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The effects of higher speed limits on traffic fatalities in the United States, 1993–2017

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ABSTRACT

Objective: The objective of this study was to estimate the effects of increased speed limits on U.S. traffic fatality rates during the period 1993–2017.

Methods: State-by-state annual traffic fatality rates per mile of travel were modeled as a function of time, the unemployment rate, the percentage of the driving age population that was younger than 25, the safety belt use rate, and the maximum posted speed limit. Separate analyses were conducted for interstates/freeways and all other roads.

Results: A 5 mph increase in the maximum state speed limit was associated with an 8.5% increase in fatality rates on interstates/freeways and a 2.8% increase on other roads. In total during the 25-year study period, there were an estimated 36,760 more traffic fatalities than would have been expected if maximum speed limits had not increased—13,638 on interstates/freeways and 23,122 on other roads.

Conclusions: Higher speed limits can yield societal benefits through reduced travel time, but there is a price to pay in terms of additional lives lost. Those responsible for managing the roadway system must recognize and carefully consider this trade-off before deciding to increase speed limits.

Keywords: Driver Behavior; Safety; Vehicles

INTRODUCTION

The speed at which a motor vehicle is traveling affects both the likelihood of a crash and the severity of the crash. All else being equal, increased speed increases the distance needed to stop or slow the vehicle in an emergency, and increased speed increases the energy of a collision. On the other hand, increased speed reduces the time it takes to complete a trip, which can positively affect both economic well-being and quality of life. The need to balance this trade-off has resulted in most governments limiting speeds on the roadways they control.

Ever since the invention of the motor vehicle, drivers have been expected to limit their speed to what is "reasonable and prudent" considering traffic, road, and weather conditions. Sometimes called the *basic rule* or the *reasonable man* requirement, this expectation still exists. However, as traffic volume and vehicle capabilities increased, governments saw the need to establish numerical speed limits on certain roadways. For example, the 1861 Locomotive Act made it illegal in the United Kingdom "to drive any Locomotive along any Turnpike Road or public Highway at a greater Speed than Ten Miles an Hour, or through any City, Town, or Village at a greater Speed than Five Miles an Hour" (Great Britain, 1861).

In the United States, the responsibility for setting appropriate speed limits rests with the states and municipalities, with the Federal government occasionally intervening to establish maximum limits. A maximum speed limit of 12 miles per hour was enacted in Connecticut in 1901 (Miller, 1950). As improvements in motor vehicle design led to higher and higher potential speeds, most other states also established numerical speed limits. During the 1930s, the speed capability of the average new automobile rose from 55 to 84 mph (DeSilva, 1942). In order to safely handle these higher speeds, many states, beginning with Rhode Island and New York in 1937, established limited-access highways. As a temporary measure to conserve fuel and rubber during World War II, the U.S. federal government established a nationwide maximum speed limit of 35 mph.

By the 1960s, most states had statutory maximum speed limits of 70 or 75 mph. The federal government again became involved in setting speed limits as a response to the 1970s oil embargo. The Emergency Highway Energy Conservation Act of 1974 established a National Maximum Speed Limit (NMSL) of 55 mph throughout the U.S. Within 3 months, all 50 states and the District of Columbia were in compliance with the rule. Both motor vehicle fatalities and vehicle miles of travel declined sharply in 1974. A National Research Council Committee in 1984 concluded the 55 mph NMSL "accounted for 3,000 to 5,000 fewer highway fatalities in 1974," and that the savings continued, estimating that "about 2,000 to 4,000 lives were saved in 1983" (Transportation Research Board, 1984).

In April 1987, in response to the increasing unpopularity of the NMSL, the U.S. Congress passed legislation allowing states to increase speed limits to 65 mph on qualifying sections of interstate highways in rural areas. By the end of that year, 38 states had raised speed limits on rural interstates, and two more states raised speed limits in 1988. The National Highway Traffic Safety Administration (NHTSA, 1992) estimated that there were almost 2,000 more fatalities during 1987–90 than would have been expected based on historical trends.

