A Projection of United States Traffic Fatality Counts in 2024

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ABSTRACT

Objectives: The objective of this study was to determine the extent to which the 2015 increase in U.S. traffic fatalities is consistent with historical relationships between the economy and fatalities and to project the trend in fatalities through 2024 based on those relationships.

Methods: Linear regression was used to model the number of vehicle miles traveled (VMT) during 1990-2015 as a function of calendar year and the unemployment rate. Then Poisson regression was used to model annual traffic fatality counts as a function of year, the unemployment rate, and miles of travel. Projections of future unemployment rates by the Bureau of Labor Statistics were used to project future miles traveled and traffic fatality counts.

Results: VMT was estimated to increase by an average 1.5% per year if the unemployment rate was unchanged. For each unit increase in the unemployment rate, the VMT declined by an average 1.8% per year. Fatalities were estimated to decline by approximately 2.2% per year if the VMT and unemployment rate were unchanged. Each 1% increase in VMT was associated with a 0.96% increase in fatalities. Finally, after accounting for the effects of time and VMT, for each unit increase in the unemployment rate fatalities declined by 2.1%.

Conclusions: The sharp increase in U.S. traffic deaths in 2015 can be tied primarily to the improving economy, although other lesser factors also were involved. However, the long-term decline in traffic deaths seems to be continuing. Assuming a more gradual improvement or leveling of the economy, it is projected that there will be about 34,000 traffic deaths in the U.S. in the year 2024.

Keywords: Safety, trends, economy

INTRODUCTION

Although traffic fatality counts in the United States declined nearly every year during the period 2000-14, there was an almost unprecedented 7% increase in 2015 (National Highway Traffic Safety Administration (NHTSA), 2016a). Similar unusual increases were seen in Europe, Australia and Japan (Adminaite et al., 2016; Bureau of Infrastructure, Transport and Regional Economics, 2016; National Police Agency, 2016). These increases triggered some concern in the highway safety community.

In particular, these increases caused some communities to reevaluate their strategies for addressing traffic casualties. For example, the U.S. Department of Transportation and the National Safety Council launched a 'Road to Zero' initiative in October 2016 with the goal of eliminating traffic fatalities within 30 years (NHTSA, 2016b). The European Union issued a report in December 2016 proposing a range of new safety measures, including alcohol ignition interlocks, intelligent speed adaptation, and driver drowsiness and distraction monitoring (European Commission, 2016).

Short-term increases in traffic fatalities have occurred periodically in the past. Two such increases occurred in the U.S. in 1984-88 and 1993-96, prompting several studies looking for an explanation (Farmer, 1997; National Safety Council, 1995). These studies concluded that the increases in fatalities were associated with short-term improvements in the U.S. economy, and that the long-term downward trend in fatalities was continuing. A number of other studies over the years have reached the same conclusion (Brude, 1995; Haight, 1991; He, 2016; Hedlund et al., 1984; Joksch, 1984; Leigh and Waldon, 1991; Maheshri and Winston, 2016; National Safety Council, 1979; Neumayer, 2004; Partyka, 1984). A consistent theme has emerged whenever there have been unusual jumps or dips in the traffic fatality trends – the state of the economy is highly correlated with those trends.

The objective of the present study was to determine if the 2015 increase in traffic fatalities fits the pattern of prior short-term increases. Using a simple model involving only the annual unemployment rate, this study attempts to project the trend in U.S. traffic fatalities through 2024.

METHOD

Data on all traffic fatalities in the U.S. during 1990-2015 were extracted from the Fatality Analysis Reporting System, a census of fatal crashes maintained by NHTSA. Estimates of the civilian unemployment rate for each year were obtained from the U.S. Bureau of Labor Statistics (2016). Data on vehicle miles of travel (VMT) for the same time period were obtained from the *Highway Statistics* series of the Federal Highway Administration (FHWA, 2016).

