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Automobile-dependency as a barrier to vision zero, evidence from the states in the USA

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ABSTRACT

With a traffic fatality rate of 10.6 per 100,000 as of 2013—more than triple that in the UK, the Netherlands, and Sweden—the United States has the worst traffic safety performance of all developed countries. Statewide variations are even more pronounced. North Dakota registers more than twice the national average and five times the rate of Massachusetts. We used panel models and annual data from 1997 to 2013 to capture the effect of seven separate sets of factors that influence traffic safety: exposure, travel behavior, socioeconomics, macroeconomics, safety policies, and mitigating factors such as health care. The results of our panel models and supplementary analysis of state effects show that two variables — Vehicle Miles Traveled and Vehicles per Capita—have the strongest impact on traffic fatality rates. This is closely followed by Infant Mortality Rates, the proxy that we used to represent the quality of health care. Policy levers such as Graduated Driver's Licenses (GDL) have improved safety, but to a limited extent. We also found that states with higher urban density and more walking are associated with lower traffic fatality rates. Taken as a whole, our findings suggest that if additional progress is to be made in reducing traffic fatalities, emphasis needs to move beyond simply focusing on policies such as GDL and seat belt laws, which have already been adopted by almost all jurisdictions across the United States. We need to also consider factors that focus on the type of urban form that we are creating to ensure that we are fostering environments that encourage multi-modal transportation such as walking to reduce the VMT and Vehicles per Capita, the two strongest predictors of traffic fatalities.

1. Introduction

Road traffic injuries are one of the leading causes of death globally. Each year, over 1.2 million people die on the world's roads, and millions more have to live with the long-term adverse consequences of serious injuries sustained in crashes (WHO, 2013). Perhaps more important are the intangible impacts—pain, grief, and suffering—of those incidents that spill out well beyond the individual to families and communities. With traffic fatalities now understood as being both predictable and preventable, considerable efforts are being made to improve safety globally. The World Health Organization has designated 2011–2020 as "The Decade of Action for Road Safety" advocating the application of a holistic safe systems approach (World Health Organization, 2013). This initiative is supported by a burgeoning body of research from academia and beyond that has sought to identify the factors responsible for road traffic fatalities and to understand the effectiveness of policies directed at improving safety in both developed and developing world settings (Ahangari et al., 2014; Leonard, 2014; Sauber-Schatz, 2016).

Traffic safety patterns and their rates of change over time vary considerably between countries (Ahangari et al., 2014). While distinctions are typically drawn between developed and developing countries, traffic safety patterns tend to follow a "Kuznets curve" (Law, 2015). According to this curve, traffic fatalities increase with level of development (usually measured in terms of GDP per capita), reach a turning point at a particular (as yet unspecified) level of development, and then decline (Law, 2015). This somewhat simplistic conceptualization of the trajectory of traffic fatalities does not take into consideration the huge variation in traffic safety records that exist across the developed world. In 2013, the United States had road fatality rates (measured in terms of deaths per 100,000 population) of 10.6, more than triple that of the safest countries in the developed world (the UK, Sweden, and the Netherlands). From a global perspective, understanding the factors shaping traffic safety in the United States is especially important

* Corresponding author at: 3 Understanding the Factors that Contribute to 4 the Wide Disparity in Traffic Fatality Rates 5 between States in the USA.
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because many developing countries are reproducing the rapid motorization and suburban development patterns associated with the 'American Dream'. From a national perspective, many jurisdictions have adopted Vision Zero goals for traffic fatalities (USDOT, 2015; Birdsall, 2016). In pursuing these goals it is important for stakeholders to understand which factors affecting traffic safety are within and also outside of the direct control of policy-makers.

Drilling down further it is evident that individual states within the U.S. exhibit considerable variation in traffic safety patterns. For example, examining data for 2012, North Dakota had the highest traffic fatality rate of all the states with 24.3 fatalities per 100,000 people—more than ten times the rate of Washington, DC (2.4 fatalities per 100,000 people), and almost five times the rate of Massachusetts (5.3 fatalities per 100,000 people). The safest jurisdictions, DC and Massachusetts, have safety records comparable to the safest countries in the world in terms of traffic fatalities—Switzerland and the Netherlands. In sharp contrast, North Dakota, Wyoming, and Montana have road fatality rates twice the level of the national average and on par with developing countries like Sudan, Somalia, Ghana, Zambia, and Vietnam (World Health Organization, 2013). Some variation in traffic safety records for states within the same country should be expected given the differences in geography and demography. However, the orders of magnitude variations between states are unexpectedly high and remain unexplained in the literature. A more detailed understanding of variations in traffic safety patterns across individual states and how they have evolved over time will help to inform stakeholders both within and beyond the United States. The relative performance of individual states has changed over time. For example, in 1997, the fatality rate in North Dakota was close to the national average but after 15 years it had a rate that was almost twice the national average, increasing by 35%. In contrast, some states experienced considerable improvements in traffic safety. For example, in Utah, traffic fatalities fell by 57% between 1997 and 2012 Fig. 1. Illustrates these temporal variations for a sample of states: Massachusetts, North Dakota, Utah, and Wyoming.