Other analyses supported the NHTSA finding of a negative effect of raising speed limits. For example, Baum, Wells, and Lund (1991), after adjusting for vehicle miles traveled and occupancy rates, estimated fatalities on rural interstates to be 19% higher under the 65-mph limit. McKnight, Klein, and Tippetts (1989), using a monthly time-series spanning six years, reported a 22% increase in fatal crashes per year on rural interstates that raised speed limits to 65 mph. Garber and Graham (1990) estimated a 15% increase in fatalities on rural interstates after speed limits were raised to 65 mph.

Some authors questioned the negative effects of raising speed limits. Chang, Carter, and Chen (1991) concluded that the increase in fatalities observed by other researchers was temporary, and it disappeared after a 1-year "learning period" for drivers. Lave and Elias (1994) theorized that higher speed limits on interstates allowed police to shift speed enforcement resources to other, more dangerous roads, thus leading to a 3–5% decline in fatality risk when looking at all roads combined. However, rural interstates typically account for a very small percentage of all motor vehicle fatalities, and it is possible that a fatality increase occurring only on rural interstates would not be detectable when looking at all roads (Lund and Rauch, 1992).

Congress repealed the NMSL effective December 8, 1995, returning authority to states to set their own speed limits. Within a year, 13 states raised maximum speed limits on rural interstates to 70 mph, and 10 states raised maximum speed limits to 75 mph. Many states also raised speed limits on urban interstates and other roads previously restricted to 55 mph. Early evaluations of the effect of the NMSL repeal reported fatality increases of 9–17% (Balkin and Ord, 2001; Farmer, Retting, & Lund, 1999; NHTSA, 1998). Longer term evaluations reported similar results. Patterson, Frith, Povey, and Keall (2002) concluded that states increasing rural interstate speed limits to 70 mph experienced 1,100 more deaths than would otherwise have been expected and those raising speed limits to 75 mph experienced 780 more deaths than would otherwise have been expected during the years 1996–99.

Friedman, Hedeker, and Richter (2009) attributed 12,545 deaths and 36,583 injuries to increased speed limits during 1995–2005.

A study published in 2017 examined the combined effect of changes to maximum speed limits during the years 1995–2013 (Farmer, 2017). State-by-state annual traffic fatality rates were modeled as a function of maximum speed limits, after accounting for general time trends, unemployment, the percentage of young drivers, and alcohol sales. Each 5 mph increase in the maximum speed limit was associated with an 8% increase in fatality rates on interstates and freeways and a 4% increase on other roads.

The trend toward increased speed limits has continued since 2013. By April 2019, there were 41 states with speed limits of at least 70 mph—six more than in 2013. The objective of the present study was to update the results of Farmer (2017) including the more recent data. Specifically, the objective was to determine the effects of the state-by-state changes in speed limits on trends in their traffic fatalities during the years 1993 through 2017.

METHOD

Data on annual traffic fatalities in each U.S. state during 1993–2017 were extracted from the Fatality Analysis Reporting System, a census of fatal crashes maintained by NHTSA. Estimates of the annual civilian unemployment rate for each state were obtained from the U.S. Bureau of Labor Statistics (2019). Annual estimates of each state population by age were obtained from the U.S. Bureau of the Census (2019). The estimated percentages of front seat vehicle occupants using safety belts were obtained from NHTSA (National Center for Statistics and Analysis, 2018). Finally, data on annual vehicle miles of travel (VMT) by state were obtained from the *Highway Statistics* series of the Federal Highway Administration (FHWA, 2019).

Both the fatality and VMT databases were categorized by type of roadway (interstates and freeways, other roads). Annual traffic fatality rates per VMT in each state were modeled as a function of time (i.e., years since 1992), the maximum posted speed limit on any road in the state, changes in the annual state unemployment rate, the percentage of the driving age population younger than 25, and the state safety belt use rate. Suppose D_{ij} represents the number of traffic deaths, V_{ij} represents the vehicle miles traveled, and s_{ij} represents the maximum speed limit (in units of 5 mph) in state i during time period j. Assuming D_{ij} was a Poisson random variable with mean $V_{ij}\ \lambda_{ij}$, a statistical model was formulated as $\log \lambda_{ij} = \alpha + \beta_1 (j) + \beta_2 (s_{ij}) + \beta_3$ (covariates). So, $100 (\exp (\beta_2)-1)$ represented the percentage change in the expected fatality rate for each one-unit increase in the maximum speed limit. Estimates of α, β_1, β_2, and β_3 were obtained using the GENMOD procedure in SAS (SAS Institute Inc., 2015). A generalized estimating equation was used to incorporate the correlation among different time periods for the same state. The correlations between measurements taken over time were assumed to be the same for every state, and measurements taken on different states were assumed to be uncorrelated (i.e., an exchangeable correlation structure). The possibility of overdispersion in the Poisson model was controlled for by estimating a scale parameter in SAS (i.e., DSCALE) and adjusting all statistics accordingly.

