An Analysis of Commercial Vehicle Driver Traffic Conviction Data to Identify High Safety Risk Motor Carriers

by

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ABSTRACT

This project explores the idea of using commercial motor vehicle driver traffic conviction data from the Commercial Driver License Information System (CDLIS) to help identify high safety risk motor carriers. Prior research and intuitive knowledge suggest that certain types of motor carriers may employ drivers with higher than average traffic conviction rates. This study should help to provide new knowledge of high-risk carriers, and allow better focusing of enforcement efforts to reduce crashes and fatalities on the highways.

Because there is not a national traffic citation database, and there are substantial problems with state or local police officers accurately identifying the employing motor carrier when issuing a traffic citation, a direct approach of using citation data for analysis is not feasible nationwide. Therefore, the present project studies whether a correlation exists between traffic conviction data (a subset of citations), accessible through CDLIS, and high risk motor carriers linked to drivers through inspection and crash reports contained in the Motor Carrier Management Information System.

This study concludes that linking driver conviction data to the employing motor carrier provides a method to identify those motor carrier companies with safety problems. A carrier driver history measure created based on the average number of convictions of drivers associated with the carriers is significantly correlated with carriers' out-of-service rates, accident rates, and SafeStat Safety Evaluation Area (SEA) scores. Carriers with higher (worse) driver history measures are also more likely to have higher OOS rates, accident rates, and SEA scores.

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Background

This project explores the idea of using commercial motor vehicle (CMV) driver traffic conviction data from the Commercial Driver License Information System (CDLIS) to help identify high safety risk motor carriers. Prior research and intuitive knowledge suggest that certain types of motor carriers may employ drivers with higher than average traffic conviction rates. This study should help to provide new knowledge of high-risk carriers, and allow better focusing of enforcement efforts to reduce crashes and fatalities on the highways.

Previous related research in this area examined 1994 traffic citation data from two states, Indiana and Michigan. Normally when a CMV driver is given a traffic citation, the employing motor carrier is not identified. However, the states agreed to have their state police attempt to identify the employing motor carrier for this study, and note it on the driver citation. The main conclusions from this study were that driver violation rates significantly differ among carriers, and that higher violation rates are associated with higher crash rates (*1*). Thus, it appears that linking driver citation information to motor carriers may provide useful information regarding high safety risk motor carriers.

Because there is not a national traffic citation database, and there are substantial problems with state or local police officers accurately identifying the employing motor carrier when issuing a traffic citation, the above approach would not be feasible nationwide. Hence, the present study examines if a similar correlation exists between traffic conviction data (a subset of citations), accessible through CDLIS, and motor carriers linked to drivers through inspection and crash reports contained in the Motor Carrier Management Information System (MCMIS).

CDLIS data is the only existing nationwide source of traffic conviction data. CDLIS is not really a single database, but a linkage between the various distributed state driver records systems. Its successful use as a pointer to high safety risk motor carriers would eliminate the need to create a new national driver citation/conviction information system. The most critical problem with using CDLIS data in this way is that it does not identify the motor carrier employing the driver.

CDLIS was created as a requirement under the Commercial Motor Vehicle Safety Act (CMVSA) of 1986, and has been in full operation since April 1992. It serves as a clearinghouse that each of the 51 jurisdictions (the 50 states and the District of Columbia) can check before issuing a commercial driver's license (CDL). CDLIS helps to ensure that only one license or CDL is issued to each driver nationwide. It also ensures that all convictions are reported to the licensing state and made part of the driver's record (*2*).

Essentially, CDLIS works by allowing the licensing computer in each state to communicate with the central CDLIS pointer system and all other state licensing systems. The central system contains identification data about each driver with a CDL. If a prior CDL has been issued to a driver, a request is made to the issuing state to provide information back to the first state. Each licensing state maintains the data regarding the status of the driver, endorsements, convictions, accidents, withdrawal history, etc.

Conversely, data obtained from accidents and roadside inspections of commercial motor vehicles and drivers are input, or transmitted via computer, by states locally into an information system termed SAFETYNET. The states then transfer relevant data for interstate carriers electronically to the National Motor Carrier Management Information System (MCMIS). Each accident and roadside inspection report in MCMIS identifies the driver and the motor carrier. There are approximately two million roadside inspections and 60,000 reported accidents each year. MCMIS also contains census information regarding each motor carrier (i.e., address, number of power units, number of drivers, cargo carried, etc.)

Methodology and Data Description

In order to not overburden the states' driver records systems, a stratified random sampling scheme was used for this initial study. The target was to obtain approximately 75,000 driver records from all sizes of carriers nationwide.