In this paper, we present an empirical study to quantify the impact of a wide range of variables on traffic fatality rates (defined as deaths per 100,000 people) for the fifty states, along with DC, using annual data from 1997 to 2013. The period of analysis was chosen to correspond to data availability for important explanatory variables. We use panel models to evaluate both spatial and temporal variations in safety patterns with the overarching objective of understanding what factors explain variations in traffic fatalities. We then go on to consider the effect of two important variables— urban density and mode share (as a proxy for infrastructure provision). This additional step of analysis was necessary because both of these two important variables were not available on an annual basis and thus could not be included in the original panel model.

The starting point for our empirical approach is a conceptual framework that we developed which builds on a schema from the World Health Organization (WHO). This conceptual framework is designed in order to capture a more complete set of factors that could potentially explain traffic fatalities. The expanded conceptual framework that we use in this paper has previously been used to study the evolution of traffic fatality patterns over time in 16 OECD countries (Ahangari et al., 2014). Switching to the statewide unit of analysis as we do in this current paper allows for additional variables to be taken into consideration.

2. Literature review

The literature on transportation safety is vast and growing because of the severity of this public health issue. In the interests of space, the very brief overview of the literature that we cover here will focus on studies that compare traffic fatalities in the United States to other countries, and studies that have investigated differences between states.

Comparisons of road safety records at the national or state level have attracted considerable attention over the last several decades (Ahangari et al., 2014; Siem, 1989; Simon et al., 1991; Brüde Ulf. and Brüde, 2015). Several studies have focused on documenting and explaining the large gap between the US and other developed countries in terms of road safety. In 2013, Oste et al. sought to understand why the US was lagging other countries in highway safety improvements (Oster and John, 2013). They decomposed road fatalities into groups based upon age, user, and road infrastructure. They found that the 2013 death rate on urban roads in America was 72 percent lower than that in 1980. In addition, they investigated the effect of variations in demographic factors and found that drivers in the 16–20 years old age group and the 21–24 years old age group had the highest fatality rates of any age group. In 2014, Evans, compared different road fatality measures such as fatality per population, and rate of road fatality reductions in the US and 25 other developed countries. He showed that since 1974 the road fatality improvement

in the US was about half that of other developed countries. While this study was helpful in identifying the extent to which the US was lagging other developed countries it fell short of providing insight into what factors were causing the discrepancies.

Using data for 16 developed countries from 1990 to 2010, (Ahangari et al., 2015) developed a two-step panel data model to understand the factors contributing to why the US was lagging in traffic fatality improvements compared to other developed countries. After controlling for macroeconomic conditions, gasoline price, motorization

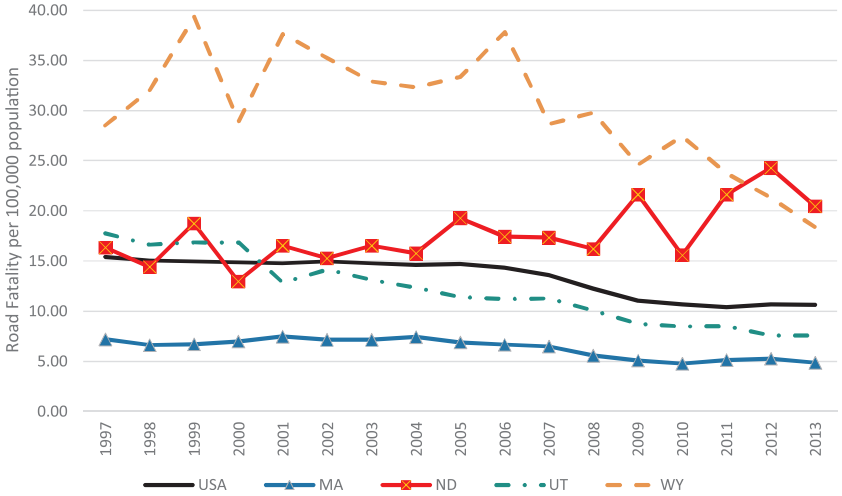

Fig. 1. Comparing Fatality per 100,000 People Nationally and in Selected States.