State Regulation of Trucking: The Policy Impact of Differential Speed Limits

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States have been primarily responsible for traffic safety policy and administration of the roadway system in America throughout our history. States largely determine licensing guidelines, speed limits, drinking and driving laws, seatbelt and child restraint requirements, highway design and maintenance, and most enforcement of driving behavior. Some policy changes are in direct response to federal pressure, such as the adoption of lower blood alcohol limits to .08 in many states over the last few years, but the states vary considerably across the range of traffic safety policies. An oft-stated goal of many traffic safety laws is the reduction of fatalities, and one area of particular concern is safety involving large trucks. Because of the size and weight of large trucks, stopping distances and reaction times are much slower and the results can be quite dangerous for both the truck drivers and occupants of the smaller vehicles around them.

In an effort to increase truck safety, states regulate both driver behavior and vehicle limitations. Truck regulations include height, weight, and length limitations, and states use scales to weigh and measure violations on these factors in the wake of federal deregulation (see Teske, Best, and Mintrom 1995). Truck driving behavior is regulated by the federal government for some issues such as required rests, but many of the regulations are the same as for other drivers, such as those prohibiting drug use, limiting drinking and driving, and requiring seat belts. For one issue, however, some states have begun to provide different limitations for trucks than cars – speed limits. In some states, trucks are limited to lower speeds on state highways than smaller vehicles. Very little is known about the impact of truck speed limits, but there is a spirited debate on the impact of speed limits in general. Some argue that increasing the speed limit for cars runs counter to the trend in reducing risk factors for fatalities because higher speeds lead to more fatalities (Meier and Morgan 1981; Kamerud 1988; Baum, Wells, and Lund 1990, 1991; Garber and Graham 1990; Chang and Paniati 1990; Wagenaar, Streff, and Schultz 1990), but others have argued that higher speeds on rural interstates do not lead to higher overall state fatality rates (Lave and Elias 1994; Houston 1999). Beyond the maximum truck speed, another concern could be that different speed limits for different vehicle types on the same roadway could affect the traffic fatality rate.

In this paper we develop and test a model explaining traffic fatalities resulting from crashes involving large trucks as defined by the National Highway Traffic Safety Administration (NHTSA). The dependent variable is taken from Fatality Analysis Reporting System (FARS), a dataset maintained by NHTSA. We use a cross-sectional time series design with data from 1994-2000, and we separately model each of the response variables. These models allow policy and covariate effects to be fixed or random, linear or nonlinear and time-independent or time-dependent. We include a number of policy and control variables in the model. We are interested in several policy variables related to truck regulation, including weight limits, length restrictions, truck speed limits, and differences in speed limits for cars and trucks. In addition, we consider enforcement efforts, measured with citations data, as well as policy variables related to highway capital, highway maintenance, and police and safety expenditures.

We control for a number of other known correlates of traffic fatalities even though less is known about whether they apply to fatalities involving large trucks. We include control variables for traffic safety laws applying to everyone (such as seat belt usage and drinking and driving policies), vehicle miles traveled annually in a state, population density, per capita income, climate, and the mix of vehicle types traveling in a state.

For estimation of policy and covariate effects for the models described above, we will use a generalized least squares random-effects estimation method. The estimated effects of all policies will be the effects adjusted for all concerned covariates and can be tested for their significance in reducing fatalities. This methodological approach will allow the identification of policies that have significant effects on reducing traffic fatalities and the ordering of all policies in terms of their effects.

Factors Influencing Highway Safety

Concern over the safety of America's highways is often revealed in regulatory efforts of the federal and state governments. Policy tools that are frequently used target the driving public in an effort to modify behavior – speed limits, seat belt laws, blood-alcohol-content limits, and minimum legal drinking age – have all been proposed and adopted by states as mechanisms to limit injurious and fatal traffic accidents. While these effects have been studied in the context of passenger vehicles, we know less about the policy impacts on a smaller, but potentially more dangerous form of transportation – large trucks.

