EFFECTS OF SEATBELT LAWS ON HIGHWAY FATALITIES

U.S. Department
of Transportation

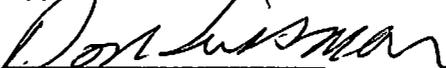**National Highway
Traffic Safety
Administration**

Project Memorandum
DOT-TSC-HS070-PM-89-28
November 1989

D. Skinner
S. Borener

OPERATOR PERFORMANCE AND
SAFETY ANALYSIS DIVISION

Approved for Distribution:

Division Chief

Overview

- *7.4 percent fatality reduction*

The statistical models used in this update indicate that states which have a seatbelt law have experienced *on average* a 7.7 percent reduction in frontseat occupant fatalities in vehicles generally covered by laws. That is, on average in any law state, these fatalities are 7.7 percent less than would have been expected in the absence of a law. This result is based on historical relationships of almost 14 years (January 1975 through December 1988) contained in the Fatal Accident Reporting System (FARS) database.

Removing any comparison with non-seatbelt law states does not change the result appreciably. It is recognized that some of the savings of lives may be attributable to greater acceptance of seatbelts in the driving population and not just the effects of the law.

Introduction

- *update of previous study*

This update is the sixth to a group of statistical models developed to evaluate the effects through 1985 of seatbelt laws in reducing highway fatalities. The original work is described in "Effects of Mandatory Seatbelt Use Laws on Highway Fatalities in 1985" (*DOT-TSC-NHTSA-87-3*) by Paul Hoxie and David Skinner of the Transportation Systems Center, Cambridge, MA.

- *originally a 6.7 percent fatality reduction*

The original work estimated the fatality effects of seatbelt laws on highway fatalities through December 1985 as measured similarly in the dimension of an average effect in any state with a law. At that time, nine states and the District of Columbia had implemented laws. The average reduction was found to be 6.7 percent in states and the District of Columbia among frontseat occupant fatalities in vehicles generally covered by such laws. Further, this average reduction was found to be stronger (about 12 percent) in the first three months after implementation of a law than in subsequent months.

- *track effects of seatbelt laws in reducing fatalities*

Clearly one main reason for doing an update when additional FARS data becomes available is to determine if any trend attributable to seatbelt use is developing in the savings of lives. This determination will bring a better understanding of progress made in achieving the full technological benefits of belting.

- *33 states have laws*

- *75 percent of U.S. covered by laws*

    .

Through December 1988, 35 states and the District of Columbia had implemented seatbelt laws. Two states --Nebraska and Massachusetts -- have repealed their laws. (These 35 states and the District of Columbia represent 88 percent of the U.S. resident population. Similarly, 84 percent of frontseat fatalities occur in states that had seatbelt laws.) The update prior to this was based on data through September 1987. At that time, twenty-eight states and the District of Columbia had implemented laws. The average effect was found to be about the same as the effect currently -- 7.8 percent then; 7.7 percent now.

- *difficulty in establishing statistical basis for a trend*

Both of these estimates are larger than the original one of 6.7 percent. However, while the increase is encouraging, in a statistical sense it is not possible to say a trend has developed. Such a claim, because of the inherent variability in the frontseat occupant fatality series, would require a larger change. In additional analysis presented below, models are developed which further try to detect a trend.

- *effect of Texas*

The statistical estimation is done in a manner which gives more weight to larger fatality states. This weighting is done because the fatality counts in these larger states are less subject to random variation and hence these larger states should give a better estimate of the true seatbelt effect. However, using this technique to produce better statistical estimates can produce results highly dependent on the unique experience of a few large states.

Texas is one such large state. Some sectors of the Texas economy remain depressed since the 1982 recession. Other sectors have experienced relatively slow economic growth. The statistical models do provide a control for economic effects. It is always possible, however, that the control may not be complete.

- *5.3 percent average fatality reduction without Texas*

Removing Texas from the estimation produces an average effect in all other seatbelt law states of 5.9 percent. This indicates the sensitivity of the estimation to a particular large state. Observational studies of seatbelt use in cities in Texas support the plausibility of a large seatbelt effect as opposed to just the effect of a relatively depressed economy.

