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16. Abstract

We measured the long-term effect of Michigan's child restraint law on injuries to children covered by the law, and intermediate effects of Michigan's adult seat belt use law on injuries and fatalities among those affected by the law. Monthly frequencies of crash-induced injuries and fatalities from January 1978 through December 1986 were analyzed using Box-Jenkins time-series methods. Exposure to injury risk was controlled by examining injury rates based on population, number of crashed vehicles, and vehicle miles traveled.

The following statistically significant effects were associated with the child restraint law:

- 29.5% reduction in frequency of injured children,
- 26.8% reduction in the rate of injured children per vehicle mile traveled,
- 31.8% reduction in the rate of injured children per crashed vehicle, and
- 29.0% reduction in the rate of injured children per population.

The following statistically significant effects were associated with the adult seat belt law:

- 12.5% reduction in the frequency of injured occupants age 16 and over,
- 10.7% reduction in the rate per vehicle mile traveled of injured occupants age 16 and over,
- 12.6% reduction in the rate per crash of injured occupants age 16 and over,
- 13.0% reduction in the rate per population of injured occupants age 16 and over, and
- 19.7% reduction in rate per crashed vehicle of front-seat fatalities among occupants age 10 and over.

Estimated reductions in the frequency (19.5%), rate per vehicle mile traveled (17.2%), and rate per population (19.0%) of front-seat fatalities following the implementation of the adult belt law were not statistically significant.

Based on these results, the child restraint law has prevented 3,283 injuries, representing cost savings of $30.8 million since implementation. The adult belt law has prevented 43,493 injuries, a cost savings of $548.1 million since implementation.

17. Key Words	18. Distribution Statement
Motor vehicle crashes, Injuries, Occupant restraint laws, Seat belts, Time-series analysis, Social costs	Unlimited

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Findings, conclusions, and recommendations in this report are solely the authors' and do not necessarily reflect the views of the Michigan Office of Highway Safety Planning or the National Highway Traffic Safety Administration.

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1 INTRODUCTION

This is one of a series of reports on crash-related injuries in Michigan (Wagenaar, 1984a; Wagenaar and Webster, 1985; Wagenaar and Maybee, 1986; Wagenaar, Maybee, and Sullivan, 1987). The specific objectives of this report are to: (1) evaluate long-term (57 month post-law period) effects of Michigan's child restraint law; (2) evaluate intermediate-term effects of Michigan's adult compulsory seat belt use law (18 month post-law period); and (3) monitor motor vehicle crash injury frequency and rate trends in the state.

This study differs from our other studies designed to evaluate the effects of Michigan's occupant restraint use policies. Periodic direct observation surveys of belt use assess the effects of these policies on observed vehicle occupant seat belt and child restraint use (e.g., Wagenaar, Molnar, and Businski, 1987, 1988). Our continuing study of hospital injury records will provide information on changes in specific types of injury (e.g., head, neck, thorax, abdomen) associated with restraint laws (Margolis, Wagenaar, and Liu, 1988). The study reported here evaluated effects of Michigan's occupant restraint policies on aggregate injury and fatality frequencies and rates, based on police-report crash data. In addition, the current study estimated aggregate economic savings to the people of the State of Michigan produced by decreased fatality and injury rates following implementation of compulsory restraint use laws.

Literature reviewed in previous reports in this series indicates that compulsory occupant restraint use laws can significantly increase the proportion of drivers restrained, and reduce crash-related injuries and deaths. Selected recent reports, which were not available at the time of previous reviews, are briefly summarized here.

Petrucelli (1987) reported that New York State's adult compulsory use law produced benefits in terms of reduced serious and fatal crashes. Based on police reports, the frequency of occupant fatalities declined 16.9%, and frequency of serious injury to vehicle occupants declined 14%, comparing 1985 figures with the previous five-year average. Rood and others (1987) estimated that New York State's law was effective in: (1) increasing belt use rates from 16% before the law to 46% eight months after the law was implemented; (2) decreasing fatalities 18%; and (3) decreasing moderate and serious motor vehicle crash injuries 18% to 20%.

The Connecticut Office of Highway Safety (1988) reported that implementation of a compulsory seat belt use law in that state resulted in no change in fatality rates, but a significant

decrease in serious and moderate injuries (3% and 9%, respectively). Interestingly, they also noted a significant 8% increase in minor injuries and a 9% increase in property damage only crashes.

Using time-series methods, Reinfurt and others (1987) found that traffic fatalities had declined 7.6% after North Carolina's belt law was implemented; moderate and serious injuries declined 9.8%. The authors concluded that injury reductions were not larger for the following reasons: (1) at least 30% of those in crashes were exempted from the law (e.g., rear-seat occupants); (2) 28% of the crash victims were not restrained at the time of the crash despite the legal requirement; and (3) changes in state population, economic activity, and driving mileage were not controlled.

Wagenaar, Webster, and Maybee (1987) examined child restraint laws in 11 states for their effect on motor vehicle fatality rates. Using Fatal Accident Reporting System (FARS) data from 1976 to 1983, time series were constructed by summing data across the 11 states for 54 months before and 12 months after child restraint laws were implemented in each state. Results of time-series modeling indicated no observable effect of the laws. Possible reasons for the lack of a significant effect of child restraint laws on fatalities were: (1) low frequency and high variation in the number of fatalities among young children; (2) analyses were heavily weighted by California which had a relatively small reduction in injured children, compared with other states; (3) incorrectly used restraint devices may not protect children in very severe crashes; and (4) in some jurisdictions, the rate of child restraint use may not have increased sufficiently after implementation of the law to affect child fatality rates.

In a time-series study of the first eight states to enact adult seat belt use laws, Wagenaar, Maybee, and Sullivan (1987) found a statistically significant 8.7% decline in the rate of front-seat fatalities associated with the laws. The fatality rate declined 9.9% in states with primary enforcement and 6.8% in states limited to secondary enforcement. Rear-seat and nonoccupant fatalities did not change at the time belt use laws were implemented.

Rutherford (1987) found reductions in the total number of crash victims, cases involving multiple injuries, injuries to the brain and chest, and facial injuries due to the seat belt law in the United Kingdom. He compared frequencies the year before the date of implementation of the seat belt law to the year after its implementation. The data were on all motor vehicle occupants coming to the emergency departments of 14 hospitals over two years. Rutherford found the total number of injured patients declined 14.6% after the law. The number of patients with severe injuries declined 20% for drivers and 24% for front-seat passengers.

Marburger and Friedel (1987) studied effects of a seat belt law in another European country, West Germany. They found that the number of vehicle occupant fatalities decreased 15% to 20% following the introduction of fines for lack of belt use for both front- and rear-seat passengers.

Although estimates of the effects of compulsory occupant restraint use laws vary, it is clear that these policies can be effective in reducing injuries and fatalities resulting from motor vehicle crashes. The purpose of this study is to estimate the effect of Michigan's occupant restraint policies on aggregate injury and fatality frequencies and rates.

2 METHODS

2.1 Research Design

A monthly **time-series** design was used to control for numerous factors influencing the number of crash injuries and fatalities that were evident in multi-year trends, cycles, or other patterns. Analyses of the effects of the child restraint law reported here were based on the same 51-month baseline (January 1978 through March 1982) used in previous studies of the short- and intermediate-term effect of the child restraint law (Wagenaar, 1984b; Wagenaar and Webster, 1985; Wagenaar and Maybee, 1986; and Wagenaar and others, 1987). However, 57 months of post-child-restraint-law data are reported here, compared to 45 months of post-law data examined in the 1987 report (Wagenaar and others, 1987). Analyses of the effects of the adult seat belt law were based on a pre-law baseline of 90 months (January 1978 through June 1985). Eighteen months of post-law data on crash-induced injuries were available (July 1985 through December 1986), whereas the previous report included only six months of post-law data.

2.2 Data Collection

Data on **injured occupants** involved in motor vehicle crashes were obtained from the Michigan State Police. Records were obtained for all traffic crashes in the State of Michigan reported to local or state police agencies. Information was collected on occupant age, sex, injury severity, and whether they were restrained at the time of the crash. **Fatality** data were obtained from the Fatal Accident Reporting System maintained by the National Highway Traffic Safety Administration. Monthly front-seat fatality totals were computed for occupants age 10 and over riding in passenger cars, vans, and light trucks. Injuries and fatalities involving ambulances, buses, specialized vehicles, and medium and heavy trucks were excluded as they are either exempt from the provisions of Michigan restraint laws or are covered by pre-existing laws or regulations. In addition to analyses of injury and fatality frequencies by month, we examined rates per vehicle mile traveled, per population, as well as rates of injury or death per crashed vehicle.

2.3 Statistical Analyses

The primary goal of these analyses was to estimate shifts in each injury and fatality time series associated with implementation of the child restraint law in April, 1982, and the adult

seat belt law in July, 1985. The Box-Jenkins and Box-Tiao (Box and Tiao, 1975; Box and Jenkins, 1976) methods were employed to control for long-term trends and seasonal cycles and to estimate any changes beginning the first month after the laws took effect. The Box-Jenkins approach is a versatile time-series modeling strategy that can model a wide variety of trend, seasonal, and other recurring patterns.

At a conceptual level, the analytic strategy involves explaining as much of the variance in each variable as possible on the basis of its past history, before attributing any of the variance to another variable, such as passage of a law making restraint use compulsory. The intervention-analysis approach is particularly appropriate for the present study, since the objective was to identify significant shifts in injury and fatality rates associated with the child restraint and adult seat belt laws, independent of observed regularities in the history of each variable. Without these methods, incorrect conclusions can be made. For example, a change in injuries might be fully attributed to a specific intervention, when in fact it is entirely consistent with a pre-existing multi-year cycle in injuries. In short, controlling for baseline trends and cycles with time-series models produces more accurate estimates of the effects of restraint use legislation. A more detailed discussion of the methods can be found in the first report of this series (Wagenaar, 1984a).

3 RESULTS

Time-series models were developed to measure the effects of four interventions designed to increase occupant restraint use in Michigan:

1. A public information and education (PI&E) program occurring January 1 through March 31, 1982, before the child restraint law was implemented;

2. Implementation of a child restraint law from April 1, 1982 through December 31, 1986;

3. Public information campaigns and mass media coverage of the passage and signing of the adult seat belt law from April 1 through June 30, 1985; and

4. Implementation of an adult seat belt law from July 1 through December 31, 1986.

Estimates of injury and fatality reductions are presented as percent change figures with their corresponding t-ratio values in Table 3.1. These data are also summarized in a single chart (Figure 3.1). A plot of each outcome measure analyzed, along with the form of the ARIMA time-series model is provided in Appendix A.

3.1 Estimated Reductions in Frequencies and Rates of Injuries and Fatalities

The child restraint law was effective in reducing motor vehicle crash injuries among children under age 4. Analyses revealed the following statistically significant injury reductions following implementation of Michigan's child restraint law:

- 29.5% reduction in frequency of injured children,
- 26.8% reduction in the rate of injured children per vehicle mile traveled,
- 31.8% reduction in the rate of injured children per crashed vehicle, and
- 29.0% reduction in the rate of injured children per population.

The effects of Michigan's adult seat belt law are approximately half as large as the effects of the child restraint law. Analyses showed the following statistically significant injury reductions were associated with the adult belt law.

- 12.5% reduction in the frequency of injured occupants age 16 and over,

Table 3.1: Effects of Michigan's Occupant Restraint Laws on Injury and Fatality Frequencies and Rates

	PI&E Effect Percent Change	*t*-ratio	Law Effect Percent Change	*t*-ratio
Age 0-3				
Injury rate per VMT	2.4	.28	-26.8	3.76*
Injury rate per crash	-17.8	2.29*	-31.8	9.56*
Injury rate per population	-2.6	31	-29.0	3.83*
Injury frequency	-3.2	.39	-29.5	4.11*
Age 16+				
Injury rate per VMT	-6.6	1.28	-10.7	1.79*
Injury rate per crash	-2.1	.64	-12.6	8.94*
Injury rate per population	-5.1	1.03	-13.0	1.87*
Injury frequency	-4.5	.93	-12.5	1.92*
Age 10+				
Fatality rate per VMT	- 4.2	.38	-17.2	1.42
Fatality rate per crash	-11.8	1.01	-19.7	3.70*
Fatality rate per population	-1.7	.14	-19.0	1.38
Fatality frequency	-2.0	.16	-19.5	1.40

* p<.05, one-tailed test

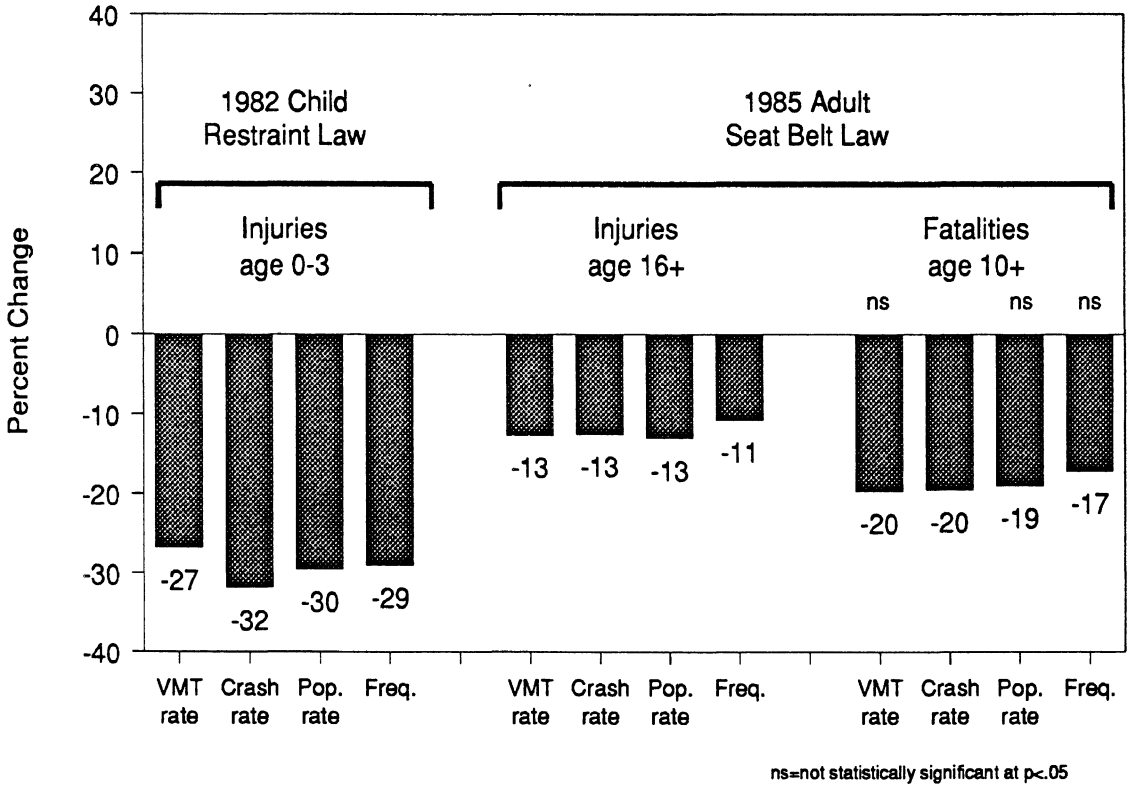

Figure 3.1: Effects of Michigan's Occupant Restraint Laws on Injury and Fatality Frequencies and Rates

- 10.7% reduction in the rate per vehicle mile traveled of injured occupants age 16 and over,
- 12.6% reduction in the rate per crash of injured occupants age 16 and over, and
- 13.0% reduction in the rate per population of injured occupants age 16 and over.

Among the following estimated reductions in fatal injuries to front-seat occupants age 10 and over, only the 19.7% reduction in the fatality rate per crashed vehicle was statistically significant:

- 19.5% reduction in frequency of front-seat fatalities among occupants age 10 and over,
- 17.2% reduction in rate per vehicle mile traveled of front-seat fatalities among occupants age 10 and over,
- 19.7% reduction in rate per crashed vehicle of front-seat fatalities among occupants age 10 and over, and
- 19.0% reduction in rate per population of front-seat fatalities among occupants age 10 and over.

Although three of the four fatality estimates were not significant, this does not mean that the adult belt use law had no effect on fatalities. Each of the estimates is in the predicted direction, and the fact that these estimates were not statistically significant may be due to smaller numbers of fatalities compared to the number of injuries observed in Michigan. Smaller counts mean a higher proportion of total variance is random, that is, cannot be explained by baseline patterns. More random variation over time increases the variance of time-series model parameter estimates, which makes finding a significant difference more difficult.

All but one of the time-series models indicate small injury or fatality declines in the three months before the adult seat belt law took effect. However, the sizes of pre-law decreases in injuries and fatalities associated with media attention prior to the implementation of the law were not consistent, and were statistically significant in only one case. The modest 6-percentage-point increase in observed belt use between passage and implementation of the adult law was not large enough to cause an identifiable decrease in injuries or deaths. Although all but one of the estimates was in the predicted direction, variability in estimates across measures and their sizable standard errors suggest that if there is an effect of this pre-law media attention, it is small. Having determined that Michigan's restraint laws are effective in reducing injuries and fatalities resulting from motor vehicle crashes, we turn now to economic savings resulting from these reductions.

3.2 Economic Benefits from Restraint Laws

Recent studies have proposed alternative approaches to valuing the injury and loss of life resulting from traffic crashes. Kragh and others (1986) compared current approaches to calculating injury costs. They suggest the willingness-to-pay method best represents the totality of costs related to traffic injuries and death. This method involves an assessment of several cost categories: (1) consumption goods (i.e., goods and services not used during the remaining lifetime); (2) human capital costs (loss of ability to perform vocational and avocational work); (3) psychosocial and quality of life costs (mental anguish, drug abuse, family problems, missed opportunities, loss of contact with friends/community); and (4) value placed on life and safety (money, time, freedom, and other measures of what one is willing to pay to reduce injuries). Currently the National Highway Traffic Safety Administration (NHTSA) employs the human capital plus consumption approach to calculate injury costs, whereas the National Safety Council uses only consumption estimates. Clearly, there are numerous estimates of the costs of each crash-related injury or fatality.

To estimate the savings in dollars to the State of Michigan and its residents, both the human capital and the willingness-to-pay approaches were used. Table 3.2 shows the number of injuries avoided as well as the cost savings for each level of injury severity using the "KABC" injury severity scale. K-level injuries are injuries caused by the crash that resulted in death within 90 days of the incident. A-level injuries are incapacitating injuries which prevent injured persons from continuing activities they were capable of performing prior to the injury. B-level injuries include nonincapacitating injuries that are evident to observers at the scene of the crash in which the injury occurred. C-level injuries are possible injuries reported or claimed but which are not fatal, incapacitating, or nonincapacitating evident injuries (National Safety Council, 1983). We adjusted all cost figures to represent current 1988 dollars.

