Extreme Heat and Fatal Car Accidents

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Abstract

1 Introduction

Extensive evidence for a link between heat exposure and cognitive performance exists in the medical literature. Complex tasks which require vigilance and tracking appear to be more affected by heat stress (Hancock and Vasmatzidis, 2003).

2 Data

Historical weather data is available from the Daily Global Historical Climatology Network (Menne et al., 2012). This includes daily minimum and maximum temperature and daily precipitation. They provide data for about 1200 measurement stations across the United States. Based on the stations' coordinates they can be matched to the county they are in. Thus, temperature data can easily be aggregated to the county level. For counties with more than one measurement station, I take the mean among those.

The National Highway Traffic Safety Administration provides data on fatal car accidents in their Fatality Analysis Reporting System (FARS). This includes every fatal accident between 1975 and 2020, including date and county information.

Table 1: Summary statistics of the relevant variables

Statistic	N	Mean	St. Dev.	Min	Median	Max
FatalAccidents	12,146,966	0.140	0.391	0	0	16
MaximumTemperature	10,195,638	18.488	11.562	−45.600	20.000	56.100
MinimumTemperature	10,187,636	5.618	10.606	−72.800	6.100	45.000
Precipitation	10,288,169	2.504	8.048	0.000	0.000	767.100

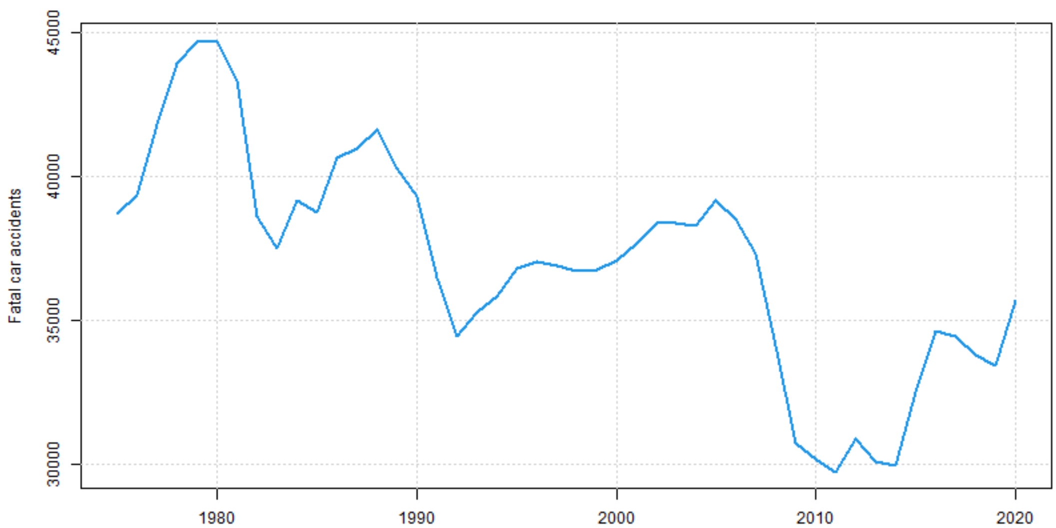

Figure 1: Fatal car accidents by year

3 Empirical Strategy

Variation in weather is quasi-random, but due to the panel nature of the data there may still be confounders. Over time vehicles have become much safer and therefore the number of fatal accidents has decreased (see figure 1). At the same time the frequency of heat events has increased due to climate change (see e.g. Habeeb et al., 2015).

Rain may be another confounder. Heavy precipitation increases the likelihood of accidents, but there is also a relationship between heat and rain.

Thus, we need to condition on the point in time and the level of precipitation to identify the causal effect. If the treatment is relative to the county (e.g. if the temperature exceeds a given quantile of temperatures in that county), county fixed effects should not be necessary. For an absolute measure of heat (e.g. absolute temperature), on the other hand, conditioning on the geography is necessary.

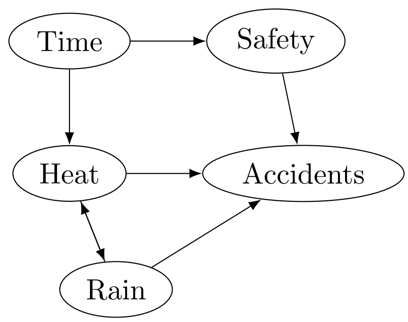

Figure 2: Directed acyclic graph of the effect

The number of fatal accidents by day and county closely follows a Poisson distribution (see figure 3). Thus, a poisson panel model with time fixed effects seems to be an attractive option.

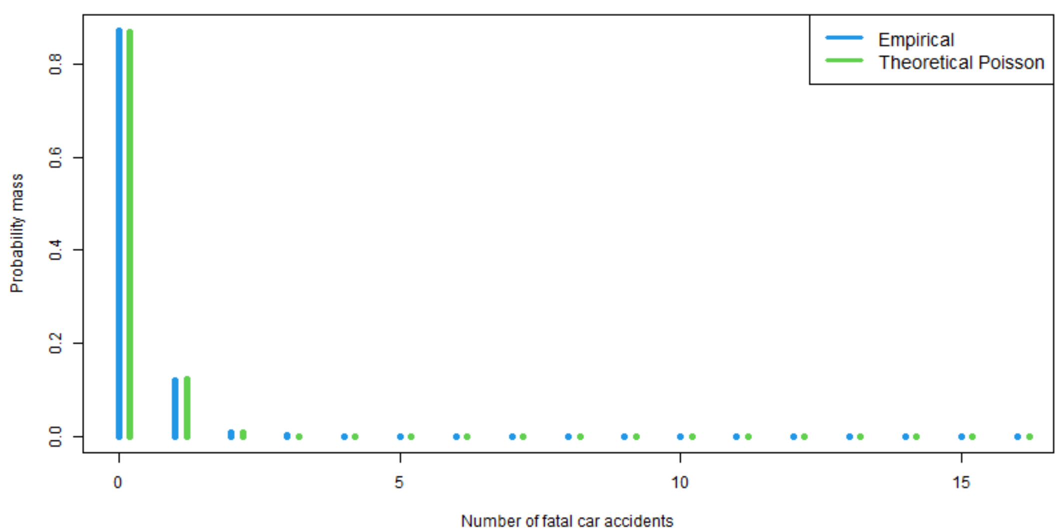

Figure 3: Probability mass of fatal car accidents and theoretical Poisson distribution

4 Results

5 Conclusion

References

Habeeb, D., Vargo, J., and Stone, B. (2015). Rising heat wave trends in large US cities. *Natural Hazards*, 76(3):1651–1665.

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Menne, M. J., Durre, I., Korzeniewski, B., McNeill, S., Thomas, K., Yin, X., Anthony, S., Ray, R., Vose, R. S., Gleason, B. E., and Houston, T. G. (2012). Global historical climatology network - daily (ghcn-daily), version 3.