Measuring Effects

- *many reasons for wearing belts*

Trying to measure any effect from seatbelt laws becomes more difficult as the time elapses from the implementation of laws. At least two issues are involved in this difficulty. First, as time elapses from the implementation of a law, persons adopt belts because they perceive seatbelts as having value in reducing injury and death in automobile accidents. Surely, the laws are instrumental in forming this perception. Seatbelt laws in addition to prescribing fines, and conditions under which fines may be given, often have stipulated that education, promotion, and evaluation be undertaken. But other sources exist which change public awareness as well. Thus, one must be careful in ascribing all of the reductions in fatalities solely to the penalties of the law. Recognition must be given to the growing public awareness of the value of seatbelts in reducing injury and death -- whatever the source of that awareness.

While it is easy to acknowledge that other factors affect the adoption of seatbelt laws, it is difficult to separate quantitatively the impacts of different motivations for belting. Thus the approach is adopted that although the reduction is described as coming from seatbelt laws, likely there are other reasons for belting.

- *many reasons for changes in frontseat occupant fatalities*

A second source of difficulty in estimating seatbelt law effectiveness is that there are reasons besides seatbelt laws which affect the level of frontseat occupant fatalities. It becomes more difficult to identify, and control for, these sources of change as time elapses. Clearly one of the most popular methods of evaluating highway safety programs, and the one used here, is to find groups of fatalities -- a companion series -- that are related with the fatality series of interest. The relationship should be on *both* a theoretical and statistical basis. The original report describes the testing for the most appropriate companion series. Obviously the companion series should not be affected by a seatbelt law.

While multiple reasons for seatbelt use can be dealt with conceptually, multiple sources of change to fatalities affected by seatbelt use is more difficult and lacks theoretical guidance.

Results

The best current estimate as shown in Table 1 of the average fatality reduction among frontseat, passenger-vehicle, occupant fatalities in the 33 states and the District of Columbia in this period is 7.4 percent. That is, on average 7.4 percent of law-covered fatalities were prevented in states implementing a seatbelt law during this period. The standard error of this estimate is about 3.0 percent.

Table 1: Evaluation of Seatbelt Law Effectiveness

File complete through	Average	t-Statistic
12/85*	-6.7%	(-2.19)**
3/86	-5.7%	(-2.27)
6/86	-5.8%	(-2.61)
9/86	-7.1%	(-3.59)
12/86	-5.8%	(-3.18)
9/87	-7.5%	(-5.46)
12/87	-7.8%	(-5.01)
12/88	-7.7%	(-5.50)

* from: "Effects of Mandatory Seatbelt Use Laws on Highway Fatalities in 1985," (DOT-TSC-NHTSA-87-3), by Paul Hoxie and David Skinner

** all t-statistics significant at the 95 percent level

Table 1 also shows past estimates of seatbelt effectiveness using the same methodology throughout. Generally each estimate is based on an increasing number of states.

Sensitivity Testing

The 7.7 percent result is tested to see if it is sensitive to several issues raised by the safety community. The first sensitivity test is actually a case selection. States are removed which have no seatbelt laws implemented as of September 1988. The expectation is that possibly those states without laws will cause the estimation of the law states to be lower. This bias would be the result of the non-law states having increased belt usage. The non-law states serve as a partial basis of comparison. A decrease in non-law fatalities would cause a corresponding decrease in the estimation of belt effectiveness in the law states.

Whether this actually is the case and to what extent is an empirical question. Estimating the effectiveness of seatbelt laws without the non-law states produces an estimate of a 7.97 percent fatality reduction. In a statistical sense the 7.7 and 7.97 percent estimates are virtually the same. Both are point estimates. Both are well within the confidence interval of the other. The fatality experience in the non-law states can be important in controlling for factors common to all frontseat occupant fatalities. As more and more states implemented seatbelt laws the value of this control, however, has weakened. The fact that the average effect is a statistical point estimate is important. As such the actual effect may be higher or lower.

