Can Government Really Save Lives?

An Analysis of State Government Expenditures and Pedestrian Fatalities

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This paper scrutinizes the effect of state government expenditures in reducing pedestrian fatality rates. Previous research has concluded that while measures to improve traffic safety reduce collision and fatalities, pedestrian and driver behavior offsets part of these benefits. This offsetting behavior may be counter conducive to the states' traffic safety programs, reducing the safety benefit of state expenditures. We analyze the mitigating effect traffic expenditures by changes in pedestrian fatality rates over three time period for the fifty states.

I. Introduction

Each year the United States federal, state, and local highway expenditures increases, from $93.5 billion in 1995 to $111.9 billion in 1999. Similarly, pedestrian fatalities in motor vehicle accidents have declined over time; in 1995 there were 5,584 pedestrian fatalities dropping to 4,763 fatalities in 2000. Graph I illustrates the decreasing trend in pedestrian fatalities. While these statistics provide comfort for those who believe that government intervention is important in pedestrian safety, there is neither clear relationship nor the effectiveness in its spending. Expenditures are not all lumped into traffic safety measures; nor does each state spend equal amounts; this dichotomy blurs the relationship of government spending in reducing pedestrian fatalities.

Therefore, it is important to ask if government expenditures are effectively and efficiently reducing pedestrian fatality rates or is the advent of such safety programs increasing the risk behavior of pedestrians and drivers. However, there is little literature on the effect of state traffic safety spending on pedestrian fatality rates. Studies that have been done do not look at the impact of traffic safety expenditures but rather the amount given to that area. Criticism or success is reduced to terms in absolute values, not the effectiveness of the expenditures.

Furthermore, government measures may have a negative effect on the safety of pedestrians, because of the behavior of the individual. Government decisions can affect traffic safety in unanticipated ways. Recently, the Federal Aviation Administration decided against a White House suggestion to require child-safety seats on airplanes. One of the conclusions the FAA reached was that by requiring the restraints, more parents would resort to driving instead of flying and paying for their baby's seat, thereby increasing the number of accidents on the roadway and adding ten to thirteen highway fatalities.

A similar behavior story also offsets the safety of improvements possibly made in traffic safety. The progress in medical technology has had a similar effect. Better surgical techniques have allowed the rescue of matadors to be faster and decreases the time the matador stays injured as a result of gore attacks and other injuries. As a result, matadors have attempted riskier maneuvers with increasing frequency; this season of bullfighting happened to be the bloodiest for the matadors. Matador behavior is offsetting the safety benefits of having more advanced technology. The same might be true for safety improvements and pedestrian behavior.

Therefore, it is the goal of this paper to analyze the effect of state traffic safety expenditures has on the pedestrian fatality rates. Specifically, we hypothesize that despite pedestrian and or driver behavior to offset the benefits of safety spending by states, that these expenditures will have a substantial mitigating effect on pedestrian fatality rates. The background section of this paper will review research done on accident rates and fatality rates. The data and methods section will explain modeling and data collection. The results portion will contain discussion on the econometric findings and the final section will conclude our research.

II. Background

Unfortunately, there is no research on the effect of state traffic safety expenditures at the present moment. Given the nature of this paper, however, we can assume several other influences, presented in current literature. Current literature focuses on behavioral patterns of drivers and pedestrians. These risk assessment literature focus on several aspects: 1) alcohol consumption, 2) speed, 3) age, 4) traffic flow, and 5) presence of law enforcement.

Peltzman (1975) is at the core of all fatality and accident research. Peltzman argues that safety improvements may be offset by changes in behavior. Peltzman analyzes motor vehicle accidents over time, hypothesizing that technological advances added to cars, such as seat belts, and anti-lock breaks may increase the probability of surviving an accident. However, changes in "driving intensity" may offset these improvements. He breaks down driving intensity into alcohol consumption, average mileage (which is shown in fuel consumption) and speed, factors which other literature have concluded to be important factors. Imposing technology as a solution for safety, he concludes, is ineffective and insubstantial.

