PRIMARY SEAT BELT ENFORCEMENT AND TRAFFIC FATALITIES

BACKGROUND

Seat belt usage has been directly linked to a decrease in traffic-related fatalities. According to the World Health Organization (WHO), wearing a seat belt can reduce the risk of fatal injuries by around 45% for front-seat occupants and up to 75% for rear-seat occupants.

The effect of seat belt enforcement comes from several mechanisms. Firstly, being ejected from the vehicle significantly increases the risk of severe injuries and fatalities. Seat belts keep occupants securely inside the vehicle, reducing the likelihood of being thrown out or partially ejected. Additionally, implementing seat belt policies including mandatory seat belt laws and public awareness campaigns could promote positive behavioral change among drivers and passengers, thereby reducing the risk of injuries and fatalities.

The U.S. seat belt use laws are subject to primary enforcement and secondary enforcement. Primary enforcement allows a law enforcement officer to stop and ticket a driver if they observe a violation. Since the implementation of a primary seat belt law is from the external policy environment, we are interested in how this exogenous shock influences fatality outcomes.

METHODS AND DATA

Variable justification

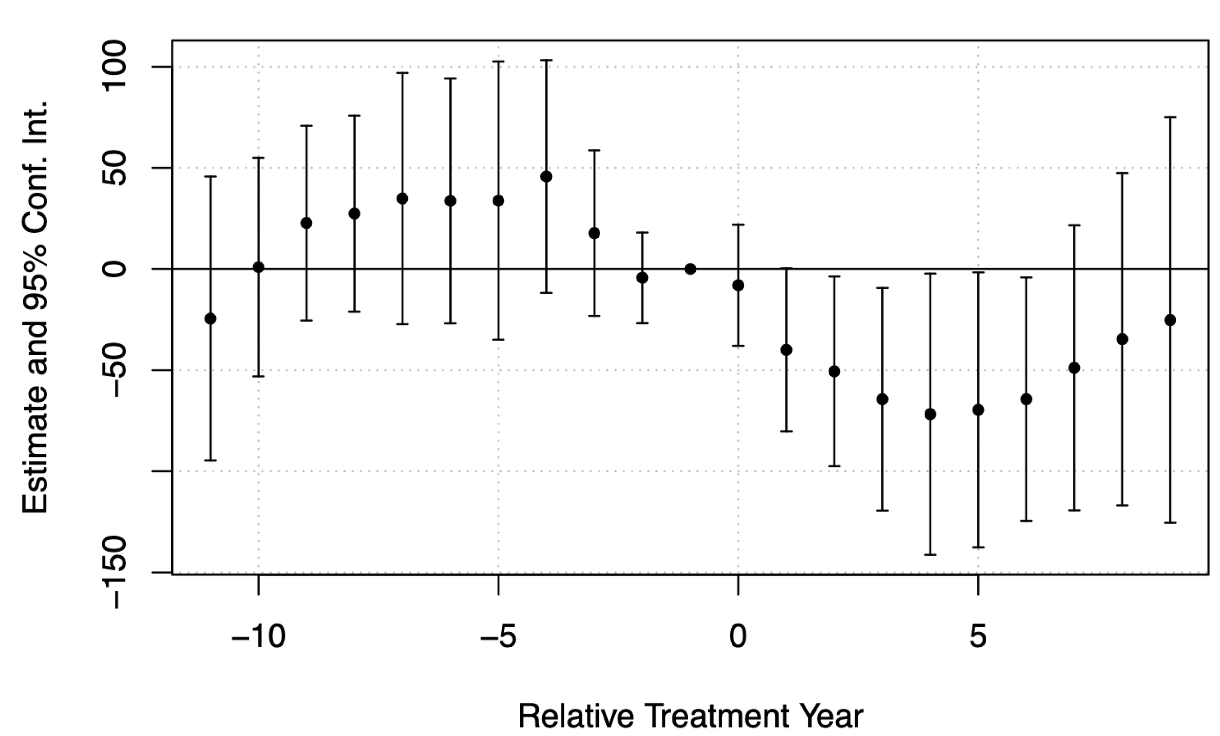
The data set I use contains yearly traffic fatalities data for 50 states and the District of Columbia for 1983-2012. The data set also includes binary policy variables including the passage of seat belt laws, distracted driving laws, speed limits, and various impaired driving regulations, indicating different policies implemented by each state in different years.

$$y_{it} = \alpha_i + \gamma_t + \beta_1 X_{it} + \beta_2 SeatBelt_{it} + \epsilon_{it} \tag{1}$$

In the fixed effect model (1), the $SeatBelt_{it}$ is primary seat belt law implementation in state i in year t to explore if this treatment affects total traffic fatality outcomes y_{it}, while state variation goes to α_i and year variation goes to γ_t. For the control variables bundle X_{it}, I choose covariates including road traffic density, population, crime, unemployment, fuel tax and income level to condition on factors that could influence traffic fatalities in each state per year. Here I control the total population for standardizing outcomes, and control other factors to get rid of confoundings.

