Relationship of 65-mph Limit to Speeds and Fatal Accidents

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A time series analysis was performed on fatal accidents, injury accidents, vehicle miles traveled, and vehicle speeds over the 5 years preceding and 1 year following the increase in the national maximum speed limit (NMSL) allowed during the spring of 1987 on rural Interstate highways. In the states that raised their limits to 65 mph, speeding on rural Interstates increased by 48 percent and fatal accidents increased by 27 percent over projections based on previous trends. A 9 percent increase in speeding and a 1 percent increase in fatalities were observed on highways still posted at 55 mph. In the states that retained the 55-mph limit, fatal accidents increased by slightly more than 10 percent both on rural Interstates and other posted highways coincident with the change in the NMSL. Speeding on the two classes of highways increased by 18 and 37 percent, respectively. The total increase in fatal accidents attributed to the raised speed limit, both in 65-mph and 55-mph states, was estimated at approximately 300/year. A shift of high-speed traffic to rural Interstates from other highways may have contributed to the changes occurring in the 65-mph states. The increase in fatal accidents on 55-mph non-Interstate highways in states that did not raise their limits may have been caused, in part, by the absence of such a shift.

The 55-mph national maximum speed limit (NMSL) was imposed during the fuel crisis of 1974 as a conservation measure. It was credited with contributing to the decline in fatal accidents that followed its passage (*1*).

As fuel became readily available, many drivers began to question the need for a 55-mph limit and the proportions of drivers who exceeded the limit began to creep upward. The greatest resistance to the lower speed limit came from the western states, where longer travel distances made an additional 10 mph a significant time saver. Some western states even threatened to raise their limits in defiance of the NMSL, even though this action would cause them to lose federal funds. Finally, in 1987 Congress voted to allow limits to be raised to 65 mph on rural Interstates, as well as on some other highways in specified experimental states. The law took effect on April 1 of that year and, by the end of the year, 38 states had raised the maximum limit.

NHTSA examined the effect of the raised limits on fatalities using time series analysis and reported that fatalities on rural Interstates were 14 percent higher than would have been expected on the basis of rates for those same highways over the previous 12 years (*2*). The report generated almost as much controversy as the change in speed limits itself. One criticism involved its use of annual accident totals, which grouped accidents during the 3 months preceding the law change with those occurring during the remainder of the year. Critics contended that the upswing in accidents over those 3 months was evidence of an upward trend that was unrelated to the change in law and, therefore, should not be credited to the increased limit but rather subtracted from it. Another criticism was that the NHTSA analysis failed to account for the increase in fatalities that took place in states that retained the 55-mph limit (although the time series model actually did so).

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In 1988, the National Public Services Research Institute undertook a study to examine the impact of the 65-mph limit on fatal accidents by (a) using monthly accident data to more precisely determine the time relationships involving changes in accidents and changes in the law, (b) studying changes in speeds as a variable intervening between the law change and accidents, (c) analyzing the extent to which the effects of the speed change on accidents varied with the states' characteristics, and (d) studying the effect of uniform versus dual speed limits on accidents to trucks and other vehicles (*3*).

The following discussion is limited to the relationship between the law change and fatal accidents. However, speed is examined as a variable mediating this relationship.

METHOD

The increase in the NMSL was evaluated by comparing accident and speed data for 65-mph versus 55-mph states for the 5 years preceding the increase in the speed limit and the year following the increase. In order to separate the effects of the speed limit change from those of other changes that might have occurred at the same time, accident and speed data were also examined for a set of comparison highways, that is, highways on which the speed limit remained the same. The comparison highways included rural Interstates in those states that did not change the speed limit as well as other 55-mph highways (urban Interstates and rural non-Interstates) in all states.

Study Variables

The attempt to assess the effect of the 65-mph limit on accidents involved speed laws, fatal accidents, and speeds.

Speed Laws

The independent variables consisted of changes in state laws permitting increased speeds on rural Interstates. The variable involved two categories: (a) those states that increased the speed limit to 65 mph, referred to as 65-mph states, and (b) those that maintained the 55-mph speed limits, referred to as 55-mph states. For this study, the 65-mph states were confined to 38 states that changed their speed limits during the period between April and June 1987. The six states that changed their speed limits at a later date during the year were excluded. Also excluded were four jurisdictions that lacked significant amounts of rural Interstate mileage. One of the states included in the 55-mph group (Virginia) ultimately increased its speed limit, but only after the 1-year followup study period was over.