Economic trends as measured by the unemployment rate were expected to influence both VMT and traffic fatality counts. Figures 1a and 1b display the 1990-2015 trends in these three measures. The severe U.S. economic recession of 2007-09 is evident in Figure 1a, with the unemployment rate increasing from 4.6 in 2007 to 9.3 in 2009. Motor vehicle crash deaths declined from 41,259 in 2007 to 33,883 in 2009. VMT declined from 3.05 trillion in 2007 to 2.98 trillion in 2009.

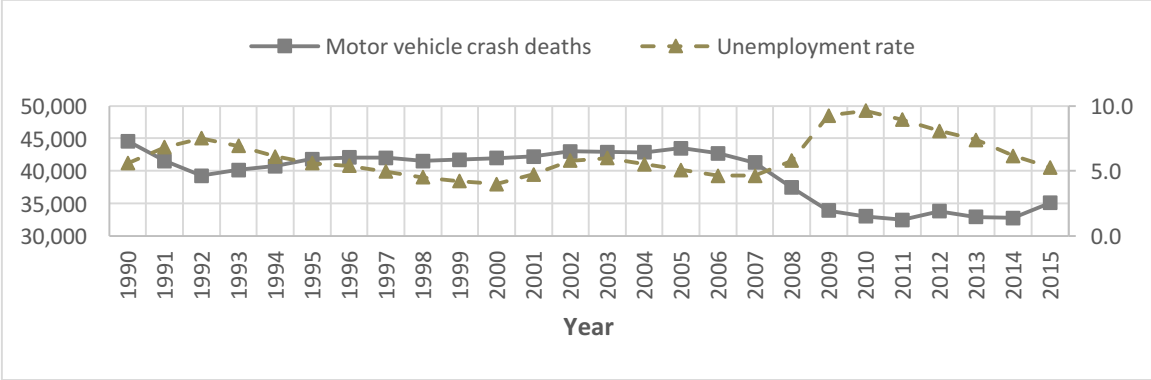

Figure 1a. U.S. motor vehicle crash deaths and unemployment rate (%), 1990-2015

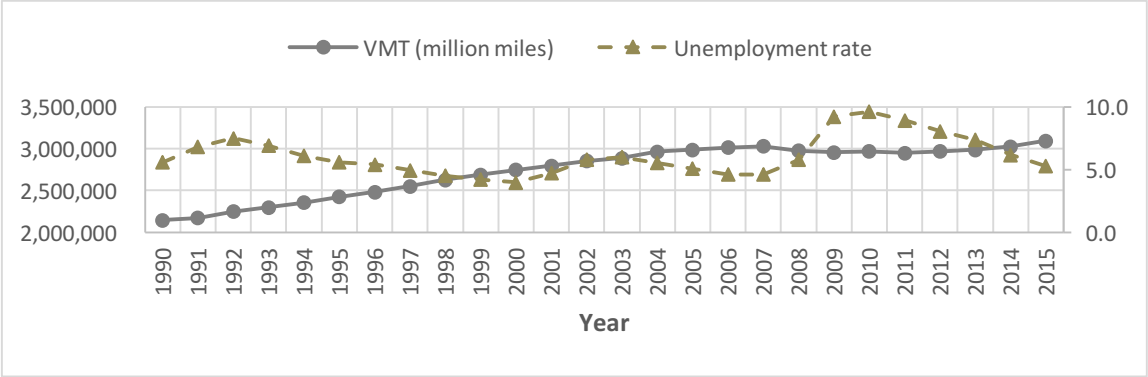

Figure 1b. U.S. motor vehicle miles traveled (millions) and unemployment rate (%), 1990-2015

Linear regression was used to model the natural logarithm of annual VMT as a function of calendar year and the annual unemployment rate. Then Poisson regression was used to model annual traffic fatality counts as a function of calendar year, the natural logarithm of VMT, and the unemployment rate. In other words, the statistical model for traffic fatalities took the form $\log(y) = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3$, where y represents the traffic fatality count, x_1 represents year (calendar year minus 1989), x_2 represents the natural logarithm of VMT, and x_3 represents unemployment rate. Parameter estimates (b_0, b_1, b_2, b_3) and statistical tests were obtained using the GENMOD procedure in SAS (SAS Institute Inc., 2015).

