Gasoline Prices and Traffic Safety in Mississippi
Guangqing Chi¹, Arthur G. Cosby¹, Mohammed A. Quddus², Paul A. Gilbert¹, and David Levinson³
¹Mississippi State University; ²Loughborough University; ³University of Minnesota

Introduction

Between 2000 and 2007, more than 40,000 deaths due to traffic crashes occurred annually in the United States (NHTSA 2009). In 2008, U.S. roadway deaths fell when gasoline prices reached $4 per gallon; there were 37,313 deaths due to vehicle traffic crashes, which is 9.1% lower than in 2007 and the fewest since 1961. It has been argued that this drop is in part due to the rise in gasoline prices and consequent adjustments of travel behaviors (e.g., Thomas 2009).

Figure 1. Average gasoline prices (in January 2009 dollars) in the U.S., 1970–2009

Though a limited number of studies have examined the effects of gasoline prices on traffic safety, they have reported on fatal crashes only (e.g., Grabowski and Morrissey 2004, 2006; Leigh and Gernaey 2008; Leigh and Wilkinson 1991; Wilson et al. 2009). While fatalities are the most grave, they represent the smallest proportion of all crashes and thus provide a biased representation of the overall level of traffic safety (Kenkel 1993; McGinn and Brown 1999). This paper extends the research by examining total traffic crashes to more accurately reflect the impact that gasoline prices have on traffic safety. Specifically, we investigate the effects of gasoline prices on total traffic crash rates from April 2004 to December 2008 in Mississippi. We further analyze these effects by age, gender, and race to explore the possible variations of these effects.

Figure 2. Conceptual Framework

Data

Mississippi traffic crash data from April 2004–December 2008 from the Mississippi Highway Patrol and regular-grade unleaded gasoline price data from the Energy Information Administration of the U.S. Department of Energy were used to investigate the effects of gasoline prices on traffic safety by age, gender, and race.

Table 1. Descriptive statistics of the variables

Table 2. Results of Poisson-gamma regression models for traffic crashes per million VMT, April 2004–December 2008, Mississippi

Table 3. Results of Prais-Winsten AR(1) regression models for traffic crashes per million VMT, April 2004–December 2008, Mississippi

Table 4. Elasticities of traffic crashes per million VMT with respect to gasoline prices, April 2004–December 2008, Mississippi

Methods

1. The augmented Dickey-Fuller test (Dickey and Fuller 1979) was first employed to diagnose whether monthly crash data are serially correlated. The results suggest that neither monthly traffic crashes nor crash rates are serially correlated.

2. Poisson-gamma (or negative binomial) regression

\[ \log(\mu_t) = \log(\lambda_t) + \sum_j \beta_j X_{jt} + \gamma_j \]

where \( Y_t \) refers to the observed monthly crash count; \( \lambda_t \) refers to the expected monthly crash count; \( \gamma_j \) refers to the explanatory variables and \( j \) is the number of explanatory variables; \( \mu_t \) refers to the crash exposure variable, such as VMT; \( \alpha \) is a random term that captures unobserved effect over time and \( \exp(\gamma_j) \sim \Gamma(\alpha_j, \alpha_j) \), in which \( \alpha \) is the over-dispersion parameter; and \( \beta_j \) and \( \beta_j \) are parameters to be estimated.

3. Prais-Winsten regression

\[ \frac{Y_{it}}{VMT_t} = \beta_0 + \sum_j \beta_j X_{it} + \mu_i \]

where \( \mu_i \) refers to the autocorrelation coefficient for the first-order autoregressive error term, in which a value of 1 suggests there is a perfect autocorrelation (i.e., random walk) among the residuals; and \( \gamma_i \) refers to the independently and identically distributed error term with zero-mean and constant variance.

Results

The results suggest that gasoline prices have both short-term and intermediate-term effects on reducing total traffic crashes and crashes of females, whites, and blacks. Gasoline prices also have short-term effects on crashes of younger drivers and intermediate-term effects on crashes of older drivers and male drivers. However, gasoline prices were not found to have long-term effects on reducing crash rates.

Overall, the intermediate-term effects are stronger than the short-term effects. By age, gasoline price changes produce immediate effects on reducing crashes of younger drivers but longer effects on older drivers. By gender, gasoline prices have short-term effects on reducing crashes of female drivers and intermediate-term effects on reducing crashes of both males and females. By race, gasoline prices have stronger short-term effects on reducing crashes of white drivers than of black drivers, and stronger intermediate-term effects on reducing crashes of white drivers than of black drivers.

Figure 3. Gasoline prices and traffic crashes per million VMT in Mississippi, 2004–2008

Policy implications

The findings suggest that if decision makers wish to reduce traffic crash rates, increased gasoline taxes are a considerable option because raised gasoline prices reduce traffic crashes directly. While higher gasoline prices due to crude oil price increases are not favored, higher gasoline taxes might be used. The additional tax revenues can be used for maintaining or improving transportation infrastructure or other purposes. In addition, gasoline price increases (through taxes) may result in additional societal benefits, such as lower gasoline demand and consumption, carbon emission reduction, and more research and investment in renewable energy production and low-emission or zero-emission vehicles.

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E-mail: gchi@ssrc.msstate.edu; Tel: (662)325-7872; Fax: (662)325-4564.

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Notes

Correspondence to: Guangqing Chi, Department of Sociology and Social Science Research Center, Mississippi State University, P.O. Box C, Mississippi State, MS 37622, USA.
E-mail: gcc@gchi@ssrc.msstate.edu; Tel: (662)325-7872; Fax: (662)325-4564.


For references, please contact the corresponding author.