Among the 38 states in the 65-mph sample, 20 changed speeds only on rural Interstates. These so-called "pure" states are emphasized here. Six states raised the limit only for automobiles, creating dual limits, and another six states raised limits for highways other than rural Interstates on an experimental basis. Finally, California did not raise limits on all eligible highways.

Fatal Accidents

Fatal accidents were used as the primary dependent variable because of their ready availability and suitability for analysis. Although they represent only about 0.2 percent of all accidents, they are routinely reported to and recorded by the NHTSA Fatal Accident Reporting System (FARS). Injury and property damage accidents, although more numerous, are available only from individual states, are often maintained in a form unsuitable to research, vary in reporting thresholds from one state to another and one year to another, and often are not recorded as occurring on 65- or 55-mph highways. Fatal accidents were chosen over fatalities as being a more stable statistic; fatalities are influenced by the number of individuals in a vehicle, a factor that is not directly related to speed limits.

Speeds

The use of speed data was important in distinguishing the extent to which changes in fatal accidents are accompanied by, and therefore are possibly attributable to, changes in speed. Speed data are routinely obtained on a sample of 55-mph highways in all states under the speed monitoring program, upon which eligibility for highway trust fund monies is ascertained. Although it was no longer necessary to monitor speeds on rural Interstates on which speeds had been raised to 65 mph, many states continued to do so.

The speed data furnished by the states to FHWA are available only in summary form and were insufficiently detailed for the needs of the study. It was therefore necessary to obtain the speed data from the states themselves. Collection of data was obviously limited to those states that had continued to monitor speeds on rural Interstates, had the data disaggregated by type of roadway, had maintained a file of speed data from previous years, had the data in a form capable of being readily accessed, and were willing to make the data available. These conditions prevailed in 16 states, of which 9 had raised their speed limits and 7 had maintained the 55-mph limit.

Because speed data are accumulated and analyzed once each quarter, data were only available on a quarterly basis. The specific speed variable selected for analysis was the percentage of drivers who exceeded 65 mph. This value was preferred over mean speed because the high speeds are the primary contributors to fatal accidents. The high proportion of drivers already exceeding the 55-mph limit created a ceiling effect that made 65 mph the better limit for analytic purposes.

Data Analysis

Speeds form a basis of a state's eligibility for federal funds; thus, the accuracy of speed data can certainly be questioned. However, any bias that exists should be fairly constant over time as far as 55-mph highways are concerned. In addition, there is no reason to expect changes in biasing factors for 65-mph highways, because the states that continued to collect speed data on such highways did so at the same location using the same procedures.

The primary method of analyzing data was time series intervention analysis, which involves analyzing a series of quantities over time to determine if the pattern conforms to that expected as a result of an intervention, such as a change in the speed limit. In analyzing the effect of speed limit changes, the quantities of primary concern were accidents and drivers who exceeded 65 mph. Accidents were studied on a monthly basis and speeding on a quarterly basis.

As explained, the time series for accident and speed data involved the period 5 years preceding the law change and 1 year following it. The five previous years provided an adequate basis for establishing long-term trends. Going back any further was contraindicated by the major shifts in accident and speed trends that took place before 1982. The inclusion of earlier years would have made it difficult to find a suitable model for the preintervention time series.

The specific method of analysis used was the Box-Tiao ARIMA intervention analysis. This method provides the ability to estimate linear models of change over time despite the presence of noise caused by seasonal or other extraneous forms of variation. In the particular form of time series used, a model of the time series representing speed or accident data was compared with a time series for a dummy variable representing the law change (a variable with 0 values leading up to the point of intervention and 1 values afterward). Through regression analysis, it was possible to measure the degree to which variation in the accident or speed time series could be accounted for by the law change variable.

