A Firm Size and Safety Performance Profile of the U.S. Motor Carrier Industry

Final Report
December 2014

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16. Abstract
The purpose of this study was the development of a driver-focused truck crash prediction model with a particular focus on the size of the carrier that the driver is associated with at the time of a state reportable crash. While previous studies have shown that the characteristics of the driver affect driver involvement in reportable crashes, scant attention has been paid to how the size of the carrier affects crash rates. Generally speaking, smaller carriers do not have the resources to invest in monitoring and implementing sound safety practices to ensure safe operations in the U.S. motor carrier industry. This represents a significant problem because the majority of carriers in the industry are small carriers. This study seeks to enhance the understanding of how the characteristics of carriers contribute to driver involvement in state reportable crashes.

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1. INTRODUCTION

Large commercial truck crashes remain a topic of serious concern in many communities, including in the State of Iowa. For example, on a highway in western Iowa near Omaha, Nebraska, two people were critically injured when a semi-trailer collided with a pickup truck (Withrow 2014). Similarly, while driving on Interstate 80 in Jasper County, Iowa, a commercial truck driver lost control of his vehicle, veered into a median, and crashed into a bridge. The commercial driver was pronounced dead at the scene. These and many other unfortunate situations highlight the need to continue to explore the factors contributing to commercial vehicle truck crashes.

Indeed, as Cantor et al. (2013) point out, safety is a critically important issue in the trucking industry. While the U.S. Department of Transportation (DOT) continues to promote truck safety policies and practices, 1.2 large trucks were involved in fatal crashes per 100 million vehicle miles traveled (VMT) in 2010 (FMCSA 2012; US DOT 2012), and the truck injury crash rate was 20.3 large trucks involved in injury crashes per 100 million VMT in 2010 (FMCSA 2012). These statistics illustrate the need to make further progress on the safety performance of motor carriers.

The purpose of this study is to present a profile of the relationship among firm size and safety performance of firms in the U.S. motor carrier industry. A shortcoming in the motor carrier literature is the development of a truck crash prediction model with a particular focus on the size of the carrier. A firm size safety model is needed so that the Federal Motor Carrier Safety Administration (FMCSA) can continue to target the carriers who most seriously violate U.S. DOT rules and regulations (FMCSA 2014a). We seek to fill this void in the literature by documenting some of these relationships.

This report is organized as follows. Chapter 2 focuses on a literature review of previous motor carrier research with a particular emphasis on firm size and safety studies. Chapter 3 describes the data collected and methodology employed to examine the firm size and safety performance relationship. We discuss the preliminary findings of our study in Chapter 4. In particular, we provide a mostly descriptive analysis of the relationships that are derived from our construction of a comprehensive safety database. In Chapter 4, we also present a preliminary multivariate regression analysis of several firm characteristics and safety performance. We discuss the implications of our findings and proposed next steps in Chapter 5.

2. LITERATURE REVIEW

There is a substantial amount of motor carrier safety management research that focuses on firm-level factors. Common firm-level motor carrier safety management factors include recruiting methods (Gupta et al. 1996, Min and Lambert 2002, Suzuki et al. 2009), conditions of motor carrier equipment (Rodriguez and Griffen 1990), technology adoption practices (Cantor et al. 2006, 2008, 2009), compensation (Rodriguez and Griffen 1990, LeMay et al. 1993, Richard et al. 1995), and the role of dispatchers (Richard et al. 1995, Gupta et al. 1996, Stephenson and Fox 1996, Keller and Ozment 1999, Keller 2002, Suzuki et al. 2009).

Within the purview of motor carrier safety performance, Corsi et al. (2012) find that unionized carriers will have a positive effect on carrier safety performance because of the provision of safety and health provisions in unionization agreements. Additionally, Cantor et al. (2009) examined and found that electronic logbooks have a positive effect on safety performance. Miller et al. (2013) and Saldanha et al. (2014) point out that there are certain conditions in which it is appropriate for firms to use formal controls such as technology to monitor driver behavior.

It is also important to note that previous motor carrier safety management research has also examined driver-level factors that affect firm safety outcomes. Some of this research includes an examination of driver characteristics (e.g., owner-operator versus company driver), employment stability, and past safety behavior (Cantor et al. 2013 and 2010, Cantor and Terle 2010), driver recruitment and retention practices (LeMay et al. 1993, Stephenson and Fox 1996, Keller and Ozment 1999, Keller 2002), driver training (Mejza and Corsi 1999, Mejza et al. 2003), reducing truck speed (Campbell 1995), use of technology (Cantor et al. 2006, 2008, 2009), and enforcement of hours of service (HOS) rules (Crum and Morrow 2002, Saltzman and Belzer 2002, Cantor et al. 2009). Lastly, Swartz and Douglas (2009) examine owner-operators' perceptions of carrier safety climate to examine an independent driver's intention to engage in potentially unsafe driving behavior.

While the literature documents several other related efforts to improve safety performance, it remains critically important to further examine additional firm-level factors that affect safety performance in the U.S. motor carrier industry. Indeed, according to the American Trucking Associations, the trucking industry continues to serve a vital role in the movement of over nine billion tons of freight on an annual basis. Unfortunately, as alluded to earlier, large commercial trucks and buses average around 125,000 crashes per year. Moreover, the FMCSA continues to seek improvements to the monitoring, management, and enforcement of safety rules and regulations. Given the dynamic changes in the regulatory environment, the constant flow of entry and exit into this industry, and the changes in firm-level safety practices, it is important to continuously examine how firm-level factors affect safety practices in the U.S. motor carrier industry. In this regard, this study seeks to fill this void in the literature.

