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The Legal Minimum Drinking Age in Texas: Effects of an Increase from 18 to 19

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Effects on motor vehicle crash involvement of raising the legal drinking age in Texas from 18 to 19 were examined, using an interrupted time-series design. Rates of single-vehicle-nighttime (SVN) and non-SVN crashes per 100,000 licensed drivers from 1978 through 1984 were examined for three levels of crash severity (serious injury, minor injury, property damage only) and four age groups (16–17, 18, 19–20, 21 and over). Results revealed significant reductions in SVN crashes for the 18-year-old target population across all levels of crash severity: serious injury, down 10.8%; minor injury, down 14.3%; and property damage only, down 12.8%. In comparison, no significant changes in SVN crashes among drivers age 21 and over were found. When the effects of macroeconomic conditions on crash rates were controlled statistically, no change in the estimated effect of the legal age law was seen. It is clear that the 1-year increase in legal age in Texas had a significant effect on youth crash involvement.

Over half of the states in the U. S. lowered their minimum legal drinking age between 1970 and 1973. After these changes, several studies found significant increases in youth alcohol-related traffic crashes, although specific results varied depending on jurisdictions studied and methods used (Cucchiaro, Ferreira, & Sicherman, 1974; Douglass, Filkins, & Clark, 1974; Whitehead, Craig, Langford et al., 1975; Williams, Rich, Zador, et al., 1975). Whitehead (1977) critically reviewed these early studies and concluded that significant increase in youth crash involvement attributable to the lowered age was consistently found in those studies using controlled methods.

In the late 1970s and early 1980s, a number of states reversed earlier actions and raised their legal minimum drinking age. Several factors appear to have encouraged this trend. First, methodologically sound research indicated substantial negative public health effects of the lower drinking age. Second, a number of government agencies,

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public interest organizations, and citizen activist groups focused attention on the drinking/driving problem (for example, The Center for Science in the Public Interest, Remove Intoxicated Drivers, Mothers Against Drunk Drivers, Students Against Drunk Driving, National Council on Alcoholism, National Transportation Safety Board, and The Presidential Commission on Drunk Driving). Third, mass media attention to drinking and driving problems increased substantially. Finally, a trend toward more conservative political and social policy may be creating an environment conducive to such increased restrictions on youth.

In the early 1980s, a number of studes were done that evaluated the short-term effects of raising the legal drinking age on youth crash involvement. Significant reductions in alcohol-related or single-vehicle-nighttime (SVN) crash involvement of 10 to 30% were typically found among those ages directly affected by the law (Hingson, Scotch, Mangione et al., 1983; Klein, 1981; Wagenaar, 1983; Williams, Zador, Harris, et al., 1983).

Not all research on the effects of increasing the minimum drinking age has shown consistent results. A 1986 study by Males, examining a number of states, reported a 6% decrease in fatal crashes among drivers affected by raised minimum drinking age laws and a 15% increase in fatalities among drivers in their first year after reaching the legal purchase age in states with raised drinking age laws. Williams (1986), however, points out that there are serious methodological problems with the Males study.

A study by Bolotin and DeSario (1985) compared 15 states that had raised their alcohol purchase age during 1979–83 with states that had not changed the purchase age during that period. The study used data on fatalities in crashes with police-reported alcohol involvement supplied by the National Highway Traffic Safety Administration's (NHTSA) Fatal Accident Reporting System (FARS). Bolotin and DeSario compared the change states with the nonchange states 2 years before and 2 years after the change date and found "no consistent pattern of decrease across the change states that can be attributed to the rise in the drinking age." Due to differences in the way states report alcohol involvement, however, NHTSA prints a warning on each page of the FARS data which indicates that they are not appropriate for comparing alcohol involvement in FARS on a state-by-state basis. Despite this warning, Bolotin and DeSario used these data for their analysis. In a critique of the Bolotin and DeSario study, Williams, Zador, and Wells (1986) suggest that "study results were derived from a measure of alcohol involvement in crashes that is useless for analytic purposes. The result is that their analysis produces inappropriate and uninterpretable comparisons."

It is clear that findings vary depending on jurisdictions studied and methods used. Despite this, the pattern of findings across the majority of sound methodological studies indicates that, in most jurisdictions, an increase in legal drinking age from 18 or 19 to 21 is followed by a decrease in the numbers of young drivers involved in alcohol-related traffic crashes.

The presumed mechanism for a reduction in traffic crashes is a change in the amount and pattern of alcohol consumption among youth. Surveys of self-reported drinking practices have identified significant changes in several dimensions of drinking behavior among young people in states that recently raised the legal age for alcohol use (Hingson et al., 1983; Williams & Lillis, 1986).