Based on census data in MCMIS, carriers were assigned to one of seven size categories and to one of 10 different regions of the country as follows:

Carrier Size Categories

(1) Missing, 0, or 1 driver
(2) 2 to 5 drivers
(3) 6 to 15 drivers
(4) 16 to 71 drivers
(5) 72 to 200 drivers
(6) 201 to 1,000 drivers
(7) 1,001 or more drivers

Carrier Regions

(1) Deep South Region: Alabama, Florida, Georgia, Louisiana, and Mississippi
(2) Great Lakes Region: Illinois, Indiana, Michigan, Ohio, and Wisconsin
(3) Mid-Atlantic Region: Delaware, Maryland, New Jersey, New York, Pennsylvania, Washington, D.C., and West Virginia
(4) Mid-South Region: Kentucky, North Carolina, South Carolina, Tennessee, and Virginia
(5) New England Region: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont

(6) Northwest Region: Idaho, Montana, Oregon, Washington, and Wyoming
(7) Pacific West Region: Alaska, California, and Hawaii
(8) South Central Region: Arkansas, Kansas, Missouri, Oklahoma, and Texas
(9) Southwest Region: Arizona, Colorado, Nevada, New Mexico, and Utah
(10) Upper Plains Region: Iowa, Minnesota, Nebraska, North Dakota, and South Dakota

Combining the size categories and regions results in a total of 70 groups. Each of the 614,530 carriers that had applicable census data in the MCMIS database was assigned to a unique group. Because there are obviously fewer drivers associated with smaller carriers, and a limited number of larger carriers, a larger sample of smaller carriers was obtained. For each carrier randomly selected from each group, drivers associated with that carrier were randomly selected, with a maximum of 50 drivers per carrier. Only accident or inspection reports within the one-year time frame between September 1999 and September 2000 were used to associate drivers with carriers. If there were no drivers able to be associated with the carrier, the next carrier was selected until there was at least one driver association. In order that there would not be duplicate driver histories associated with carriers, checks were completed to ensure that a driver was not associated with the same carrier more than once. However, it was acceptable, and expected, that a driver could be associated with more than one carrier.

The initial selection resulted in a sample of 15,829 carriers, with an associated 79,244 drivers. The sample range consisted of approximately 200 carriers and 8,600 drivers from the largest size group to 5,700 carriers and 10,300 drivers from the smallest. Regarding regions of the country, there were 1,200 to 1,700 carriers from each of the 10 regions; and about 4,700 to 9,600 associated drivers in each of the regions.

The identifying information from MCMIS for each of the 79,244 drivers in the sample was sent to TML Information Services, Inc. in order to obtain the driver history records through CDLIS. Driver histories were requested for the three-year time period between September 1997 and September 2000. TML was able to successfully obtain history records regarding 64,711 of the drivers. Because an officer at an inspection or accident site often hand-enters the driver information contained in MCMIS, this 82 percent return rate is surprisingly good. These drivers were associated with 13,829 carriers. The range for this sample was approximately 200 carriers and 7,200 drivers from the largest size group to 4,800 carriers and 8,200 drivers from the smallest. There were between 900 and 1,600 carriers in each region, and between 2,400 and 7,800 associated drivers in each region.

For each driver, the data obtained from the driver history record included the driver's date-of-birth and state, as well as information regarding any convictions in the three-year time frame. The conviction information detailed the date of the conviction, whether or not it was a commercial vehicle offense, and the associated AAMVAnet Code Dictionary (ACD) conviction code and detail.

For each carrier, in addition to their census information such as state, number of power units and number of drivers; critical safety information was also obtained. This data included the number and type of crashes, number and type of out-of-service roadside inspections and violations, as well as the carriers' scores in each Safety Evaluation Area (SEA) of the Motor Carrier Safety Status Measurement System (SafeStat). SafeStat evaluates carriers in four areas B accidents, drivers, vehicles, and safety management. If a carrier has sufficient data in a 30-month time period to be evaluated in a SEA, they receive a score of zero to 100 in that area, with 100 being worst (*3*). The safety data for each carrier was obtained as of September 2000.

In order to test for a correlation between traffic conviction rates of drivers employed by a carrier and the carrier's safety record, a driver history measure was required for each carrier. The first step was to create a type of measure for each driver. Rather than simply summing the convictions for each driver, it was decided to weight the convictions based on severity. The CMVSA of 1986 identified certain convictions as serious offenses, and others as disqualifying offenses. An example of a serious offense would be driving more than 15 miles over the posted speed limit, while an example of a disqualifying offense would be driving under the influence of alcohol.

Therefore, the individual driver history measures were created by combining convictions in the database according to the following formula:

Driver History Measure = 3[A disqualifying offense] +2[A serious offense] +[Any other offense]

The driver history measures in the database ranged from zero (no convictions) to 49. To create the driver history measure for each carrier, the mean of all the driver history measures associated with the carrier was calculated. These carrier driver history measures ranged between zero and 27, with an average of 0.74.

