515 of the pool of 700 state years.

motor vehicle occupant crash fatalities per each state each year. This number was extracted from the Fatal Accident Reporting System (FARS 1983–1996) maintained by NHTSA. In order to be included in the study, the death had to occur to an occupant (driver or passenger) of a passenger car, light truck or minivan.

Other variables to be used in our analysis included characteristics of the population in each state and year (e.g. proportion of population ages 18–24), characteristics of the road system, miles traveled, and insurance systems in each state each year, and information on the population safety belt use. Table 1 presents a selection of these variables. Three variables were created that contained the total number of residents in each state each year, the percent of the state population between 18 and 24 years of age, and the percent of the population older than 65 years old using census data. Using data from the US Census Bureau–Department of Commerce, variables were also created to indicate the proportion of the population in each state and year living in metropolitan areas. Information regarding the real income per capita per each state year came from the Bureau of Economic Analysis (Department of Commerce). Income was transformed into 1982 constant US dollars using the Consumer Price Index. Using data from the National Institute on Alcohol Abuse & Alcoholism, a variable was created to indicate the per capita consumption of alcohol (including distilled spirits and beer). The cost of a hospital day, as an indicator of level of care, as well as the number of community hospitals, was obtained from the American Hospital Association. The education level is represented by the proportion of the population with at least college degrees as reported by the Census Bureau. The numbers of miles driven in rural non-interstate, interstate, and urban roads as well as the total miles available in each state (in each of the three types of road above mentioned) were obtained from the Federal Highway Administration. By dividing the total vehicle miles traveled by the total miles available a variable was created that reflects traffic density. Information on the insurance systems in each state and year available from the Insurance Information Institute and the Insurance Services Office (The Fact Book, 1999) was synthesized by whether the state had a no-fault, tort or mixed system. Data on the proportion of uninsured by state was provided by the Insurance Research Council (1999) (IRC). Last, data regarding the motor vehicle occupant safety belt usage were obtained from the state observational surveys through NHTSA.

Data limitations of the NHTSA observational studies restrict the statistical analyses that can be conducted. First, observational safety belt usage data are available for the full 1983–1996 period for only four states.[4] Data for all 50 states are available from 1991 to 1996.[5] This limits the analysis to 515 state years of data from the potential 700 state years of data. Second, published

[3] Fatality rates considered here are fatalities per million population and per 10 billion vehicle miles traveled.

[4] Hawaii, Nebraska, New Mexico, and Virginia.

[5] Maine and West Virginia data became available in 1991.

Table 2
Fatal/VMT covariates coefficients and statistical significance in fixed effects models[a]

Covariates or independent variables	Deterministic models					
	A	B	C	D	E	F
Population Safety belt usage rate (%)	−0.060	−0.059	−0.007	–	–	–
Primary safety belt law (Dummy)	–	–	–	−2.925	−3.442	−3.06
Insurance:						
Uninsured	−39.715	–	–	−20.384	–	–
No fault	–	−0.920	–	–	−3.895	–
MIXED	–	8.504	–	–	10.514	–
INSTR	–	–	25.276	–	–	−0.068
Education (college %)	−0.425	−0.369	−0.346	−0.302	−0.269	−0.263
Total population (*N* in millions)	20.968*	20.543*	21.638*	16.456*	16.008*	16.442*
Population between 18 and 24 years old (%)	9.114*	8.864*	7.448*	9.117*	9.002*	9.085*
Population over 65 years old (%)	−7.135*	−7.517*	9.920*	−1.82	−1.751	−1.937
Population living in metropolitan areas	0.152	0.047	−0.010	−0.131	−0.274	−0.15
Median age (years)	10.683*	10.913	11.260*	7.188*	7.197*	7.215*
Real income per capita	0.004	0.003	0.003	0.005*	0.005*	0.005*
Alcohol consumption per capita	20.604*	22.140*	25.587*	24.784*	25.17*	25.094*
Hospitals per cost per day	−0.066*	−0.066*	−0.065*	−0.063*	−0.064*	−0.064*
Hospitals (*N*)	−0.400*	−0.363*	−0.309	−0.359*	−0.356*	−0.335*
Traffic density	−43.005	−46.314	−47.627*	−79.281*	−80.893*	−81.222*
Rural interstate roads (%)	−1.834	−1.876	−1.973*	−1.356	−1.312	−1.383
Vehicle miles traveled (*N* in billions)	−16.950*	−16.388*	−16.553*	−10.834*	−10.394*	−10.584*
Precipitation	−0.487*	−0.494*	−0.405*	−0.484*	−0.489*	−0.484*
State dummy	(9/49)*	(6/49)*	(5/49)*	(12/49)*	(11/49)*	(12/49)*
N	515	515	515	515	515	515
Adj r^2	0.87	0.87	0.87	0.84	0.84	0.84