Based on evidence available to date, numerous agencies and organizations have advocated a uniform national drinking age of 21 (American College of Emergency Physicians, 1986; American Medical Association, 1983; National Council on Alcoholism, 1982; National Safety Council, 1985; National Transportation Saftey Board, 1983; Presidential Commission on Drunk Driving, 1983). In 1984 the U. S. Congress passed the Uniform Minimum Drinking Age Act; beginning in 1986, this law withholds a fraction of federal highway trust funds from states without a minimum drinking age of 21.

After the national law was passed, several states increased their legal age to 21 to avoid losing federal highway funds.[1] However,

[1]As of January 1986, there were only 13 states with

some states do not fully support a legal age of 21, even though they have passed legislation to avoid the penalities of lost federal funding. For example, Texas passed legislation in 1985 that increased its legal drinking age from 19 to 21. However, the law remains in effect *only as long* as federal sanctions for noncompliance continue.

In summary, there is considerable evidence that a higher legal age for purchase and consumption of alcoholic beverages is associated with lower rates of traffic crash involvement among young drivers. Many states have raised their drinking ages, and increasing proportions of U. S. youth do not have legal access to alcoholic beverages until age 21. Nevertheless, consensus on the exact magnitude of the expected beneficial effects of higher drinking ages has not been achieved, and the debate continues on whether the public health benefits of higher legal ages are large enough to warrant restricting youth drinking.

The present study was designed to provide additional information for consideration in these policy debates. Most studies to date have focused on a change in legal age from 18 to 20 or 21. One exception was a study of the short-term effects of Ontario's increase in legal age from 18 to 19 (Vingilis & Smart, 1981). In that study no significant reductions were found in drinking/driving convictions or monthly crash fatalities among 18-year-old drivers. The Ontario law included a grandfather clause for those already 18 when the law was passed. A survey of high-school-age youth conducted 2 months after the Ontario law was passed and a survey of high school administrators 6 months after the law was passed found limited changes in the drinking behavior of the target age group as a result of the law.

The goal of the current study was to measure the effects of a 1-year increase in the legal age for purchase of alcoholic beverages on youth crash involvement in Texas. Texas raised its legal age for drinking from 18 to 19 for all types of alcoholic beverages effective September 1, 1981. The short- and intermediate-term effects of that law were assessed, using data on motor vehicle crashes occurring between January 1978 and December 1984. Data were not yet available to measure the effects of the 1985 increase in legal age from 19 to 21.

METHOD

Design

A nonequivalent multiple time-series design was used. The design provides high levels of internal validity, strengthening interpretation of the results in causal terms (Cook & Campbell, 1979). A time-series design is the strongest design possible when random assignment cannot be used and extensive longitudinal data are available. The multiple time-series design employed in this study compares a series of observations over time for a specified population affected by a policy change (treatment group) with a control series of observations not affected by the policy change (comparison group).

Based on previous research, we hypothesized that there would be a reduction in traffic crash involvement among 18 years old in Texas following the increase in legal drinking age from 18 to 19. Because reduced accessibility of alcohol to 18 year olds may also make it more difficult for 16 and 17 years olds to obtain alcohol, the crash involvement experience of underage drinkers before and after the drinking age was raised was also examined. Two comparison groups of drivers not directly affected by the legal age change were also analyzed, drivers age 19 and 20 and those age 21 and over.

It was hypothesized that an increase in the legal drinking age would reduce crash involvement among *alcohol-impaired* young drivers, but would have no effect on the numbers of nondrinking young drivers involved in crashes. Therefore, within each of the four age groups, crashes likely to involve alcohol were compared with those not likely to involve alcohol. The comparison of these two categories of crashes helped determine whether observed changes in numbers of crashes were due to the drinking age change or other coincident factors.

Because of the unreliability of police re-

legal drinking ages below 21 (National Safety Council, personal communication, January 17, 1986).

ports concerning the involvement of alcohol in traffic crashes, an indirect measure of alcohol involvement was used. Single-vehicle nighttime (8 p.m. to 5 a.m.) crashes have a high probability of alcohol involvement. Cerrelli (1983) examined fatal crash data from 29 states and found that 68% of SVN crashes involve alcohol-impaired drivers, whereas non-SVN crashes have a significantly lower probability of involving alcohol. If increasing the legal drinking age in Texas reduced alcohol-related crashes among youth, we would expect to see larger declines in youth SVN crashes than in youth non-SVN crashes.

SVN crashes are not a prefect measure of alcohol-involved crashes, however, because a significant proportion of SVN crashes do not involve alcohol, and a number of non-SVN crashes do involve alcohol. Some scientists studying the effects of raised legal drinking ages have argued for analyses of total crash involvement by age, avoiding problems both with police data on alcohol and with measurement error associated with surrogate measures (Cook & Tauchen, 1984; Saffer, Grossman et al., 1985). Although such an approach is reasonable, it may provide less statistical power than an approach examining SVN versus non-SVN crashes. The research design must provide sufficient statistical power to detect the magnitude of the policy effect anticipated. For example, if alcohol-related injury-producing crashes decline 10% following a policy change, and 25% of all injury-producing crashes involve alcohol, the expected decrease in total crash involvement is 2.5%. With many research designs and analytic methods a 2.5% change would not be considered statistically significant. As a result, one might incorrectly conclude that the policy change had no effect. To reduce this very risk of making a Type II error, we examined SVN and non-SVN crash involvment separately.

