

**The Determinants of Truck Accidents  
in the United States**

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**NOT TO BE QUOTED WITHOUT PERMISSION OF THE AUTHORS**

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## **I. INTRODUCTION**

Economists and policy makers have been serious students of the determinants of transportation accidents for many years. These investigations have included studies of the causes of accidents involving primarily motor vehicles, aircraft, boats, and railroads. Loeb, Talley, and Zlatoper (1994) provide a detailed review of many of these studies along with the theoretical underpinnings of them. This present study extends this research in the area of truck accidents in the United States. It is based on the theoretical and empirical findings of prior studies pertaining to motor vehicle accidents (both automobile and truck accidents) as well as railroad accidents, given the potential for the interaction between these two modes of transportation. In addition to the commonly considered causes of motor vehicle accidents, we investigate the effect of deregulation of the trucking industry by the Motor Carrier Act of 1980 while controlling for the potential effect of the Staggers Act of 1980 which deregulated the railroads. The study is conducted using time series data on truck accident rates and factors which contributed to them for the period 1970 to 2001 using econometric models, which, in turn, are subjected to stringent specification error tests to assure that the results are statistically viable.

## **II. BACKGROUND**

Truck accidents<sup>1</sup> have trended upward since 1970 with the exception of a large downturn in these accidents between 1990 and 1996.<sup>2</sup> Many determinants of motor vehicle accidents,

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<sup>1</sup> Trucks are defined by the National Safety Council (1997, p.6) to include single-unit trucks and truck combinations. They are, "designed primarily for carrying property." A single-unit truck is defined by the National Safety Council (1997, p.7) as, "a truck consisting primarily of a single motorized device. When connected to a trailer, such a device may be part of a truck combination." A truck combination is defined by the National Safety Council (1997, p.7) as, "consisting primarily of a transport device which is a single-unit truck or truck tractor together with one or more attached trailers."

<sup>2</sup> This downturn may be associated with a rise in unemployment rates. Unemployment rates remained above 5.4% from 1990 to 1996 and fell below 5% in 1997.

including truck accidents, have been suggested previously. They include: socio-economic factors such as real GDP and the unemployment rate; the distribution of the population by age, gender, and race; roadway characteristics such as rural to urban highway mileage driven, interstate highway travel, proximity to hospitals, degree of congestion, speed limits, average speed and speed variance, and miles driven; weather conditions; public safety expenditures (e.g., expenditures on police and law enforcement activities or the number of employees providing law enforcement); and safety characteristics of motor vehicles themselves, including changes in technology and the age of the truck fleet. A time trend has been used in the past to proxy changes in technology. However, this trend variable may also proxy permanent income as noted by Peltzman (1975). Finally, alcohol consumption is a known significant contributor to motor vehicle accidents.<sup>3</sup> More specifically:

We expect truck accidents to be positively associated with real GDP. Improvement of economic activity is expected to result in an increase in the distribution of products from suppliers of inputs to manufacturers and from manufacturers to wholesalers and retailers. This is expected to increase the likelihood of accidents. Further, unemployment rates have been shown to be inversely related to motor vehicle accidents.<sup>4</sup>

Miles driven on roadways is expected to be associated with accidents. Similarly, alcohol consumption by drivers of trucks and automobiles (and the general public) have been shown to be positively linked to accidents. Population characteristics, such as the age distribution of the population, suggest that youthful drivers and older drivers are more likely to be involved in accidents. However, these results are not conclusive and consistent across studies.

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<sup>3</sup> See Loeb, Talley, and Zlatoper (1994) for further discussion.

<sup>4</sup> See Evans and Graham (1988), and Fowles and Loeb (1989).

Evidence also exists that male drivers are more likely to be involved in accidents than their female counterparts.<sup>5</sup>

Highway characteristics such as speed, speed variance, speed limits, the ratio of urban to rural travel, proximity to hospitals, interstate highway usage, among others have been examined by researchers. The effect of speed versus speed variance was a highly contested issue. However, there seems to be some evidence and possible consensus that both speed and speed variance may affect fatalities.<sup>6</sup> Speed limits have also been shown to have some effect on fatalities.<sup>7</sup> Truck inspection per mile driven has also been shown to be inversely associated with truck related fatalities<sup>8</sup> while police enforcement has been found to be inversely related to truck accidents.<sup>9</sup> Weather conditions have been shown to effect motor vehicle related deaths with average temperatures positively associated and precipitation negatively associated with such deaths.<sup>10</sup> Some evidence has also been found indicating the age of the motor vehicle fleet to be inversely related to traffic fatalities.<sup>11</sup> Also, some evidence has been found linking a time trend, a possible proxy for technology and /or permanent income, with automobile driver involved injury rates.<sup>12</sup>