Following Peltzman's model, Crandall and Graham (1984) proposes a variant mathematical and research model. Their results mirror Peltzman's observations that driver behavior, such as speeding, alcohol level, and length of the road trip, do offset the technological changes made to improve the safety of cars and roads. However, their results contradict Peltzman's conclusion, stating that the driver behavior does not completely offset the safety engineering; the positive effect of the improvements are greater than the negative impact of driver behavior on motor vehicle accidents.

In addition to the economics literature, there is extensive public health literature on pedestrian and driver behavior. The starting point for this literature is Cohen (1955). Cohen analyzes the behavior of pedestrians crossing the street when a car was present, determining risk assessment behavior on the basis of age, sex, time and distance the car took to reach the intended pedestrians crossing point. Cohen, et al concludes that there are impacts with the effect of age, noting that their observations based on age related material suggest that traffic sense might be improved, provided that the children have training.

In another study about youth, Connelly (1998) examines ages and response rates of youths to oncoming cars. Connelly's findings suggest that age matters in behavior of crossing, with younger children making riskier crossings than the older children. However, all age groups experienced a dramatic decline in their ability to judge correctly once the vehicle exceeded 55 miles per hour, suggesting that children rely on distance in their judgments. The study provided a similar conclusion to other research done on age and suggests that behavior based on distance judgment provides riskier crossings, leading to higher fatalities.

Youth is not the only focus age group. Accounting for the older age effect, Oxley et al (2005) measures three age groups, consisting of ages 30-45, 60-69, and over 75. Their results indicate that a higher percentage of old adults would cross at unsafe or risky crossing conditions. Their findings also suggest that older adults were more concerned with the distance of the car from the crossing point, not the car's relative speed. While judging speed should be of no consequence to adults, older adults were observed to have a slower cross speed, indicating that the illusion of distance made crossings for this age group riskier. While they may take their walking speed into account for crossing, compensation was not made for the distance and speed of the car.

In addition to age, traffic flow, law enforcement and alcohol consumption may influence pedestrian fatality rates. Lee and Abdel-Aty (2005) factors several variables in accident frequency, including alcohol use by the driver and or pedestrian, age of groups, lighting, weather conditions, speed, as well as the injury rating, from light to fatal injuries. They also analyze road engineering of lanes, traffic signals and the location, urban vs. rural. Their results reveal several correlations for the environment in Florida; alcohol is correlated to higher crash rates, presence of traffic signals correlates to crash rates, nighttime/daytime factors, and that higher speed and older ages affect the fatality rates.

Traffic flow specifically is the focus of attention in certain literature. Peirson (1998) provides detailed microeconomic analysis of traffic flow and accident rate relationship. Their observations denotes that the risk of accidents between car-car and bus-car are different, but when drivers are aware of the risk between bus or car, there may exist a tendency to ignore other risks, such as pedestrian. They mathematically adjusted for this behavior and their results showed that pedestrians make up most of the risk externalities in accidents, implying that safety behaviors of drivers affect the pedestrian fatality rate. However, they also concluded that pedestrian behavior needs to be analyzed and that the rates are lower when they assume that pedestrians will also change behaviors dependent on traffic flow.

In another traffic flow study, Dickerson (2000) examines traffic flow rates and correlates it with pedestrian accident rates. Through econometric evidence and research, Dickerson, et al, provides evidence that urban areas with higher traffic flows have a correlated higher accident rate. Dickerson also concludes from studying over time in London that while there is a direct proportion between marginal accident rates and average accident rates at low traffic flows, marginal accident rates increase and is greater than average accident rates at high traffic flow areas.