Although large trucks comprise fewer than 5% of registered vehicles and only 8% of the total miles driven, they are involved in passenger vehicle occupant deaths at a substantially higher rate (Lyman and Braver 2003). Previous research on passenger vehicle fatal crashes provides us the general contextual factors that influence highway safety. Our interest is in understanding what public policies and transportation factors contribute to fatalities crashes involving large trucks. We utilize a state-level data set over the time period from 1994 – 2000. Apart from specific policy tools, states engage in budgetary decision making related to highway construction and maintenance. Further law enforcement efforts are funded by states and enacted by officials in the field to enhance compliance with transportation laws designed to prolong the lifespan of roadways and provide a safer travel environment.

With regard to truck transportation, states not only regulate speed but limit size and weight of trucks to promote both safety and the longevity of roadways. States frequently monitor adherence to these limit though the use of weight scales at stations close to state borders as well as mobile units tasked with enforcement and issuance of citations for violations.

Policy Factors

Our policies of interest are the speed limit for trucks and the difference in speed limits between the two maximum speed limits possible for passenger vehicles and trucks. Previous research has shown mixed results regarding the effect of speed limits on traffic fatalities (Meier and Morgan 1981; Garber and Graham 1990; Pant, Adhami, and Niehaus 1992; Lave and Elias 1994; Houston 1999). We expect that higher truck speed limits and differences in speed limits between cars and trucks may exacerbate this problem by creating two streams of traffic that flow at drastically different rates.

Lower speed limits for trucks should reduce the number of fatalities, but it is difficult to operationalize a measure of average speeds across the states for the entire time period. The only measure that is consistently available across the data set is the maximum speed limit allowed on any state roadway. In most states, this maximum applies only to rural interstate highways, but in some it also applies to any rural state highway. Some states (often with large urban populations) have no differences in urban or rural speed limits or by road type. We found a variety of sources for the speed limit data, but sources often conflicted with each other so we confirmed all data by checking state websites for relevant statutes, driver license guides, or information from the highway patrol. In a few cases, we also called states to confirm the data for past years.

The maximum weight and length requirements also vary by roadway type, but we use the highest figure possible in a state (which usually applies to state highways only for those states that allow more than the federal 80,000 pound limit on interstates for a total truck combination). The truck policies data were collected from several sources including the American Trucking Association as well as state agencies. We expect that states that allow longer and heavier trucks will experience higher levels of fatalities.

Truck VMT data allow for a more precise modeling of the impact that truck traffic has in estimating the effects on fatality rates.   In order to understand how the composition of the traffic in a state impacts fatalities, we utilize the percentage of total VMT that is traveled by trucks to control for higher levels of truck traffic. We expect that as the VMT of trucks in a state increases as a percentage of all VMT, the rate of fatalities involving trucks will also increase. Unfortunately, NHTSA has collected this data since only 1994 so it severely limits our ability to develop a longer time series for the models we test.

To account for the stringency and effort with which length and weight restrictions are enforced by the states, we use the percent of vehicles cited for violating these limits. To control for differences in truck traffic in each state, we use the percent of citations issued for all trucks weighed with the state. The data are collected by the states and provided by the Federal Highway Administration.

Clearly, drinking and driving affects traffic safety. Many studies have found that the minimum legal drinking age affects passenger vehicle safety (Houston, Richardson and Neeley 1995), but this factor is invariant during the time period studied here (from 1994 to 2000). There are a wide number of state laws affecting drinking and driving behavior, and one that many states have adopted during our time frame is the .08 per se Blood Alcohol Content (BAC) laws. This law specifies a certain level of BAC as evidence of illegal intoxication, and many states have adopted this more stringent standard over the last few years in response to federal pressure involving highway funds. We expect that states with such a law will experience fewer traffic fatalities. The data were taken from various years of *Traffic Safety Facts*, published by NHTSA.

Mandatory seatbelt laws are also frequently found to have a significant impact on traffic fatalities (Chorba et al 1988, Wagenaar et al 1988; Houston et al 1995, 1996; Houston and Richardson 2002). We examine the impact of restraint systems by moving beyond the typical modeling of mandatory seatbelt laws and instead relying on a more precise indicator of individual behavior – state level data of seat belt usage rates provided by NHTSA in various years of *Traffic Safety Facts*.