One final estimation is made to try and determine if any trend has developed since the original estimation was made based on data through December 1985. The average effect in the original report and six subsequent updates was partitioned into a first quarter effect and a continuing effect. This division gave an indication that for the first three months after the implementation of a law, the fatality-reduction effectiveness was on average higher (9.0 vs. 7.5 percent for the 12/87) in a state than in subsequent months. Now with over two years experience in many of the seatbelt law states, the initial period has been lengthened to one year. Partitioning in this way will provide an additional way of testing for any trend in the effectiveness from seatbelt laws.

The results of this redefinition of the initial effect are similar proportionally to those found in the earlier analysis. The first year effect is 10.1% and the continuing effect is about 7.2%. The trend of effectiveness is consistently lower after the initial effect in the longer and shorter periods.

Methods

- *pooled cross-section, time series models*

The original study and the six updates are based on the results of pooled cross-section, time-series models. These models produce an estimate of the overall effect seatbelt laws have in reducing fatalities in general. As mentioned above, this effectiveness is expressed as the average reduction in a seatbelt-law state among fatalities generally covered by these laws.

• *companion series as control*

The models evaluate the seatbelt effect by capturing historical relationships among law-covered fatalities and a companion series, fatalities in the same state and time period not covered by the law. High correlation exists between these two series. Deviations from the historical relationships are interpreted as seatbelt effectiveness (deviation from what would have happened without the law). Evaluation is very much an exercise of predicting what fatalities would have been without a law and comparing that estimate with what fatalities actually are.

Fatalities change for many reasons, not just because of seatbelt laws. Other sources of fatality variation are controlled for in these models to the extent possible. As mentioned above, control for other factors which affect fatalities becomes more difficult as time goes on. A full description of both types of econometric models is included in the report "Effects of Mandatory Seatbelt Use Laws on Highway Fatalities in 1985".

• *variation among states*

In the original work cited above, and for six subsequent updates, individual state models were estimated for each of nine states. The nine states were chosen to be explicitly modeled because of their fatality size and because of their length of post-implementation fatality experience. These states were California, Illinois, Massachusetts, Michigan, Missouri, New Jersey, New York, North Carolina, and Texas. Modeling these states individually gave evidence that there is wide variation in effectiveness among states. Many states had reductions. However, most of these reductions were not statistically significant. Texas, had a significant reduction possibly as high as 20 percent.

The fact that some states have a larger reduction in law-covered fatalities than others should create interest in the characteristics of larger reductions.

Beginning with this update, the nine individual state models will no longer be estimated. The models depend significantly on the fatality experience in non-law states. As mentioned above, 88 percent of the U.S. population in 32 states and the District of Columbia are now covered by seatbelt laws. The experience in the non-law states is no

longer representative enough of experience in each of the nine states to act as a control.

Final Note

- *seatbelts reduce injuries as well*

The original study and all the updates have dealt with the effects that seatbelts have on fatalities. Fatality data is easier to work with when a lot of states are involved. It is recognized that seatbelts reduce injuries as well. Thus any effect expressed solely in terms of fatalities underestimates the true benefits of seatbelt use.

States with Seatbelt Laws Implemented as of September 1988

(ordered by date of implementation)

States	Effective Date
New York	12/1/84
New Jersey	3/1/85
Illinois	7/1/85
Michigan	7/1/85
Texas	9/1/85
Nebraska	*9/6/85
Missouri	9/28/85
North Carolina	10/1/85
District of Columbia	12/12/85
Hawaii	12/16/85
California	1/1/86
Connecticut	1/1/86
Massachusetts	**1/1/86
New Mexico	1/1/86
Tennessee	4/21/86
Utah	4/28/86
Ohio	5/6/86
Washington	6/11/86
Florida	7/1/86
Idaho	7/1/86
Iowa	7/1/86
Kansas	7/1/86
Louisiana	7/1/86
Maryland	7/1/86
Minnesota	8/1/86
Oklahoma	2/1/87
Colorado	7/1/87
Indiana	7/1/87
Nevada	7/1/87
Montana	10/1/87
Pennsylvania	11/23/87
Wisconsin	12/1/87
Virginia	1/1/88
Georgia	9/1/88

* Nebraska repealed law November 30, 1986

** Massachusetts repealed law December 4, 1986

Note: Wyoming will implement a seatbelt law on 6/8/89.