An important reason for using the SVN surrogate measure as opposed to police-reported alcohol involvement is its reliability over time. Longitudinal consistency of the dependent variable is particularly important for time-series designs (Kendall, 1976). Any change in the measurement process may be confounded with a change in crash rates attributable to the policy change under examination. It is very unlikely that reporting to the time of a crash or the number of vehicles involved changed between 1978 and 1984. Thus, the indirect indicator SVN is a more reliable alternative than reported alcohol involvement based on the subjective observations of investigating police officers. Use of SVN crashes as a surrogate for alcohol-related crashes is well established in the traffic safety literature (Voas, 1985).

Within the four age groups and within the two categories of SVN and non-SVN crashes, comparisons were made across three levels of crash severity. The first level, *serious injury*, consisted of crashes in which there was at least one fatality or incapacitating injury. The second, *minor injury*, consisted of crashes causing nonincapacitating or possible injuries. The third, *property damage only*, consisted of crashes that only caused property damage, with no injuries reported. These categories were analyzed separately for two reasons. First, the quality of the data on traffic crashes varies by crash severity. If a crash only causes property damage, however, it may not be reported to police and therefore not be recorded in the data files used here. Because of a lower level of confidence in the property-damage crash data, they were not combined with the data from minor and serious crashes. Thus, we avoided having property-damage-only crashes skew the overall results.

A second reason for examining crash severity is the possibility that increasing the legal drinking age has differential effects by crash severity. Perhaps the young people who are least observant of legal drinking age restrictions are also those who have a higher probability of involvement in a serious crash. If so, increasing the legal age may have a larger effect in reducing minor crashes than serious crashes.

Police judgments of crash injury severity are far from perfect, and a significant proportions of injuries are not recorded by police (Barancik & Fife, 1985; Greenblatt, Merrin, Morganstein et al., 1981). Nevertheless, police records are adequate for a broad ordinal grouping of injury severity, as used here. Furthermore, there is no evidence that the quality of injury reporting changed substantially during the time period under study.

Finally, to control for changes over time in the numbers of drivers in each age group, rates of crash involvement per 100,000 licensed drivers were analyzed. Descriptive statistics for the major study variables are shown in Table 1.

Analyses

Effects of raising the minimum drinking age in Texas from 18 to 19 were examined using Box-Jenkins interrupted time-series intervention analyses (Box & Jenkins, 1976). This method uses iterative Auto-Regressive Integrated Moving Average (ARIMA) model identification, estimation, and evaluation

TABLE 1
DESCRIPTIVE STATISTICS FOR MAJOR VARIABLES

AGE	CRASHES PER 100,000 LICENSED DRIVERS				
	Crash Type	Minimum	Maximum	*M*	*SD*
16–17	SVN				
	Serious injury	1.41	13.61	7.57	2.67
	Minor injury	11.84	51.27	26.58	8.05
	Property damage only	29.66	93.70	54.59	15.30
	Non-SVN				
	Serious injury	14.36	57.26	38.11	10.16
	Minor injury	32.70	107.13	62.16	17.20
	Property damage only	326.83	1002.90	639.75	160.75
18	SVN				
	Serious injury	2.61	21.49	11.68	3.87
	Minor injury	23.31	63.82	40.80	8.59
	Property damage only	44.19	113.06	75.00	15.05
	Non-SVN				
	Serious injury	25.41	66.63	48.17	9.42
	Minor injury	49.16	130.16	86.69	17.28
	Property damage only	526.65	1092.02	803.02	115.53
19–20	SVN				
	Serious injury	7.57	16.19	11.77	2.06
	Minor injury	28.95	50.49	38.86	4.51
	Property damage only	46.85	88.70	65.74	8.84
	Non-SVN				
	Serious injury	26.47	59.94	43.03	7.54
	Minor injury	75.07	131.17	99.98	11.20
	Property damage only	475.65	887.18	672.61	89.68
21 and over	SVN				
	Serious injury	2.16	4.01	3.13	0.35
	Minor injury	8.05	11.77	9.61	0.75
	Property damage only	12.68	22.73	17.27	2.07
	Non-SVN				
	Serious injury	13.37	22.56	19.15	1.89
	Minor injury	15.11	26.13	20.40	2.13
	Property damage only	248.29	415.42	320.56	38.49

techniques for analyzing time-series data and can control for a wide variety of trend, seasonal, and other autocorrelation patterns. The form of the general seasonal ARIMA model is shown in Figure 1. Compared to alternative analytic strategies, the Box-Jenkins methods more accurately account for time-series data regularities, as evidenced by lower residual error variances (McCleary & Hay, 1980; Vigderhous, 1977).