Another concern of researchers has been the effect of deregulation on transportation accidents. Economists have studied the impact of such regulations for most modes of transportation, and in particular in the aircraft, trucking, and most recently the railroad

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<sup>5</sup> See Loeb, Talley, and Zlatoper (1994), Loeb (1995), and Fowles and Loeb (1995,1989).

<sup>6</sup> See Loeb, Talley, and Zlatoper (1994), Lave (1985), Fowles and Loeb (1989,1995), and Levy and Asch (1989). We would expect variables related to fatalities to be similarly related to accidents.

<sup>7</sup> See Fowles and Loeb (1995) and Loeb (1993).

<sup>8</sup> See Kraas (1993).

<sup>9</sup> See Alexander (1992).

<sup>10</sup> See Loeb, Talley, and Zlatoper (1994).

<sup>11</sup> See Fowles and Loeb (1995).

<sup>12</sup> See Loeb (2001, 1993) and Peltzman (1975).

industries.<sup>13</sup> The trucking industry was deregulated (most recently) in 1980 with the Motor Carrier Act. This act allowed for easier entry into the trucking industry and allowed trucking companies more flexibility in pricing. However, there was concern that the Motor Carrier Act of 1980, hereafter the MCA, would result in a reduction of safety. This would be due to a reduction of profitability leading to, among other things, reduction in maintenance, the hiring of inexperienced labor, a reduction in driver training programs, etc. Others argued that as the wage rates fell in the industry, trucking firms would increase safety expenditures and accidents might then decline.<sup>14</sup> Still others were concerned that as trucking rates fell, some freight transportation might be shifted from relatively safe railroads to the less safe trucking industry.<sup>15</sup> In any case, empirical studies of the effect of the MCA on truck accidents and safety have not been conclusive. The difficulty in measuring the impact of the MCA on truck safety is exacerbated due to the railroad industry being deregulated that same year with the Staggers Act of 1980. In any case, Adams(1989), Daicoff (1988), and Kraas (1993) find some evidence indicating an association between deregulation and reduced safety in the trucking industry while Moore (1989), Viscusi (1989), and Alexander (1992) do not find deregulation resulted in a decline in measures of safety.

The current paper examines the effect of many of the above factors on trucking accidents, including the effect of the MCA using econometric methods and a time series data set covering the period 1970 to 2001.

### **III. THE MODEL AND DATA**

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<sup>13</sup> See Loeb, Talley, and Zlatoper (1994), Loeb and Clarke (2001), and Clarke and Loeb (2005).

<sup>14</sup> See Alexander (1992, p. 30) for a discussion on this.

<sup>15</sup> See Boyer (1989).

## A. The General Linear Model

A model of the form:

$$(1) \ln(\text{Truck Accidents/Mile Driven}) = \beta_0 + \beta_1 + \beta_2 \underline{\mathbf{X}} + \beta_3 \text{DEREG} + \mu$$

is suggested where:

$\underline{\mathbf{X}}$  is a matrix of socio-economic and truck/motor vehicle related variables thought to determine the dependent variable. The variables comprising  $\underline{\mathbf{X}}$  are in natural log form when they are continuous, i.e., not dummy variables. DERE $\text{G}$  is a dummy variable indicating when the Motor Carrier Act of 1980 was in force.  $\mu$  is a random error term assumed to comply with the full ideal conditions underlying the Classical Linear Regression Model which would result in best linear unbiased estimates (BLUE) of the coefficients when the model is estimated using ordinary least squares.