While traffic flow, age, and alcohol consumption have all been analyzed, little research has been done on the institutional aspects of public health. One of few researches in this area is by Wong, et al (2004). Wong measures the impact of publicizing traffic safety, educational programs, and presence of law enforcement on the accident rates. Other variables, such as roadway condition, weather, and car engineering were taken into account, leading only behavior as a major factor in fatality rates. Their results indicate that publicity campaigns on traffic safety and presence of law enforcement reduces the fatality rates of driver and pedestrians. Also, certain campaigns may affect both groups, reducing casualty rates, such as the dissemination of road safety messages through electronic devices.

III. Data and Methods

Our dependent variable, pedestrian fatality rates per 10000 people, was gathered from total state pedestrian fatalities from the Fatality Reporting System (FARS). The number of fatalities was corrected for state size by dividing by the population for the relevant year. Population data for each state was gathered from the Census Bureau. This number was then multiplied by 10000for ease of exposition.

To explain what increases or reduces the state pedestrian fatality rates, we included variables that best identify factors in fatality rates. However, data on a state level is incomplete. Behavioral patterns, such as pedestrian and or driver willingness to take risks such as speeding, alcohol consumption, improper crossing and percentage of state population who walk are not available. Therefore, our model was limited to several variables: state traffic safety expenditures per capita, police officers per person for states, the number of vehicles per person in a state, state population density, percentage of state populations that are 65 years and above, and state personal income per capita. However, because we are running fixed effects, biases from omitted variables should be held to a minimum.

At the core of this study is state traffic safety expenditures per capita. Since we are measuring pedestrian fatalities as a rate per 10000 people, expenditures are measured per person, i.e. how much does a state spend on traffic safety per person. Traffic safety expenditures include crosswalks and engineering of intersections to driver and pedestrian education and adding distance between the pedestrian and vehicle. This data was obtained by the Federal Highway Administration and population was drawn from the Census Bureau. We also had to account for inflation problems across the three years. If left unaccounted for, our results would be skewed due to time variances. Using 2004 as a base year, we calculated the dollar amount of expenditures in years 1995 and 2000 in terms of 2004 dollars. We expect that traffic safety expenditures will reduce pedestrian fatalities.

Since literature suggests at the changes in behavior due to the presence of law enforcement, we included a measure of law enforcement: police officers per capita.

Individuals may behave differently in the presence of law enforcement officials. Furthermore, we reason that individuals are more aware of their actions and surroundings when enforcement persons are present. We believe that increases in police officers per person will create heightened awareness of individual's surroundings. Furthermore, police officers may act as crossing guards, preventing vehicles from colliding into pedestrians. Data on the total police officer population in a state was found at the Federal Bureau of Investigation. Thus, police officers per person should be significant in reducing the pedestrian fatality rate.

To account for traffic flows, we use vehicles per person. Vehicle data came from the Census Bureau and the Bureau of Transportation Statistics to determine total vehicles registered in a state. To get per person level data, we divided the totals by state population. While it does not discriminate between rural and urban settings, our variable permits us on a per capita level to judge the effect of high population level of vehicles on the road. Our expectations is that the greater the number of vehicles per person, the greater the likelihood that there are more vehicles on the road. In higher vehicles per person states, we expect greater traffic flows to occur and as a result more accidents and higher pedestrian fatalities.

We determined the population densities from the Census Bureau population estimates. We used this variable for two reasons. First, states that have higher population densities can expect to see more pedestrians; the states have a population that lives closer together, so more pedestrian traffic should occur. Similarly, densely populated states should expect heavier traffic flows, as more people have to drive and there is less room to drive around, again increasing the risk of pedestrian fatalities. Therefore, population density should be a factor that increases pedestrian fatality rates.

To account for age, we included a variable focusing on the age group of 65 years and over. This information came from demographic estimates of states by age and sex from the Census Bureau. We expect that the age variable, in accordance to literature, will have a negative significant impact on fatality rates; pedestrian fatalities should increase as age increases.