The analyses cover the years 1993–2017. Table 1 lists the state-by-state changes in maximum speed limits during this period. Five states raised their maximum speed limits from 55 to 65 mph during these years. Forty-one states raised their maximum speed limits to at least 70 mph. The maximum speed limit remained constant at 65 mph in Alaska, Massachusetts, and Vermont.

Table 1. Changes in maximum speed limits, 1993–2017.

	Maximum speed limit increased to				
Year*	65 mph	70 mph	75 mph	80 mph	85 mph
1995	MD, NY, PA				
1996	DE, RI	AL, AR, CA, FL, GA, KS, MI, MS, MO, NC, ND, TX, WA	AZ, CO, ID, NE, NV, NM, OK, SD, UT, WY		
1997		LA, MN, WV			
1998	NJ	TN			
1999	CT	SC	MT, TX		
2003			ND		
2005		IN, IA		TX	
2007		KY			
2008				UT	
2010		VA			
2011		OH	KS, LA		TX
2012			ME		
2014		IL, NH, PA		ID, WY	
2015		WI	WA	SD	
2016		MD, OR		MT, NV	
2017			AR, MI		

*Year of change if the effective date was prior to October 1; otherwise the next year was used.

To estimate the difference in fatality counts if none of the maximum speed limits had changed, the statistical model was used to predict annual fatality counts for each state with the maximum speed limits held constant at their 1993 levels (i.e., either 55 or 65 mph).

RESULTS

The highest speed limits in each state are found on interstates and freeways—roadways specifically designed for higher speed. So, it would be expected that the effects of higher maximum speed limits were most evident on these roads. Results of the statistical model for fatalities on interstates and freeways are summarized in Table 2. There was a general decline in fatality rates over time—approximately 3% per year. Fatality rates declined even further when the unemployment rate went up. Fatality rates were higher when there was a higher proportion of young drivers. Finally, fatality rates on interstates/freeways were 8.5% higher for each 5 mph increase in the maximum speed limit.

Table 2. Poisson regression of state-by-state fatality rates, 1993–2017, interstates and freeways.

Parameter	Estimate	Effect (%)	Lower CL	Upper CL	*p*-value
Intercept	−6.5186	−99.9	−100.0	−99.6	<.0001
Time	−0.0299	−2.9	−3.9	−1.9	<.0001
Change in unemployment rate	−0.0197	−1.9	−2.9	−1.0	<.0001
Percent younger than 25	0.0423	4.3	0.1	8.7	0.0435
Percent using safety belts	−0.0002	0.0	−0.6	0.5	0.934
Maximum speed limit (5 mph)	0.0813	8.5	5.5	11.5	<.0001

Note. CL= confidence limit.

The effect on roads other than interstates and freeways was much weaker, but still in the same direction (Table 3). Fatality rates on these other roads were 2.8% higher for each 5 mph increase in the maximum speed limit.

Table 3. Poisson regression of state-by-state fatality rates, 1993–2017, roads other than interstates and freeways.

Parameter	Estimate	Effect (%)	Lower CL	Upper CL	*p*-value
Intercept	−4.3256	−98.7	−99.1	−98.0	<.0001
Time	−0.0156	−1.6	−1.8	1.3	<.0001
Change in unemployment rate	−0.0138	−1.4	−1.9	−0.9	<.0001
Percent younger than 25	0.0162	1.6	0.2	3.1	0.0263
Percent using safety belts	−0.0035	−0.3	−0.6	−0.1	0.0015
Maximum speed limit (5 mph)	0.0273	2.8	0.9	4.7	0.0045

Note. CL=confidence limit.