Table 3.2: Cost Savings from Michigan's Occupant Restraint Laws

	Injuries Prevented	Willingness-to-Pay Approach	Human Capital Approach
Children			
A-injuries	81	$2,622,780	$1,497,609
B-injuries	167	1,443,882	996,489
C-injuries	323	1,285,217	1,110,797
Annual Savings: Children	571	$5,351,879	$3,604,895
Savings Since Implementation of Child Restraint Law	3,283	$30,773,304	$20,728,146
Adults			
Fatal	44	$56,975,776	$21,511,732
A	2,447	79,233,860	45,242,583
B	5,048	43,956,264	30,336,228
C	9,822	39,081,738	33,777,858
Annual Savings: Adults	17,397	$219,247,638	$130,868,401
Savings Since Implementation of Adult Seat Belt Law	43,493	$548,119,095	$327,171,003
Total Savings Due To Michigan's Occupant Restraint Laws	46,776	$578,892,399	$347,899,149

3.2.1 Cost Savings from Michigan's Child Restraint Law

We stated earlier that Michigan's child restraint law reduced the frequency of motor vehicle crash-related injuries to children under four years of age by 29.5%, preventing 577 injuries each year since the implementation of the child restraint law. Estimates of the number of A-, B-, and C-level injuries were calculated by multiplying the total annual estimated injury reduction figure (571) by the proportion of total injuries accounted for by each level. Approximately 14.1% of all nonfatal injuries are level A injuries, 29.3% are level B injuries, and 56.6% are level C injuries. The "willingness to pay" approach estimates annual savings of $5.35 million due to the child restraint law. Total savings since the law was implemented in April, 1982 to the end of 1987 are estimated to be $30.77 million. The "human capital" approach estimates annual savings of $3.60 million due to the law, resulting in a total savings of $20.73 million from 1982 through 1987. Estimated cost savings are summarized in Table 3.2.

3.2.2 Cost Savings from Michigan's Adult Seat Belt Law

Michigan's seat belt law reduced nonfatal injuries for vehicle occupants age 16 and over by 12.5%. This 12.5% decline translates into an annual reduction of 17,353 nonfatal injuries due to the adult seat belt law. Estimates of the number of A-, B-, and C-level injuries were calculated by multiplying the total annual estimated injury reduction figure (17,353) by the proportion of total injuries accounted for by each level. Approximately 14.1% of all nonfatal injuries are classified level A, 29.3% are level B injuries, and 56.6% are level C injuries. Annual injury cost savings is $162.27 million using the "willingness to pay" model. Using this model, a total of $405.67 million has been saved because of injury reductions due to the adult law from its implementation in mid-1985 to the end of 1987. Annual injury cost savings of $103.36 million are estimated using the "human capital" model, resulting in a total savings of $273.39 million due to the adult belt law from its implementation through 1987 (Table 3.2).

Of the four measured reductions in fatalities, only the 19.7% drop in fatality rate per crashed vehicle was statistically significant. Despite the lack of statistical significance for three of the four fatality decline estimates, we conclude that the adult seat belt law has reduced traffic fatalities because each of the estimates is in the hypothesized direction. However, we believe the 19.7% figure may be overly optimistic. Evans (1987) reported that seat belt use can be expected to reduce fatalities by around 43%. That is, if everyone who wasn't using seat belts prior to the law began doing so, there would be a 43% decline in fatalities due to the law (all else being equal). However, only about one-quarter of vehicle occupants who did not use belts prior to the

law have begun to do so since. Therefore, the maximum reduction in fatalities due to increased belt use in Michigan we could expect would be about 10.8%.

In an earlier study of multiple states, we found that Michigan's adult belt use law resulted in a 4.1% reduction in fatalities when the percent reduction figures were adjusted taking into account the experience in a control state. Using this more conservative and empirically based 4.1% reduction, we estimate that the adult belt law prevented at least 44 fatalities each year since its implementation. The willingness-to-pay model estimates this fatality reduction would produce savings of $56.98 million per year, or a total of $142.44 million from its implementation in July 1985 to the end of 1987. The human capital model estimates annual savings of $21.51 million from fatalities prevented by the belt use law, resulting in an estimated $53.78 million saved as a result of fatality reductions from mid-1985 through 1987.

In summary, a total of 46,776 injuries have already been prevented as a result of Michigan's restraint laws, representing a total cost savings of $578.89 million using the willingness-to-pay model, and $347.90 million using the human capital model.

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Appendix A

Time-series Charts

This appendix contains time-series plots of each variable examined. When examining the plots, note that the solid line represents a centered moving average line, which is useful for discerning overall trends. The moving average trend line was created by summing the six data points preceding and the six data points following each point for which the moving average was calculated and dividing this sum by 12 to provide the average. This procedure is replicated for each of the data points in the series with the exception of the first and last six points. These points are omitted since a full set of 12 data points, 6 preceding and 6 following each data point are necessary for calculating the moving average.

Trend lines are provided to make it easier to determine trends across time and pre-post law differences in frequencies and rates. Patterns of raw data points often have substantial "noise" or variance around a general trend that may mask patterns in the data. Trend lines eliminate much of this "noise," thus making interpretations about general trends and pre-post law differences more straightforward. Note differences in the vertical axis scale across plots. Understanding the scale used is critical for assessing the magnitude of discontinuities associated with the restraint laws.

All estimates of law effects (percent change figures) are based on carefully developed Box-Jenkins time-series models for each dependent variable. Percent change figures are calculated as the percent change of the post-intervention period from the levels that were expected given baseline (pre-law) patterns. All estimates reported here are statistically significant ($p<.05$, one-tailed test) unless specifically noted to the contrary.