Results

The initial analyses completed consisted of overall correlation analyses between the carrier driver history measure and the carrier safety-related data available. The first set of safety variables examined was the vehicle and driver roadside inspection out-of-service (OOS) rates. These are calculated by dividing the number of inspections that resulted in a vehicle (driver) being placed out-of-service by the total number of applicable inspections. OOS rates were only calculated for carriers that had at least three roadside inspections in the time period. The second set of safety variables examined was the number of crashes per power unit and the number of crashes per driver during the time period. The final set of safety variables analyzed was the carriers' score in each of the four SafeStat Safety Evaluation Areas (SEAs) as defined previously. The results of these analyses are displayed in Table 1.

These results (Table 1) indicate significant positive linear correlations between the carrier driver history measure and every safety variable examined except the crashes per driver rate. In general, the higher (worse) a carrier's driver history measure score, the higher the OOS rates, crash rates, and SEA scores of the carrier. A measure of the strength of the linear relationship between two variables is the Pearson correlation coefficient. This measure, denoted by the symbol r, can range between -1 and $+1$. When $r=0$, it implies no linear correlation. Not surprisingly, the Pearson correlation coefficients are highest with the driver OOS rate ($r=0.149$) and the driver SEA score ($r=0.188$). However, there was a high correlation with the accident SEA score as well ($r=0.175$). The SEA scores are perhaps the best safety variables to examine as several data quality and sufficiency checks are completed before the scores are assigned to the carrier.

Table 1. Overall Correlation Analysis Between the Carrier Driver History Measure and Safety Variables

	Correlation with Carrier Driver History Measure		
Carrier Safety Variable	**Sample Size**	**Pearson Correlation Coefficient**	**Significance Level**
Vehicle OOS Rate	7,991	0.043	0.0001
Driver OOS Rate	8,789	0.149	0.0001
Crashes per Power Unit Rate	12,802	0.085	0.0001
Crashes per Driver Rate	12,110	0.009	0.3208
Accident SEA	2,946	0.175	0.0001
Driver SEA	9,745	0.188	0.0001
Vehicle SEA	8,980	0.080	0.0001
Safety Management SEA	915	0.097	0.0035

The second set of analyses completed consisted of a similar correlation analysis for each size group of carriers. As above, every size group illustrated significant correlations between the carrier driver history measure and both driver OOS rates and the driver SEA scores, as well as with the crash per power unit rates. The correlations with the index and the accident SEA scores were only significant for the three largest size groups (those with 72 or more drivers). The Pearson correlation coefficients associated with the index and all four of these safety variables for the three largest size groups ranged from r=0.323 up to r=0.553.

The third set of analyses conducted was the same correlation analyses for each of the 10 regions of the country. Once again, the same significant positive correlations were found between the carrier driver history measure and driver OOS rates and driver SEA scores for carriers in each region. Significant correlations, at the 0.05 significance level, with the index and both the accident SEA scores and the crash per power unit rates were found for carriers in every region except the Deep South and Great Lakes regions.

Additional analyses were completed because there was some concern expressed regarding the way drivers were matched with carriers. The concern was that if only drivers involved in an accident or an out-of-service inspection were matched with carriers then the results might be biased. Therefore, additional data was requested to identify those drivers that were matched with carriers based only on roadside inspections with no out-of-service violations. There were 57,713 drivers associated with 13,130 carriers that matched these criteria. The overall correlation analyses for this sample of drivers and carriers are displayed in Table 2. Although the correlation coefficients are slightly lower than with the full sample, the overall results are identical, and the same significant correlations are found. Analyses completed on this sample for each size group and region also revealed similar conclusions as with the full sample.

Table 2. Correlation Analysis Between the Carrier Driver History Measure and Safety Variables for Only Those Drivers Matched with Carriers Based on Non-OOS Inspections

	Correlation with Carrier Driver History Measure		
Carrier Safety Variable	**Sample Size**	**Pearson Correlation Coefficient**	**Significance Level**
Vehicle OOS Rate	7,809	0.041	0.0003
Driver OOS Rate	8,563	0.141	0.0001
Crashes per Power Unit Rate	12,166	0.078	0.0001
Crashes per Driver Rate	11,509	0.007	0.4821
Accident SEA	2,901	0.167	0.0001
Driver SEA	9,440	0.178	0.0001
Vehicle SEA	8,730	0.076	0.0001
Safety Management SEA	899	0.093	0.0052

Conclusions and Recommendations

Based on the results described above, the overall conclusion is obvious. Linking driver conviction data to the employing motor carrier appears to serve as an indicator of those motor carrier companies that have safety problems. A carrier driver history measure created based on the average number of convictions of drivers associated with the carriers is significantly correlated with out-of-service rates, accident rates, and SEA scores. Carriers with higher (worse) driver history measures are also more likely to have higher OOS rates, accident rates, and SEA scores.

Further research is needed into exactly how this information can be used. The next phase of this study will examine integrating this data as another component of the current Safety Management SEA in SafeStat to determine if it adds more information regarding carriers already identified, as well as new information regarding carriers not identified. During this phase, other possible carrier driver history measures will be tested, and data quality and sufficiency tests will be determined. A full cost-benefit analysis will also be conducted to ensure that the benefits of this new information exceed the costs of collecting it.

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