Projections of future traffic fatality counts required projections of unemployment rates. The projected unemployment rates were then inserted into the regression models for VMT and fatality counts to obtain projections of those measures. Projection of unemployment rates was accomplished in two ways. In 2015, the Bureau of Labor Statistics projected a 1.7% average annual decline in the unemployment rate for the years 2014-24 (Byun and Nicholson, 2015). In other words, the unemployment rate was projected to decline from 6.2 in 2014 to 5.2 in 2024. Although the declines in 2015 and 2016 were both far greater than this projection, the 1.7% figure was used to project unemployment estimates for 2017-24. Alternatively, unemployment rates were projected to remain constant at the 2016 level of 4.9.

RESULTS

Table 1 summarizes the results of the linear regression of VMT on year and unemployment rates. VMT was estimated to increase by an average 1.5% per year if the unemployment rate was unchanged. For each unit increase in the unemployment rate the VMT declined by an average 1.8% per year. The regression model replicated most of the VMT trends during 1990-2015 (Figure 2). Differences between the actual VMT and the values predicted by the model ranged from 2.2 billion (0.1%) to 242 billion (7.6%).

Table 1. Linear regression of log vehicle miles traveled (VMT), 1990-2015.

Parameter	Estimate	Standard error	p-value
Intercept	14.72155	0.03012	<.0001
Year	0.01518	0.00101	<.0001
Unemployment rate	−0.01801	0.00497	0.0014

R^2=0.91

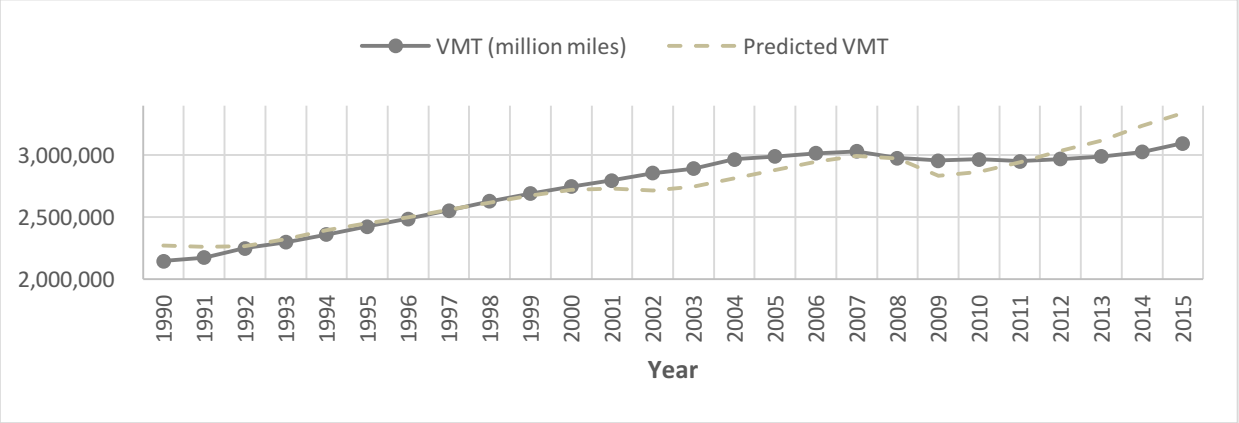

Figure 2. U.S. motor vehicle miles traveled and model predictions (millions), 1990-2015

Table 2 summarizes the results of the Poisson regression of traffic fatality counts. Fatalities were estimated to decline by approximately 2.2% per year if the VMT and unemployment rate were unchanged. Each 1% increase in VMT was associated with a 0.96% increase in fatalities. Finally, after accounting for the effects of time and VMT, for each unit increase in the unemployment rate fatalities declined by 2.1%. The regression model replicated the fatality trends during 1990-2015 (Figure 3). Differences between the actual fatality counts and the values predicted by the model ranged from 170 (0.4%) to 2,855 (6.4%).