The variables considered for possible inclusion in  $\underline{\mathbf{X}}$  are:

YEAR	=	a time trend from 1970 to 2001.
RGDP	=	real GDP (1996=100).
MD	=	vehicle miles traveled (in billions of miles). <sup>16</sup>
TOTALC	=	total per capita consumption of alcoholic beverages in gallons.
TRUCKAGE	=	average age of the truck fleet in use.
UNEMP	=	unemployment rate.
FRTMI	=	volume of domestic railroad intercity freight traffic (in billion ton-miles).
POP	=	population (in thousands).
D1 <sup>17</sup>	=	dummy variable for the mandatory 55 mph speed limit where D1=1 for the period 1974 to 1986. D1=0 at all other times.
REALFP	=	real price of unleaded regular gasoline.
POLICE	=	total employees involved in police protection (in thousands).

Again, DERE $\text{G}$  is a dummy variable to account for the period the MCA was in effect, where

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<sup>16</sup> MD would be used as a regressor only when the model is estimated in level form, i.e., not as a rate.

<sup>17</sup> D1 is used to account for the 1987 bill passed by Congress allowing states to set the speed limit at 65 mph on rural interstates. An alternative measure to account for a change in the speed limit, D2, was also examined. D2 accounts for the repeal of the 55 mph speed limit law by Congress in December 1995. Substituting D2 for D1 to account for changes in the speed limit law did not change the general results reported in Table 2. The results using "D2" are available from the authors.

DEREG=1 for the period 1980 to 2001 and DEREG=0 for all prior time periods. The dependent variable, TAFR, is defined as truck accidents per mile driven.<sup>18</sup>

As mentioned above, the model is estimated using natural logarithms of the continuous variables. Estimated coefficients associated with such variables are interpreted as elasticities. Coefficients associated with dummy variables indicate the percentage change in the dependent variable due to the binary variable taking on the value of “1”.<sup>19</sup>

We anticipate a positive effect on the dependent variable by TOTALC, TRUCKAGE, MD and POP. We expect a negative effect by YEAR (a proxy for technology and permanent income), UNEMP, FRTMI, REALFP, and POLICE. We do not have strong a priori expectations regarding the effects of RGDP, D1, and DEREG on the dependent variable.

## **B. The Data**

Data generally cover the period 1970 to 2001. The dependent variable (TAFR) is measured as truck accidents per vehicle miles driven. Truck accidents are in millions and are reported by the U.S. Bureau of the Census, Statistical Abstract of the United States (various years). Miles driven, measured in billions of miles, are reported in U.S. Department of Transportation, National Highway Traffic Safety Administration (2002). RGDP is reported in the Economic Report of the President (2003) as is UNEMP. YEAR is a generated series taking on values of 1970 to 2001 inclusive.

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<sup>18</sup> An attempt was made to consider the potential impact profitability of the trucking industry might have on truck accidents. Industry data are not available for this variable. Data are available (Statistical Abstract of the United States –various issues) on Operating Revenue, Long Distance Revenue, and Operating Expenses for the years 1984 forward which precludes making any comparison to the pre-deregulation period. However, these variables are found to be highly correlated with a time trend (YEAR), i.e., the correlations between YEAR and operating revenue and YEAR and operating expenses are 0.988 and 0.994 respectively. As such, we expect the inclusion of YEAR in the regressions will pick up revenue effects.

<sup>19</sup> The actual percentage change of the regressand (measured in log form) when the dummy variable takes on the value of “1” is determined by the formula:  $100[\exp(b)-1]$ . See Woodridge (2003), Halvorsen and Palmquist (1980), and Thornton and Innes (1989) on this.

TOTALC is reported in U.S. Department of Agriculture, Economic Research Service at:  
<http://www.ers.usda.gov/Data/FoodConsumption/Spreadsheets/beveragexls>.

TRUCKAGE, measuring the average age of trucks in use, is reported in U.S. Department of Transportation, Federal Highway Administration, at:  
<http://www.fhwa.dot.gov/ohim/ohh00/line3.htm>.

FRTMI is included in the model to normalize for the potential effect the deregulation of the railroads (via the Staggers Act) may have had on truck accidents since both the truck and railroad industries were deregulated in 1980 and could serve as substitutes for one another with regard to freight shipping. These data are reported in the U.S. Bureau of the Census (various years).

POP is included in the model to account for exposure and the data are reported in the Economic Report of the President (2003).

D1 accounts for the 55 mph speed limit. D1=1 for the period 1974-1986 and is set equal to zero for all other periods. This reflects Congress passing a bill in 1987 allowing states to set the speed limit at 65 mph on rural interstates.