[a] Tests for fixed effects models significant at 1% level.
* Covariate significance (*) is at the 5% level. Note: Insurance proxies vary with models A and D using the rate of uninsured vehicles, models B and E using no-fault, add-on dummy variables, and models C and F using a no-fault instrumental variable. Primary enforcement of mandatory safety belt laws appears as a dummy variable in models D, E and F replacing safety belt usage rate in models A, B, and C.

statewide safety belt usage rates may not represent the same target population. Observational data may reflect driver and/or front seat and/or all occupant usage rates depending upon state and year (NCSA, 1996). Third, the methods for collecting the observations may preclude estimates of the true mean usage rate (e.g. daylight usage rates only). These data limitations allow for balanced regressions only when restricted to 1991–1996 state years.

The analyses were done in five steps: (1) univariable analysis; (2) development of an instrumental variable as one proxy for the insurance status; (3) panel data fixed effects model analysis using the alternative methods for handling the insurance system; and (4) replication of the models used in step number 3 substituting a dummy variable for primary enforcement states instead of the population safety belt use reported in the observational surveys (see Table 2). Throughout the analysis, statistical significance was defined at $P < 0.05$. SAS was the statistical software used, specifically TSCSREG: Unbalanced Data (SAS Institute Inc., 1996).

First, the effect on the number and rates of motor vehicle occupant fatality rates per state and year of each possible covariate was evaluated using Pearson's correlation (r) (Greene, 1993). Those covariates that had statistically significant effects on the outcome were considered for the multivariable regression models.

Second, the need for developing and using instrumental variables was evaluated. Instrumental variables are appropriate when the response variable (in this case, fatalities) may be a determinant of one of the covariates (Zohoori and Savitz, 1997; Newhouse and McClellan, 1998). Of all the selected covariates, only insurance type (i.e. non-fault vs. tort) was a covariate likely to be determined by the state fatality rate itself; hence, we explored the development and use of an instrumental variable that would replace insurance type in the models. Using variables that are highly correlated with the insurance status but have absolutely no relationship with the outcome of interest, motor vehicle occupant fatalities, one can build an instrumental variable that allows for making causal arguments. The appropriateness of the instrumental variable was tested here using the Hausmann Test (Greene, 1993).

Third, using the instrumental variable developed in step 2, fixed effects regression models were run (Hsiao, 1986). Three proxies for the risk-taking incentives of the insurance system were tested: the proportion of uninsured drivers, as indicative of individual risk-taking, no-fault, mixed, and tort state dummies, as indicative of a systematic incentive, and a no-fault insurance system instrumental variable.

Fourth, one simultaneously tested for the influence of primary safety belt laws by performing the analyses a second time with a primary safety belt law dummy variable.[6] It seems reasonable that if population safety belt usage rates are to affect fatalities significantly, then that effect should be more apparent in those states with primary laws (Rivara et al., 1999) which tend to have higher safety belt rate in observational surveys (Fig. 2). This addition is a test of whether the primary enforcement states provide whatever salutary effect of the population safety belt usage rate is found in step 3.

3. Results

3.1. The data

The mean number of fatalities across state-years was 600, with a range between 34 in Alaska in 1987 and 3433 in California in 1987. Motor vehicle occupant safety belt use, as reported by the observational surveys, ranged from a low 10% in Indiana (1985) to a high 87% in California in 1996. Regarding insurance status, among the 700 state years, 368 (50%) had a tort system, 171 (23%) had a mixed system, and the remaining 211 (28%) had no-fault systems. Only three states changed their insurance status in these years: Connecticut and Georgia changed from a no-fault state to a tort state in 1994 and 1992, respectively, Pennsylvania changed from a no-fault state to an add-on (mixed) state in 1985 and then back to a no-fault state in 1991. Table 1 provides a descriptive summary of the mean, standard deviation and range of selected variables across state-years. Appendix A shows the insurance system data for each state. Appendix B provides the sources of all variables.

