COVID-19's Effect on Traffic Fatalities

Sammy Rosofsky

0 Abstract

The COVID-19 pandemic brought along many fundamental changes to society. Some were understandably predictable, such as a heightened awareness for infectious diseases, while others were less obvious. One surprising result of the pandemic in the United States was an increase in the number of traffic fatalities, even when people were driving less at the start. Using data sourced from the United States Department of Transportation and interrupted time series models, various hypotheses will be tested to learn more about the causes for the rise in traffic fatalities.

1 Introduction

1.1 Literature Review

One of the most immediate impacts of the COVID-19 pandemic was a reduction in traffic, as workers started working from home more, governments issued stay-at-home orders, and people generally were traveling less to visit others. Despite this reduction in traffic, there was a noticeable spike in traffic

fatalities, and the rate of traffic fatalities did not decrease as the pandemic progressed. It would normally be thought of as common sense that amount of traffic and deaths caused by traffic should be closely related, due to more vehicles on the road making for more opportunities for collisions, but at the start of the pandemic the opposite was observed.

This seemingly paradoxical relation did not go unnoticed, and several possible explanations arose. Probably the simplest, proposed by David Leonhardt in Bloomberg [1] was the idea that people's driving behavior did not change much as a result of the pandemic, but that the reduction in traffic created more space for drivers to move at higher speeds on the road. He cited an international meta-analysis[5] that showed an increase in high speed collisions that was consistent across the world despite a given country's number of collisions overall.

The counter to this idea is the argument that the pandemic brought about much mental anguish, as described by David Leonhardt in the New York Times[4], which causes more reckless behavior and increased drug use, which would have clear effects on driving safety. While monthly or quarterly data on public health like number of suicides or DUIs are hard to come by, it is possible to find a variable that is linked to those as a substitute. This concept is similar to "Deaths of Despair", a term coined by Princeton economists Anne Case and Angus Deaton[2]. Their research, mostly taking place in the years shortly before the pandemic, was for the purpose of finding why certain populations in developed countries were seeing higher mortality. They found that there were rising numbers of deaths by suicide, drug overdose, and alcoholic liver disease, and that this was caused by people's poor economic

well-being. Based on this, it could be possible to use a proxy variable like unemployment, which soared at the beginning of the pandemic, to measure some of the behavioral change that occurred as a result of the pandemic.

Lastly, a survey done by the AAA Foundation[3] noted that there may have been some sort of selection bias involved that caused the increase in fatalities. The survey stated that while in the aggregate people were driving less, of the people that were driving more they were disproportionately younger and male, which are demographics that drive less safely. This would be an interesting idea to investigate, but unfortunately the raw data was not released so it's not possible to incorporate it into a statistical model.

1.2 Summary of Results

The hypotheses above were tested using an interrupted time series model, a type of quasi-experimental analysis, where the start of the pandemic was used as a treatment effect on the number of traffic fatalities per mile driven. In the absence of any control variables, the pandemic was confirmed to have a substantial impact on the rate of highway fatalities. When adjusted for the number of miles driven, there was not sufficient evidence to suggest that less traffic led to increased deaths. When adjusted for unemployment, the overall effect of the pandemic was substantially reduced. While unemployment itself was not a significant explanation for the higher rate of deaths, the diminished effect of the pandemic as a whole implies that there would be a more accurate measure correlated with unemployment that would better explain what fundamentally changed as a result of the pandemic.

2 Data Description

The data involved is sourced from the United States Department of Transportation. It consists of time series data going back several decades and collected on a monthly basis. While there are several dozen variables, largely involving the spending of local governments on various infrastructure, the main variables of concern are:

- Highway Fatalities, which were measured on a *quarterly* basis
- Highway Vehicle Miles Traveled (all systems), which was by a factor of 100 million to make for clarity
- Seasonally adjusted unemployment, which was the national unemployment rate for a given month

Because fatalities were measured quarterly, the other variables were averaged for a given quarter. Further, for the dependent variable of this analysis, number of highway fatalities was divided by miles traveled (per 100 million) to measure the rate of fatalities per miles driven. The relation between these two variables can be demonstrated in figure 1.

If we split time into two periods, one pre-pandemic and one post-pandemic with the pandemic starting in Q1 2020, we can see a correlation between miles driven and fatalities. This rate can also be demonstrated in figure 2. Here we see that the rate increased by a large amount at the start of the pandemic, and this rate did not return to pre-pandemic levels as the time moved on.