Most models used in this study were first-order moving average, first-order seasonal moving average models operating on the seasonal differences of log-transformed crash rates. Step functions were added to the ARIMA models to estimate the effects of the drinking age intervention while controlling for cycles and other long-term patterns in the crash time series. All percent change estimates reported below are based on such intervention models. The estimates represent the percent of change in the crash rate *from the level expected* if the drinking age had not been increased.

Because the models are intrinsically nonlinear, the Gauss-Marquardt method implemented in the computer program BMD2T was used to estimate the parameters (Dixon, Brown, Engelman et al., 1983). Each model was carefully evaluated in terms of the mutiple criteria set forth by Box and Jenkins (1976). When inadequacies were found, the model was respecified, reestimated, and reevaluated until a parsimonious model was obtained that adequately accounted for all of the significant autocorrelation patterns in the original series.

RESULTS

Significant reductions in the rate of SVN crash involvement per 100,000 18-year-old licensed drivers were found at all levels of crash severity (Table 2). After the legal drinking age was increased from 18 to 19, serious-injury crashes among 18-year-old drivers declined 10.8% (Figure 2), minor-injury crashes declined 14.3% (Figure 3), and property-damage-only crashes declined 12.8% (Figure 4). Similar decreases were found for SVN crash involvement among 16–17-year-old drivers, with serious-injury crashes down 7.8% (Figure 5), minor-injury crashes down 11.2% (Figure 6), and property-damage-only crashes down 15.8% (Figure 7). In contrast to drivers age 18 and under, those age 19 and over experienced no significant change in rate of SVN crash involvement based on our criteria of .05 probability level, one-tailed test. Using a liberal significance level of .10, one might consider the 4.5% decline in serious-injury crashes and 7.8% decline in property-damage-only crashes among 19 and 20-year-old drivers evidence of a real decline. Even with such a liberal significance level, however, drivers age 21 and over experienced no change in SVN crash involvement at the time Texas raised its legal drinking age from 18 to 19. The significant reductions in SVN crash involvement among 16–18 year olds following implementation of the 19-year-old drinking law, with no comparable reductions among drivers 21 and over, indicate that the new law was primarily

FIGURE 1
GENERAL SEASONAL ARIMA MODEL WITH TRANSFER FUNCTION

$$Y_t = \frac{(1-\Theta_1 B^s - \ldots \Theta_Q B^{sQ})(1-\theta_1 B - \ldots \theta_q B^q)u_t + \alpha}{(1-\Phi_1 B^s - \ldots \Phi_P B^{sP})(1-\phi_1 B - \ldots \phi_p B^p)(1-B^s)^D (1-B)^d} + \frac{(\omega_0 - \omega_1 B - \ldots \omega_s B^s)}{(1-\delta_1 B - \ldots \delta_r B^r)} (I_{t-b})$$

p = order of the auto-regressive process
d = degree of nonseasonal differencing
q = order of the moving-average process
P = order of the seasonal auto-regressive process
D = degree of seasonal differencing
Q = order of the seasonal moving average process
s = seasonal span
Φ_1 to Φ_P = seasonal auto-regressive parameters
ϕ_1 to ϕ_p = regular auto-regressive parameters
Θ_1 to Θ_Q = seasonal moving-average parameters
θ_1 to θ_q = regular moving-average parameters
u_t = random (white noise) error component
α = constant
B = backshift operator such that $B(z_t)$ equals z_{t-1}
ω_0 to ω_s = transfer function shift parameters
δ_1 to δ_r = transfer function memory parameters
I_t = step (or pulse) function
b = delay parameter

TABLE 2
CHANGES IN MOTOR VEHICLE CRASH INVOLVEMENT ASSOCIATED WITH RAISING THE LEGAL MINIMUM DRINKING AGE IN TEXAS: TIME-SERIES MODELING RESULTS

AGE	CRASH TYPE	ADJUSTED R^2	t-RATIO	% CHANGE
16–17	SVN			
	Serious injury	0.58	1.78	– 7.8*
	Minor injury	0.84	3.41	– 11.2
	Property damage only	0.86	7.71	– 15.8*
	Non-SVN			
	Serious injury	0.83	1.62	– 4.3
	Minor injury	0.86	7.17	– 14.7
	Property damage only	0.95	1.22	–
18	SVN			
	Serious injury	0.51	1.74	– 10.8*
	Minor injury	0.66	4.88	– 14.3*
	Property damage only	0.66	1.71	– 12.8*
	Non-SVN			
	Serious injury	0.63	3.03	– 8.1*
	Minor injury	0.74	1.43	– 9.7
	Property damage only	0.82	0.84	–
19–20	SVN			
	Serious injury	0.26	1.41	– 4.5
	Minor injury	0.16	0.35	–
	Property damage only	0.57	1.55	– 7.8
	Non-SVN			
	Serious injury	0.69	3.91	– 8.1*
	Minor injury	0.31	0.52	–
	Property damage only	0.84	0.15	–
21 and Over	SVN			
	Serious injury	0.58	0.76	–
	Minor injury	0.49	0.24	–
	Property damage only	0.69	0.47	–
	Non-SVN			
	Serious injury	0.74	0.97	–
	Minor injury	0.69	0.80	–
	Property damage only	0.86	0.08	–