REALFP is based on the average price of unleaded regular gasoline reported by the U.S. Bureau of the Census (various years) which is deflated using the consumer price index for motor fuel (in 1996=100 terms) from the Economic Report of the President (2003). POLICE is reported in the Bureau of the Census (various years).

DEREG is a dummy variable to capture the effect of the Motor Carrier Act of 1980 on truck accident rates. It is set equal to one for the period 1980 to 2001 and it is set to zero for all other time periods.

## **1. Data Problems**

Data were generally available for all variables for the period 1970 to 2001. Truck accident data were not available for the years 1971, 1992, and 2001. Rather than omitting these years, simple econometric models were developed to provide forecasts of the three missing observations.<sup>20</sup>

Finally, many regressors were highly correlated, both in terms of the original data and in natural log form. For example, the correlation coefficients between LYEAR and LMD (log of miles driven), LRGDP, and LPOP were: 0.9989, 0.9971, and 0.9990 respectively while the correlation between LYEAR and LPOLICE was 0.9859. Such strong linear associations between regressors suggest that some should be dropped from the model to be estimated, provided, in so doing, bias is not introduced due to omission of variable(s).<sup>21</sup>

### III. MODEL SELECTION AND EMPIRICAL RESULTS

#### A. Model Selection

Given the aforementioned problems, a model for Truck Accidents/Mile Driven was specified as:

$$(2) \ln \text{TAFR} = \beta_0 + \beta_1 \underline{\mathbf{Z}} + \beta_2 \text{DEREG} + \mu$$

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<sup>20</sup> The forecasting models took the form:  $Y_t = \beta_0 + \beta_1 \text{YEAR} + \mu$  and were estimated using various numbers of observations to adjust for turning points in the series. These equations are available from the authors. In addition, some regressors did not have observations available for the years 2000 and 2001 and thus did not require forecasted values of the dependent variable for those years if those variables were included in the model. In addition, REALFP suffered from omission of data for the years 1971, 1972, 1974, and 2001. When using this regressor, those observations are dropped and thus the missing observation problem associated with the dependent variable is lessened. Also, data on POLICE suffered severely from missing data. Hence, this variable was usually omitted in the present study. However, it should be noted that the correlation between POLICE and many other regressors, both in level form and in natural log form was very high. For example, the correlations between POLICE and RGDP, MD, and POP were greater than 0.98. Hence, severe multicollinearity would suggest dropping this variable in any case.

<sup>21</sup> One way to address part of the problem is to estimate the models in terms of the log of Accidents/Mile Driven instead of the log of accidents as a function of the log of miles driven (among other variables). This indeed is the approach taken in the paper.

where  $\underline{Z}$  is a subset of  $\underline{X}$  (measured in natural log form where applicable). The regressors in  $\underline{Z}$  are selected so as to avoid some of the major collinearity problems discussed above, while attempting not to create a situation where biased estimates result.

Variations of equation (2) are estimated by OLS. Under the full ideal conditions, the OLS estimates are Best Linear Unbiased estimates. However, concern arose due to the possibility of not only serial correlation, but bias due to potential omission of variables, simultaneous equation problems, and misspecification of the structural form of the model. As such, the estimated models were subjected to a set of specification error tests to examine for violation(s) of the full ideal conditions. More specifically, we use the Regression Specification Error Test (RESET) developed by Ramsey (1974) as well as the Jarque-Bera Test (J-B) for normality, and the Durbin-Watson Test (DW) for serial correlation. RESET is a test performed on the residuals of a regression to detect errors of omitted variables, simultaneous equation bias, and error of the structural form of the model. Any given specification estimated is rejected if any one or more of the above tests rejects the null hypothesis of the existence of the full ideal conditions. This is a relatively severe requirement imposed on model specifications as opposed to relying on student t statistics and adjusted  $R^2$ s.<sup>22</sup> It allows us to concern ourselves with a subset of potential specifications by eliminating those which have a significant probability of being misspecified (from a single equation perspective).

## **B. Empirical Results**

Models of the form suggested in equation (2) were estimated by Ordinary Least Squares (OLS) and examined for specification errors. Table 1 provides summary statistics on the variables used in those equations not rejected by specification error tests or concern for

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<sup>22</sup> See Ramsey and Zarembka (1971) on this.

multicollinearity.<sup>23</sup> Table 2 provides a set of estimated models not rejected by the above mentioned tests.<sup>24</sup>

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<sup>23</sup> A correlation matrix is available from the authors.