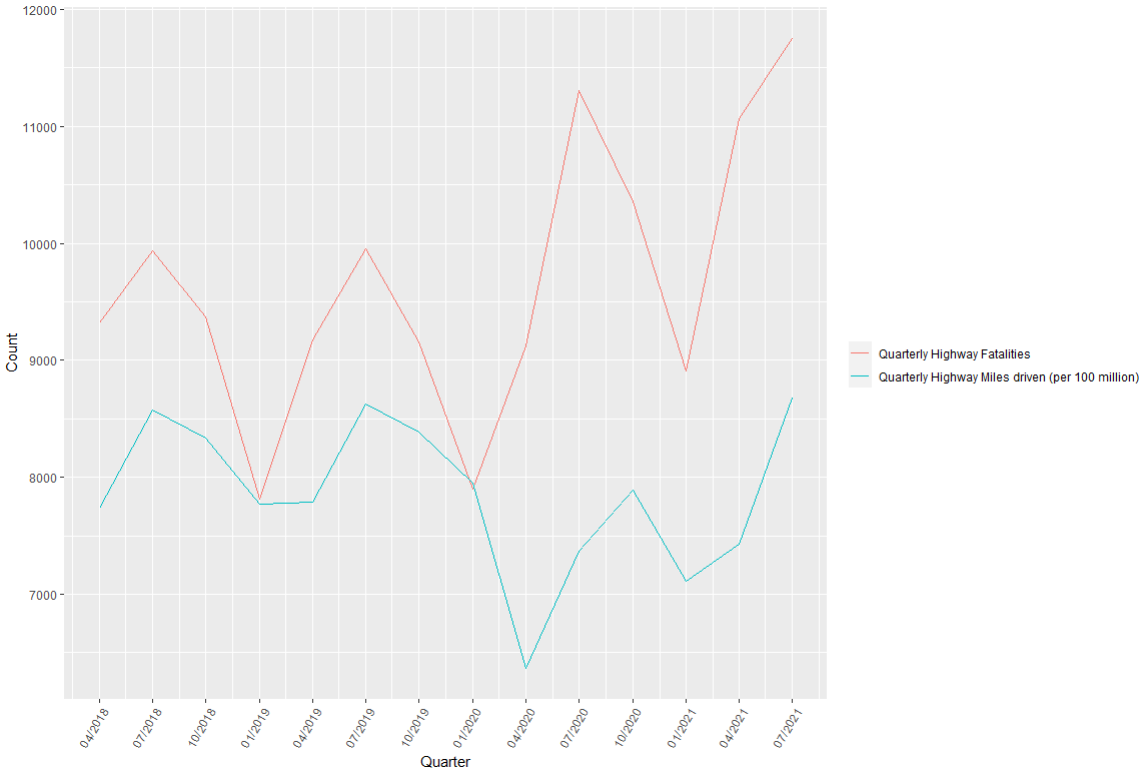

Figure 1: Highway fatalities and highway miles driven by quarter

3 Method

For this analysis, an interrupted time series model was fitted with highway fatalities per 100 million highway miles as the dependent variable, the start of the pandemic as a treatment variable, and unemployment as a control variable. An interrupted time series model is a form of quasi-experimental design that, in its most basic form, can be expressed by the following formula:

$$y = \alpha + \beta_1 T_1 + \beta_2 x + \beta_3 T_2$$

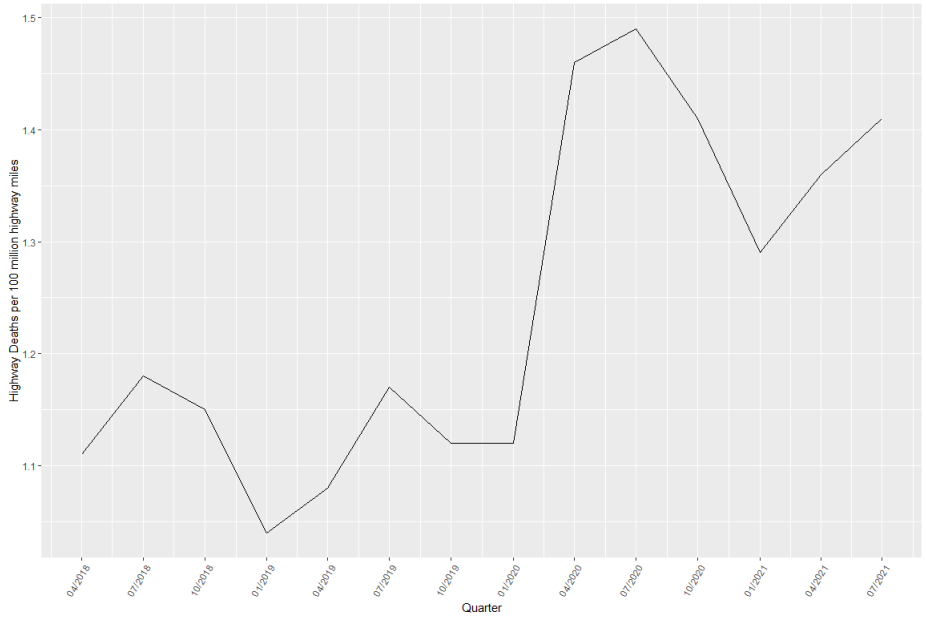

Figure 2: Highway fatalities per 100 million highway miles driven by quarter

In this formula, y is the dependent variable, T_1 is the time since the start of the data, x is a dummy variable equal to 0 if the observation happened before the treatment and 1 if the observation happened after the treatment, and T_2 is time since the treatment happened (for observations before the treatment, T_2 is always equal to 0. This formula then has β_1 as the overall slope for the entire time, β_2 as the aggregate difference between the pre-treatment and post-treatment periods, and β_3 is the slope for observations after the treatment. This model allows us to answer three questions:

1. What is the overall trend during the entire time period? (Answered by β_1)

2. What is the overall effect of the treatment? (Answered by β_2)

3. What is the new trend following the treatment? (Answered by $beta_3$)

Interrupted time series are useful because they can explain both the immediate and long term effects of a treatment. The data on miles driven only go back to 2018, so we have the following variables in the most basic form of interrupted time series:

$y =$ highway fatalities per 100 million miles driven

$T_1 =$ time since 4/1/2018 (Q1 2018)

$x =$ dummy variable of 0 or 1 to indication pre-pandemic and post-pandemic

$T_2 =$ time since start of pandemic (1/1/2020)

To expand on the basic model, a variable for unemployment is added to see if the effect of the pandemic remains consistent when adjusted for unemployment.

In addition to the interrupted time series model, a basic linear regression is used to see the effect of number of miles driven on the rate of traffic fatalities.

4 Results

First, the result of the linear regression is shown below:

Estimate	-.0003
p-value	.1264

Table 1: Effect of number of miles driven on fatalities per 100 million miles driven

Here it is shown that miles driven has an insignificant effect on the rate of fatalities per mile driven, so it would not be sufficient evidence for why fatalities increased despite people driving less.

For the basic interrupted time series model, we get the following results:

	Time Since Start	Pandemic	Time since Pandemic
Estimate	-.0015	.3635	-.0202
p-value	.863	.0002	.24

Table 2: Basic Interrupted Time Series

Here it is shown that over the entire period, the rate of fatalities is not affected by time. The effect of the pandemic on fatality rate is shown to be substantial. The effect of time since the pandemic is larger than time overall, but it is still not statistically significant, which implies some amount of lasting effect caused by the pandemic.

When adjusted for unemployment, we get the following results:

	Time Since Start	Pandemic	Time Since Pandemic	Unemployment
Estimate	-.0005	.255	-.0086	1.64
p-value	.95	.075	.67	.3457

Table 3: Interrupted Time Series adjusted for unemployment

The effects of time still remain insignificant. The immediate effect of the pandemic is also diminished by a large amount. While it is technically no longer statistically significant, it is still possible that there is still something that changed at the start of the pandemic that is unaccounted for. Unemployment by itself is not a statistically significant effect, but its addition to the model removes some of the treatment effect of the pandemic. This implies that there would be something correlated with unemployment that

would show a more accurate and substantial effect that was brought about by the pandemic.

5 Conclusion

From the interrupted time series models, it is clear that something fundamental changed with the U.S. population's driving behavior as a result of the COVID-19 pandemic. While it has not been demonstrated exactly which aspect of the pandemic led to the large increase in fatalities, when the model is adjusted with something like unemployment, which in previous literature has been demonstrated to have an effect on people's behavior that can be linked to more dangerous driving, much of the significance of the pandemic's effect is removed.

There is still much to research to give a complete picture of why traffic fatalities increased as a result of COVID-19, however this would require more substantial longitudinal data that's measured with more granularity than merely on an annual basis. Population-wide crises are rare, but as has been demonstrated by COVID-19, when they do happen the repercussions are omnipresent, and can extend into areas that would seemingly have no direct relation.

References

[1] Mark Buchanan. *Why Covid Saw Fewer Fender-Benders But More Traffic Deaths*. Apr. 2022.

[2] Anne Case and Angus Deaton. *Deaths of Despair and the Future of Capitalism*. Princeton University PRess, 2022.

[3] Andrew Gross. *Solving A Puzzle: With Fewer Drivers on the Road During COVID, Why the Spike in Fatalities?* AAA Foundation, Feb. 2022.

[4] David Leonhardt. *Vehicle Crashes, Surging*. Feb. 2022.

[5] Yasin Yasin, Michal Grivna, and Fikri Abu-Zidan. "Global Impact of COVID-19 pandemic on road traffic collision". In: *World Journal of Emergency Surgery* (2021).