Personal income per capita was included because states with higher personal incomes may have individuals who are willing to pay for more safety technology for cars and pedestrian safety. Data on personal income per capita was found at the Census Bureau. Income presents two problems. The first was similar to the problem experienced with expenditures; Census Bureau data did not take into account for inflation. Using the same method applied to expenditures, we accounted for personal income per capita in 1995 and 2000 using 2004 dollars. The second problem is that we were aware that income may influence police officers per person, vehicles per person and state expenditures. States with higher personal incomes may need to offer police officers more benefits and or wages, which reduces the level that the state can spend on traffic safety. Furthermore, higher income states contain individuals who are able to own more than one vehicle. Therefore, we need to test the significance of income in the determination of these three variables. To be safe, we exclude income from one model and include it in a second model.

IV. Results

The results from Table 1 show that the state average pedestrian fatality rate across the three selected time periods, 1995, 2000, and 2004, is 0.16 for every ten thousand people in the state or 1.6 pedestrian fatalities for every one hundred thousand people. Average state spending on traffic safety and driver education is only $35.60 per 10,000 people. The average police population per person across the states is 21 police officers for every 10,000 people. Average vehicle per person is 0.826 vehicles per persone. State population density average is 181.82 people per acre. State average of 65 or older population is about 12.4% of the state total population. Finally, average personal income per capita is $30.19 thousand across the states.

To analyze the determinants of state pedestrian fatality rates we employed two fixed-effects panel models. While random-effects model is a more efficient method of estimating, fixed-effects is preferred in this case due to results from the Hausman test. We estimate two different specifications. Both specifications retain population density and percentage of the population that is 65 or older. However, model one includes state traffic safety expenditures, vehicles per person, and police per person. Model two excludes these three variables and includes personal income per capita. Separation of income and these three variables occurs because income is correlated to the three variables and could possibly skew results. Table 2 shows the independent variable income coefficients regressed to the three variables.

The results of the fixed-effects panel regression is shown in Table 3. Column 1 represents the fixed-effect model without the personal income variable. Column 2 represents the fixed-effects model without expenditures, police, and age variables. Both models are presented with the within R-squared values.

Our results are surprising. State traffic safety and driver education expenditures, has the correct sign but is insignificant. The traffic safety programs of the fifty states may focus on other target groups, such as drivers and or passengers. As a result, little goes towards pedestrian safety and instead tries to improve conditions for vehicles. Another possible explanation follows Peltzman's results and conclusions; pedestrian and or driver behavior, in light of these new safety measures, may take riskier actions and offset the benefit of the states' spending. A third possibility is that this variable fails to capture lag effects; that is, expenditures in previous years continue to have an effect on present year fatality rates. However, a single time lag of n-1 yielded no significant results. At the current moment, any speculation is inconclusive due to the insignificance of expenditures per capita.

Police population in proportion to state population is significant and reduces pedestrian fatalities. An increase in police officers per 10,000 people by one officer reduces the pedestrian fatalities by .0061 per 10,000 people. The results suggest that the presence of a police officer may force pedestrians and drivers to be more aware of their actions and behavior, minimizing risky behavior. While the number of officers has increased since 1995 to 2000 for all states, a few states have drastically reduced the number of officers per person from 2000 to 2004. States that had a dramatic decrease in the police officer to population ratio experienced an increase in pedestrian fatality rates.

Vehicles per person is insignificant in our model. We expected a greater presence of vehicles on the road would increase the pedestrian fatality rate, but the sign is negative. Drivers or pedestrians may take different risks with more vehicles on the road, reducing the chance of accidents. However, since the variable is insignificant at the time, it is unlikely that any additional variable would change the effect of the number of vehicles per person for a state.