<sup>24</sup> Models differed in terms of number of observations depending on which independent variables were included or excluded. When LFRTMI was included, observations for the years 2000 and 2001 were omitted since data on FRTMI were not available for those years. This eliminated the need to use a forecasted value for the dependent variable for the year 2001. When LREALFP was included, observations for the years 1971, 1972, 1974 and 2001 were omitted due to data not being available. Thus, in cases where both LFRTMI and LREALFP are included in a model, it was not necessary to use forecasted values of the dependent variable for the years 1971 or 2001.

**Table 1 – Summary Statistics of Selected Variables**

Variable Name	Mean	Standard Deviation
TAFR	0.003	0.0005
YEAR	1985.500	9.3808
RGDP	6003.866	1695.255
TOTALC	25.975	1.9299
TRUCKAGE	7.742	0.572
UNEMP	6.284	1.4254
FRTMI	1013.533	230.3107
POP	241931.7	24011.50
D1	0.406	0.4990
REALFP	1.277	0.0558
POLICE	805.733	169.4421
DEREG	0.688	0.4709

**Table 2 – Regression Results for Models of the ln TAFR<sup>a</sup>**

<b>Equation #/ Independent Variable Name</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
<b>Constant</b>	3561.37 (2.832)	3779.967 (2.874)	3496.283 (1.465)	3932.984 (2.069)	3659.337 (3.863)
<b>LUNEMP</b>	-0.662 (-3.256)	-0.679 (-3.272)	-0.706 (-2.901)	-0.702 (-3.284)	-0.640 (-3.389)
<b>DEREG</b>	0.079 (0.687)	0.002 (0.015)	0.117 (0.589)		
<b>LTOTALC</b>	2.184 (2.861)	2.561 (2.673)	1.891 (2.142)	2.535 (3.663)	2.415 (5.830)
<b>LFRTMI</b>	-1.849 (-2.911)	-1.692 (-2.469)	-1.797 (-2.295)	-1.685 (-2.338)	-1.939 (-3.230)
<b>LYEAR</b>	-512.349 (-2.838)	-543.036 (-2.880)	-502.252 (-1.478)	-564.518 (-2.085)	-527.145 (-3.869)
<b>D1</b>	0.025 (0.239)	0.022 (0.205)	0.065 (0.419)		
<b>LPOP</b>	26.646 (2.866)	27.512 (2.894)	25.766 (1.616)	28.304 (2.229)	27.798 (3.820)
<b>LTRUCKAGE</b>		0.713 (0.667)		0.871 (1.042)	
<b>LREALFP</b>			-0.221 (-0.075)	0.282 (0.145)	
<b>Adjusted R<sup>2</sup></b>	0.689	0.681	0.685	0.712	0.709
<b>DW<sup>b</sup></b>	1.765	1.832	1.934	1.992	1.767
<b>J-B<sup>c</sup></b>	0.443	0.623	0.392	0.616	0.468
<b>RESET<sup>d</sup></b>	0.261	0.519	0.339	0.598	0.249

<sup>a</sup>Numbers shown within parentheses below the coefficients are t-statistics. “L” preceding the variable indicates that the variable is measured in terms of the natural logarithm.

<sup>b</sup>Durbin-Watson Statistic.

<sup>c</sup>Jarque-Bera Test.

<sup>d</sup>Regression Specification Error Test.

The various estimated equations show fairly consistent results across specifications. The unemployment variable is consistently negative and significant which is consistent with many prior studies.<sup>25</sup> Our measure of alcohol consumption is positively associated with the log of truck accident rates and it is statistically significant. This result conforms with prior studies. LFRTMI was included in the model to account for shipping by railroad as a substitute for trucking and to account for the Staggers Act. As expected, the coefficients associated with this variable were always negative and significant.<sup>26</sup> LYEAR is a measure of technology changes over time and permanent income. It is always negative and in all cases but one, statistically significant. The dummy variable (D1) to account for the 55 mph speed limit was never significant.<sup>27</sup> The population variable was included to account for exposure and was always positive and generally significant.<sup>28</sup> The coefficients associated with the age of the truck fleet (which may account for changes in technology and deterioration of the truck stock) proved always positive, as expected, but were never statistically significant. The real fuel price variable (LREALFP) was never statistically significant and its sign was fragile. Finally, the coefficient associated with the Motor Carrier Act of 1980 to account for deregulation of the industry was never statistically significant. When this variable, along with the dummy variable for the 55 mph speed limit, was omitted from the specifications estimated, results improved with regard to the adjusted R<sup>2</sup>s. As such, we find no evidence that deregulation of the trucking industry resulted in an increase in accidents. This conforms with a great deal of similar work on other modes of transportation, where deregulation was

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<sup>25</sup> See Loeb, Talley, and Zlatoper (1994) and Partyka (1984) on this.