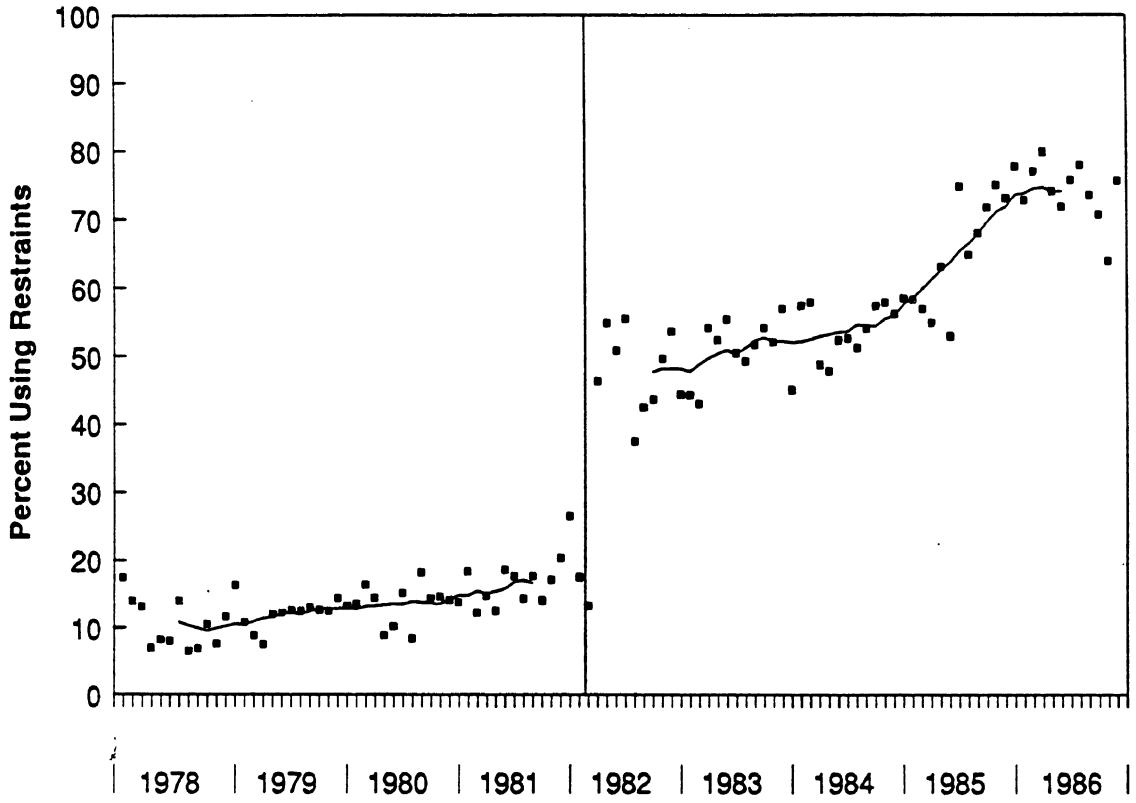

Figure A.1 Restraint Use Among Injured Occupants Age 0-3

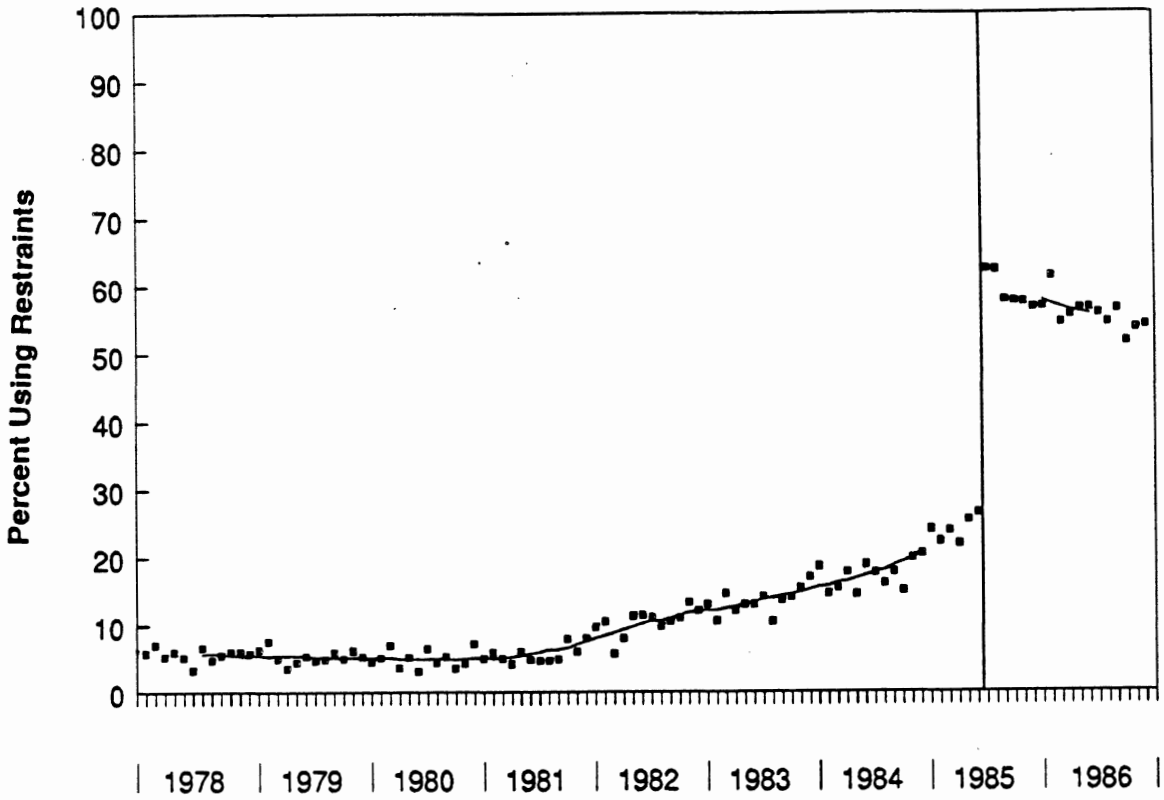

Figure A.2 Restraint Use Among Injured Occupants Age 4-15

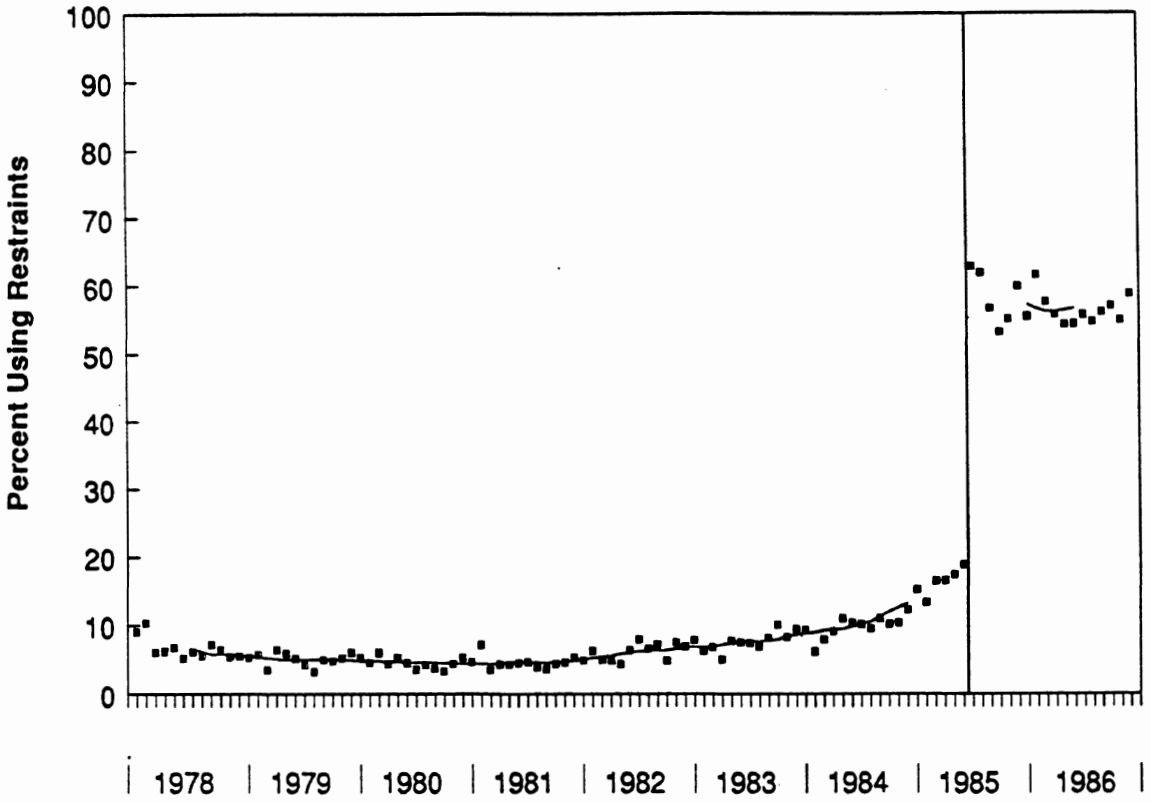

Figure A.3 Restraint Use Among Injured Occupants Age 16-17

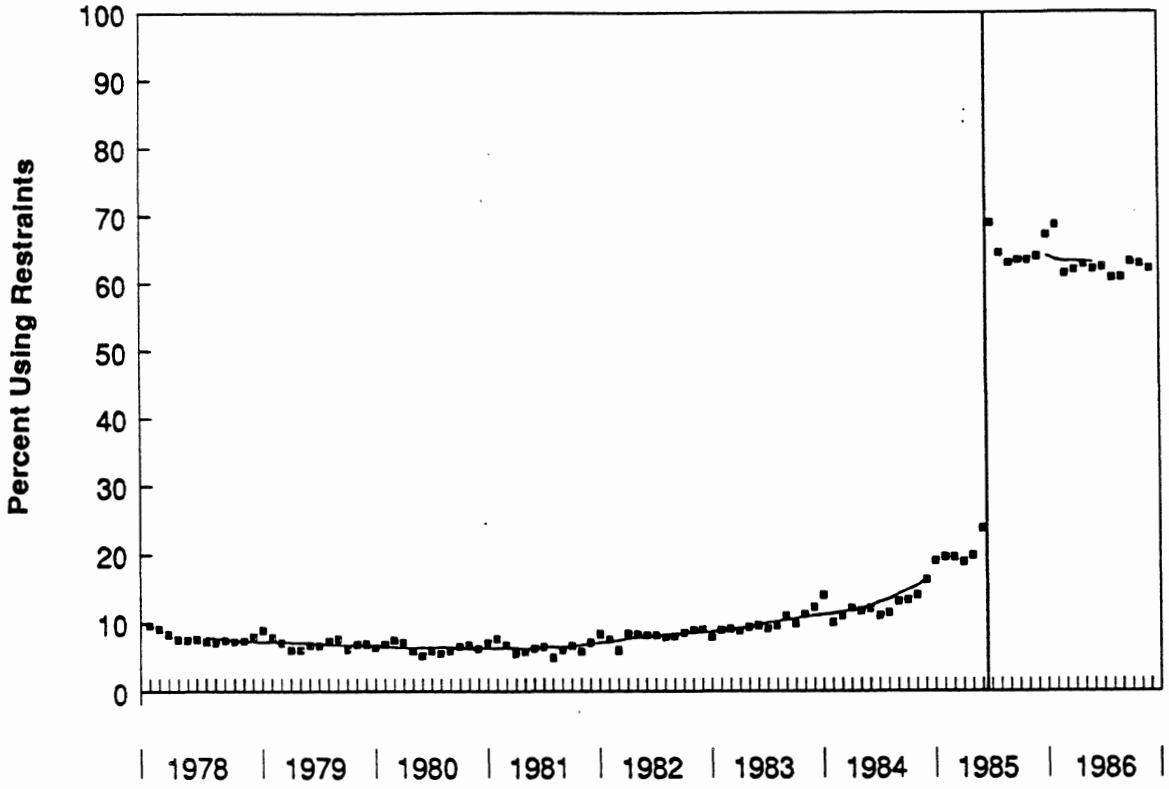

Figure A.4 Restraint Use Among Injured Occupants Age 18-24

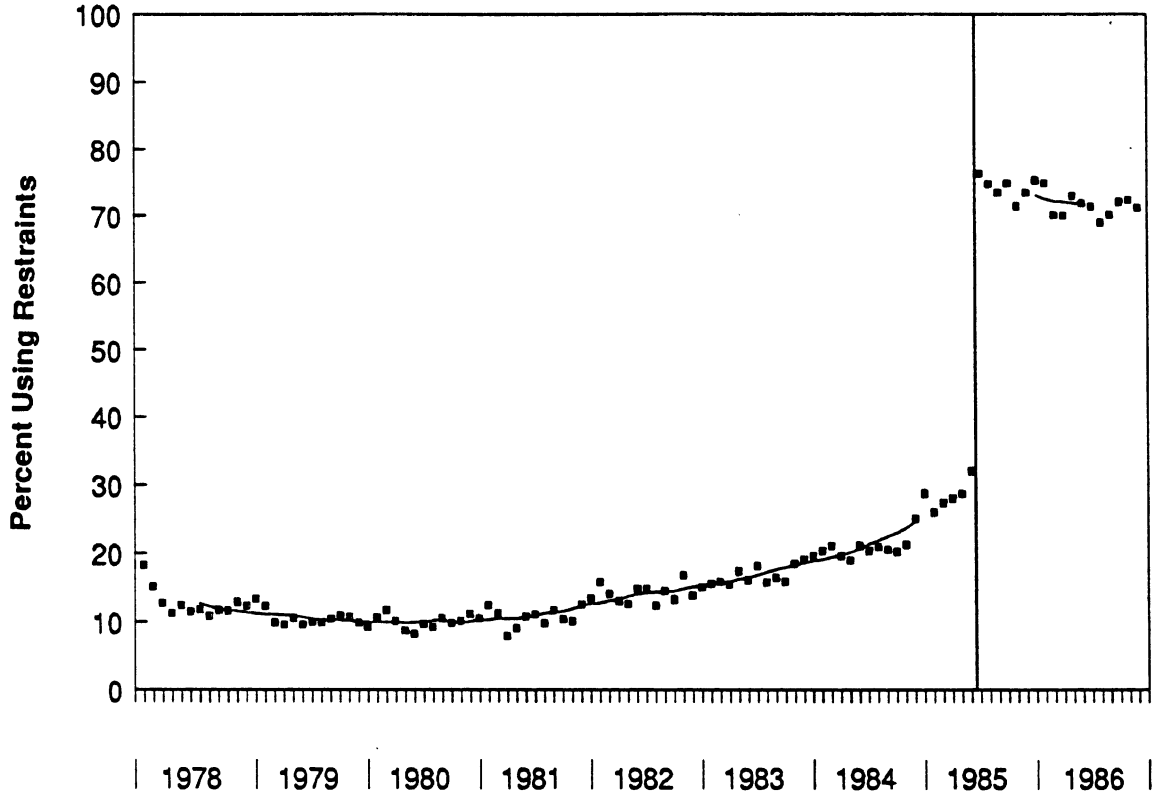

Figure A.5 Restraint Use Among Injured Occupants Age 25-34

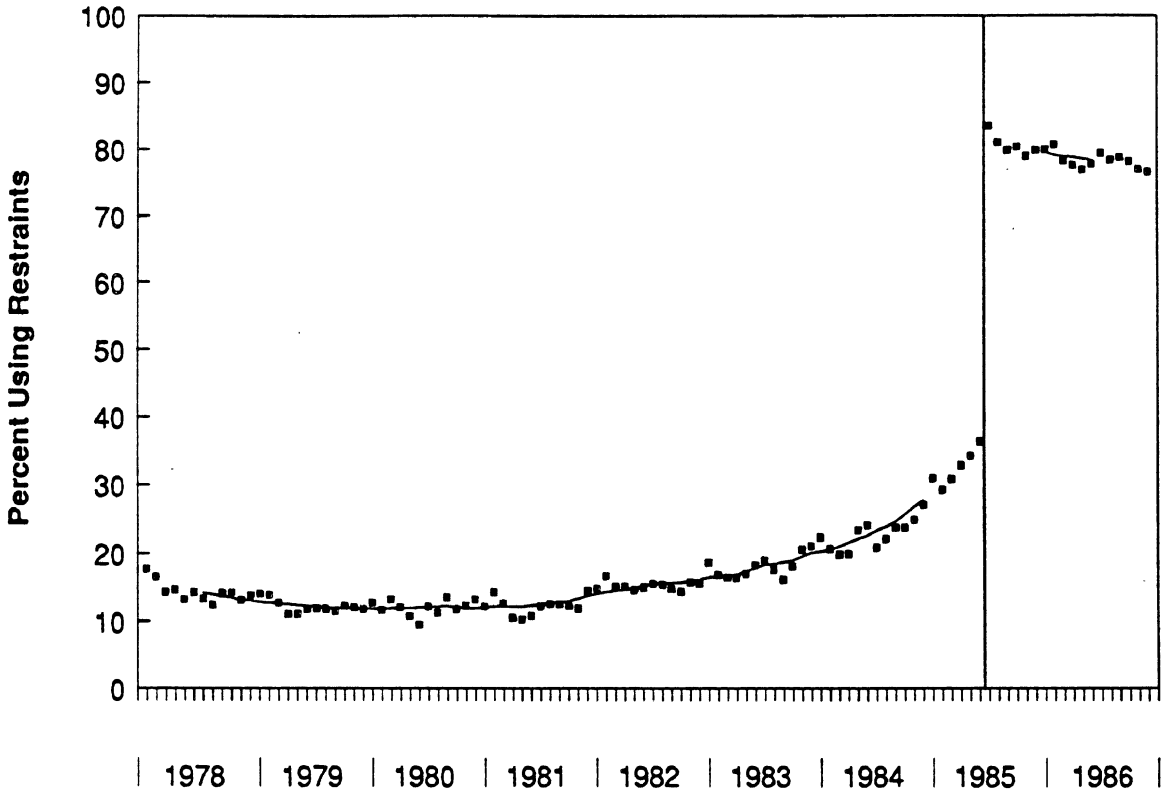

Figure A.6 Restraint Use Among Injured Occupants Age 35-54

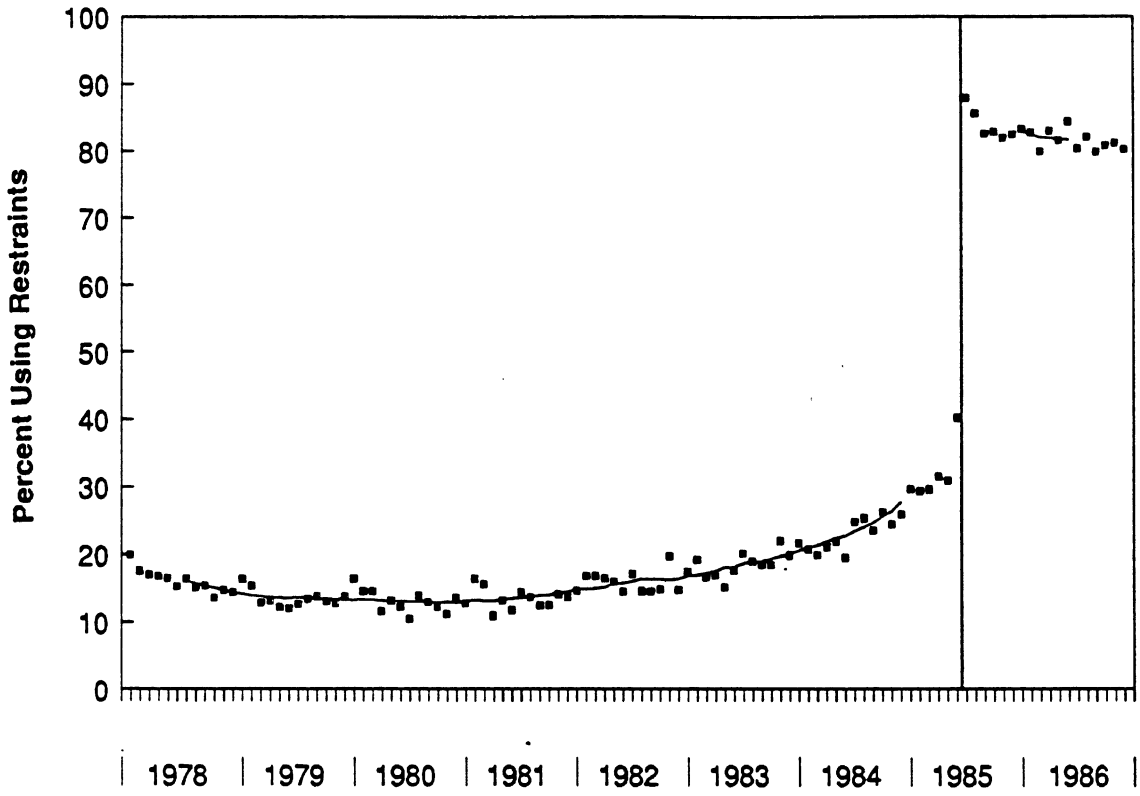

Figure A.7 Restraint Use Among Injured Occupants Age 55 and Over

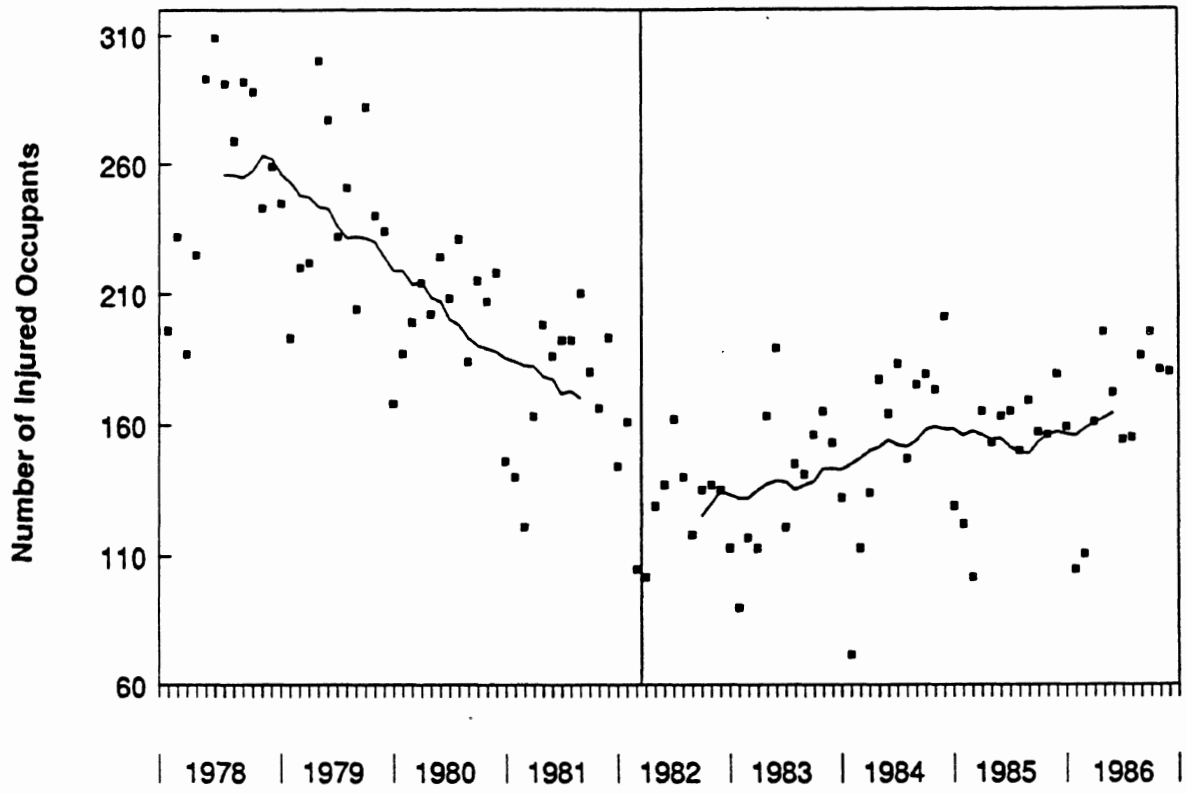

Figure A.8 Number of Injured Occupants Age 0-3

	Percent Change	*t*-Ratio
Effects of CRD PI&E, January-March 1982	-3.16†	0.39
Effects of CRD Law, April 1982-December 1985*	-29.46	4.11

Baseline time-series model: ARIMA $(0,1,5)\ (0,1,1)_{12}$

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* Effective date of mandatory child restraint law was April 1, 1982.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

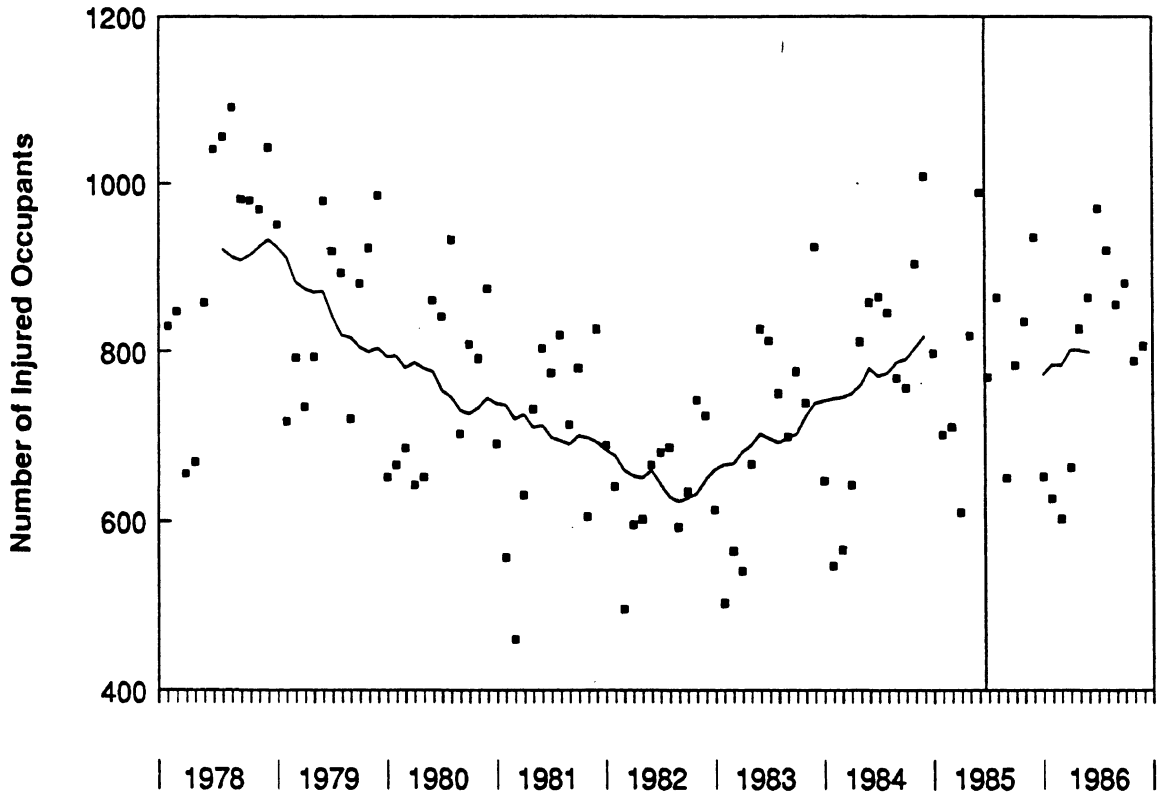

Figure A.9 Number of Injured Occupants Age 4-15

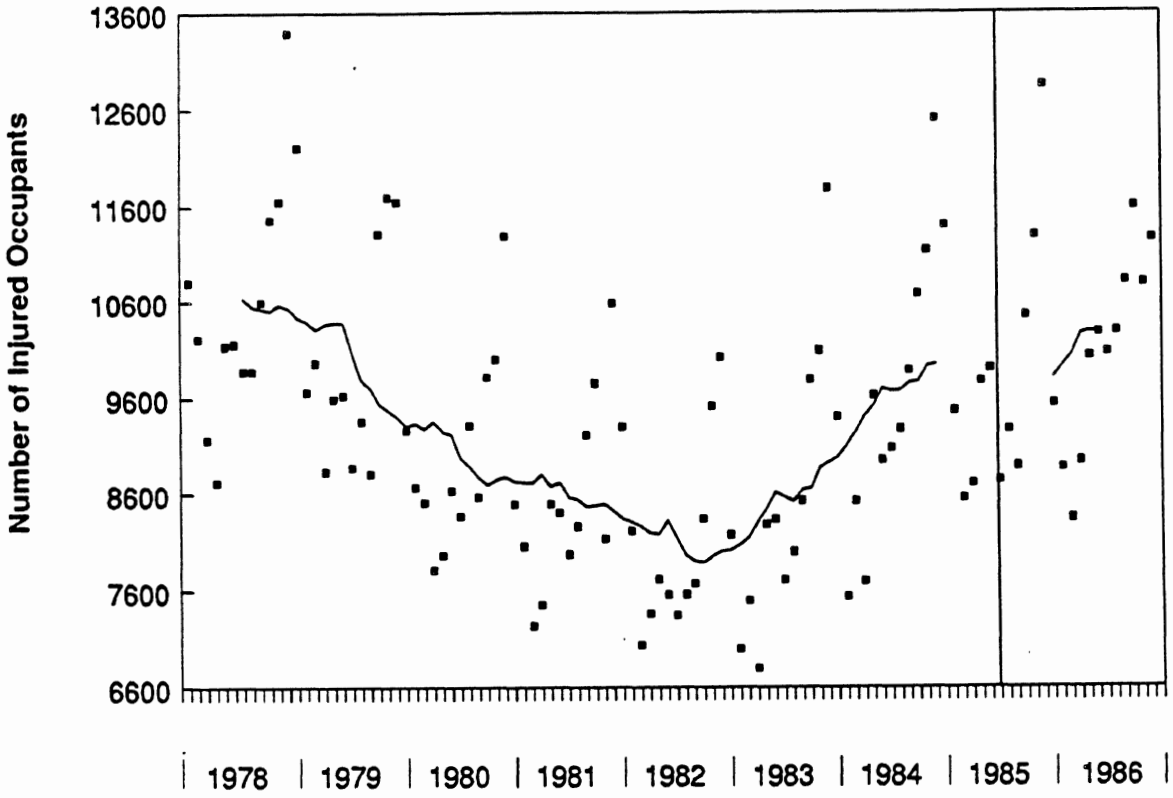

Figure A.10 Number of Injured Occupants Age 16 and Over

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-4.49†	0.93
Effects of Adult Law, July 1985-December 1985*	-12.49	1.92

Baseline time-series model: ARIMA $(0,1,4)\ (0,1,1)_{12}$

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* Effective date of adult seat belt law was July 1, 1985.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

