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Econometrics

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Project Part 1

This literature review uses 6 academic journals that looks at the underlying factors that affect the severity of car crashes. It is important to understand these factors not only to improve road safety, but also for informing effective public policy and resource allocation. Fatal car crashes not only lead to the loss of ones life, but also affect economic and social factors. It is important for economists to understand factors that increase the likelihood of severe car crashes- such as speed limits, driver distraction, weather conditions, vehicle age, economic conditions, demographics/alcohol consumption- because it can allow for data driven strategies and policies to reduce the likelihood of injuries.

Speed limits remain a consistent predictor of traffic fatalities. There tends to be a trade-off between time saved and safety which is a risk the driver should make. In 1987 there was a policy change that allowed states to raise rural interstate speed limits from 55 to 65 mph. Ashenfelter and Greenstone (2002) analyzed this policy change finding that this change increased fatality rates 35%, while travel times were reduced 3.5%. This implied that states accepted 125,000 hours of saved travel time per life lost, valuing each statistical life at approximately $1.54 million (in 1997 dollars), revealing the trade-off between travel time saved and life.[[1]](#footnote-1) In addition, Greenawalt (2006) found that for every one unit of increase in SPEEDMILE (proxy for speed limit exposure) increased fatalities by 0.00106 per million vehicle miles traveled.[[2]](#footnote-2) This further confirms the importance of speed limit when driving as higher speed limits increases the likelihood of having a fatal crash.

Distractions, particularly from mobile phone use or in-vehicle activities, significantly increases the likelihood of traffic accidents. Moreira, Sachsida, and Loureiro (2004) found that smoking, cell phone use, or having children in the vehicle significantly increased the probability of traffic accidents. Their probit model illustrated that smoking while driving increases the probability of an accident by 20.51%, mobile phone usage by 12.09%, and children riding with the driver by 13.89%, all with a significance level less than 1%.[[3]](#footnote-3) One way to reduce the probability of accidents from being distracted is through law enforcement and policies. Abouk and Adams (2013), used a difference-in-differences approach to evaluate the effects of texting bans across U.S. states. Their results revealed that states with primary enforcement bans experienced an 8% reduction in fatal single-vehicle, single-occupant crashes, which are most likely to involve distracted driving.[[4]](#footnote-4) However, overtime this reduction soon increased implying persistent enforcement and policies to stop distractions on the road will help the reduction of fatal crashes.

Weather is a critical yet often underestimated factor influencing the severity of car crashes, especially when other factors like speed is involved. Becker, Rust, and Ulbrich (2022) show that adverse weather conditions—particularly rain, snow, and sun glare—substantially increase the probability of severe crashes, with snow raising single-truck crash risk by 75% and sun glare increasing multi-car rear-end crashes by up to 40% under higher speed limits.[[5]](#footnote-5) On the other hand, Greenawalt’s (2006) broader economic analysis, found that states with warmer average temperatures experienced more fatalities due to the lack of comfortability and increased aggression in hotter temperatures.[[6]](#footnote-6) It is also mentioned that in cooler, snowier climates, car travel much slower reducing the probability of crashes. While these two journals have contradicting viewpoints of weather on crash severity, it suggests that weather should be considered as an interactive variable making the probability of crash severity increase in relation to another variable like speed limit, or distraction.

The age and build year of a vehicle play a critical role in determining crash severity, with newer vehicles offering greater protection due to improved safety features. Anderson and Searson (2015) found that vehicles manufactured after 2004 demonstrate a consistent decline in fatality rate, while the risk of fatal crashes increase as the car gets older[[7]](#footnote-7). It is important to note that even though policies and road changes overtime have helped reduce the risk of a fatal crash, vehicle design and improvements is what’s driving the amount of saved lives and accidents. Drivers aren’t going to change how they drive, and there is only so much rules and regulations law enforcement can do when it comes to reducing distractions and speed limits, but with technology and equipment getting more advanced, having a newer car reduces your chances of even getting in a crash than an older car.

Based on the literature review I have decided to remain with my original hypotheses which are the following:  
Research Question 1: **Does driver distraction significantly increase the likelihood of an injury in a crash?**

Hypothesis 1 (Null and Alternative):

* H0: Driver distraction has no effect on the likelihood of injury in a crash
* Ha: Driver distraction increases the likelihood of injury in a crash

Research Question 2: **Does vehicle age significantly affect the probability of injury in a crash?**

* Hypothesis 2 (Null and Alternative):
  + H0: Vehicle age has no effect on the likelihood of injury in a crash
  + Ha: Older vehicles are associated with a higher likelihood of injury in a crash.

Research Question 3: **Do specific weather conditions increase the probability of injury in a crash compared to clear weather?**

* Hypothesis 2 (Null and Alternative):
  + H0: There is no difference in the likelihood of injury during adverse weather conditions (Cloudy, Fog/Smog, Rain, Snow, etc.) compared to clear weather.
  + Ha: At least one adverse weather condition significantly increases (or decreases) the likelihood of injury in a crash compared to clear weather.

I have decided to keep all of the four original variables which was the dependent variable being **injury severity**, the type of **weather** when the crash happened, the recorded **speed limit,** whether the driver was **distracted** or not, and the **vehicles age.** Below is a detailed summary of each variable:

|  |  |
| --- | --- |
| **Variable Name** | **Variable Type** |
| DV: Injury | Factor w/ 2 levels (yes, no) |
| Speed.limit | numeric |
| Vehicle\_age | numeric |
| Weather | Factor w/ 8 levels (Clear, Cloudy, Fog/Smog Other, Rain, Sand/Dirt, Snow, Wind |
| Driver\_distracted | Factor w/ 2 levels (yes, no) |

For the data cleaning process, I first removed all the variables I was not using in my regression before removing any missing variables. This is because at least one row had a missing variable when all variables included. After removing any missing variables, I went from 192,966 observations to 142,549. I then created a new variable called vehicle\_age which was formed from the vehicle year by subtracting 2025, the current year. I took observations where vehicle year was greater than 1950 and less than 2025 as some vehicle years did not make sense. For my dependent variable I had to group the answers into injured or not because for logistic regression you need a binary variable. Following that, I cleaned up the weather variable by grouping weathers into similar groups to make regression output easier to visualize.

When it comes to the variable I decided to transform, I took the square of speed limit because I believe that at a certain speed limit the probability of being injured in a crash plateaus. With the interaction term, I decided to take driver distracted and vehicle age to see if newer cars, with better safety features, reduce the risks associated with distracted driving compared to older vehicles.

Below is the logistic regression I ran with the dependent variable being injury, with independent variables being vehicle age, speed limit, weather, driver distracted, speed limit squared (transformed variable), and vehicle age:driver distracted by (interaction)

**Appendix Output:**

A screenshot of a computer

Description automatically generated

**Bibliography:** APA Format

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6. Greenawalt, K. R. (2006). *The Effect of Macroeconomic Conditions on Traffic Fatality Rates across the United States*. [↑](#footnote-ref-6)
7. Anderson, R. W. G., & Searson, D. J. (2015). *Use of Age–Period–Cohort Models to Estimate Effects of Vehicle Age, Year of Crash and Year of Vehicle Manufacture on Driver Injury and Fatality Rates*. [↑](#footnote-ref-7)