RESULTS

Fatal Accidents

The time series of fatal accidents is shown in Figure 1. The left column provides the series for data gathered from the pure 65-mph states, and the right column represents all of the 55-mph states. In each column, the top series represents rural Interstates, the second series represents other 55-mph highways, and the third series represents the ratio of rural Inter-

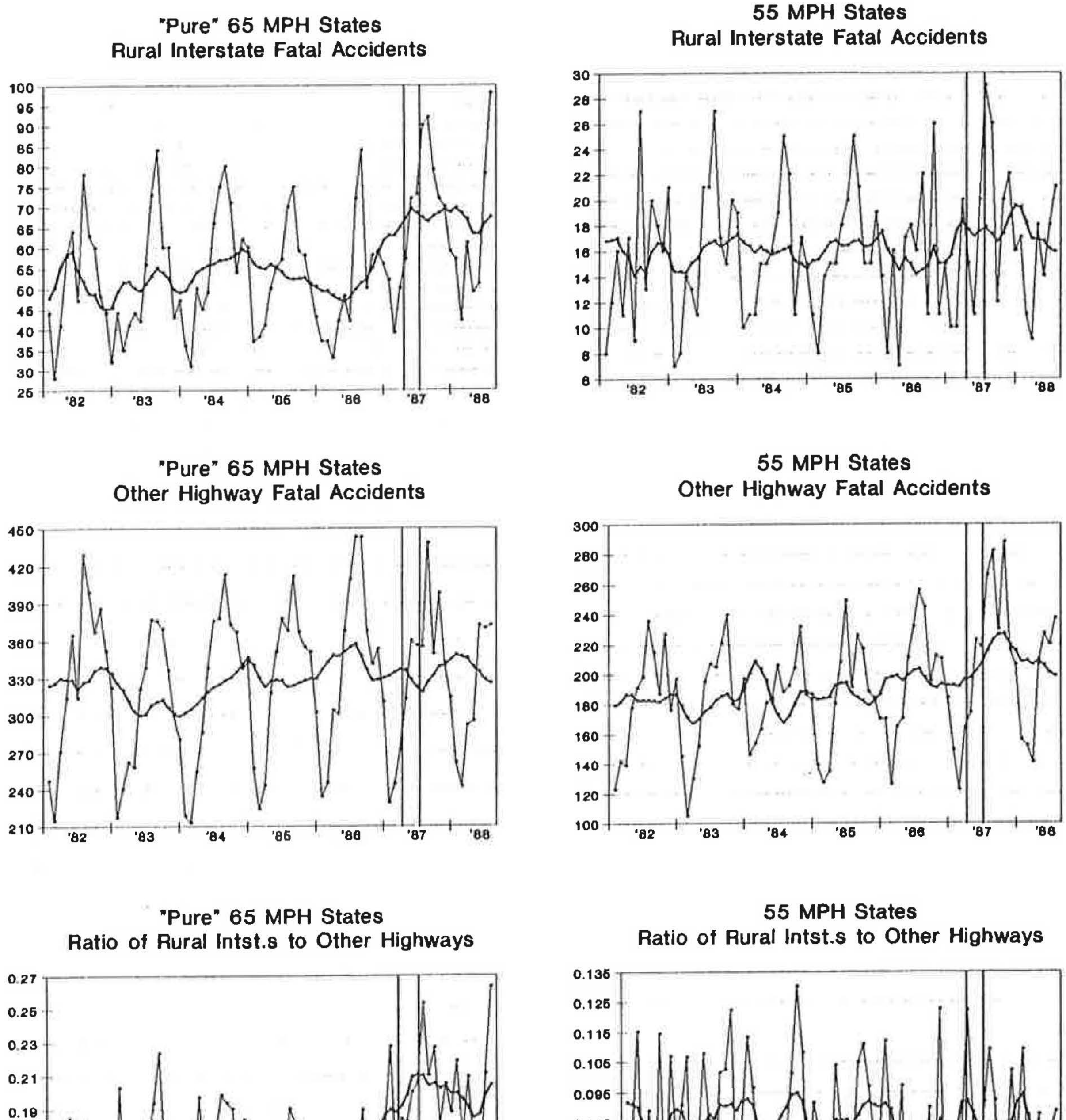

FIGURE 1 Monthly time series of fatal accidents by category of state and type of highway.

states to other 55-mph highways. All of the accident time series are seasonally adjusted.