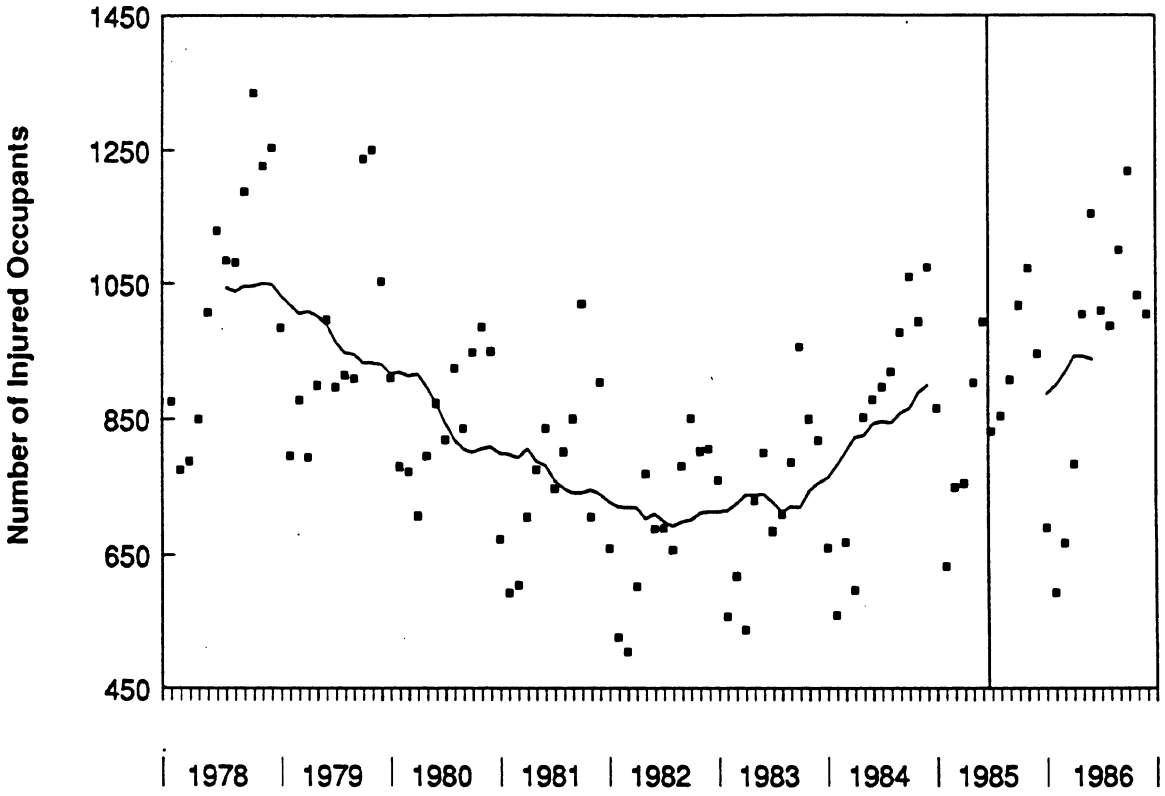

Figure A.11 Number of Injured Occupants Age 16-17

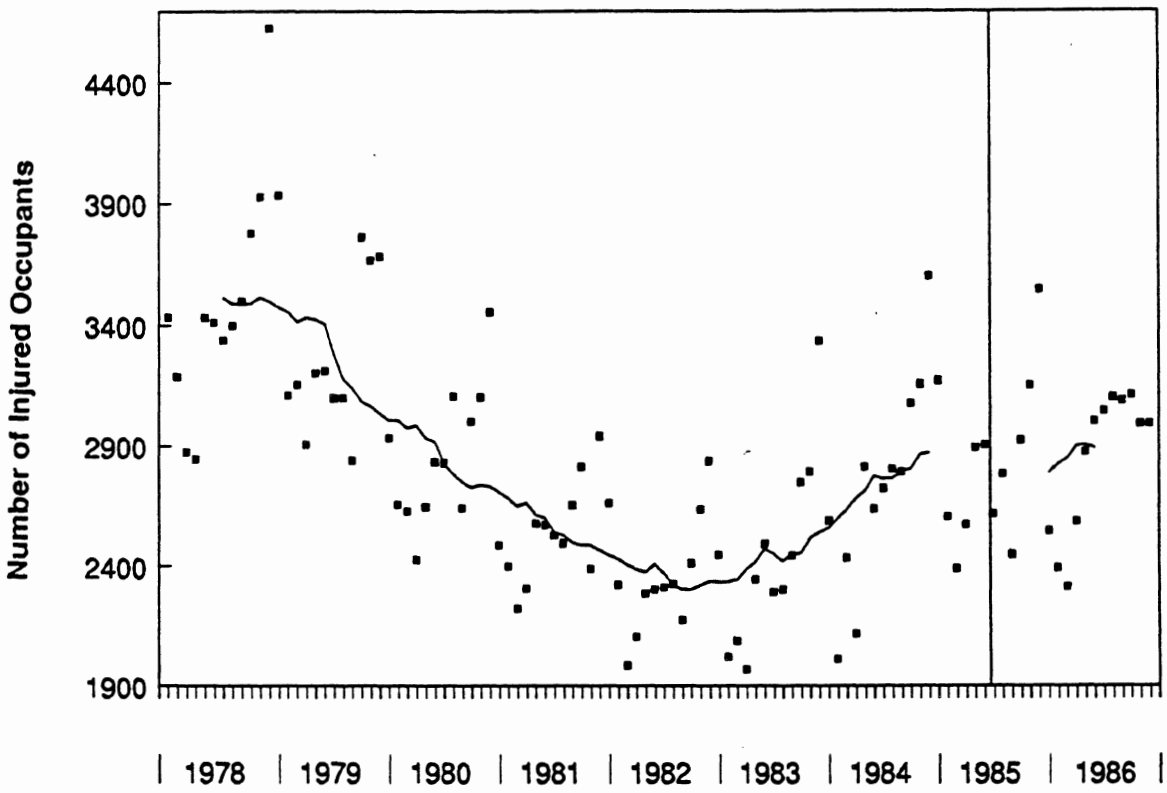

Figure A.12 Number of Injured Occupants Age 18-24

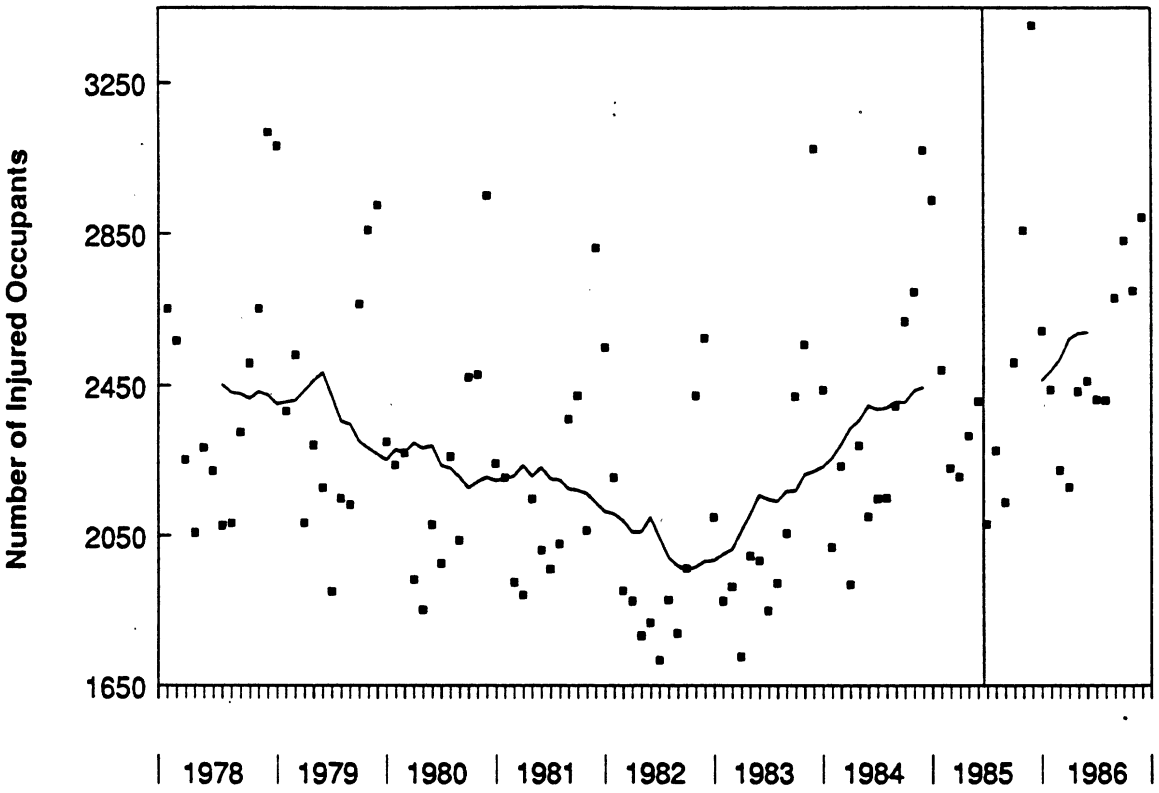

Figure A.13 Number of Injured Occupants Age 25-34

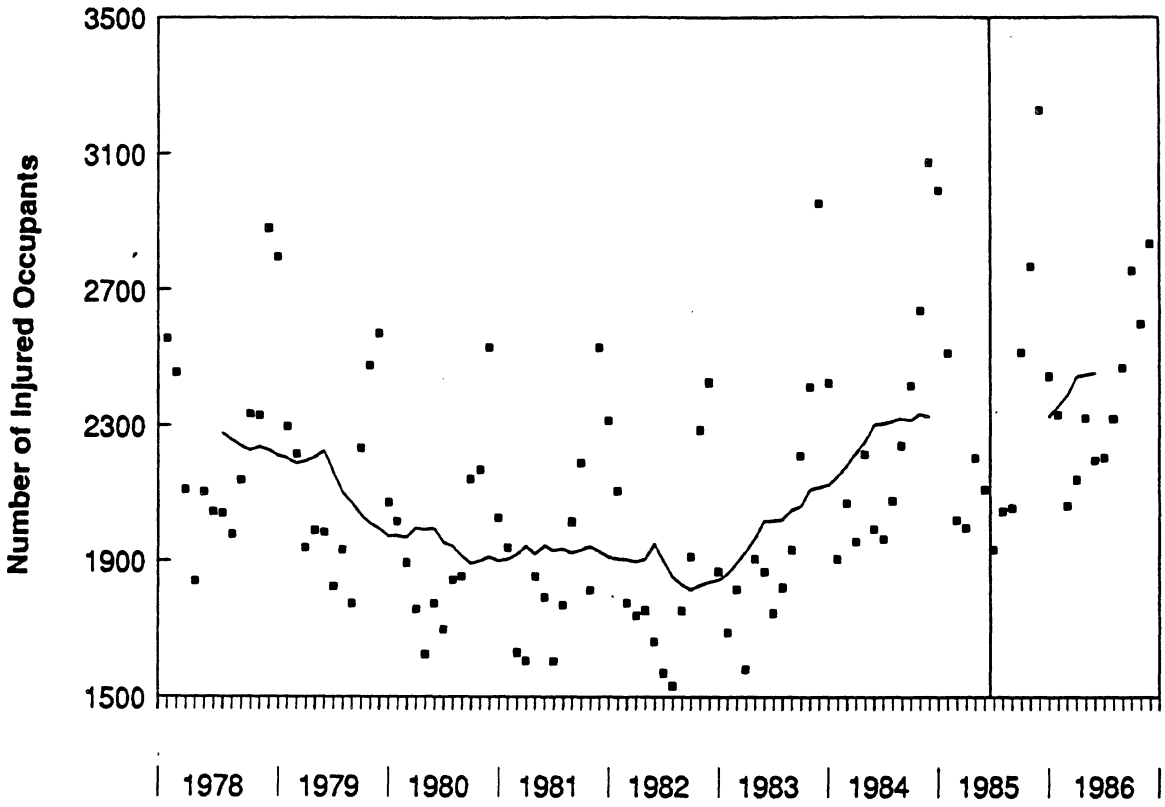

Figure A.14 Number of Injured Occupants Age 35-54

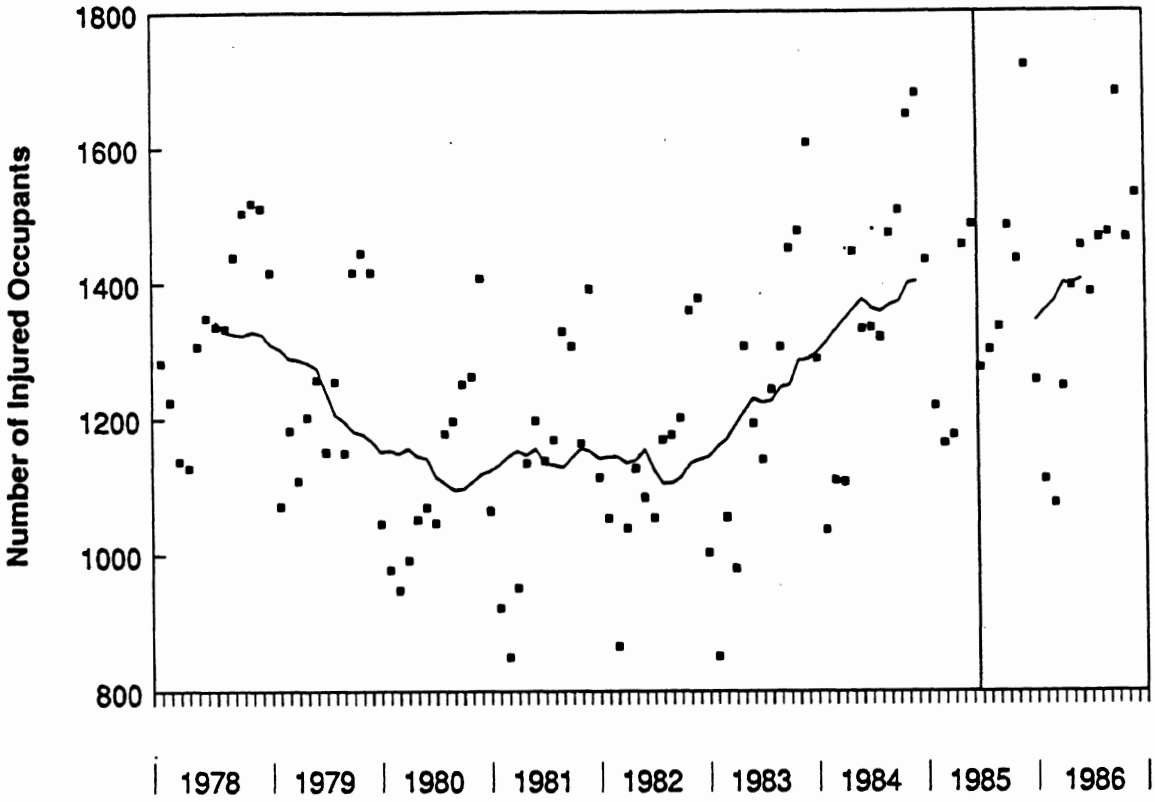

Figure A.15 Number of Injured Occupants Age 55 and Over

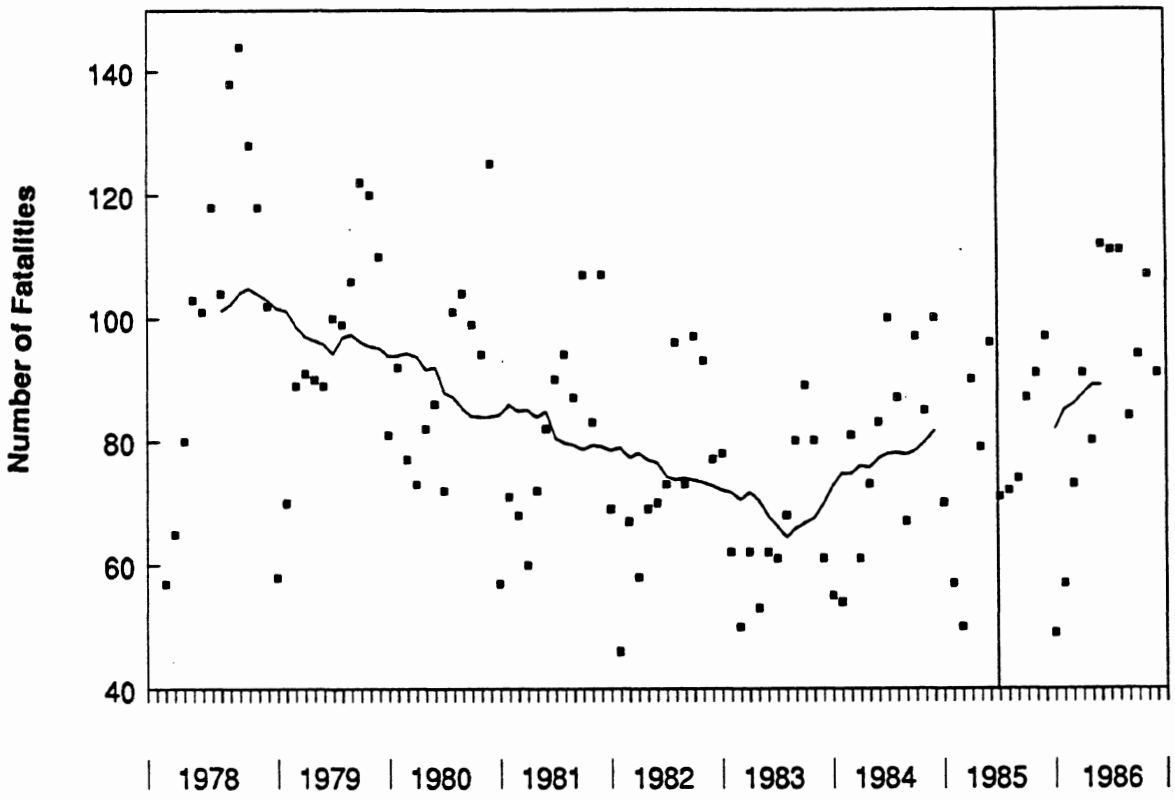

Figure A.16 Number of Front-seat Fatalities Age 10 and Over

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-1.97†	0.16
Effects of Adult Law, July 1985-June 1986*	-19.46†	1.40

Baseline time-series model: ARIMA $(0,1,1)\ (0,1,1)_{12}$

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* Effective date of adult seat belt law was July 1, 1985.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