Note. Calculations based on crash rates per 100,000 licensed drivers.
*Percent change is significantly different from zero; $p < .05$; one-tailed test.

responsible for the 8 to 16% declines observed among teenagers.

An alternative method for estimating the effects of the raised drinking age is examination of relative rates. Relative rates of SVN crash involvement were derived by dividing the rate of SVN crashes among 18-year-old drivers by the rate among those age 21 and over for each crash severity category. This rate controls for changes in crash involvement due to factors that are not age-specific. Time-series modeling results revealed significant declines in SVN crash involvement among 18-year-old drivers relative to those age 21 and over. Specifically, the relative rate of serious-injury crashes declined 9.5% ($t = 1.84$), minor-injury crashes declined 7.6% ($t = 2.32$), and property-damage-only crashes declined 7.8% ($t = 2.69$).

Reductions in the rate of non-SVN crash

FIGURE 2
RATE OF SVN SERIOUS-INJURY CRASHES PER
100,000 LICENSED 18-YEAR-OLD DRIVERS IN TEXAS

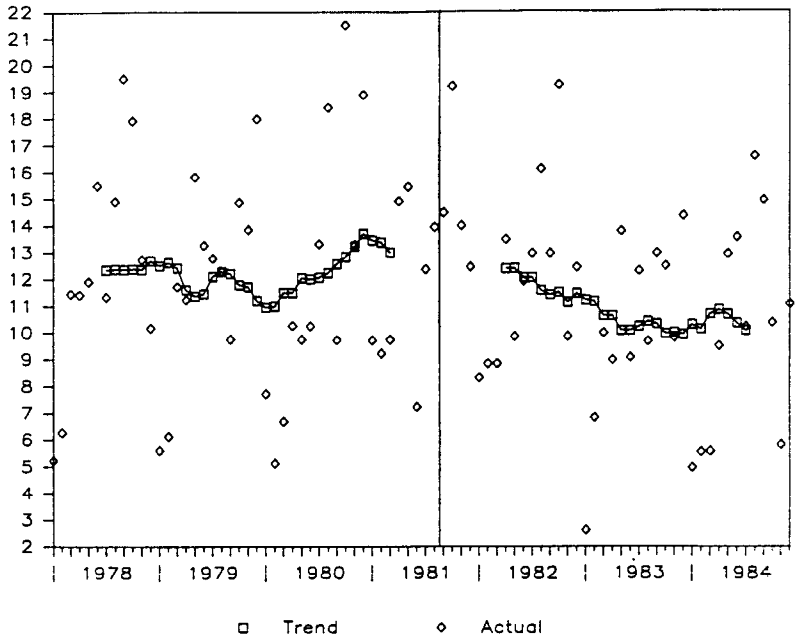


FIGURE 3
RATE OF SVN MINOR-INJURY CRASHES PER
100,000 LICENSED 18-YEAR-OLD DRIVERS IN TEXAS

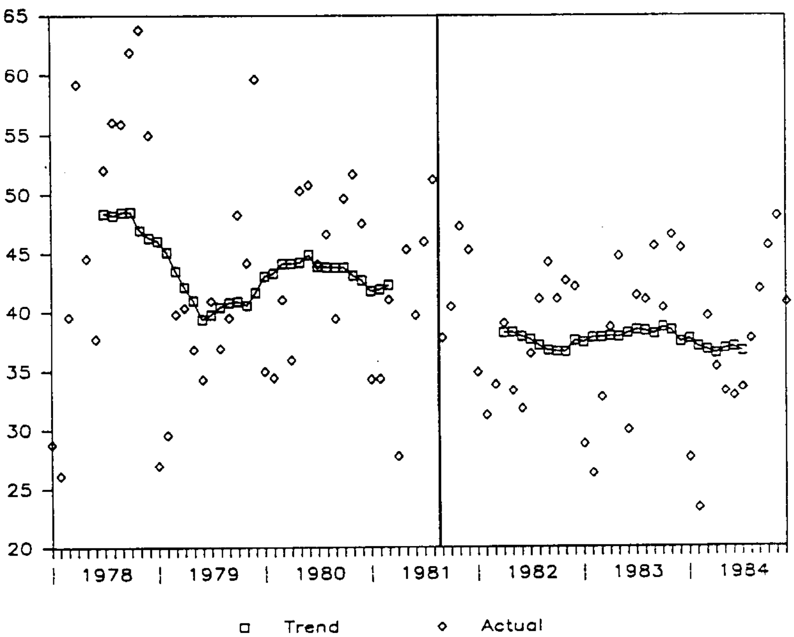


FIGURE 4
RATE OF SVN PROPERTY-DAMAGE-ONLY CRASHES PER
100,000 LICENSED 18-YEAR-OLD DRIVERS IN TEXAS