Table 2. Poisson regression of log traffic fatalities, 1990-2015.

Parameter	Estimate	Standard error	p-value
Intercept	−3.2449	2.7695	0.2413
Year	−0.0223	0.0031	<.0001
Log VMT	0.9620	0.1881	<.0001
Unemployment rate	−0.0210	0.0057	0.0003

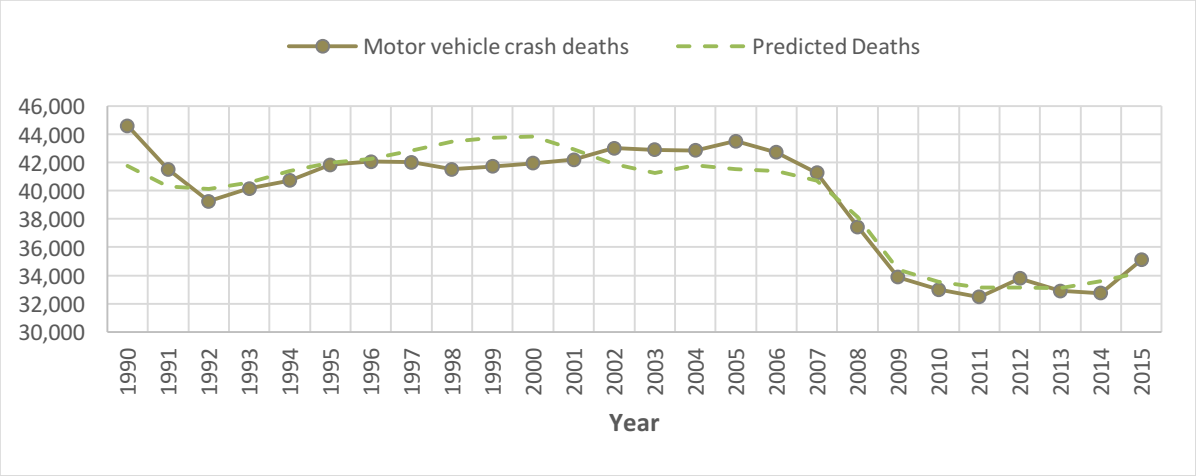

Figure 3. U.S. motor vehicle crash deaths and model predictions, 1990-2015

Table 3 lists the projected values for VMT and traffic fatality counts based on the regression models and a 1.7% annual decline in the unemployment rate.

Table 3. Projected VMT and traffic fatalities, 2015-2024 – declining unemployment.

Year	Unemployment rate	Projected VMT	Projected fatalities
2015	5.30[1]	3,095,373	35,092
2016	4.90[1]	3,170,924	35,411
2017	4.82	3,228,336	35,296
2018	4.73	3,286,623	35,179
2019	4.65	3,345,798	35,060
2020	4.58	3,405,877	34,939
2021	4.50	3,466,871	34,816
2022	4.42	3,528,796	34,691
2023	4.35	3,591,664	34,564
2024	4.27	3,655,491	34,435

[1] actual value

Table 4 lists the projected values for VMT and traffic fatality counts based on the regression models and a constant unemployment rate.

Table 4. Projected VMT and traffic fatalities, 2015-2024 – constant unemployment.