Population density contains surprising results as well. One would expect that as states become heavily populated, more people in the population would be walking, presenting a greater risk for single vehicle accidents and raising the fatality rates. However, the reverse is true. Population density significantly lowers pedestrian fatality rates; an increase in the population density by 1 person in person per acre decreases pedestrian fatality rates by 0.0015 per 10000 people. While statistically important in both models, population density should be accounted for states with high population, where its effects are maximized. It is possible that our expectation of increased density actually lowers rates; more people walking forces drivers to become more aware of pedestrians en masse, altering their risk behavior. It is also possible that by sheer force of numbers, that as a state becomes more densely populated, the population dilutes fatality rates. This effect is unlikely, since the data suggests that overall total pedestrian deaths have declined as well.

On the other hand, the age effect is insignificant in both models, unlike the observations made by previous research. While the coefficient percentage of the population 65 or older is positive, it is insignificant. Despite not observing behavioral patterns of this age group, we may suggest that older citizens may take fewer risks, even if their spatial judgment is incorrect as previous research suggests. Our results are inconclusive of the effect of age on state pedestrian fatality rates to make any definitive remarks.

In model 2, income significantly reduces pedestrian fatality rates for states. Higher personal income states may contain citizens who are able to afford safety gear, vehicles with better safety engineering, and or education, all of which creates an awareness of the consequences of risk and produces risk adverse citizens. However, the overall impact of personal income per capita is low; an increase in $1000 in personal income only reduces pedestrian fatality rate by .00387 per 10,000 people. It is important to keep in mind, however, that an increase in personal income per capita is also positively correlated to increased traffic safety expenditures, police officers per person, and vehicles per person, all increasing those rates. It is impossible to tell the overall impact on pedestrian fatalities, but we assume that it is greater than .00387 per 10,000 people when the other variables are accounted.

V. Conclusion

The pedestrian fatality rate is very much an economic issue as it is political and social. Federal, state and local governments have all passed legislation to ensure that their citizens are safer while walking. Whenever a pedestrian fatality occurs, many people demand government action to prevent pedestrian deaths. While state governments respond to this call, the effectiveness of such expenditures remains to be seen.

While we hypothesized that state government traffic safety expenditures would reduce pedestrian fatalities, our results are inconclusive. Our results show that expenditures have a minimal impact on the current year in states. Furthermore, police officer per person, population density, and personal income per capita all reduce pedestrian fatality rates. However, population density and personal income are only effective in high population states. Also, our results suggest rejecting previous literature on the effect of age on pedestrian behavior. Across the states, expenditures do not matter in reducing pedestrian fatality rates. Therefore, it is plausible to conclude that pedestrian behavior offsets the traffic safety expenditures.

The regression yields some surprising results. However, it is important to note that this analysis is incomplete. Most of the variation in data occurred outside the fixed-effects. Better sampling in years and more complete data, such as population in states that walk, mentioned in the data collection and methods, would possibly yield better results. Also, data at the local government level may provide more detailed results. Further research is necessary in determining if current state policy on traffic safety spending is efficient and maximizing the safety benefits.

References

Cohen, John and E. J. Dearnaley and C. E. M. Hansel. "The Risk Taken in Crossing a Road." *OR*. Vol 6, No 3 (Sept. 1955): 120-128.

Connelly, Marie L. and Helen M. Conaglen and Barry S. Parsonson and Robert B. Isler. "Child Pedestrians' Crossing Gap Threshold." *Accident Analysis and Prevention*. Vol 37 (July 1998): 443-453.

Crandall, Robert W. and John D. Graham. "Automobile Safety Regulation and Offsetting Behavior: Some New Empirical Estimates." *The American Economic Review*. (1984): 328-331.

Dickerson, Andrew and John Peirson and Roger Vickerman. "Road Accidents and Traffic Flows: An Econometric Investigation." *Economica*. Vol 67: No 265 (February 2000). 101-121.

Johnson, Keith. "Spain's Glory Pastime Creates Bull Market for Star Surgeons". *Wall Street Journal*. (November 10, 2005): A1, A6.