In 65-mph States

The time series that should reflect the effect of the increased speed limits is that shown in the upper left corner—rural Interstates in 65-mph states. There is an apparent increase in fatalities in the early part of 1987 and a leveling off during the middle of the year. However, the increase appears to begin in mid-1986 rather than coinciding with the change in the NMSL, which occurred in the spring of 1987. The question is whether the leading edge of the upswing represents a true increase in fatalities or merely a return from an earlier downswing. The time series intervention model shows a significant increase in fatal accidents ($t = 5.82$, $p < 0.01$), estimated at 14.6 per month, for a yearly total of 176 fatal accidents associated with the increased posted speed limit. This result amounts to a 27.1 percent (±9.4 percent) increase over those that would have occurred if there had been no change in speed limit. (All confidence intervals correspond to the 95 percent level.)

Another uncertainty is whether the increase in fatal accidents on 65-mph posted highways was caused by the speed limit change or was the result of other variables. One series that might be expected to reveal the effects of other variables would be that representing fatal accidents that occur on 55-mph highways in 65-mph states—the second series in the left column of Figure 1. This series does not indicate any effect of the change in the NMSL. A model of the time series shows an increase of only 0.6 percent (±4.5 percent), a difference that is not statistically significant ($t = 0.28$, $p > 0.10$). If the increase in fatalities on 65-mph highways was not caused by the higher speed limit, then it was caused by any factor that would also have affected fatal accidents on 55-mph highways in the same states.

That the increase in fatal accidents on rural Interstates existed apart from any change on the 55-mph highways is evident in the time series for the ratio of fatal accidents on the two highways that appears in the lower left position in Figure 1. The increase in the ratio is similar to that observed on the rural Interstates, amounting to a 26 percent increase ($t = 4.01$, $p < 0.01$).

In 55-mph States

It is possible that the increase in fatal accidents on rural Interstates was caused by some set of variables (other than the speed limit change) that affects fatal accidents only on rural Interstates. Such an effect might appear in the time series of fatal accidents on rural Interstates in those states that maintained the 55-mph limit. This series is shown in the top right chart in Figure 1. There appears to be a small increase in the spring of 1987, and a leveling off thereafter. A model of the time series shows a statistically significant ($t = 4.08$, $p < 0.01$) increase of 20 fatal accidents per year, or a 10.4 percent (±5.1 percent) increase. A similar increase in fatal accidents early in 1987 also appears in the time series for fatal accidents on other highways in the 55-mph states. A time series model estimates the increase at 12.7 percent (±6.5 percent), which is also statistically significant ($t = 4.03$, $p < 0.01$). Because the raw number of accidents on other 55-mph highways is much greater than the rural Interstates toll, a similar percentage increase amounts to a much larger number of accidents—an increase of 295 fatal accidents per year.

The variable that produced the increased speeds in the 55-mph states seems to have affected rural Interstates and other 55-mph highways equally. The similarity in effects is evident in the ratio of fatal accidents on rural Interstates to those on other highways (bottom right), which seems to represent random variation. No significant change was associated with the change in the NMSL ($t = 0.52$, $p > 0.10$).

In States with Mixed Limits

The 65-mph category in Figure 1 included the pure states only. It did not include the six states with dual limits for trucks and passenger vehicles, the six states that were allowed to increase speed limits experimentally on some segments of rural non-Interstate highways, or California, which maintained the 55-mph limit on 23 percent of eligible Interstate highways. Each of these categories yielded time series that were similar to those observed in the pure 65-mph states, showing substantial and significant increases in fatal accidents on rural Interstates but insignificant changes on non-Interstate highways.

When all of the 65-mph states were combined, a statistically significant ($t = 6.671$, $p < 0.01$) increase of 21.8 percent, or 313, fatal accidents per year occurred on rural Interstates, whereas an insignificant change ($t = 0.76$, $p > 0.10$) occurred on the 55-mph posted highways. A 21 percent increase in the ratio of rural Interstates to 55-mph posted highways is also statistically significant ($t = 6.37$, $p < 0.01$).