Control Factors

We employ a variety of control factors that have been found to impact state fatality rates over time (Houston, Richardson, and Neeley 1995, 1996). Population density as a measure of urbanization should have a negative impact on fatalities due to decreased need for highway travel and higher levels of congestion that result in decreased speed. Per capita income (in constant dollars) as a measure of economic conditions has frequently been used in state fatality studies, but the expectations of its impact vary. Some researchers have posited that those with higher incomes will have a higher demand for safety (Legge and Park, 1994), while others have argued that drivers with higher income will place a higher value on time thus increasing risky behavior (Peltzman, 1975; Graham and Garber, 1984). Population density and income per capita in constant dollars were obtained from the Census Bureau.

Climate factors may influence highway conditions with higher temperatures encouraging faster driving (Evans, 1991). We also include a measure of precipitation to capture the potential effects of snow and rain. In studies of smaller vehicles, it is often posited that precipitation will reduce speeds and therefore the severity of crashes, but less is known about the impact on fatalities involving large trucks. Because truck drivers may have more difficulty slowing down and controlling the vehicle in heavy precipitation of any form, it is possible that states with higher average precipitation levels will experience higher levels of fatalities in crashes involving large trucks. At the state level, we approximate these factors by utilizing average temperature (of either a single city value or the average of multiple cities per state) and precipitation from the *Statistical Abstract of the United States*.

Highway conditions have been found to be important factors in explaining fatalities (Houston, Richardson, and Neeley 1995, 1996), and we include measures for three categories of highway expenditures that contribute to the safety: capital, maintenance, and police and safety. These expenditures are from *Highway Statistics* and include expenditures from all levels of government adjusted to constant dollars and standardized by vehicle miles traveled (VMT). Correcting for constant dollars removes inflationary tendencies that are often related to autocorrelation effects over time, and standardization by VMT controls for the impact of size of a state's roadway system and usage. While these budgetary mechanisms are not high profile safety policies, their influence needs to be accounted for in any study of traffic fatalities. We expect that capital expenditures will have a positive effect on fatalities while maintenance and police and safety expenditures will have a negative impact.

Analysis Plan

We utilize the XTREG procedure in STATA to model the cross-section time-series data set. Given the dominance of the cross-section over the time component, we estimate a random effects model using Generalized Least Squares regression to analyze the impact of different factors and policies on fatalities involving tractor-trailers with the state as our unit of analysis. We standardize our dependent variable, fatalities in which a tractor-trailer was involved, by the total vehicle miles traveled in a state by all vehicles. This adjustment controls for the vast differences in road mileage and usage. We analyze data from 1994 – 2000 when truck VMT estimates first became available to control for the proportionate mileage of trucks on a state's roadways. Because the number of fatalities is very low relative to the number of vehicle miles traveled, our coefficients in Table 1 appear to be quite small even though the impact of any given variable may be significant and substantively important.

Results

Our results presented in Table 1 show fairly good model fit, but more importantly for this first examination of this particular set of traffic fatalities the results indicate the policy impact of speed limits. Similar to previous studies regarding the deleterious effects of the 65-mph speed limit, we find that a higher maximum speed for tractor-trailers has a significant and positive impact on the fatality rate. Alternatively, the difference in maximum speeds between cars and trucks has no statistically significant impact. Overall, if states seek to reduce traffic fatalities involving trucks, they can lower the truck speed limit without changing the normal vehicle speed limit and still achieve the desired results.

Other truck specific regulatory policies -- maximum length, maximum weight, and percentage of weighed vehicles given citations – have no significant effect on truck-related fatalities. Because most of the states with higher weight and length limitations are in less populated western states, such as Wyoming with a maximum length of 85 feet and a weight limit of 117,000 pounds, the higher limits may not matter much. This may also suggest that more densely populated states would need further analysis of this phenomenon before considering relaxing their regulations. The absence of an enforcement effect is also somewhat surprising because it is likely that states who are more vigorous in checking trucks would also be more likely to reduce the risk of a variety of other safety concerns with vehicles and driver behavior.