Lee, Chris and Mohamed Abdel-Aty. "Comprehensive Analysis of Vehicle-Pedestrian Crashes at Intersections in Florida." *Accident Analysis and Prevention*. Vol. 37 (2005): 775-786.

Meckler, Laura. "FAA Opts Not to Require Child-Seat Use on Planes". *Wall Street Journal*. (August 28, 2005): B2.

National Center of Statistics and Analysis, Fatality Reporting System (FARS). http://www-fars.nhtsa.dot.gov/main.cfm

Oxley, Jennifer A. and Elfried Ishen and Brian N. Fildes and Judith L. Charlton and Ross H. Day. "Crossing Roads Safely: An Experimental Study of Age Differences in

Gap Selection by Pedestrians." *Accident Analysis and Prevention*. Vol. 37 (2005): 962-971.

Peirson, John and Ian Skinner and Roger Vickerman. "The Microeconomic Analysis of the External Costs of Road Accidents." *Economica*. Vol 65, No 259 (August 1998): 429-440.

Peltzman, Sam. "The Effects of Automobile Safety Regulation." *The Journal of Political Economy*. Vol. 83; No. 4 (August 1975): 677-726.

Sahr, Robert C. *Consumer Price Index Conversion Factors*. Oregon State University. 2005. http://oregonstate.edu/Dept/pol_sci/fac/sahr/cv2004.pdf

US Department of Commerce, US Census Bureau. 2005. http://www.census.gov/

US Department of Justice, Federal Bureau of Investigation. 2005. http://www.fbi.gov/homepage.htm

US Department of Transportation, Bureau of Transportation Statistics. http://www.bts.gov/

US Department of Transportation, Federal Highway Administration. *2002 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*. (2002). *Highway Statistics*. 1995, 2000, 2004. http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm

US Department of Transportation, National Highway Traffic Safety Administration. *Pedestrian Roadway Fatalities*. (April 2003): 6.

US Department of Transportation, National Transportation Library. 2005. http://ntl.bts.gov/

Wong, S.C. and B.S.Y. Leung and Becky P.Y. Loo and W.T. Hung and Hong K. Lo. "A Qualitative Assessment Methodology for Road Safety Policy Strategies." *Accident Analysis and Prevention*. Vol 37 (2004): 281-293.