Vehicle Miles of Travel (VMT)

An increase in a variable other than speed that might have contributed to the increase in fatal accidents on 65-mph posted highways could be the increase in VMT that was not shared by 55-mph highways in the same states. Such an increase would result if the increased speed limit caused drivers to shift to the rural Interstates from other highways.

In 65-mph states, annual VMT on rural Interstates increased by 8.1 percent between 1986 and 1987, compared with a 6.7 percent increase on non-Interstates—a difference of 1.4 percent. Although this increase is small, it could have had a major impact on the number of fatal accidents if it consisted primarily of drivers operating at high speeds. In this case, however, any effect would be attributed to the higher speeds rather than simply to increased mileage.

Summary

Fatal accidents appear to have increased sharply on rural Interstates in the 65-mph states coincident with the increased speed limit. No significant increase in fatal accidents occurred on highways posted at 55 mph in those states. This result was expected. What was not expected, and cannot readily be explained by the change in the NMSL, is the increase in fatal accidents on 55-mph posted highways in the states that did not raise their speed limits. Although this increase was less than half the magnitude of the increase in states that raised the limit, these increases in fatal accidents are statistically significant.

Speed Data

The time series for the percentage of drivers who exceeded 65 mph are shown in Figure 2. These series parallel those for fatal accidents shown in Figure 1 but are based on quarterly rather than monthly data.