Finally, the two statistical models were used to estimate the number of deaths that would have been expected in each year if there had been no changes in the maximum speed limits. These expected deaths are listed in Table 4 and plotted in Figure 1 along with the actual number of deaths from each year. In total, there were an estimated 36,760 more traffic fatalities than would have been expected if maximum speed limits had not increased—13,638 on interstates/freeways and 23,122 on other roads.

Table 4. Traffic fatalities and expected deaths if maximum speed limits had not increased in the U.S., 1993–2017.

	Deaths			Expected deaths		
Year	Interstate/freeway	Other	Total	Interstate/freeway	Other	Total
1993	6,244	33,906	40,150	6,244	33,906	40,150
1994	6,632	34,084	40,716	6,632	34,084	40,716
1995	6,642	35,175	41,817	6,546	34,994	41,540
1996	6,783	35,282	42,065	6,318	34,489	40,807
1997	6,628	35,385	42,013	6,142	34,542	40,684
1998	6,670	34,831	41,501	6,142	33,916	40,058
1999	6,959	34,758	41,717	6,354	33,736	40,090
2000	7,037	34,908	41,945	6,428	33,890	40,319
2001	7,090	35,106	42,196	6,494	34,107	40,601
2002	7,286	35,719	43,005	6,690	34,728	41,418
2003	7,235	35,649	42,884	6,630	34,660	41,289
2004	7,502	35,334	42,836	6,886	34,328	41,214
2005	7,717	35,793	43,510	7,038	34,694	41,732
2006	7,240	35,468	42,708	6,576	34,376	40,952
2007	6,859	34,400	41,259	6,210	33,315	39,525
2008	6,260	31,163	37,423	5,647	30,137	35,784
2009	5,415	28,468	33,883	4,855	27,506	32,361
2010	5,469	27,530	32,999	4,882	26,527	31,409
2011	5,405	27,074	32,479	4,743	25,964	30,707
2012	5,135	28,647	33,782	4,479	27,538	32,017
2013	5,156	27,738	32,894	4,521	26,641	31,162
2014	5,219	27,525	32,744	4,560	26,371	30,931
2015	5,680	29,805	35,485	5,005	28,625	33,630
2016	6,195	31,611	37,806	5,496	30,400	35,895
2017	5,879	31,254	37,133	5,180	30,018	35,199
	160,337	816,613	976,950	146,699	793,491	940,190