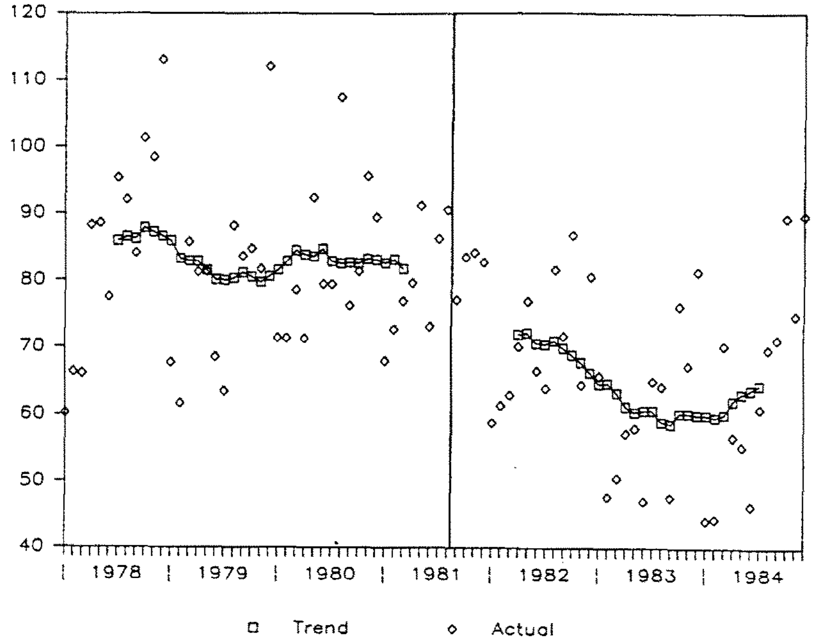


FIGURE 5
RATE OF SVN SERIOUS-INJURY CRASHES PER
100,000 LICENSED 16–17-YEAR-OLD DRIVERS IN TEXAS

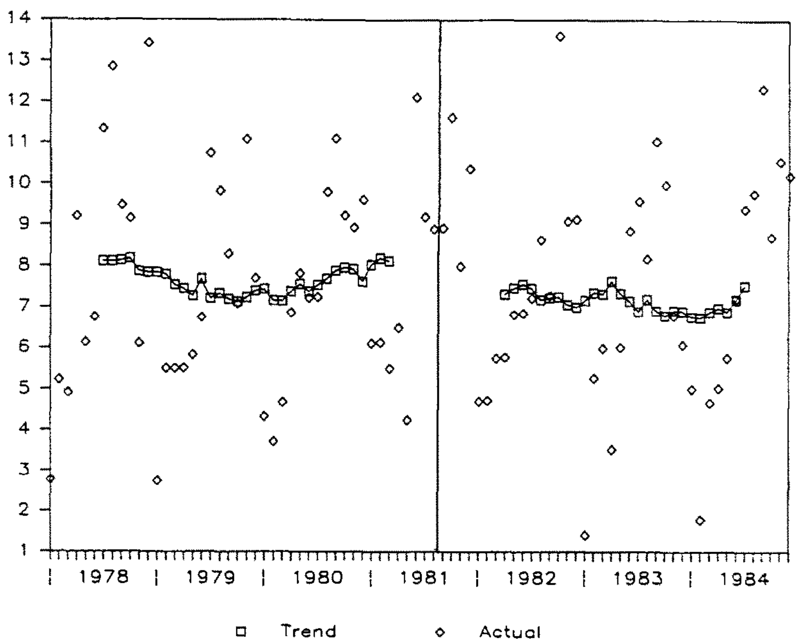


FIGURE 6
RATE OF SVN MINOR-INJURY CRASHES PER
100,000 LICENSED 16–17-YEAR-OLD DRIVERS IN TEXAS

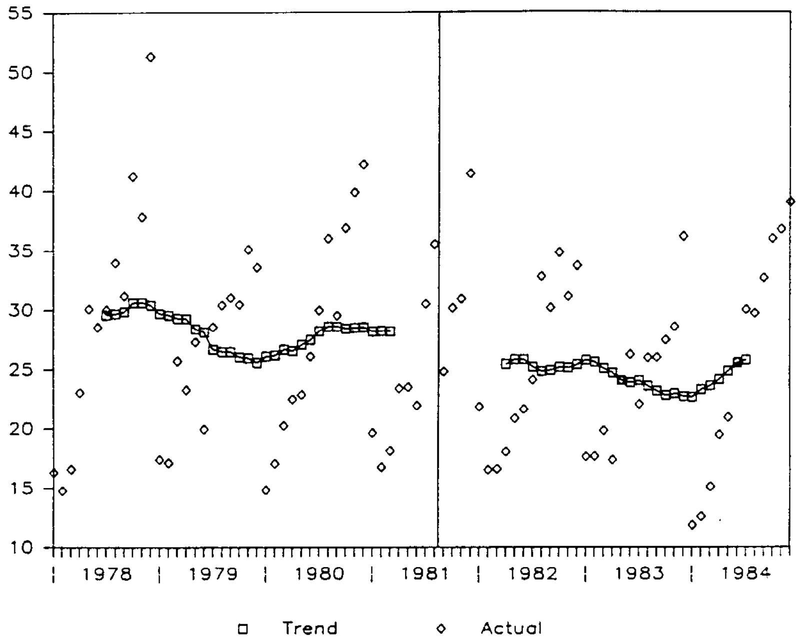
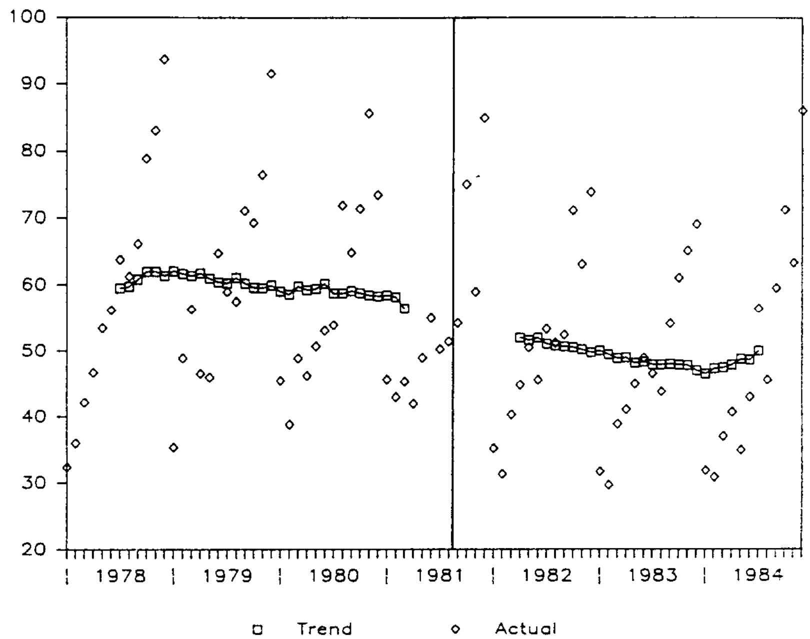


FIGURE 7
RATE OF SVN PROPERTY-DAMAGE-ONLY CRASHES PER
100,000 LICENSED 16–17-YEAR-OLD DRIVERS IN TEXAS



involvement among 18-year-old drivers were consistently smaller than reductions in SVN crash involvement (Table 2). This pattern is consistent with the hypothesized effect of the legal age and the assumption that SVN crashes are more likely to involve alcohol than non-SVN crashes.

Results indicated that 19- and 20-year-old drivers may have experienced a slight decline in crash involvement at the time the drinking age was increased. The evidence for this decline is weak, with only the 8.1% decrease in non-SVN crashes significant at $p < .05$ and nonsignificant decreases in SVN crashes for two of the three severity categories examined (Table 2). However, if 19- and 20-year-old drivers experienced crash reductions at the time the legal age was increased from 18 to 19, perhaps part of the decline in crash involvement among 18-year-old drivers was due to the same factor(s) that caused the declines among those 19 and 20. One important factor known to influence driving patterns and aggregate crash rates is the state of the economy (Wagenaar, 1984). To ensure that the observed crash reductions among 18-year-old motorists were not partially due to coincident changes in macroeconomic conditions, additional time-series models were developed including economic indicators as covariates.

The time-series model for SVN crash involvement among 18-year-old drivers is shown in Equation 1 of Figure 8. Standard errors are shown below each parameter estimate. Converting the −0.11 estimate of the intervention effect (based on natural logarithm transformation of the dependent variable) to a percent change produces the 10.8% decrease listed in Table 2. A new model for SVN serious-injury crash rate among drivers age 18 was then developed, including the industrial index of production for Texas as a covariate. The lag structure for the relationship of the production index on crash rates was based on analyses of the cross-correlation function for those two variables. Cross-correlations at lags 5 and 7 months were the only ones that approached significance and were therefore included. Final estimation results produced the model shown in Equation 2 of Figure 8, in which I_t represents a step function at September 1981 when the legal drinking age was raised and X_t represents the industrial production index in Texas.