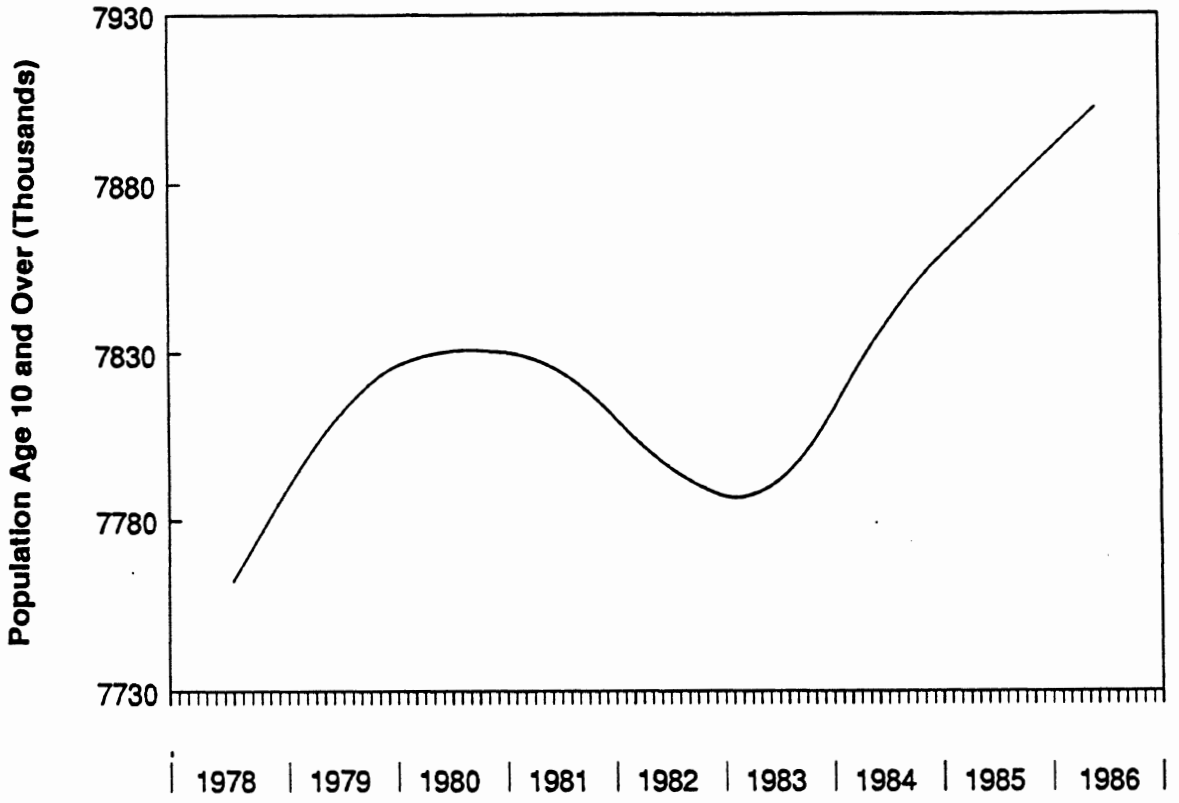

Figure A.17 Michigan Resident Population Age 10 and Over

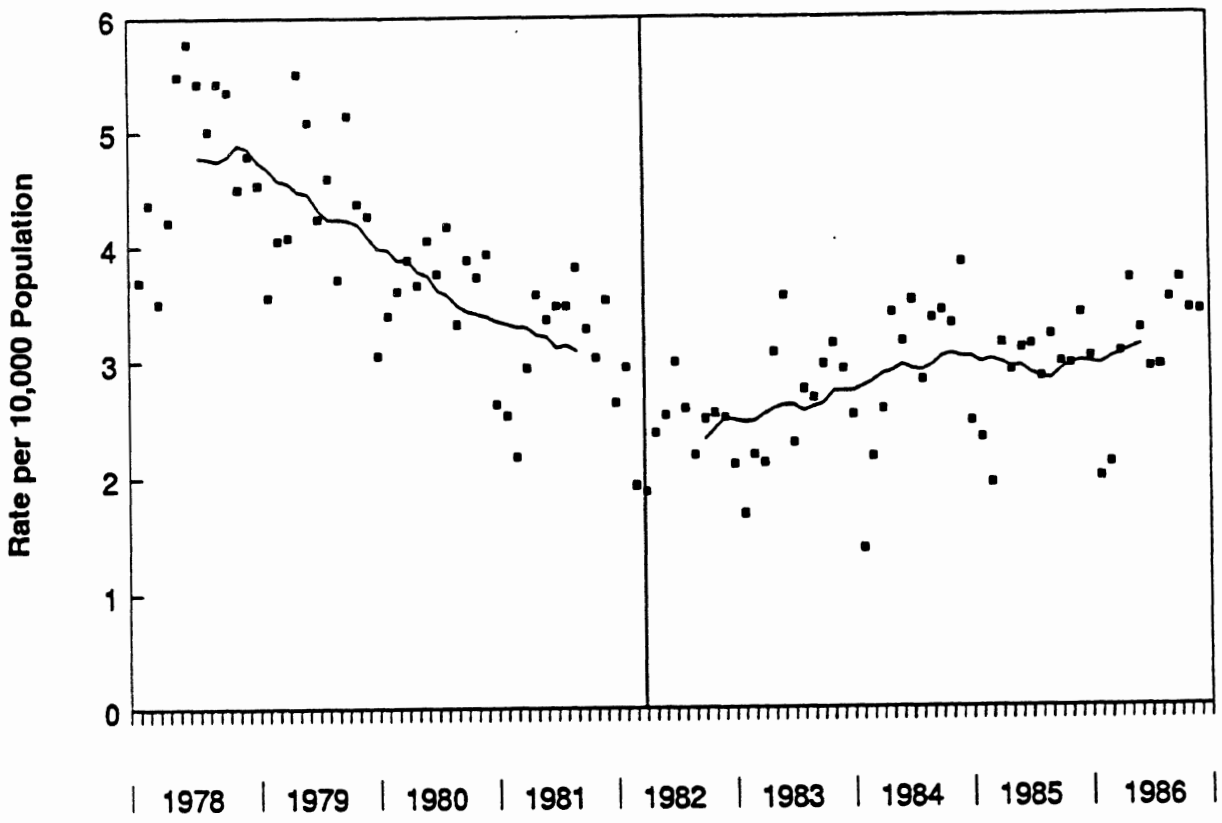

Figure A.18 Rate of Injured Occupants Age 0-3 per 10,000 Population

	Percent Change	*t*-Ratio
Effects of CRD PI&E, January-March 1982	-2.61†	0.31
Effects of CRD Law, April 1982-December 1985*	-29.04	3.83

Baseline time-series model: ARIMA $(0,1,5)\ (0,1,1)_{12}$

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* Effective date of mandatory child restraint law was April 1, 1982.

† Percent change not significantly different from zero, $p<.05$, one-tailed test

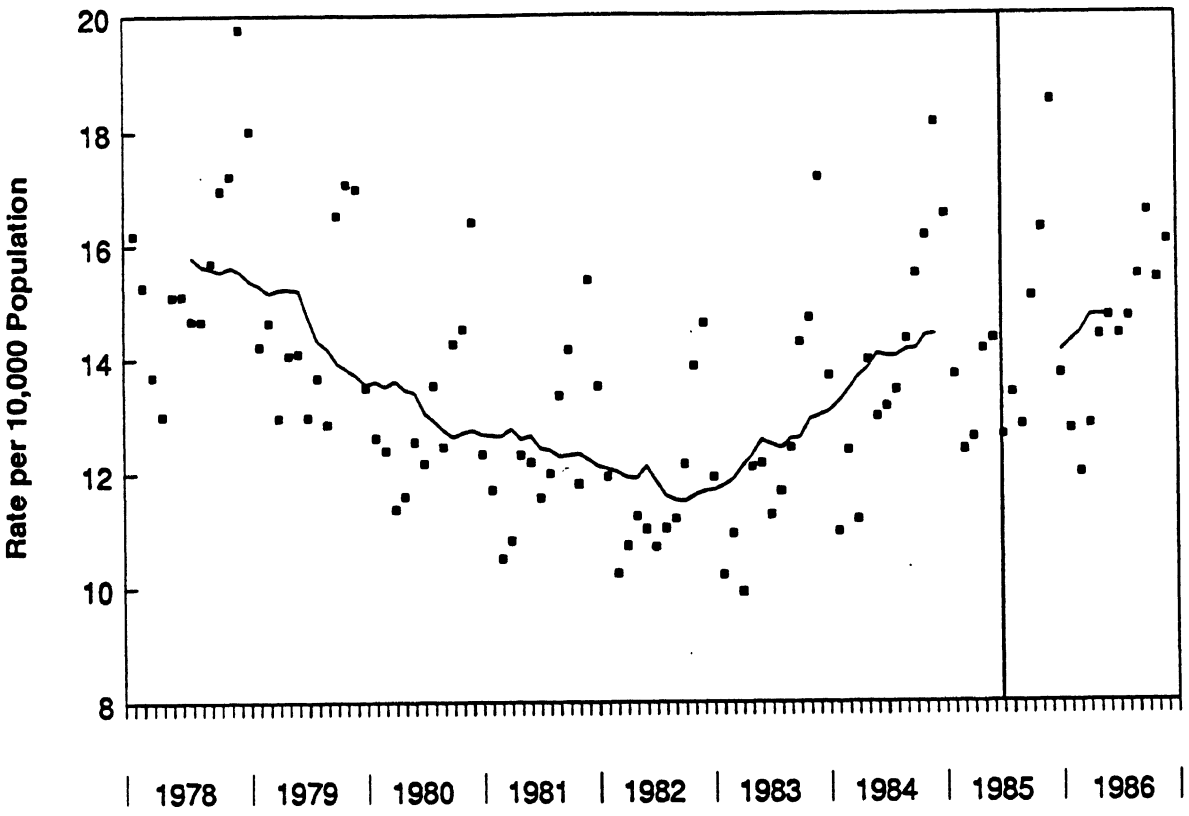

Figure A.19 Rate of Injured Occupants Age 16 and Over per 10,000 Population

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-5.15†	1.03
Effects of Adult Law, July 1985-December 1985*	-13.02	1.87

Baseline time-series model: ARIMA $(0,1,4)\ (0,1,1)_{12}$

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* Effective date of adult seat belt law was July 1, 1985.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