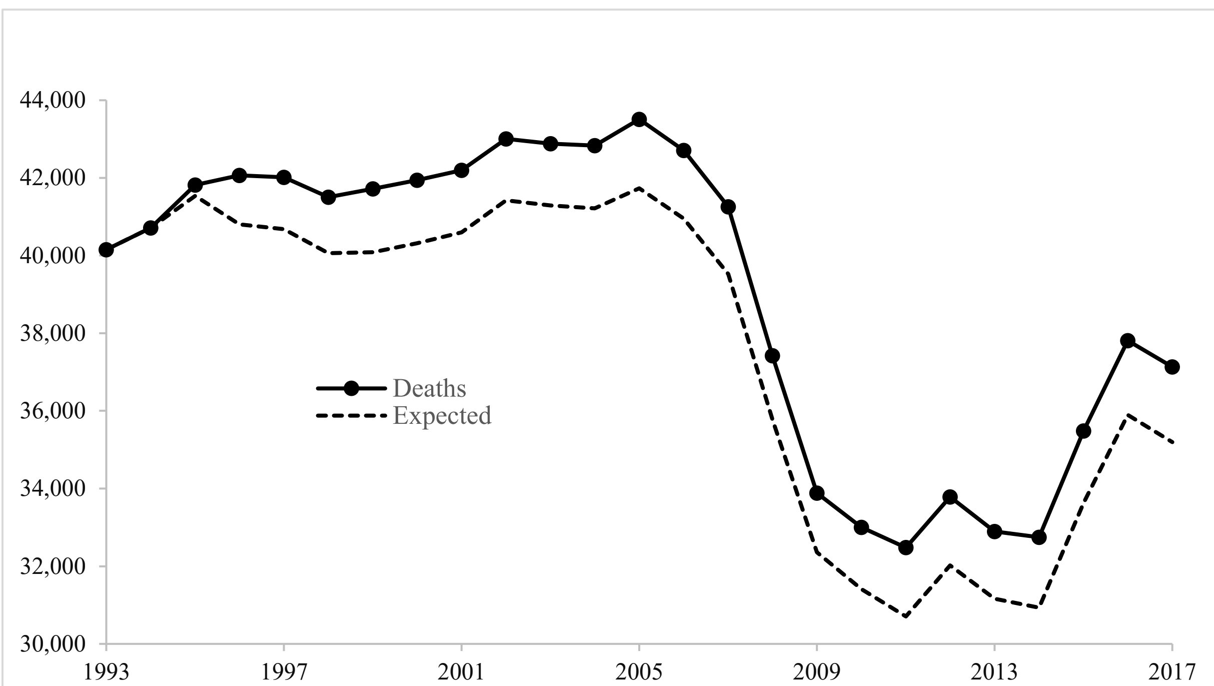

Figure 1. Traffic fatalities in the U.S., 1993–2017, and expected deaths if maximum speed limits had not increased.

DISCUSSION

Each 5 mph increase in the maximum speed limit for a state has been associated with an 8.5% increase in traffic fatalities on interstates and freeways and a 2.8% increase on other roads. These estimates are based on averages and may well be higher or lower for individual states and in individual years. However, this analysis adds to the extensive accumulation of evidence that the repeal of the NMSL has negatively impacted traffic safety in the U.S. (Balkin and Ord, 2001; Farmer et al., 1999; Friedman et al., 2009; NHTSA, 1998; Patterson et al., 2002). The repeal of the NMSL led to higher speed limits in most states, which led to higher speeds on their roadways (Hu, 2017; Kockelman, 2006; Retting and Cheung, 2008; Retting and Greene, 1997; Retting and Teoh, 2008). Those higher speeds resulted in more deaths due to roadway crashes.

For 2017, the latest year of data available, the analysis concludes that 1,934 of the 37,133 deaths—or 5.2%—would not have occurred if speed limits had remained at the 1993 levels. For the 25 years combined, the conclusion is that 36,760 deaths—or 3.8% of the total—would not have occurred otherwise. That is the size of the trade-off between efficiency/convenience and safety. Factors historically associated with fewer fatalities, such as increased safety belt use and improved vehicle design, continue to spread (Farmer and Lund, 2015; Glassbrenner, 2012). However, after dropping precipitously during the 2007–2010 economic recession, traffic fatalities have leveled off or begun to climb. Increased speed limits, along with other retrograde policies such as the repeal of motorcycle helmet laws, are offsetting the gains made, and hampering efforts to reduce traffic injuries at the national, state, and local levels (Rand Corporation, 2018).

There were a number of relevant state-specific factors not accounted for in these analyses due to the lack of consistently available data. Among the safety-related factors that may have differed by state are roadway improvements, public safety campaigns, and driving regulations (Goodwin et al., 2015; Griffith, 1999; McCartt, Teoh, Fields, Braitman, & Hellinga, 2010; Neumann et al., 2009; Peng, Geedipally, & Lord, 2012; Persaud, Retting, Garder, & Lord, 2001; Williams, McCartt, & Sims, 2015). Changes in these factors over the period of study may have obscured some of the effects of the speed limit increases. Also, while this analysis focused on changes to the maximum speed limit in each state, there were many changes to the limits on lower speed roads. The effects of increased speed limits on these lower speed roads are not included here.

It is unclear how much time is saved after speed limits are raised and the economic impact of such savings. Ideally, traveling at 70 mph instead of 65 mph should save a driver 6.6 minutes for every 100 miles. However, traffic and weather conditions often force drivers to slow down. Also, the time saved after a 5 mph increase gets progressively smaller for higher speeds. So, traveling at 80 mph instead of 75 mph ideally would save a driver only 5 minutes for every 100 miles. Drivers tend to overestimate how much time they save by traveling fast (Ellison and Greaves, 2015).

In conclusion, higher speed limits can yield societal benefits through reduced travel time, but there is a price to pay in terms of additional lives lost. Those responsible for managing the roadway system must recognize and carefully consider this trade-off before deciding to increase speed limits.

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