GRAPH 1 – Pedestrian Fatality Time Trends

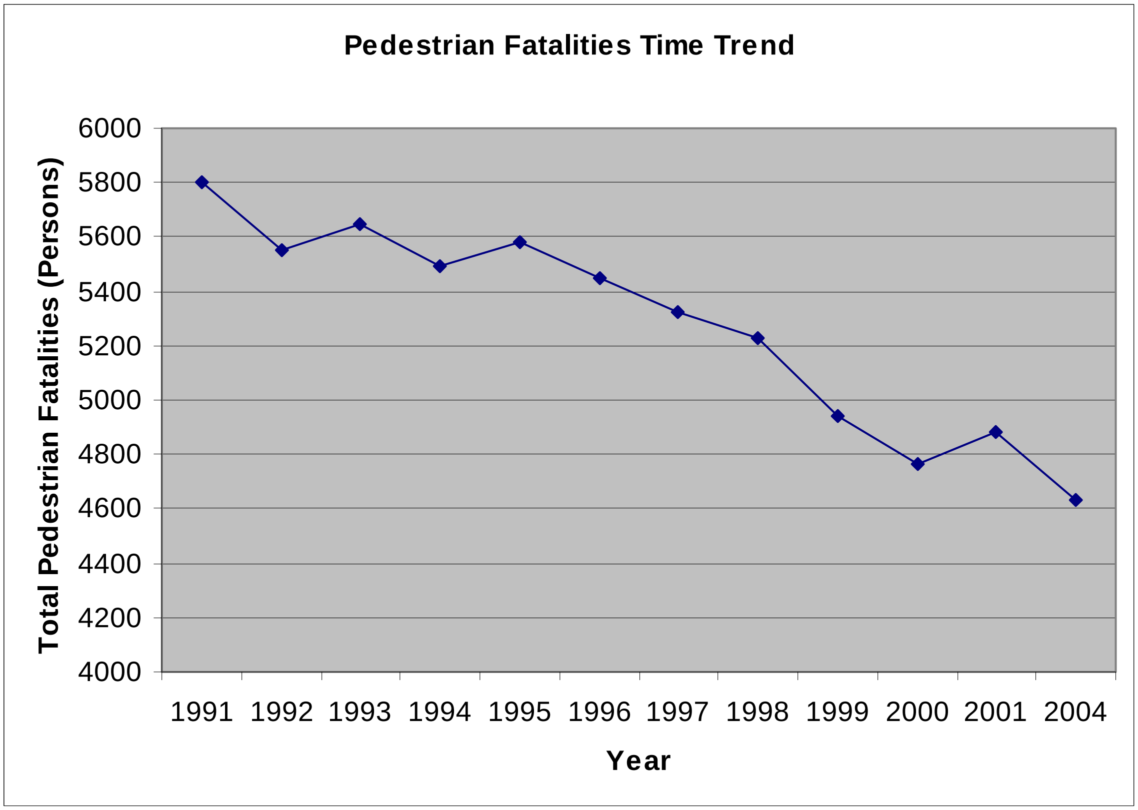

TABLE 1 - Means & Standard Deviations

Variable Name	Mean	Standard Deviation	Minimum	Maximum
Fatalpc	0.161415	0.075331	0.03087	0.50569
Expendpc	36.6012	40.1268	1.8969	228.2964
Policepc	21.1330	4.9294	13.3031	37.7582
Vehicles	0.8266313	0.133630	0.4337	1.2584
Pop_dens	181.8267	248.3089	1.0	1029
Age65pc	0.124535	0.019412	0.049381	0.18075
Income	30.19	4.645	21.294	45.398

$Fatalpc_{i\,t}$: Pedestrian fatalities as a unit number per a population of 10,000 people in state i in year t.

$Expendpc_{i\,t}$: Traffic safety expenditures per capita for state i in year t, using 2004 dollar values.

$Policepc_{i\,t}$: Total police per person for state i in year t.

$Vehicles_{i\,t}$: Vehicles per person for state i in year t.

$Pop\_dens_{i\,t}$: Population density in people per acre for state i in year t.

$Age65pc_{i\,t}$: Percentage of the population that is 65 years or older for state i in year t.

$Income_{i\,t}$: Personal Income per capita for state i in year t, using 2004 dollar values.

TABLE 2 –Results for Income

Income	FE Regression: Expendpc	FE Regression: Policepc	FE Regression: Vehicles
Probability > t	0.0000	0.0000	0.0021
Probability > F	0.0005	0.0000	0.0002

Fixed-Effect Regression for Variables with Independent Variable Income for state i in year t.

Probability > t : Represents the probability of the t-value at n-1 degrees of freedom at α = 0.05 being greater than the income per capita's t-value.

Probability > F : Represents the probability of the F-value at n-k-1 degrees of freedom at an α = 0.05 being greater than the model's F-value.

TABLE 3 – Fixed-Effects Regression Results for Pedestrian Fatality Rates

Variable	Fixed Effects 1	Fixed Effects 2
Expendpc	-0.000098 (0.00015)	
Policepc	-0.006107* (0.00293)	
Vehicles	-0.004549 (0.075469)	
Pop_Dens	-0.001556** (0.00036)	-0.00075* (0.00041)
Age65pc	0.000013 (0.00008)	0.167806 (0.80886)
Income		-0.00387** (0.00103)
R-Square within	0.2639	0.3233
R-Square overall	0.0010	0.0003
n	150	150

( ) indicates standard errors
* indicates significant at the α = 0.05 level
** indicates significant at the α = 0.01 level