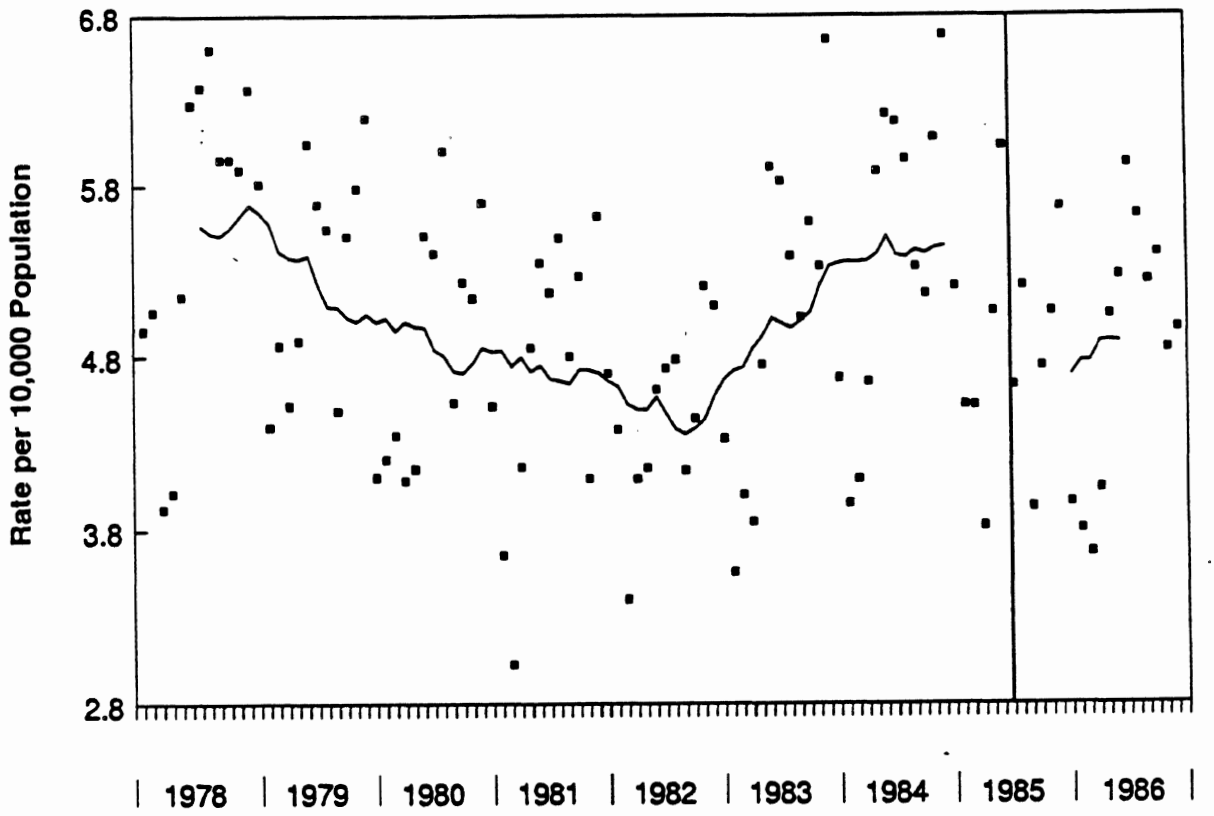

Figure A.20 Rate of Injured Occupants Age 4-15 per 10,000 Population

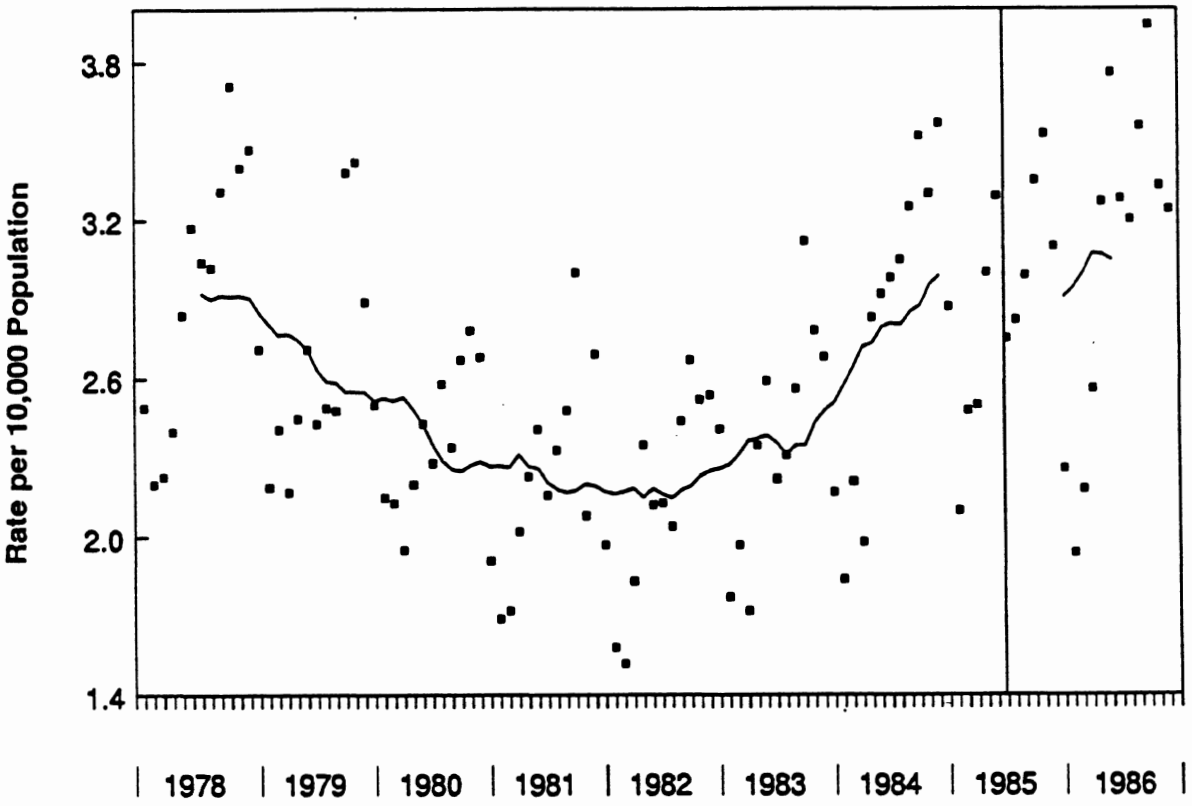

Figure A.21 Rate of Injured Occupants Age 16-17 per 10,000 Population

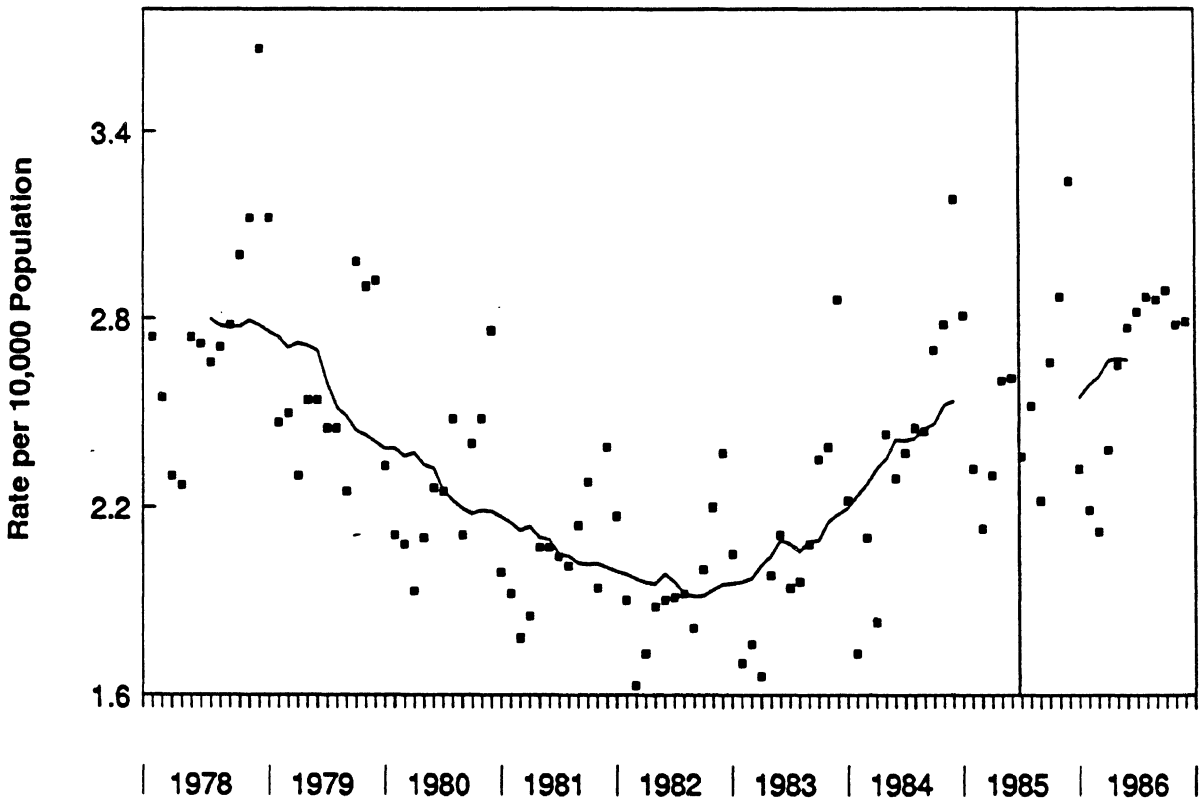

Figure A.22 Rate of Injured Occupants Age 18-24 per 10,000 Population

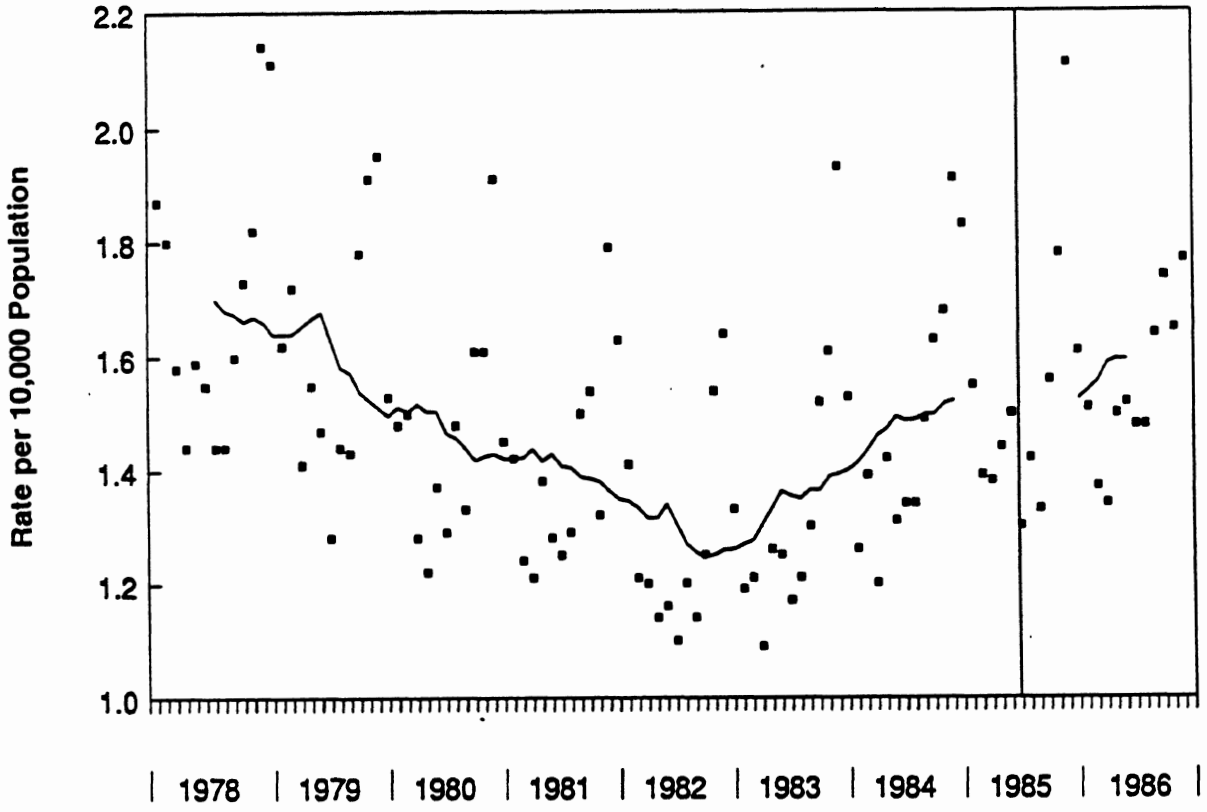

Figure A.23 Rate of Injured Occupants Age 25-34 per 10,000 Population

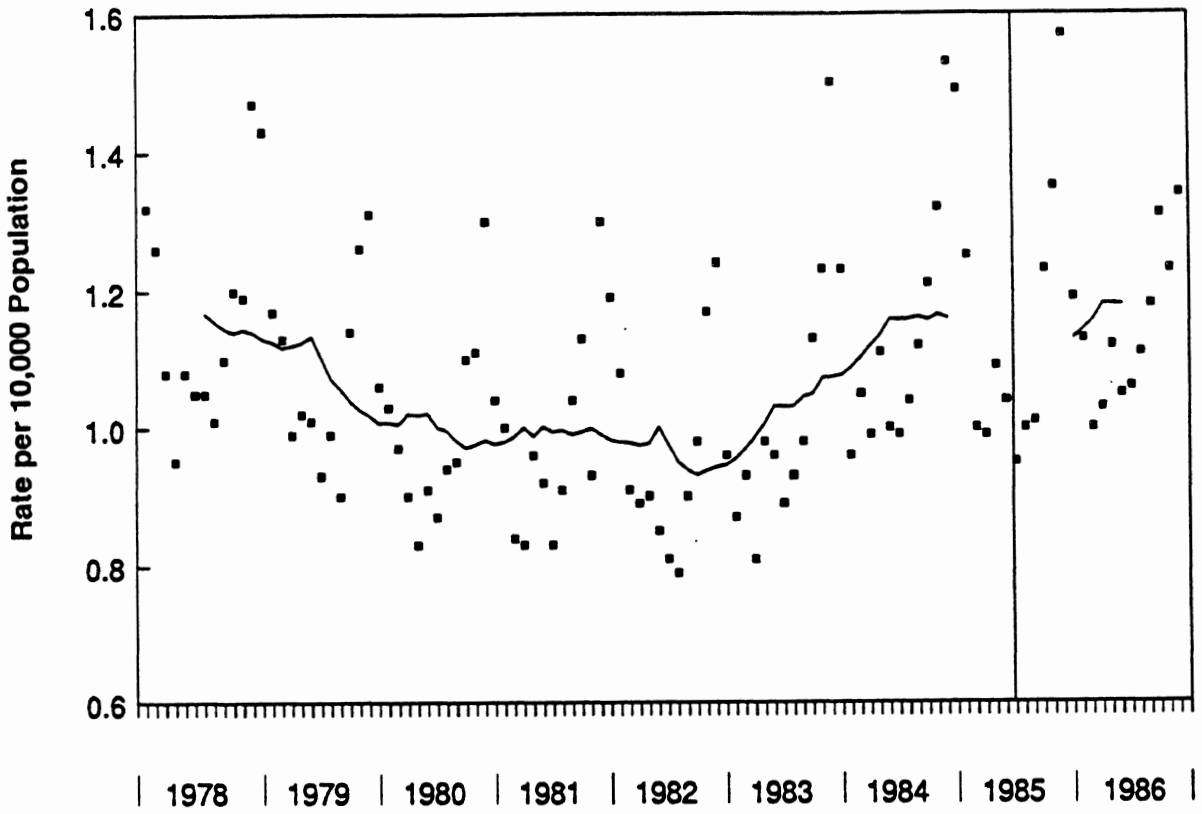

Figure A.24 Rate of Injured Occupants Age 35-54 per 10,000 Population

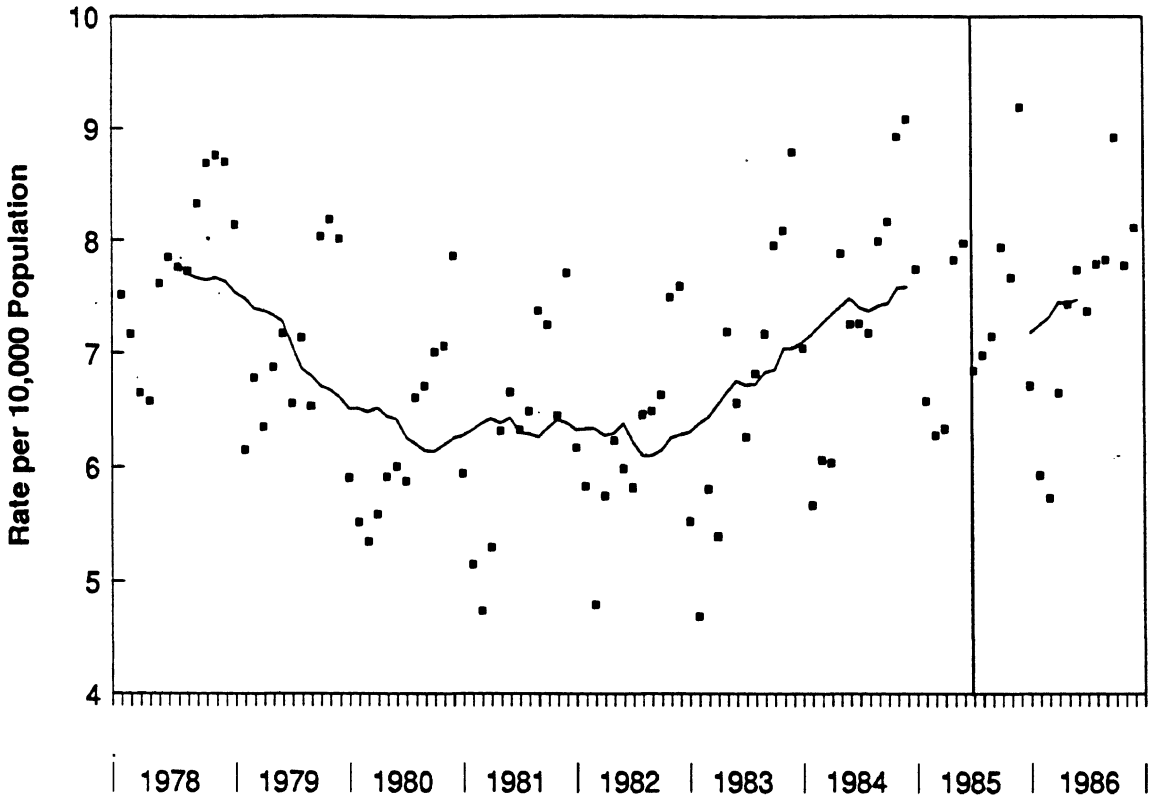

Figure A.25 Rate of Injured Occupants Age 55 and Over per 10,000 Population

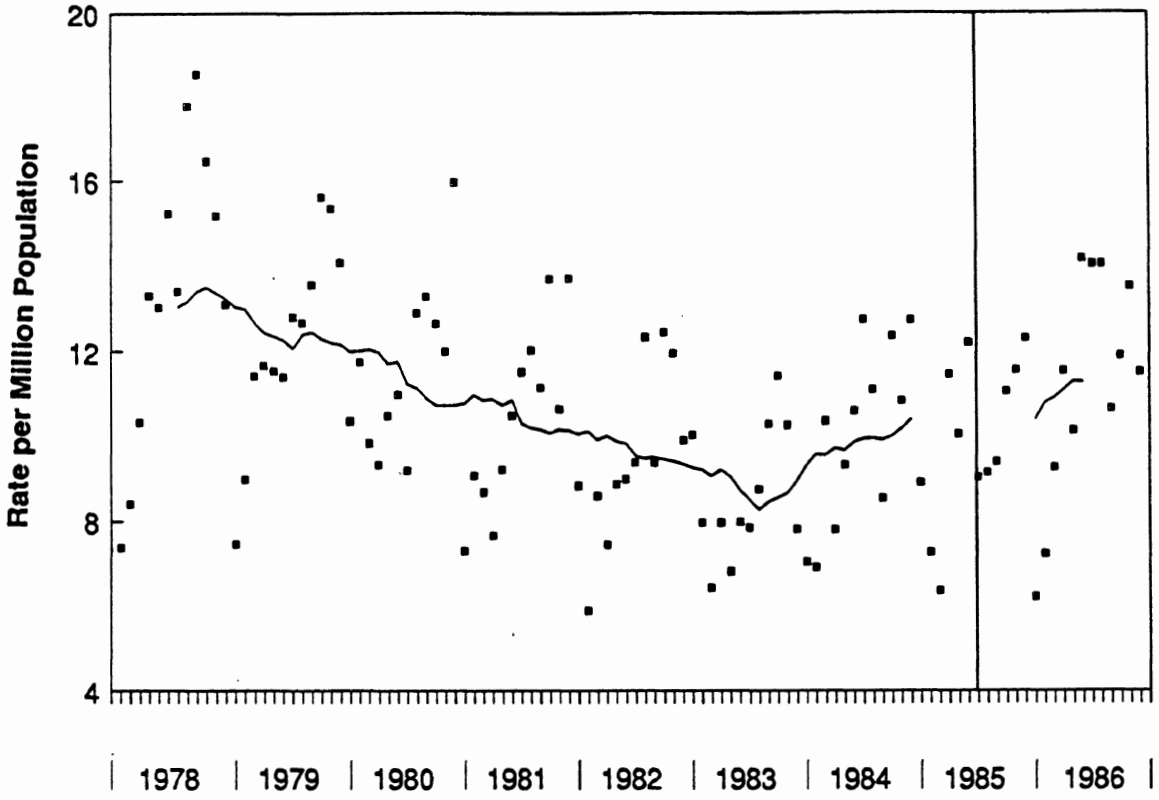

Figure A.26 Rate of Front-seat Fatalities Age 10 and Over per Million Population

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-1.71†	0.14
Effects of Adult Law, July 1985-June 1986*	-18.99†	1.38

Baseline time-series model: ARIMA $(0,1,1)\ (0,1,1)_{12}$

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* Effective date of adult seat belt law was July 1, 1985.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

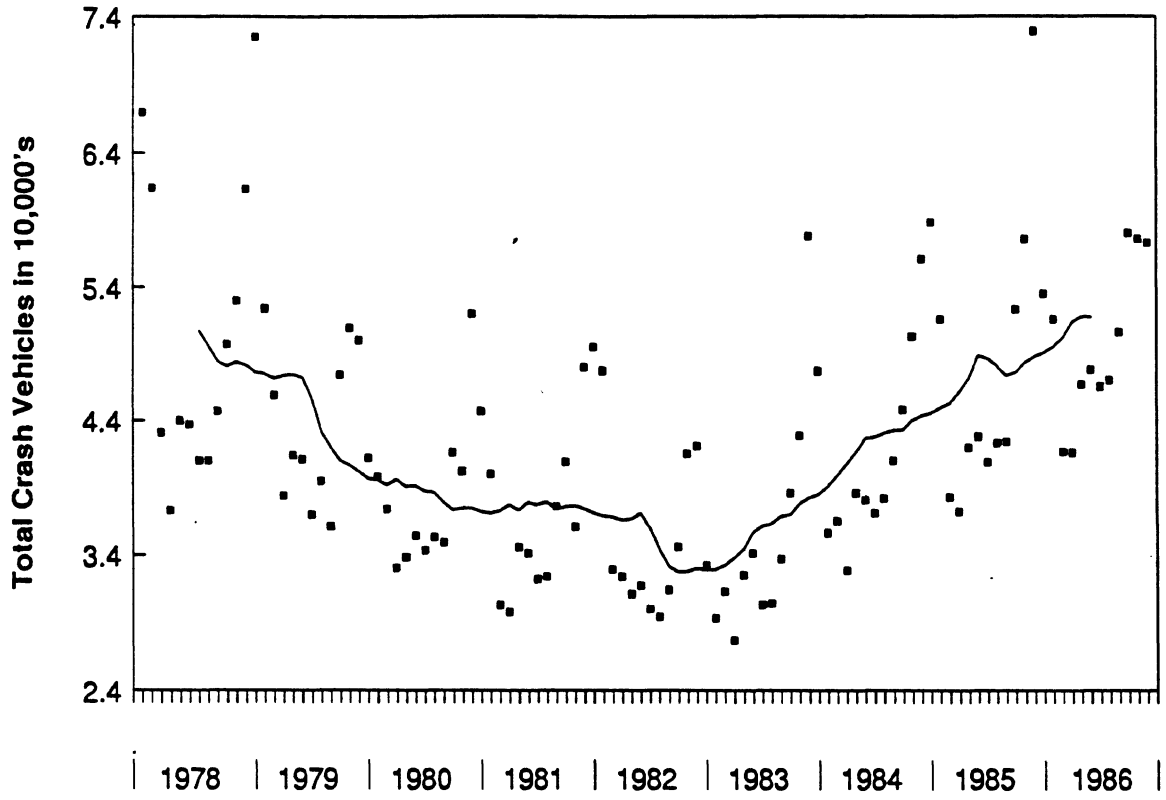

Figure A.27 Number of Vehicles Involved in Traffic Crashes in Michigan

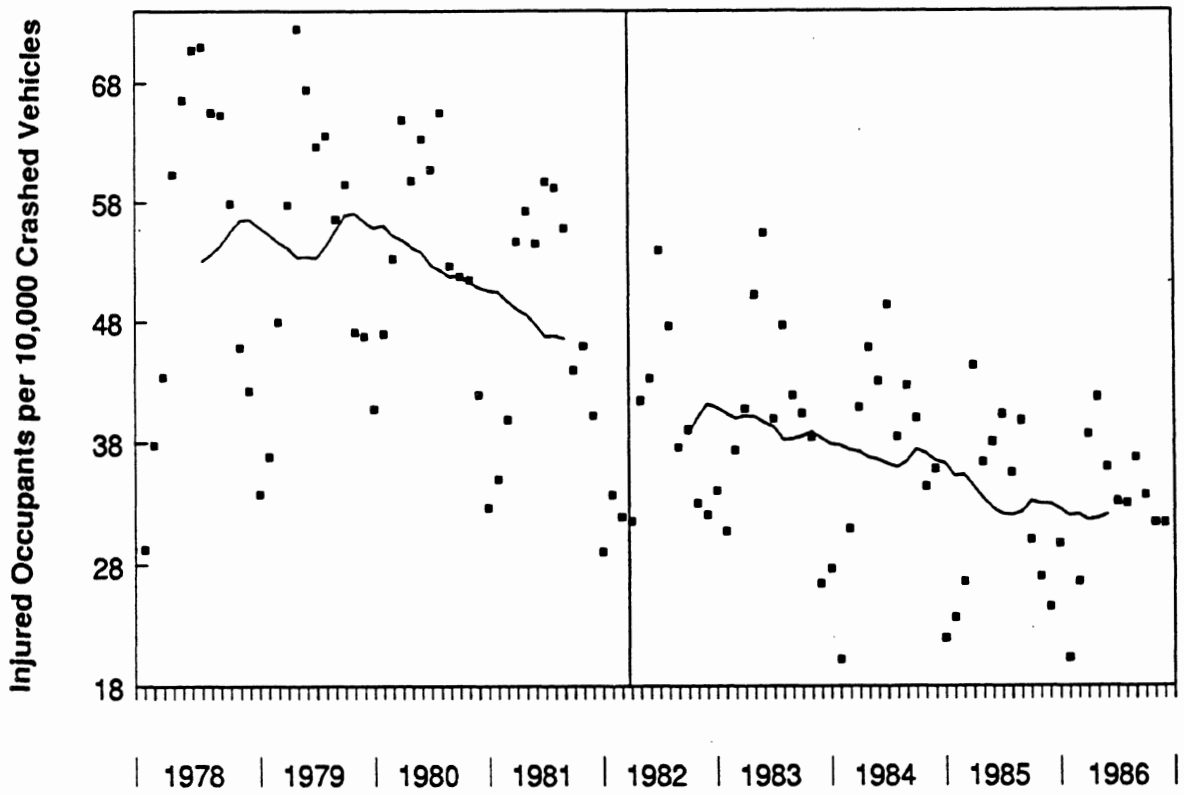

Figure A.28 Injured Occupants Age 0-3 per 10,000 Crashed Vehicles

	Percent Change	*t*-Ratio
Effects of CRD PI&E, January-March 1982	-17.77	2.29
Effects of CRD Law, April 1982-December 1985*	-31.81	9.56

Baseline time-series model: ARIMA $(0,0,5)(0,1,1)_{12}$

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* Effective date of mandatory child restraint law was April 1, 1982.