Concept	Variable	Description
Dependent Variable	Traffic Fatalities	Total traffic fatalities
Treatment	Seat Belt	=1 if state has a primary enforcement seat belt law
Control Variables	Population	Total population
	Property Crime	Property crime rate (per 100,000 people)
	Unemployment	Unemployment rate
	Income	Per capita personal income (dollars)
	Fuel Tax	Fuel tax (cents per gallon)
	Rural Density	Density of cars in rural roads (VMT / Total Length)
	Urban Density	Density of cars in urban roads (VMT / Total Length)

Parallel Trend Examination

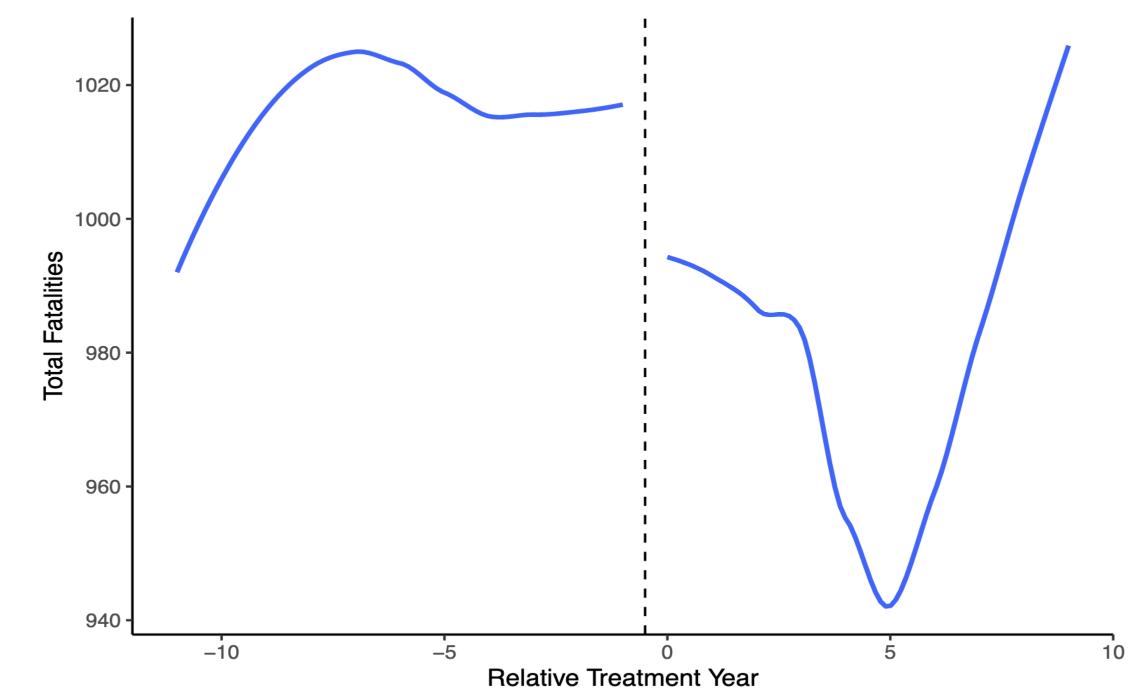


METHODS AND DATA

Motivation Plot

Since the primary seat belt enforcement is implemented in each state in different years, I use multiple periods of DID with two-way fixed effects on state and year levels and cluster the standard error on the state, I carefully examined parallel trends and found common trends between treatment and control groups before the treatment was implemented.