3.2. Univariable analysis

All the evaluated variables, except three, had statistically significant effects on motor vehicle occupant fatality rates by state and year (1991–1996). Two of the exceptions were the political affiliation of the state governor in 1974 (a year concurrent with states adopting no-fault insurance) and in 1996 (the year of the most recent elections covering the years in the dataset). Those two variables were subsequently used in defining instrumental variables for insurance. The third exception was the weather proxy, precipitation, but that had a significant effect in the total (unbalanced) data.

3.3. Multivariable analysis

The coefficients and statistical significance of the covariates in each of the three insurance models used are presented for fatalities per VMT and per capita in Tables 2 and 3 respectively. Across all three sets of models, safety belt usage was associated with little or no reduction in fatality rates. The primary enforcement law appears to have a fatality rate reducing effect but fails to reach statistical significance. For the remaining covariates in the models, increases in median age, proportion of youthful (18–24) population, and alcohol resulted (as expected) in increases in fatalities. Higher college education rates, proportion of elderly drivers (65 +) and annual precipitation levels were associated with decreased fatalities. The expected negative correlation of fatalities with the availability of hospitals and trauma centers appears significant. Population and VMT variables have opposite effects on the fatality rates and achieve significance only for the vehicle miles traveled rate. Higher traffic density appears to have somewhat of a rate reducing effect.

3.4. Creating the instrumental variables for insurance

Whether the state governor in 1974 or 1996 was democratic was highly positively correlated with the existence of a no-fault insurance system for that state. Political affiliation of the governor had, on the other hand, no relationship with the number of motor vehicle occupant fatalities occurring in the states, an ideal situation for a potential instrumental variable regressor.

To create the instrumental variable, a logistic multivariable regression model was used where the dependent variable was a dummy variable indicating whether a state year had a no-fault insurance system and the independent variables were dummy variables to indicate whether the state governor was democratic in 1974 and 1996. One then defined the instrumental variable with the predicted probability that any given state year would have a no-fault system given the information regarding the governor's political affiliation in 1974 and 1996. The instrument variable validity was confirmed using the Hausman Test. Appendix A summarizes the range of the instrumental variable values across the years per each state.

3.5. The insurance system effect

The uninsured and no-fault/mixed/tort variables show insignificant effects on fatality rates in all cases. The instrumental variable appears as a significant positive effect as in Cummins and Weiss (1999), but only for one of the fatality rate per capita models.

[6] The primary safety belt law dummy assigned one to any state year in which a primary enforcement law was in effect for at least 9 months, zero otherwise.

Table 3
Fatal/POP covariates coefficients and statistical significance in fixed effects models[a]

Covariates or independent variables	Deterministic models					
	A	B	C	D	E	F
Population safety belt usage rate (%)	0.129	0.130	0.246*	–	–	–
Primary safety belt law (Dummy)	–	–	–	−5.102	−4.941	−4.844
Insurance:						
Uninsured	−1.137	–	–	20.097	–	–
No fault	–	4.738	–	–	3.548	–
MIXED	–	15.471	–	–	16.924	–
INSTR	–	–	55.167*	–	–	4.402
Education (college %)	−0.409	−0.405	−0.379	−0.436	−0.452	−0.473
Total population (N in millions)	1.354	0.807	2.792	−1.613	−2.146	−1.495
Population between 18 and 24 years old (%)	11.933*	11.793*	8.759*	12.356*	12.308*	12.154*
Population over 65 years old (%)	−11.649*	−11.668*	−16.446*	−4.476*	−4.312	−4.606
Population living in metropolitan areas	1.381*	1.430*	−1.114	1.257*	1.262*	1.241*
Median age (years)	17.540*	17.521*	18.230*	17.599*	17.536*	17.651*
Real income per capita	0.004*	0.004*	0.002	0.006*	0.006*	0.006*
Alcohol consumption per capita	19.705*	19.648*	27.500*	31.9*	31.515*	32.135*
Hospitals per cost per day	−0.064*	−0.062*	−0.060*	−0.075*	−0.074*	−0.074*
Hospitals (N)	−0.131	−0.121	−0.048	−0.038	−0.056	−0.057
Traffic density	−11.818	−13.645	−16.529	−12.14	−11.168	−11.544
Rural interstate roads (%)	−3.484*	−3.724*	−3.689*	−2.474*	−2.534*	−2.457*
Vehicle miles traveled (N in billions)	−1.370	−0.893	−1.103	3.563	3.782	3.416
Precipitation	−0.531*	−0.529*	−0.341*	−0.52*	−0.515*	−0.505*
State dummy	(44/49)*	(44/49)*	(45/49)*	(45/49)*	(45/49)*	(45/49)*
N	515	515	515	515	515	515
Adj r^2	0.92	0.92	0.92	0.89	0.89	0.89