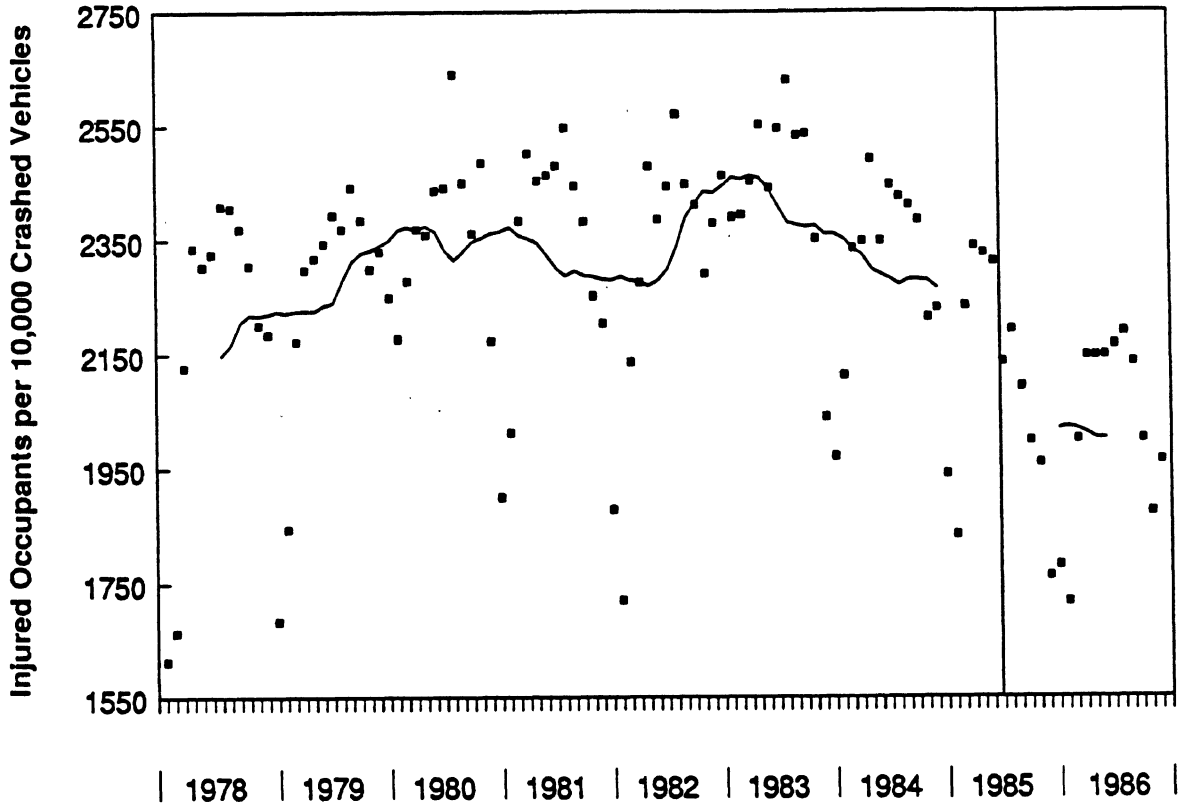

Figure A.29 Injured Occupants Age 16 and Over per 10,000 Crashed Vehicles

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-2.12†	0.64
Effects of Adult Law, July 1985-December 1985*	-12.60	8.94

Baseline time-series model: ARIMA $(0,0,11)(0,1,1)_{12}$

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* Effective date of adult seat belt law was July 1, 1985.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