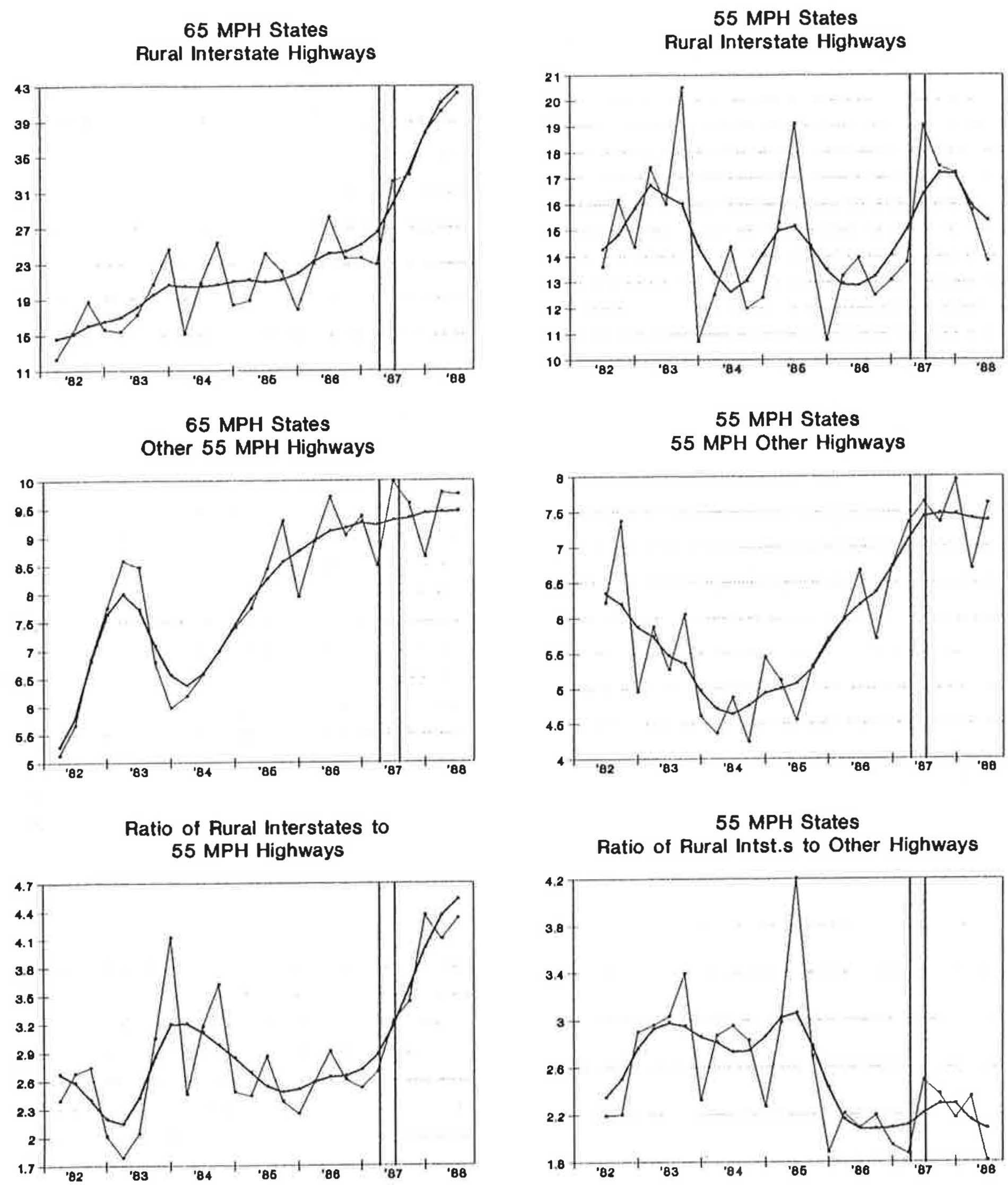

FIGURE 2 Quarterly time series of percentage of drivers who exceeded 65 mph by category of state and type of highway.

In 65-mph States

The nine 65-mph states from which speed data were obtained included two pure 65-mph states, two experimental states, four states with dual limits, and California. However, an analysis not presented here indicated that all four categories of 65-mph states evidenced the same pattern of change in fatal accidents. Indeed, within the sample of nine states, fatal accidents increased by 20.6 percent on rural Interstates ($t = 4.33$, $p < 0.001$) and by 0.2 percent on non-Interstates ($t = 0.14$, $p = 0.789$). The speed changes observed in the nine-state sample may therefore be generalized to the remaining 65-mph states.

A marked increase in the proportion of drivers who exceeded the 65-mph limit on rural Interstate highways is readily observable in the top left chart in Figure 2. Expressed in relation to the baseline series, the increase is equal to 48.2 percent ($\pm$18.4 percent) and is statistically significant (t = 4.97, $p < 0.01$). A multivariate time series showed the increase in speeding to be significantly related to the increase in fatalities (t = 3.97, $p < 0.001$).

The second chart in the left column of Figure 2 displays the speed series for 55-mph highways in the same states. Clearly, speeds on other 55-mph highways did not increase as sharply as did those on the rural Interstates. Whether there is an increase at all is debatable. If the series is viewed as beginning to level off or decline to an earlier level, then the slight increase through 1987 might be considered an increase in the amount of speeding. On the other hand, 1987 might well be viewed as part of a leveling off and thus a decline relative to the upward trend of earlier years. The time series model estimates the change at a 9.1 percent ($\pm$6.7 percent) increase, which is statistically significant (t = 2.67, $p < 0.01$).

In any case, the increase in speeders on roads posted at 65 mph far exceeded that experienced on roads that maintained the 55-mph limit. This effect is shown in the ratio of the two sets of highways, which indicates an increase of 28 percent—a result that is highly significant (t = 3.27, $p < 0.01$). The three times series for speeding in 65-mph states parallel those for fatal accidents, lending support to the idea that speed was involved in the increased number of fatal accidents on rural Interstates. The time series do not show drivers' increasing their speed from 55 to 65 mph; rather, they show increased numbers of drivers exceeding 65 mph.

In 55-mph States

The right side of Figure 2 displays the time series for all of the states that maintained the 55-mph limit. The results are not dissimilar to those for fatal accidents—indicating slight increases on both classes of highways. The increase in speeders on rural Interstates is estimated by the model as 18 percent ($\pm$17.7 percent) (t = 2.02, $p < 0.05$) and that on other 55-mph highways as 37 percent ($\pm$19.9 percent) (t = 3.66, $p < 0.01$). The ratios of speeds on the two categories of highways have no meaningful pattern.

Again, the results suggest that the apparent increase in fatal accidents was associated with increased numbers of speeding drivers.

SUMMARY AND CONCLUSIONS

Increasing the speed limit to 65 mph on rural Interstates was associated with a marked (27 percent) and statistically significant increase in the number of speeders and fatal accidents on the highways affected by the change. On highways that retained a 55-mph limit, there was no increase in fatalities and a relatively small (9 percent) increase in speeders. There seems little doubt that the increase in speeding that occurred in the spring of 1987 led to an increase in fatal accidents.