Two features of this model are noteworthy. First, the production index covariate had no significant relationship to the rate of SVN serious-injury crashes among 18-year-old drivers. Second, and more importantly, inclusion of the production index covariate produced virtually no change in the legal age intervention effect (−0.11 in Equation 1 and −0.12 in Equation 2). The analyses were repeated using the unemployment rate as the covariate. The result was the model shown in Equation 3 of Figure 8, in which I_t

FIGURE 8
TIME-SERIES MODELS
INCORPORATING ECONOMIC INDICATORS

1. $$\operatorname{Ln} Y_t = \frac{(1 - \underset{(0.043)}{.85}B^{12})(1 + \underset{(0.113)}{.178}B)u_t}{(1-B^{12})} - \underset{(0.66)}{.11}I_t$$

2. $$\operatorname{Ln} Y_t = \frac{(1 + \underset{(.0672)}{.0922}B - \underset{(.052)}{.829}B^{12})u_t}{(1-B^{12})} - \underset{(.107)}{.12}I_t \quad (-\underset{(1.538)}{.745}B^5 - \underset{(1.551)}{.775}B^7)X_t$$

3. $$\operatorname{Ln} Y_t = \frac{(-\underset{(.046)}{.835}B^{12})(1 + \underset{(.117)}{.190}B)u_t}{(1-B^{12})} - \underset{(.099)}{.13}I_t + \underset{(.219)}{.27}X_t$$

represents a step function at September 1981 when the legal drinking age was raised and X_t represents the unemployment rate in Texas.

No significant effect of the unemployment covariate was found, and virtually no change in the estimated effect of the legal age change (−0.11 in Equation 1 versus −0.13 in Equation 3) was evident. These results clearly demonstrate that the reduction in rate of SVN serious-injury crashes among 18-year-old drivers at the time the drinking age was increased is not attributable to corresponding changes in economic conditions.

DISCUSSION AND CONCLUSIONS

The findings support the hypothesis that the increase in legal age in Texas was associated with a decrease in youth crash involvement. Statistically significant declines for all three levels of crash severity were found only among drivers age 18 and under (who were expected to be influenced by the legal change) and only for SVN crashes (which have a higher probability of involving alcohol). No significant decreases in any crash category occurred among drivers age 21 and over at the time the drinking age was raised. Statistical controls for changes in macroeconomic conditions, as measured by the industrial index of production and the rate of unemployment, had no effect on the magnitude or significance of the estimated impact of changing the legal drinking age.

Results of the current study support the contention that efforts to prevent alcohol-related motor vehicle crashes among youth should focus on changes in broader social and policy environments, not on attempts to modify the behavior of individual drinking drivers. This is also supported by recent studies of the longer-term effects of raised purchase ages (Arnold, 1985; DuMouchel, Williams, & Zador, 1985; Wagenaar, 1986) and by studies of other public policies concerning young drivers. Effective prevention tools reduce the number of people in high-risk groups and reduce the number of occasions of high-risk activities. The amount of youth drinking/driving can be reduced by increasing the legal driving age (Williams, Karpf, & Zador, 1983). The amount of youth driving can be reduced through curfew hours, requirements for adult supervision, or other restrictions in opportunities to drive (Preusser, Williams, Zador et al., 1982). All of these policies reduce aggregate exposure to risk of involvement in an alcohol-related crash. Such policies also reduce the privileges of a single age group, while not directly affecting other age groups, such as those age 21 and 24, who are significantly overrepresented among alcohol-impaired crash-involved drivers.

Although not directly examined in this paper, an alternative policy that may have a large effect on youth drinking/driving is increasing the price of alcohol. A price policy would apply to *all* drinkers and not be limited to a single age group. The effects of price changes on youth drinking have received relatively little research attention, with the notable exception of Grossman and associates (Grossman, Coate, & Arluck, in press; Saffer, Grossman et al., 1985). Saffer, Grossman et al. conducted detailed comparisons of the estimated effects of changes in alcohol excise taxes with estimated effects of a national drinking age of 21. Results indicated modest increases in alcohol taxes would reduce youth alcohol consumption more than a national uniform legal drinking age of 21. Increasing alcohol taxes, and consequently alcohol prices, as a way to reduce alcohol-related problems has a number of advantages. First, the excise tax is easily manipulated via public policy. Second, it is not limited to a single age group, thus eliminating the potential fairness issues that age-specific policies raise. Third, because youth are particularly susceptible to the effects of beverage prices, an increase in excise tax would have a larger-than-average effect on young drinkers, a group that has higher-than-average rates of alcohol-related problems. The advantages of a price policy do not eliminate the benefits of the minimum legal drinking age. Multiple prevention avenues are required to achieve substantial reductions in the major public health problems associated with the use of alcoholic beverages.

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