[a] Tests for fixed effects models significant at 1% level.

* Covariate significance (*) is at the 5% level. Note: Insurance proxies vary with models A and D using the rate of uninsured vehicles, models B and E using no-fault, add-on dummy variables, and models C and F using a no-fault instrumental variable. Primary enforcement of mandatory safety belt laws appears as a dummy variable in models D, E and F replacing safety belt usage rate in models A, B and C.

4. Conclusions

Across models and regardless of whether insurance is incorporated as a dummy or instrumental variable, alcohol, median age of the population, and percent population ages 18–24, increase the motor vehicle occupant fatality rates, most of the times in a statistically significant manner. Higher proportions of the population with higher education always decrease the fatality rates, but not in a statistically significant manner. Larger proportions of safety belt use as reported in observational surveys have little or no fatality rate reducing effects when the covariates are taken into consideration. The vulnerability of older drivers and passengers to severe injuries appears to be offset at the statewide level, because of their low driving volume, resulting in a net rate reduction effect.

Risky behavior levels as proxied by insurance system variables (whether as an uninsured rate, liability system dummy or an instrumental variable) appear to have little significant effect. Cummins and Weiss (1999) finds an instrumental variable effect to be significant, similar to our finding in the per capita fatality rate modelling (Table 3, Model C).

As a result of the findings it is believed that recent increases in safety belt usage rates may not be primarily responsible for the observed decrease in road fatalities. The population safety belt usage increase may be due to risk adverse drivers and their occupants (who were very unlikely to be in a crash to begin with), while less risk adverse drivers (i.e. those who get into crashes) maintain their current behavior. NHSTA should target its efforts to increase safety belt use among this subpopulation and use whichever incentives work for that goal rather than reward overall increase in safety belt rates as shown by general population observational surveys. Increased safety belt use by the risky driver subpopulation should have the desired effect of decreased fatalities. Primary law enforcement, while generally not significantly associated overall with fatality rate reduction,[7] remains a principal legal step in convincing drivers to engage safety belts. In addition, this analysis, reinforces the primary roles of alcohol consumption, education levels, and medical facilities in the determination of fatality rates.

[7] Table 3, Models D, E, F show the primary law effect significant at the 10% level but not at the 5% level.

The analyses have some limitations. For example, except for the findings with regards to no-fault insurance when using the instrumental variable, one must remind the reader not to make any causal associations between the independent and dependent variables. In trying to circumvent this problem, other proxies were explored for the incentive effects of the auto insurance system. The missing safety belt usage rates in early years has an unknown effect on the outcomes by state. Additionally, the mixture of *types* of usage rate (i.e. the occupant types being recorded and statistical sampling strategies) by state and year questions the consistency and reliability of the observational data used as the primary independent variable. However, these same data are the data used to reward states for their safety belt use rates. While one hopes for complete and valid data to test for effects, one cannot relive the past 15 years. Thus there is little one can do to improve that information. The availability of cleaner, more complete data in the future should alleviate these problems.

A reasonable follow-up analysis to the findings reported here would be a replication of our models for subsets of the population. For example, do increases in observational safety belt use at night, or among younger occupants, relate to lowering fatality rates for these groups. Unfortunately, the degree of detail in the observational surveys does not allow for this type of evaluation. Despite these limitations, our analyses convey a very clear message. At the current population safety belt use rates, general population safety belt use is not associated with fatality reductions, which remain a very important goal for our population. In as much as one has all reasons to support and endorse general efforts to promote safety belt use in the population, it is believed that the scarce resources that one has available to combat this problem are better used targeting and encouraging safety belt use among specific populations. This should become the priority.