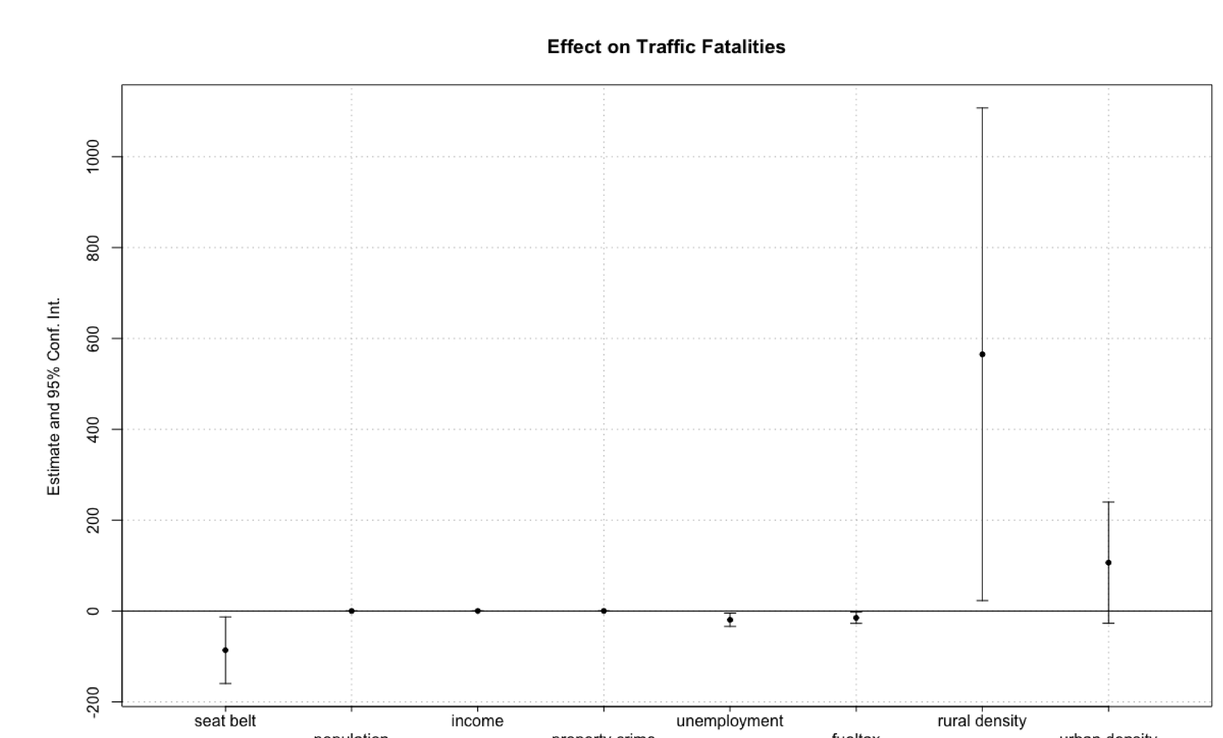
The first plot shows an overall annual trend for traffic fatality of treatment and control groups (to sensibly scale fatality measure, I divide total traffic fatalities by the total population*1000, representing a standardized level of fatalities in each state.) In the second plot, an obvious switch in fatalities before and after treatment can be observed, indicating policy reform could have some effects.



RESULTS

The simple DID indicates a significant negative effect of the seat belt law on traffic fatalities. After controlling the population and other factors, if a state implements a seat belt law, the traffic fatalities will decrease by 86.2 units.

For control variables results, the unemployment rate and fuel tax have negative effects on traffic fatalities, probably because higher unemployment rate and fuel tax lead to less traffic activities. Higher rural road car density increases traffic fatalities.



ROBUSTNESS CHECK

For the robustness check, I include other policy dummies (except primary seat belt enforcement) implemented in each state as control variables and found little change in the treatment coefficients.

I also run a random effect model and conduct the Hausman test and found a significant difference between these two estimates, so using a fixed effect model is reasonable.

Considering simple DIDs make "forbidden" comparisons by including some treated groups as controls after those treated groups are treated. But we want to control the effects from units treated or untreated in other periods. Therefore, I use Sun and Abraham estimator (2021) that addresses the treatment order issue in DID TWFE to approach dynamic treatment effects via event-study analysis. The specification is displayed in (2) and the comparison baseline is *Relative Treatment Year* = -1:

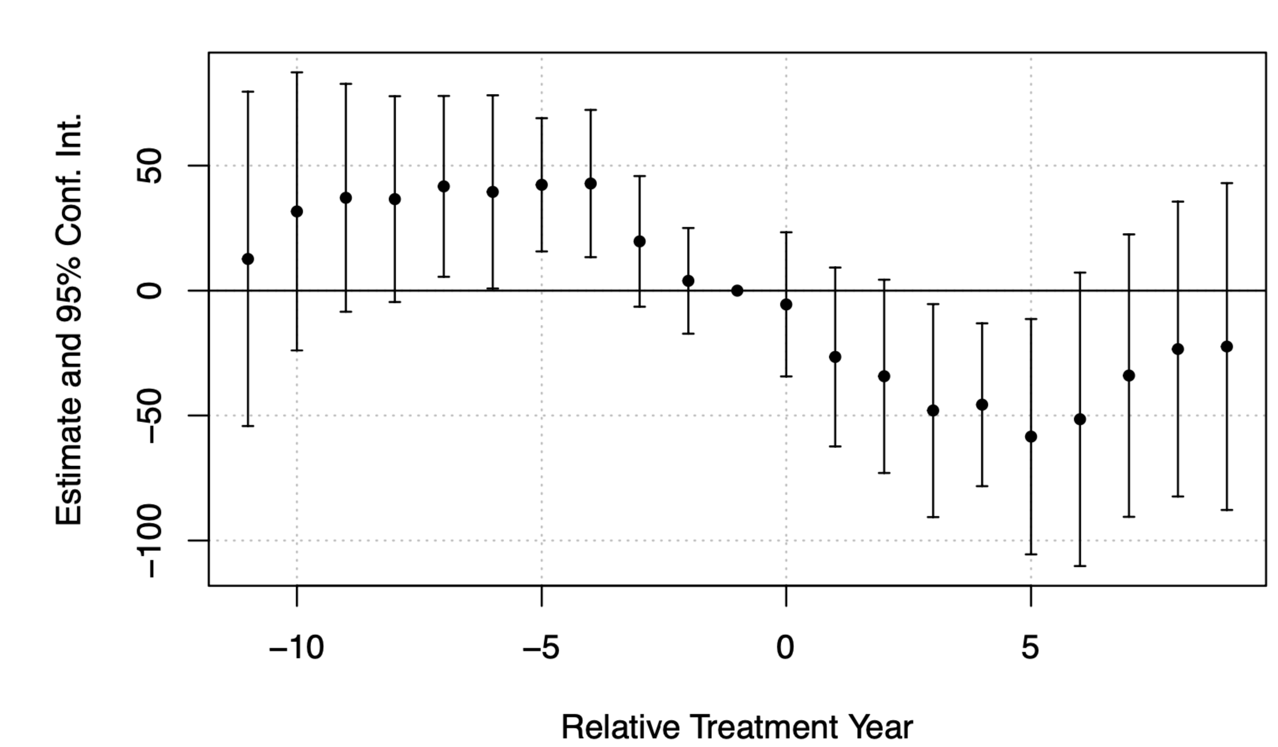
$$y_{it} = \alpha_i + \alpha_t + \gamma_k^{<-K} D_{it}^{<-K} + \sum_{k=-K}^{-2} \gamma_k^{lead} D_{it}^k + \sum_{k=0}^{L} \gamma_k^{lag} D_{it}^k + \gamma_k^{L+} D_{it}^{>L} + \epsilon_{it} \tag{2}$$

where $D_{it}^k = 1\{t - G_i = k\}$ is an "event-study" dummy variable that takes value one if a unit i is k periods away from initial treatment at time t and zero otherwise. The result shows that treated units have relatively lower fatalities.

	Traffic Fatalities		
	(1)	(2)	(3)
Seat Belt Coefficient	-75.7*	-86.2**	-86.1**
Control other factors (X_{it})	No	Yes	Yes
Control policies	No	No	Yes
Fixed Effect	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes
Observations	1530	1500	1500

*Note: *p<0.1; **p<0.05; ***p<0.01*

Placebo Test (Sun and Abraham estimator)



CONCLUSIONS

By plotting the data, I get a general sense of the relationship between treatment and outcome, assuming that primary seat belt policy reform leads to lower traffic fatalities. To identify the causality, I conduct a two-way fixed-effect model and find there is a significant difference before and after the primary seat belt enforcement is implemented in each state in different years, indicating the policy plays a positive role in decreasing traffic fatalities.

Through the dynamic TWFE based on event-study analysis and other approaches, I have a more detailed sense of the policy effect. The multiple coefficients plot shows that seat belt law significantly decreases traffic fatalities in the first 5 years after implementation, but then the effect fades away. Therefore, policymakers should design enforcement more carefully to maintain its long-term validity.