What caused the increase in speeding? If it was the increase in the NMSL, why did speeding go up both on rural Interstates and on other highways in states that maintained the 55-mph limit? The increases were less than half of those observed on 65-mph highways but were statistically significant.

The increase in speeds and accidents in the 55-mph states might be attributed to factors other than the change in speed limit, and those factors could be adjusted for by subtracting the change found in the 55-mph states from that observed in the 65-mph states. Doing so would reduce the estimated increase in fatal accidents attributed to the speed limit by approximately one-half, placing it close to the estimate of 14 percent provided by NHTSA. However, if the increases in speeds and fatalities on highways in the 55-mph states were caused by a factor other than the change in law, why did they coincide with the law change and why did they not also appear on 55-mph posted roads in the 65-mph states?

One explanation of the findings could be a change in the public's attitude toward the 55-mph limit that coincided with the change in law. Whether the law change led to the shift in attitudes or vice versa, greater numbers of drivers in 55-mph states began to operate at higher speeds at the time Congress voted to ease the 55-mph limit.

If changes in attitude toward the 55-mph limit did cause the increase in speeds and fatal accidents on 55-mph highways in states that did not raise the limit, why was there no significant increase in fatal accidents on 55-mph highways in those states that did raise the limit? One possibility is that drivers who wanted to drive at 65 mph in the states that raised their limits could legally do so by using rural Interstates. Although the relative change in vehicle mileage to rural Interstates in 65-mph states was quite small (1.4 percent), it could have had a significant impact on speeds and fatal accidents if it consisted primarily of high-speed traffic. The 27 percent increase in fatal accidents on rural Interstates might then have kept an even larger increase from occurring on the more numerous and more heavily traveled 55-mph segments.

The idea that raising speed limits on rural Interstates drew high-speed traffic from other roads and produced a net benefit is highly speculative. However, it seems reasonable to assume that any attempt to hold speed limits on rural Interstates at 55 mph at a time when large segments of the driving public believe they are safe at 65 mph will only be successful when enforcement is sufficient to maintain a high degree of compliance with speed limits. In the absence of such enforcement, it may be better to raise the speed limits on those highways most able to accommodate higher speeds than to allow drivers to speed on all highways.

It is clear that an increase in speeding concurrent with the change in the NMSL led to an increase in fatalities. However, it is unclear whether the speeding resulted from the law change or whether both resulted from fundamental changes in the public's definition of an acceptable speed. In any case, merely maintaining a 55-mph limit did not suppress speeding or fatal accidents. Indeed, with respect to fatal accidents, attempting to maintain a 55-mph limit on all highways may have been counterproductive.

From the results of the study, the following conclusions are offered:

1. Raising speed limits to 65 mph coincided with an estimated 48 percent increase in the number of speeders on rural Interstates, resulting in a 22 percent increase in fatal accidents (approximately 300 fatal accidents per year).
2. In the 65-mph states, neither the number of speeders

nor the number of fatal accidents on 55-mph highways increased following the increase in speed limits.

3. In states that retained the 55-mph limit, fatal accidents on rural Interstates and other 55-mph highways increased by an estimated 10 and 13 percent, respectively. This increase also amounts to an estimated increase of approximately 300 fatal accidents per year.

4. Although the increased number of fatal accidents in 55-mph states cannot be attributed directly to the change in speed limit, it appears to be the result of significant increases in the numbers of speeders coinciding with the change in speed limit.

5. In the face of widespread noncompliance with the 55-mph limit, raising the limit on rural Interstates may benefit safety by diverting some speeders to the highways best able to accommodate them.

ACKNOWLEDGMENTS

The project was supported by a grant from NHTSA. The authors are grateful to Susan Partyka, who monitored the grant and aided in gaining access to data, as well as to David Shinar and A. Scott Tippetts, who contributed to the research.

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The findings and conclusions presented are those of the authors and do not necessarily represent those of NHTSA.

Publication of this paper sponsored by Committee on Traffic Records and Accident Analysis.