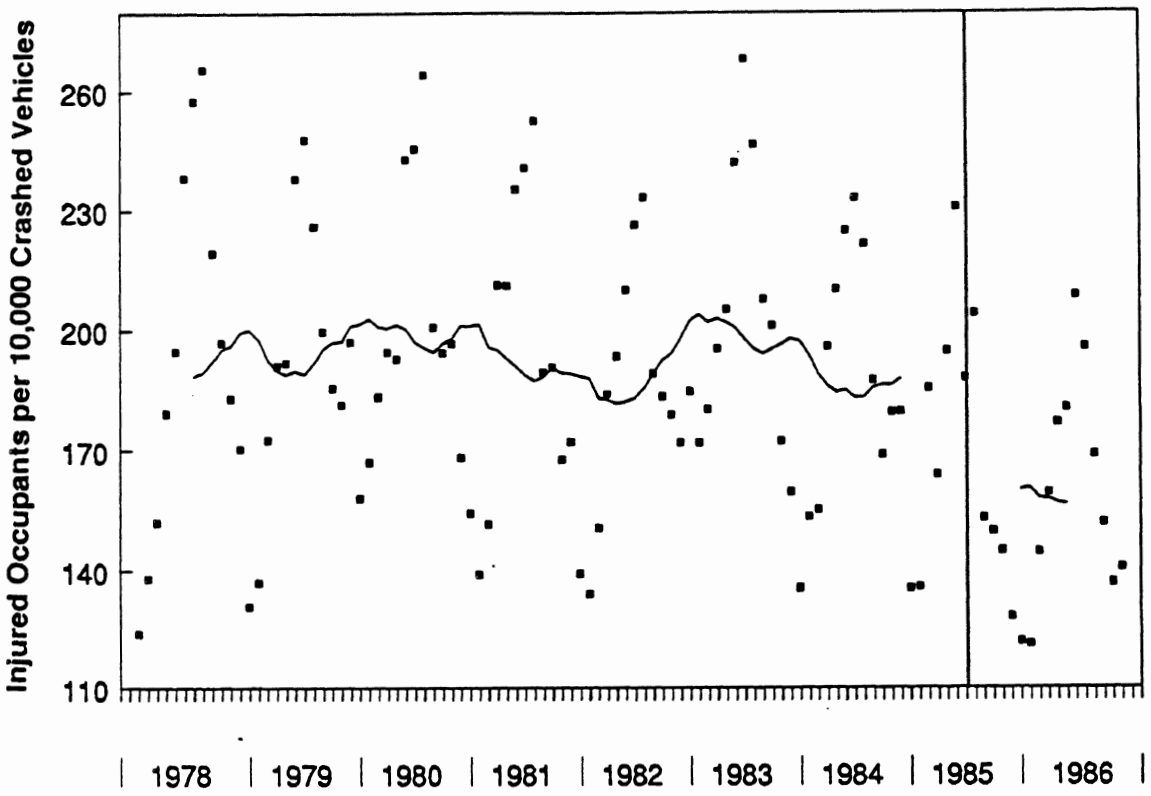

Figure A.30 Injured Occupants Age 4-15 per 10,000 Crashed Vehicles

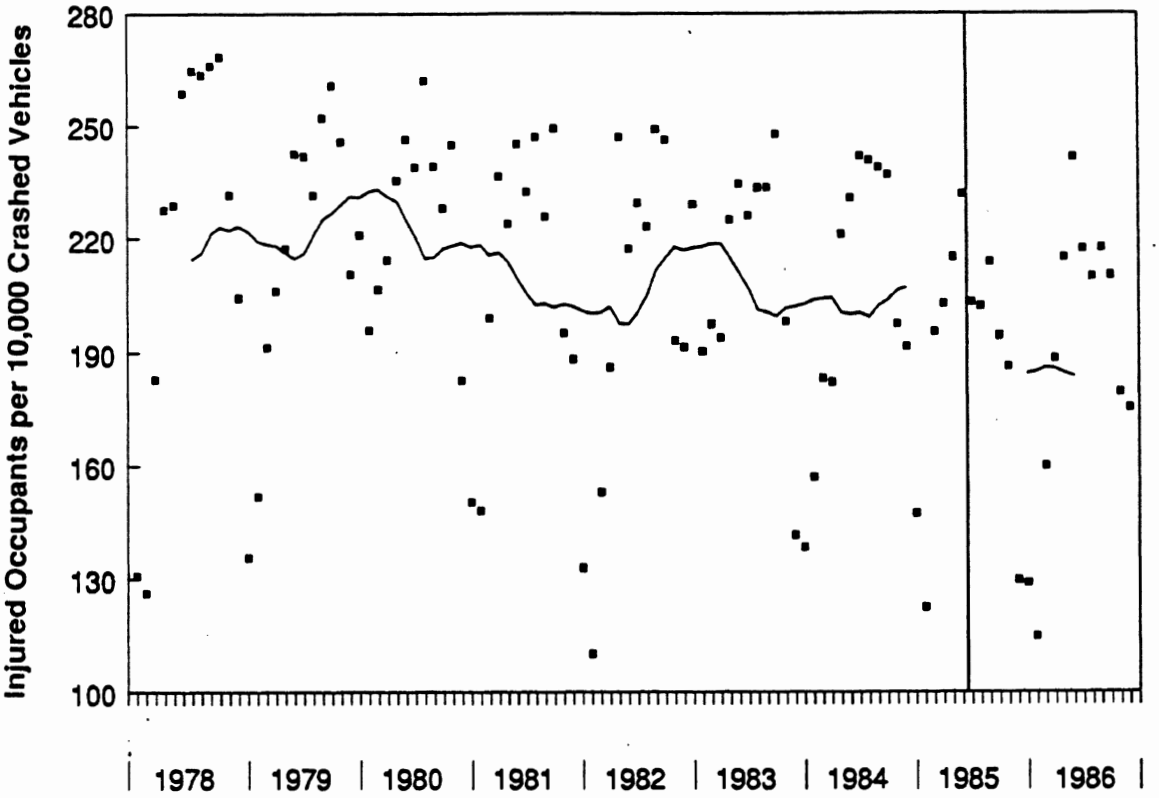

Figure A.31 Injured Occupants Age 16-17 per 10,000 Crashed Vehicles

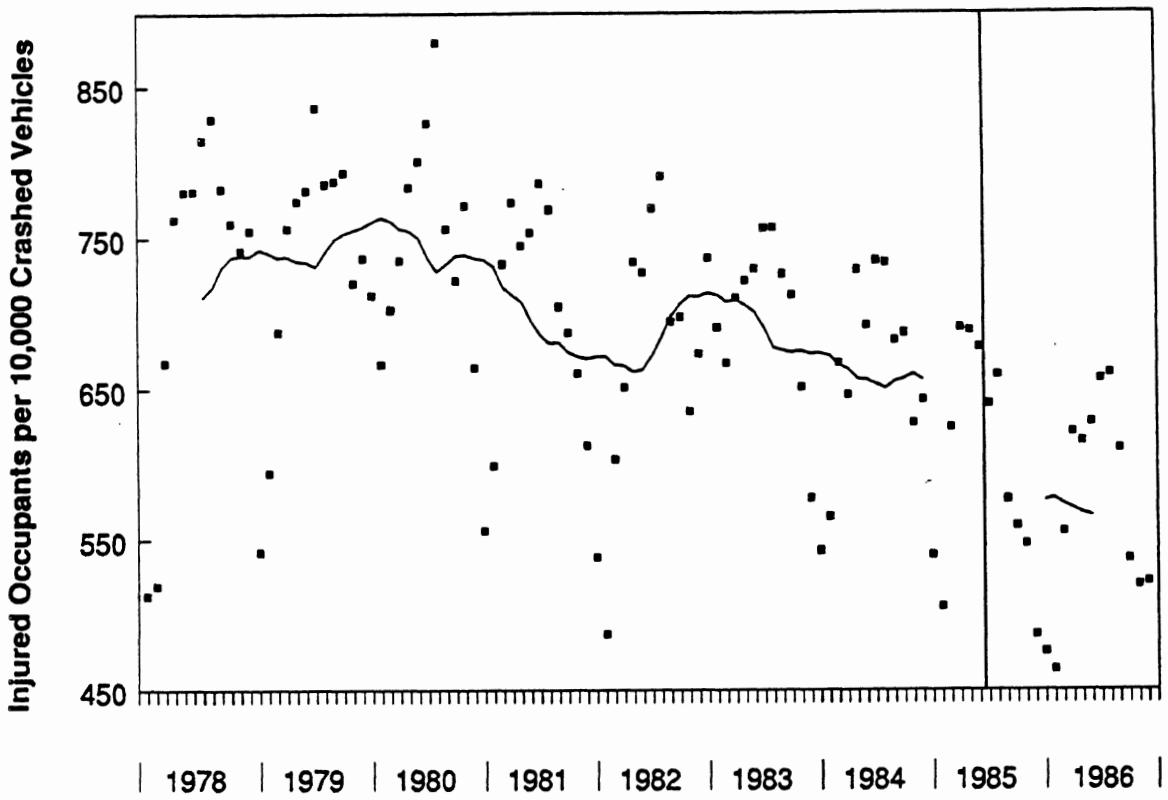

Figure A.32 Injured Occupants Age 18-24 per 10,000 Crashed Vehicles

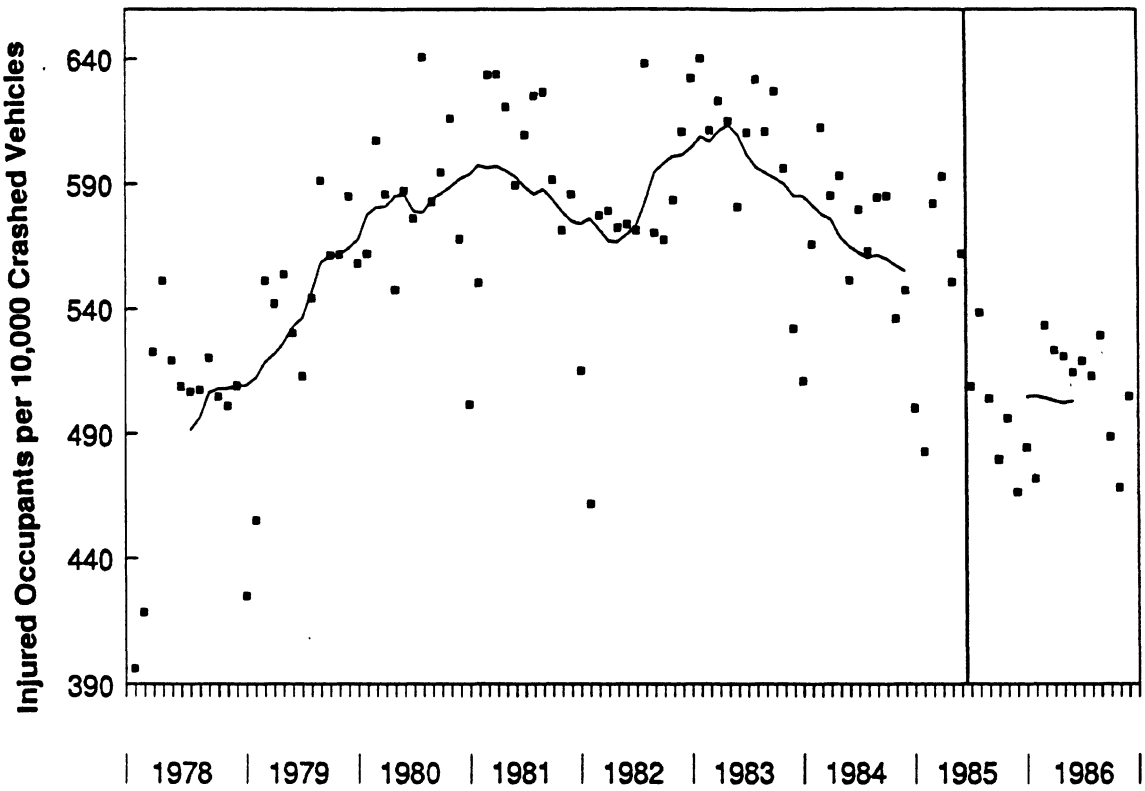

Figure A.33 Injured Occupants Age 25-34 per 10,000 Crashed Vehicles

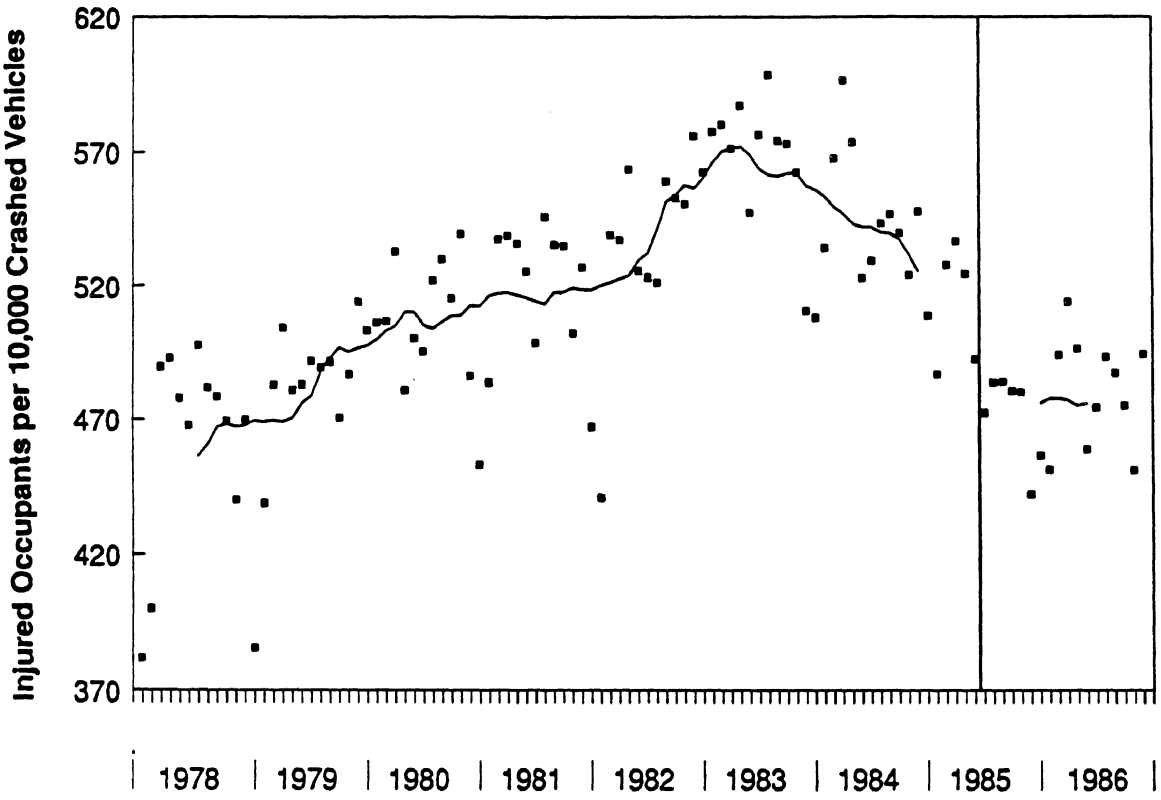

Figure A.34 Injured Occupants Age 35-54 per 10,000 Crashed Vehicles

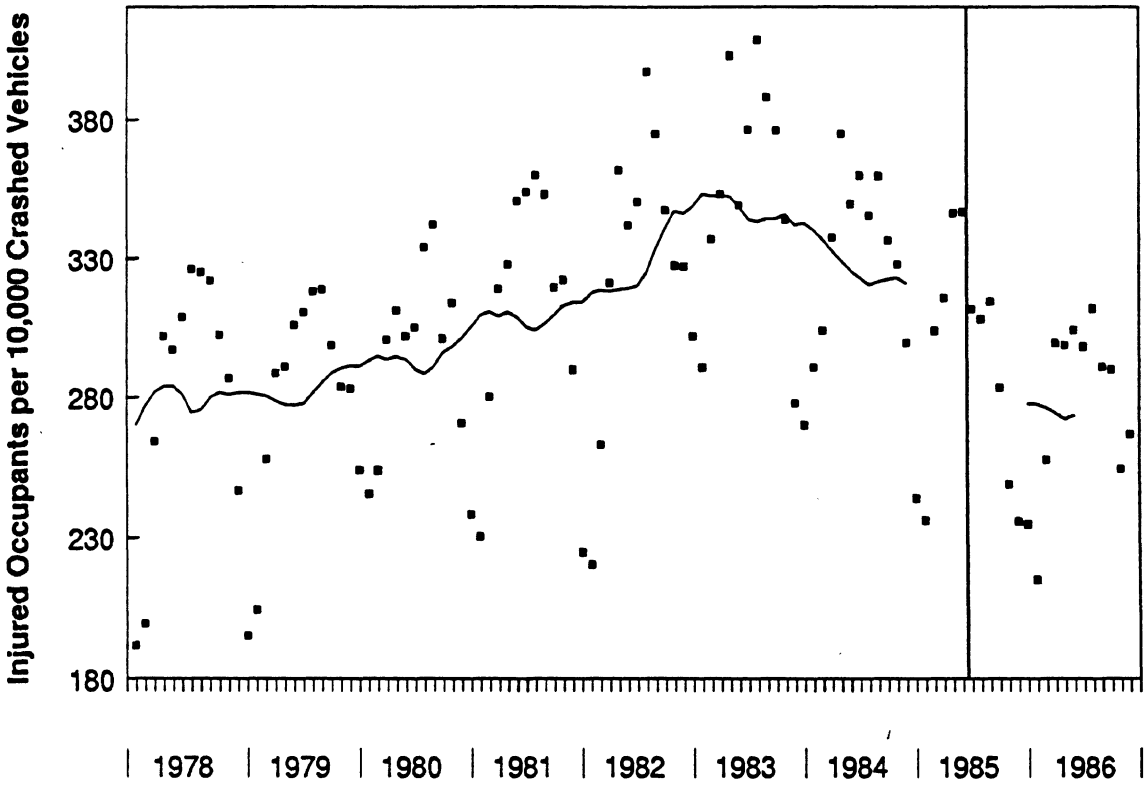

Figure A.35 Injured Occupants Age 55 and Over per 10,000 Crashed Vehicles

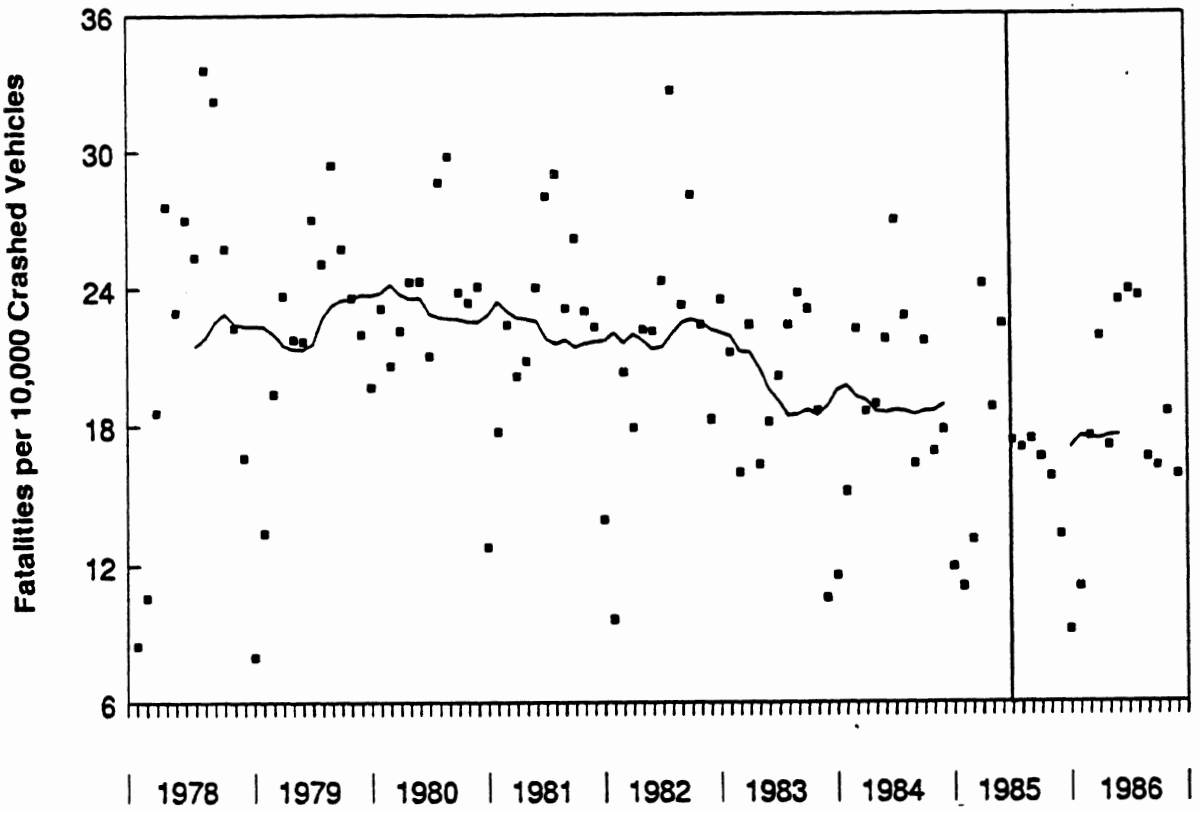

Figure A.36 Front-seat Fatalities Age 10 and Over per 10,000 Crashed Vehicles

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-11.78[†]	1.01
Effects of Adult Law, July 1985-June 1986[*]	-19.70	3.70

Baseline time-series model: ARIMA $(0,0,1)(0,1,1)_{12}$

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[*] Effective date of adult seat belt law was July 1, 1985.

[†] Percent change not significantly different from zero, $p<.05$, one-tailed test.

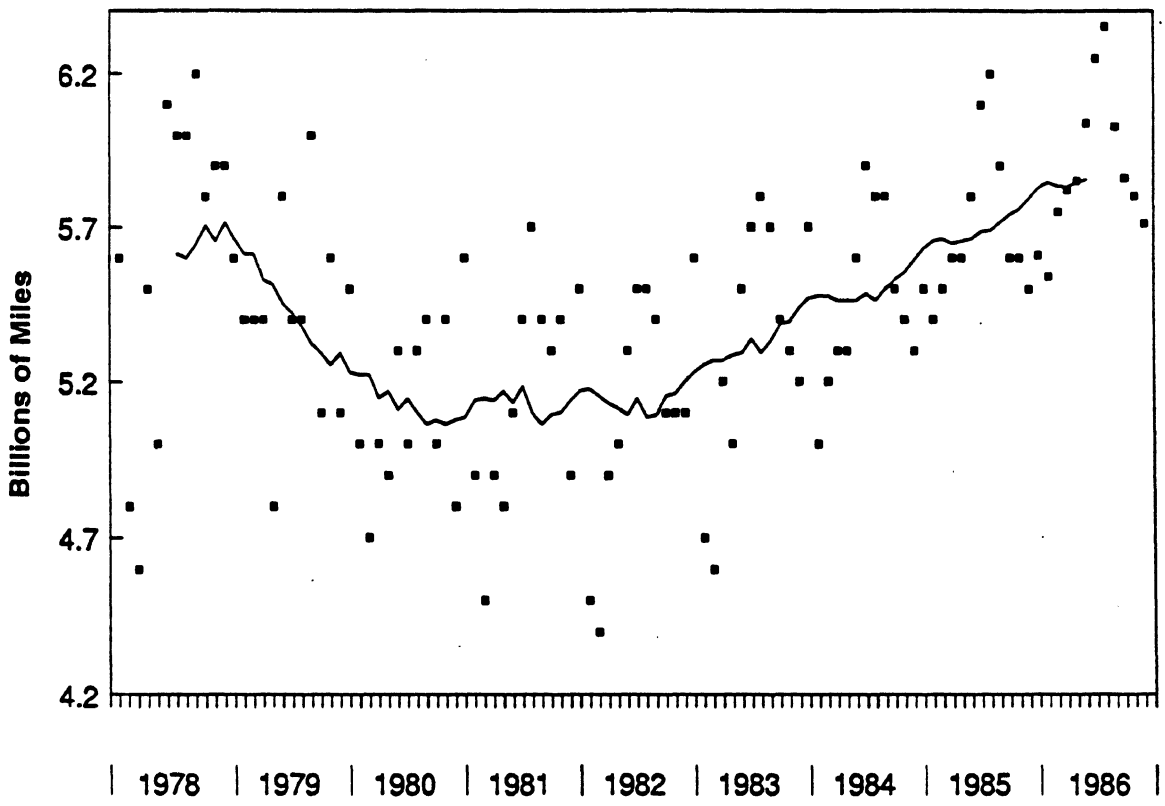

Figure A.37 Estimated Number of Vehicle Miles Traveled

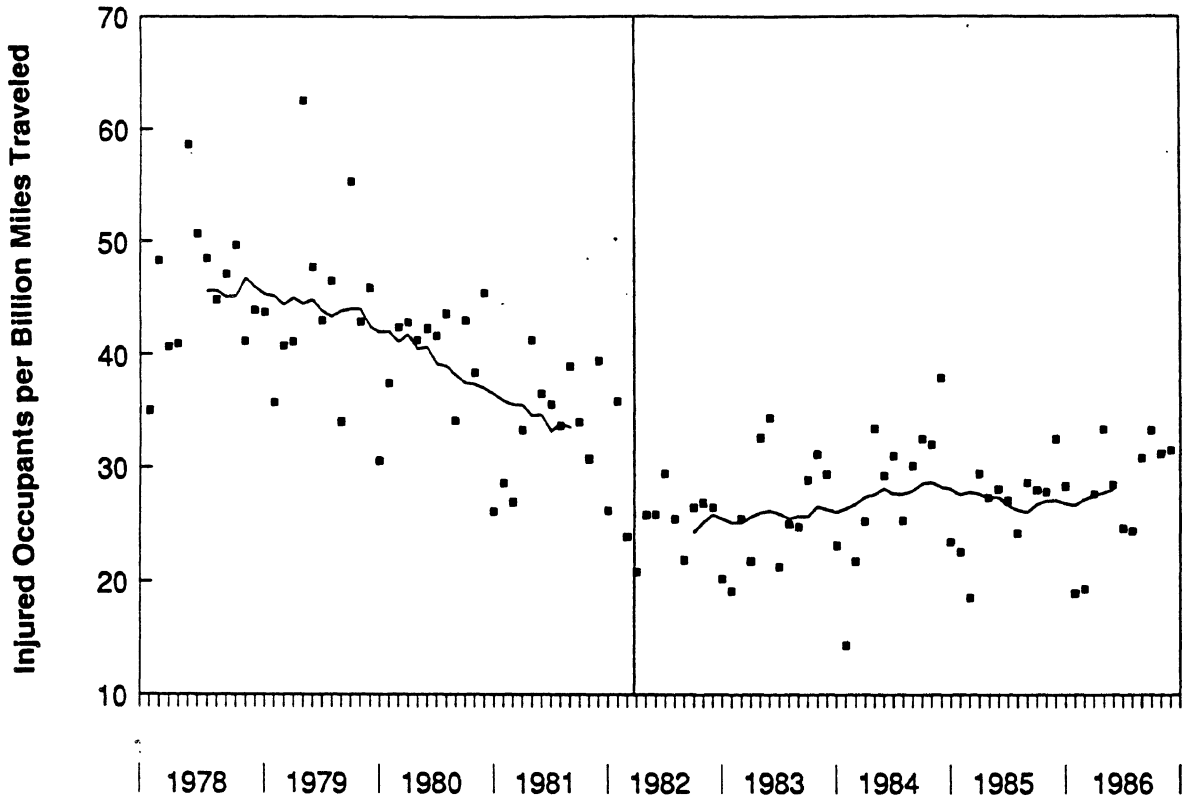

Figure A.38 Injured Occupants Age 0-3 per Billion Miles Traveled

	Percent Change	*t*-Ratio
Effects of CRD PI&E, January-March 1982	-2.41†	0.28
Effects of CRD Law, April 1982-December 1985*	-26.80	3.76

Baseline time-series model: ARIMA $(0,1,3)(0,1,1)_{12}$

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* Effective date of mandatory child restraint law was April 1, 1982.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

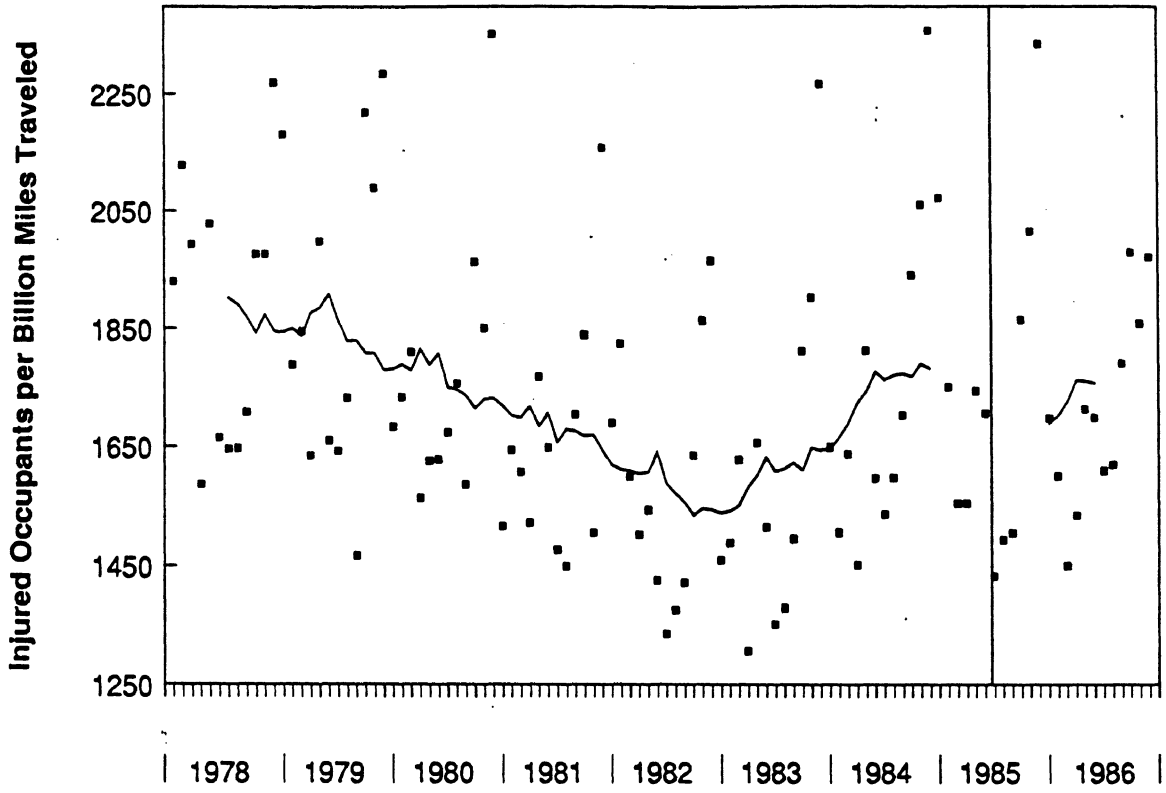

Figure A.39 Injured Occupants Age 16 and Over per Billion Miles Traveled

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-6.56†	1.28
Effects of Adult Law, July 1985-December 1985*	-10.72	1.79

Baseline time-series model: ARIMA $(0,1,1)\ (0,1,1)_{12}$

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* Effective date of adult seat belt law was July 1, 1985.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.

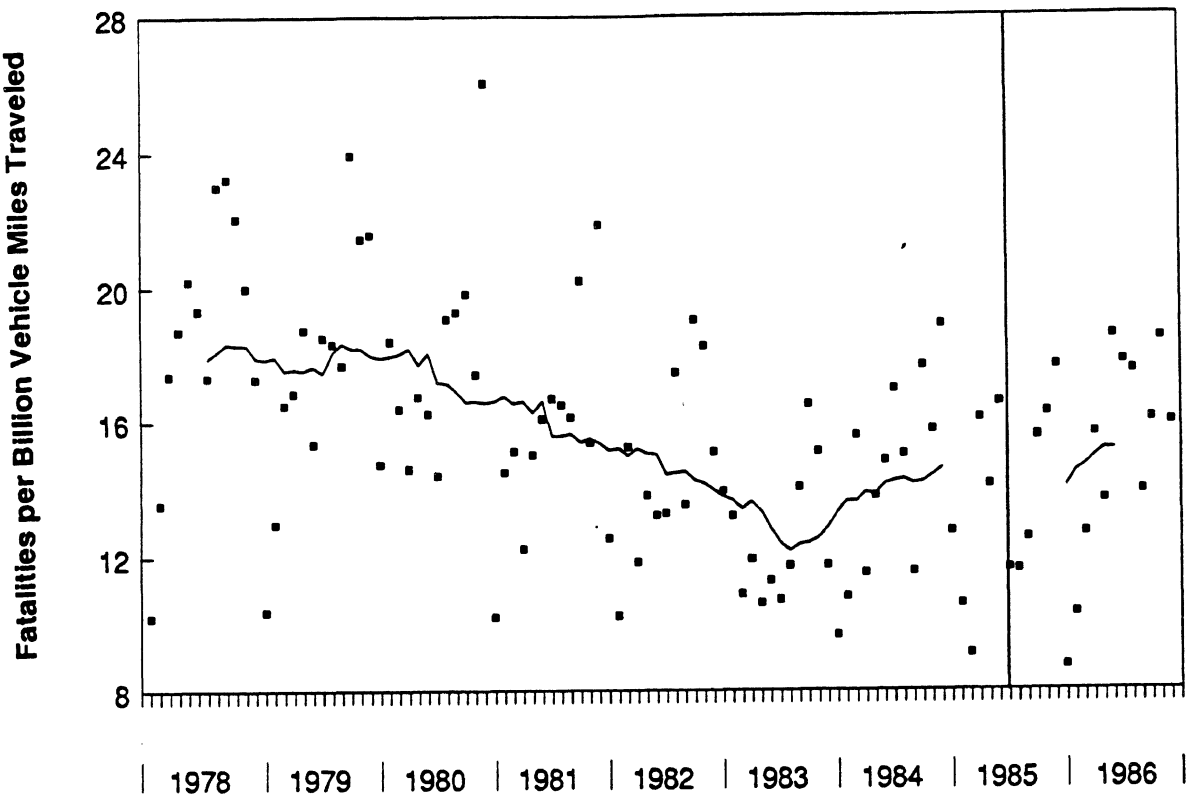

Figure A.40 Front-seat Fatalities Age 10 and Over per Billion Miles Traveled

	Percent Change	*t*-Ratio
Effects of Adult PI&E, April 1985-June 1985	-4.24†	0.38
Effects of Adult Law, July 1985-June 1986*	-17.17†	1.42

Baseline time-series model: ARIMA $(0,1,1)(0,1,1)_{12}$

---

* Effective date of adult seat belt law was July 1, 1985.

† Percent change not significantly different from zero, $p<.05$, one-tailed test.