Two safety policies geared toward all vehicles affect the fatality rate differently. While the rate of seatbelt usage has no impact on fatalities, the adoption of a BAC .08 policy has a significant and negative effect. Even though seatbelt laws have been found to have a significant effect in reducing all traffic fatalities (Chorba et al 1988, Wagenaar et al 1988; Houston et al 1995, 1996; Houston and Richardson 2002), the use of seatbelts may not matter much in crashes between smaller vehicles and large trucks. Alternatively, the lower threshold for alcohol affects the likelihood of a crash occurring so it has a similar impact on fatalities in crashes involving trucks as it has on the overall traffic fatality rate. Because our dependent variable does not consider who caused the crash, we do not know if the BAC level impact influences truck driver behavior or the drivers of the smaller vehicles in the crashes.

The control variables generally act as expected. The proportion of a state's VMT that is comprised of tractor-trailer miles, as opposed to total truck VMT, has a very strong and positive impact. As a state sees an increase in truck traffic, the fatalities in crashes involving trucks also increases. On the other hand, none of the expenditure variables attain significance. Further, there is no impact of temperature on fatalities, but average precipitation does have a significant positive effect on fatalities. Because wet conditions may exacerbate braking distances and steering control for large trucks, wetter states experience more fatalities involving large trucks. Population density negatively impacts fatalities as states with more rural populations see relatively higher truck-fatality rates. Income per capita (in constant dollars) also impacts fatality rates in a significant negative direction. This effect could be because states with higher average income have more citizens who can afford more expensive cars with more safety features or that more prosperous states may be able to afford other safety features not specified in the model.

Conclusion

Very little research on the impact of trucking regulations on traffic safety has been conducted, but this paper seeks to fill this gap. We conducted a cross-sectional time series analysis of traffic fatalities involving large trucks in the 50 American states over the time period from 1994 to 2000. The time frame was somewhat constricted by the collection of truck travel rate data by NHTSA, but it was an important time for our research question involving the impact of truck speed limits in the states. Because of the removal of federal restrictions on speed limits, a number of states raised their speed limits prior to or early in our time frame so there was considerable variation in the dependent variable. Further, several states implemented speed limits that differed for large trucks versus other smaller vehicles so this allowed us to test for not only the impact of truck speed limits but also whether speed differences in the same traffic flow would negatively affect traffic safety.

Our results, which are still somewhat tentative and early in the diagnostic stages, suggest that truck speed limits and the .08 BAC per se law (setting tighter restrictions on drinking and driving) are the only state laws that significantly reduce fatalities in crashes involving large trucks. On the other hand, the difference between truck and car speed limits does not affect safety, and none of the weight or length restrictions significantly affect traffic fatalities. Further, enforcement efforts, as measured by citations per truck weighed, do not increase safety. Finally, differences in state expenditures on building, maintaining or policing highways do not matter for traffic safety. Overall, states appear to have a limited set of policy tools that can be used to significantly affect the rate of fatalities caused by crashes involving large trucks.

Table 1 - Cross-Sectional Time Series Model of Fatalities Involving Trucks in the US States, 1994 – 2000, Random-effects GLS Regression

	Fatalities Per Total VMT	
	Coefficient	Std.Err.
Constant	.0025**	(.00095)
VMT Truck Ratio	.00415***	(.0013)
Total Truck VMT	-.000000003	(.00000001)
Maximum Length	.000007	(.000007)
Maximum Weight	-.000000004	(.000000004)
Truck Maximum Speed	.000009*	(.000004)
Speed Difference	-.000007	(.00001)
Temperature	.000002	(.000008)
Precipitation	.00002***	(.000005)
Seatbelt Usage	.000002	(.000005)
Percent Citations	-.0002	(.0003)
BAC .08	-.0003*	(.0001)
Per capita income (constant $)	-.0000001	(.00000003)
Highway Capital Expenditures per VMT (const $)	.000004	(.000009)
Highway Maintenance Expend per VMT (const $)	-.00004	(.00002)
Police & Safety Expend per VMT (constant $)	.00005	(.00004)
Population Density	-.000001***	(.0000004)

N = 285

Groups = 49

R^2 within = .03

R^2 between = .77

R^2 overall = .65

Wald Chi2 (df) = 152.97

Prob > chi2 = 0.0000

sigma_u = .0003

sigma_e = .0004

rho = .4717

* p<.05
** p<.01
*** p<.001

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