<sup>26</sup> See Loeb and Clarke (2001) and Clarke and Loeb (2005) for an evaluation of the effect of deregulation of the railroad industry on railroad fatalities.

<sup>27</sup> Using the alternative measure to account for the 55 mph speed limit (D2) did not change the regression estimates in any meaningful manner. These regressions are available from the authors.

<sup>28</sup> Specifications which omitted this variable often suffered from specification errors and/or provided unreasonable results associated with the remaining regressors.

similarly found not to effect safety.<sup>29</sup> Hence, our results using a rather long time series, conform with those of Alexander (1992) who used pooled cross-section data on the years 1977, 1982, and 1987.<sup>30</sup>

#### IV. ALTERNATIVE MODELS AND INTERACTIVE EFFECTS

The models specified in equations (1) and (2) were re-evaluated in linear form so as to examine an alternative structural form as well as to allow for the examination of possible interaction between deregulation (DEREG) and the volume of domestic railroad intercity freight traffic (FRTMI). The model takes the form:

$$(3) \text{ TAFR} = \beta_0 + \beta_1 \mathbf{Z} + \beta_2 \text{ DEREG} + \beta_3 (\text{DEREG} * \text{FRTMI}) + \mu$$

where: TAFR the truck accident rate and (DEREG\*FRTMI) – the interaction term - is the product of DEREG and FRTMI.

In the above model,  $\partial(\text{TAFR})/\partial(\text{DEREG}) = \beta_2 + \beta_3 \text{ FRTMI}$  and the effect of deregulation on truck accidents will be dependent on the level of freight mileage.<sup>31</sup>

Various alternative estimated specifications are presented in Table 3. The interaction term never has a significant coefficient associated with it and its inclusion in the model results in a reduction of the adjusted R<sup>2</sup> and tends to result in a reduction of significance of other coefficients, all else equal.<sup>32</sup> Empirical results are similar to those associated with the logarithmic models (Table2) with regard to: UNEMP, TOTALC, FRTMI, YEAR, and POP – all having estimated coefficients which are statistically significant and non-fragile across

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<sup>29</sup> See Loeb and Clarke (2001) for an example.

<sup>30</sup> Alternative models were evaluated in terms of the log of the level of accidents, as opposed to the log of the accident rate. Variants of these specifications adjust for miles driven by including the log of MD as a possible regressor. Regardless of the inclusion of the log of MD as a regressor, the results are consistent with those reported in Table 2 and are available from the authors.

<sup>31</sup> See Peoples and Talley (2004), and McCarthy (1999, 1994) on the use of interaction terms in transportation studies. Equation (2) was respecified to include an interaction term (in non-log form) as well. The results were not superior to those reported in Table 2 and the adjusted R<sup>2</sup>s tended to be diminished.

<sup>32</sup> Compare equations 1 vs. 1' and 2 vs. 2'.