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Appendix A. Motor vehicle insurance characteristics by states

	Uninsured rate 1995	No fault = 2; Tort = 0; Mixed = 1	Instrumental variable (range)
Alabama	0.262	0	0.16–0.24
Alaska	0.179	0	0.001–0.004
Arizona	0.151	0	0.18–0.30
Arkansas	0.133	1	0.13–0.31
California	0.319	0	0.23–0.51
Colorado	0.343	2	0.86–0.94
Connecticut	0.091	0 (1994–1996) 2 (1982–1993)	0.93–0.97
Delaware	0.106	1	0.61–0.86
Florida	0.197	2	0.41–0.65
Georgia	0.137	0 (1992–1996) 2 (1982–1991)	0.17–0.44
Hawaii	0.084	2	0.80–0.93
Idaho	0.076	0	0.009–0.16
Illinois	0.121	0	0.10–0.13
Indiana	0.113	0	0.21–0.46
Iowa	0.100	0	0.002–0.008
Kansas	0.086	2	0.53–0.87
Kentucky	0.108	2	0.005–0.13
Louisiana	0.084	0	0.006–0.001
Maine	0.038	0	0.10–0.16
Maryland	0.166	1	0.84–0.92

Massachusetts	0.064	2	0.84–0.95
Michigan	0.114	2	0.006–0.12
Minnesota	0.118	2	0.60–0.87
Mississippi	0.247	0	0.002–0.004
Missouri	0.133	0	0.006–0.33
Montana	0.092	0	0.003–0.007
Nebraska	0.069	0	0.50–0.79
Nevada	0.163	0	0.003–0.10
New Hampshire	0.090	1	0.004–0.10
New Jersey	0.123	2	0.70–0.91
New Mexico	0.320	0	0.007–0.002
New York	0.095	2	0.79–0.88
North Carolina	0.056	0	0.27–0.55
North Dakota	0.077	2	0.27–0.45
Ohio	0.134	0	0.40–0.56
Oklahoma	0.165	0	0.34–0.57
Oregon	0.126	1	0.51–0.75
Pennsylvania	0.091	1 (1985–1990) 2 (1982–1984) 1991–1996)	0.55–0.76
Rhode Island	0.112	0	0.20–0.57
South Carolina	0.254	1	0.17–0.28
South Dakota	0.055	1	0.11–0.25
Tennessee	0.173	0	0.12–0.34
Texas	0.191	1	0.28–0.63
Utah	0.093	2	0.72–0.90
Vermont	0.087	0	0.005–0.12
Virginia	0.118	1	0.63–0.79
Washington	0.161	1	0.21–0.46
West Virginia	0.072	0	0.007–0.20
Wisconsin	0.107	1	0.19–0.40
Wyoming	0.061	0	0.001–0.007

Appendix B. Safety Belt Study Variable List

Variable	Source
Total population (N in millions)	US Census
Population between 18 and 24 years old (%)	US Census
Population over 65 years old (%)	Based on the data from US Census
Median age	US Census
Population living in metropolitan areas	Based on the data from US Census
Real income per capita	Based on the data from US Census
Alcohol consumption per capita (Gallons)	NIAAA
Hospitals' cost per day	Statistical Abstract; AHA
Number of community hospital	Statistical Abstract; AHA
Traffic density	FHWA
Rural interstate roads (%)	Based on the data from FHWA
Vehicle miles traveled (N in billions)	FHWA
Precipitation (in.)	NCDC
No fault instrument	Derived Variable
No fault (Dummy)	Insurance Facts Book
Mixed (Dummy)	Insurance Facts Book
Uninsured motorist	IRC
Occupant fatality	NHTSA, FARS
Rate of occupant fatality per million population	Calculation

Rate of occupant fatality per 10 billion VMT	Calculation
Population safety belt usage rate	NHTSA
Primary safety belt law (Dummy)	NHTSA

Note:

1. FHWA: Federal Highway Administration, Highway Statistics; Section V.
2. NCDC: National Climatic Data Center.
3. NIAAA: National Institute on Alcohol Abuse and Alcoholism.
4. AHA: American Hospital Association.
5. IRC: Insurance Research Council.

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