Year	Unemployment rate	Projected VMT	Projected fatalities
2015	5.3[1]	3,095,373	35,092
2016	4.9[1]	3,170,924	35,411
2017	4.9	3,223,133	35,183
2018	4.9	3,276,141	34,956
2019	4.9	3,329,959	34,730
2020	4.9	3,384,601	34,504
2021	4.9	3,440,078	34,280
2022	4.9	3,496,404	34,057
2023	4.9	3,553,592	33,835
2024	4.9	3,611,654	33,613

[1] actual value

The models of Tables 1 and 2, when taken together, predict that year-to-year traffic fatalities will decline except during years that the unemployment rate declines by more than 0.20 (i.e., [0.0223 – 0.962 (0.01518)] / [0.0210 + 0.962 (0.01801)]). For example, if the 2017 unemployment rate was 4.69, then the projected fatalities would be 35,469 – slightly higher than the projection for 2016.

DISCUSSION

The factor most directly affecting traffic fatality counts is the number of vehicle miles traveled. Logically, overall risk increases as exposure to that risk increases. A 1% increase or decrease in VMT is associated with a nearly equivalent change in fatalities. However, the fatality count also is heavily affected by economic factors. An increase in the unemployment rate from 5% to 6% is associated with a 2% decrease in VMT, which in turn decreases the number of fatalities by nearly 2%. But the economy affects traffic fatalities through other means than the VMT. Even after accounting for the VMT decline, an increase in the unemployment rate from 5% to 6% is associated with another 2% decrease in fatalities.

Given the continued large decline in unemployment during 2016, the statistical model developed here predicts a 0.9% increase in 2016 to 35,411 traffic deaths. Although comparable FARS counts for 2016 were not available at the time of this study, the National Safety Council has estimated a total of 40,200 traffic deaths in 2016 (NSC, 2017). Unlike NHTSA, NSC includes deaths occurring outside of traffic and deaths occurring more than 30 days after the crash, so the NSC counts have averaged about 2,500 higher than NHTSA counts over the years. Even so, the NSC projected increase of 6% is higher than that predicted here. One explanation for the discrepancy could be that the 2016 VMT was higher than predicted by the model. The statistical model predicted a 2% increase in VMT (Table 3), but NSC estimated a 4% increase.

If current trends continue, it is reasonable to expect that there will be 34,435 traffic deaths in the year 2024. This would be 1.9% lower than the 2015 count of 35,092 deaths and 2.8% lower than the projected 2016 count. A precipitous drop in the unemployment rate could counteract this projected decline in traffic deaths. However, the average annual U.S. unemployment rate was 4.9% in 2016, and it has not been below 4% since the year 1969. So a large drop in the unemployment rate is unlikely during the next decade.

Should the decline in deaths continue at the same rate beyond 2024 (0.2% per year), there would be approximately 33,000 deaths in the year 2045. This is considerably short of the goal of the Road to Zero initiative (NHTSA, 2016b). Thus, new strategies and expanded effort are needed to accelerate the decline in traffic deaths.

Twenty-nine percent of the traffic deaths in 2015 involved a driver impaired by alcohol, and this number has barely changed during the past two decades (NHTSA, 2016a). Technology that can detect and restrict any driver impaired by alcohol without inconveniencing sober drivers currently is being developed and should prevent many of these deaths in the future (Driver Alcohol Detection System for Safety, 2017). Improvements in vehicle design have been shown to be responsible for cutting driver death rates by half between model years 1984 and 2009 (Farmer and Lund, 2015). More recent vehicle technology and technology currently in development, particularly involving collision avoidance, is expected to have an even greater effect on death rates (Jermakian, 2011, 2012). Finally, increased use of behavioral and environmental countermeasures that have been proven beneficial, such as strong

safety belt laws, lower speed limits, and roundabouts, would prevent many more deaths (Insurance Institute for Highway Safety, 2011).

In summary, the sharp increase in U.S. traffic deaths in 2015 can be tied primarily to the improving economy, although other lesser factors also were involved (the unemployment rate does not explain everything). However, the long-term decline in traffic deaths seems to be continuing. Assuming a more gradual improvement or leveling of the economy, it is projected that there will be about 34,000 traffic deaths in the U.S. in the year 2024.

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