**Table 3 – Regression Results of Models of the TAFR<sup>a</sup>**

<b>Equation #/</b>	<b>(1)</b>	<b>(1')</b>	<b>(2)</b>	<b>(2')</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>
<b>Independent Variable Name</b>							
<b>Constant</b>	1.167 (3.356)	1.166 (3.270)	1.217 (3.411)	1.216 (3.335)	0.837 (1.201)	1.119 (2.053)	1.227 (4.143)
<b>UNEMP</b>	-0.0002 (-2.509)	-0.0002 (-2.434)	-0.0002 (-2.513)	-0.0002 (-2.476)	-0.0002 (-2.619)	-0.0002 (-2.818)	-0.0002 (-2.651)
<b>DEREG</b>	0.0002 (0.620)	0.0002 (0.071)	-3.69E-05 (-0.084)	-0.001 (-0.313)	0.0001 (0.201)		
<b>TOTALC</b>	0.0003 (3.235)	0.0003 (2.625)	0.0003 (3.063)	0.0004 (2.508)	0.0002 (2.168)	0.0003 (3.351)	0.0003 (6.236)
<b>FRTMI</b>	-4.44E-06 (-2.475)	-4.44E-06 (-1.445)	-3.86E-06 (-1.969)	-4.58E-06 (-1.477)	-4.28E-06 (-2.137)	-3.94E-06 (-1.984)	-4.57E-06 (-2.642)
<b>YEAR</b>	-0.0006 (-3.345)	-0.0006 (-3.259)	-0.0006 (-3.401)	-0.0006 (-3.325)	-0.0004 (-1.227)	-0.0006 (-2.082)	-0.0007 (-4.135)
<b>D1</b>	9.93E-05 (0.362)	9.93E-05 (0.353)	7.97E-05 (0.287)	7.12E-05 (0.249)	0.0002 (0.499)		
<b>POP</b>	2.68E-07 (3.201)	2.68E-07 (3.112)	2.70E-07 (3.193)	2.68E-07 (3.079)	2.06E-07 (1.514)	2.53E-07 (2.291)	2.81E-07 (3.775)
<b>TRUCKAGE</b>			0.0003 (0.775)	0.0003 (0.817)		0.0003 (0.859)	
<b>REALFP</b>					0.003 (0.416)	0.002 (0.465)	
<b>DEREG*FRTMI</b>		1.93E-11 (6.3E-06)		1.01E-06 (0.305)			1.6E-07 (0.518)
<b>Adjusted R<sup>2</sup></b>	0.711	0.697	0.706	0.692	0.716	0.737	0.722
<b>DW<sup>b</sup></b>	1.692	1.692	1.813	1.862	1.857	1.925	1.689
<b>JB<sup>c</sup></b>	0.822	0.822	1.339	1.839	0.478	1.069	1.067
<b>RESET<sup>d</sup></b>	0.731	0.838	0.451	0.640	1.504	0.806	0.74

<sup>a</sup>Numbers shown within parentheses below the coefficients are t-statistics.

<sup>b</sup>Durbin-Watson Statistic.

<sup>c</sup>Jarque-Bera Test.

<sup>d</sup>Regression Specification Error Test.

specifications, i.e., not switching signs. The coefficients associated with the dummy variable for deregulation, as in the logarithmic models are consistently insignificant across specifications. The interaction of deregulation with railroad freight mileage is never statistically significant and does not add information to the model.<sup>33</sup> Clearly, alcohol consumption stands out to be a potential factor addressable with policy actions, i.e., tax policy, to reduce accidents involving trucks. Further, additional statistical support is obtained indicating that the deregulatory climate of the 1980's did not result in an increase in truck accidents.

## **V. CONCLUDING COMMENTS**

This paper examined the effect of deregulation of the trucking industry on trucking accidents along with the potential effects of other determining factors on such events. Econometric models were developed using time series data for the years 1970 to 2001 and a set of stringent specification error tests to increase the probability that the results reported are statistically reliable.

As expected, alcohol consumption adversely affects trucking accidents and high unemployment rates are associated with lower truck accidents, as with other motor vehicle accidents. More specifically, using the results in Table 2, one can see that truck accidents per mile driven are highly elastic with respect to alcohol consumption. This statistically significant finding is consistent across all specifications. This lends support to public policies which would reduce alcohol consumption, such as increased taxes on alcoholic

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<sup>33</sup> Models in terms of the level of truck accidents were also estimated. Empirical results are similar to those reported in Table 3 and are available from the authors. However, these specifications were likely to be rejected for specification errors.

beverages and/or raising the minimum legal drinking age.<sup>34</sup> Increases in railroad freight mileage, all else equal, is associated with a reduction in truck accidents. This is expected, given that railroads may serve as a good substitute for carrying freight. One can infer that a reduction in truck hauling prices (relative to railroad fees) may result in a transfer of shipping from a relatively safe mode of transportation (railroads) to one which is less safe (trucking). Finally, our models do not find statistical evidence that deregulation of the trucking industry resulted in an increase in truck accidents.

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<sup>34</sup> See Chaloupka et al. (1993) on the relationship between alcohol control policies and motor vehicle fatalities.

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