3. DATA AND METHODOLOGY

Since the purpose of this study is to present a profile of the relationship between firm size and safety performance for firms in the U.S. motor carrier industry, a commercial carrier safety database was constructed. Specifically, in June 2014, FMCSA's Motor Carrier Management Information Systems (MCMIS) and Safety Measurement System (SMS) data were derived from Volpe, The National Transportation Systems Center (Volpe). From its Oracle database, Volpe provided safety and motor carrier census data across more than 30 Oracle relational tables. Based on the purpose of this study, the research team focused on Oracle tables that contained MCMIS and the FMCSA's Compliance Safety Analysis 2010 (CSA 2010) data. This section of the report will provide specific details of the data used for the safety profile analysis.

Sample

The sample included all interstate motor carriers in the FMCSA's MCMIS and the FMCSA's CSA 2010 databases as of June 2014. The total number of firms in the database is approximately 462,725 for which complete data is available for all the variables in the models presented below.

The dependent variables in our analysis are a series of safety performance indicators derived from the FMCSA's CSA 2010 databases. These variables are derived from the SMS methodology developed as part of the CSA 2010 project (Volpe National Transportation Systems Center 2008).

The SMS relies on information collected from the following comprehensive data sets: (1) commercial vehicle crash data, reported by states to FMCSA; (2) data collected from individual compliance reviews; (3) data from roadside inspections including violations; (4) data from closed enforcement cases; and (5) MCMIS Census File data on individual carriers, including their type of operations and fleet size.

Safety Performance Measures

We first describe our dependent variables. First, the commercial driver out-of-service (OOS) rate is defined as the drivers' out-of-service violations divided by total driver inspections. Next, the commercial vehicle OOS rate is defined as the vehicles' out-of-service violations divided by total vehicle inspections. Crash total is defined as the total number crashes that the firm was involved in. Crash rate is defined as the total number of crashes divided by the firm's number of power units. Similarly, crash miles are the total number of crash involvements divided by the total number of vehicle miles traveled.

We now turn to describing the firm's safety performance data derived from the SMS database. We will focus on the following seven Behavior Analysis Safety Improvement Category (BASIC) measure scores associated with carriers in our sample. Our first safety BASIC variable is unsafe driving, which is the rating a firm receives when operating a commercial motor vehicle (CMV) dangerously or carelessly. Our next BASIC is HOS, which is the rating that measures when a firm operates a CMV with drivers who are ill, fatigued, or in non-compliance with the HOS regulations. The third BASIC variable is the firm's driver fitness score, which is a rating of the firm's CMV drivers who are unfit to operate a CMV due to lack of training, experience, or medical qualifications. Next, the vehicle maintenance BASIC rates the firm's vehicle failure rate as reflected by improper or inadequate maintenance. The controlled substances/alcohol BASIC score rates the firm's drivers who use or are in possession of controlled substances and alcohol. Next, the hazardous materials (HAZMAT) and compliance rating BASIC indicates the firm's compliance to regulations regarding leaking containers, improper packaging, and placard placement issues. Lastly, the carrier's crash BASIC rating reflects the firm's histories of crash involvement.

Carrier Characteristics Measures

We now turn to discussing the independent variables in our model. Our independent variables mainly assess the carrier's characteristics. First, firm size is defined as the firm's total number of power units. Because firms in the industry are very small, we operationalized firm size as a categorical variable in our mean difference analysis. Stated otherwise, we classified firm size across 12 distinct groups, as shown in Table 1.

The next independent factor in our model is the commodity segment in which the firm participates. There are 30 commodity segments that are reported in our motor carrier database. We focus our analysis on the top 11 of the commodity segments that exhibit the most participation among the carriers in our database. We discuss this issue in more detail in Commodity Segments and Safety Performance in Chapter 4.

Our next independent variable in our model is fleet ownership. Fleet ownership was first operationalized by the ratio of owned straight trucks, tractors, and trailers to total owned and leased straight trucks, tractors, and trailers. We then transformed fleet ownership into a discrete variable (Fleet Ownership) based on the percentage of owned equipment into quartiles (i.e., four distinct categories).

We present our preliminary findings in Chapter 4.

4. PRELIMINARY FINDINGS

Firm Size

The analysis begins by examining firm safety performance across discrete categories of firm size. We classified firm size across 12 distinct groups, as shown in Table 1. Please note that the predominant number of firms in our sample is in the discrete firm size groups 1 and 2.

Table 1. Firm size definition

Firm Size Category	Definition (in Power Units)	Number of Firms
1	1	778,367
2	2 to 5	455,488
3	6 to 10	78,704
4	11 to 20	39,295
5	21 to 30	12,066
6	31 to 40	5,822
7	41 to 50	3,539
8	51 to 60	2,151
9	61 to 70	1,502
10	71 to 80	1,141
11	81 to 90	888
12	91 and above	5,560

Driver Out-of-Service Rates

We now analyze the driver out-of-service violation rate patterns by firm size. As previously mentioned, driver out-of-service rate is defined as the drivers' out-of-service violations divided by total driver inspections. Figure 1 clearly demonstrates that there is a downward trend in driver out-of-service rates as firm size increases.

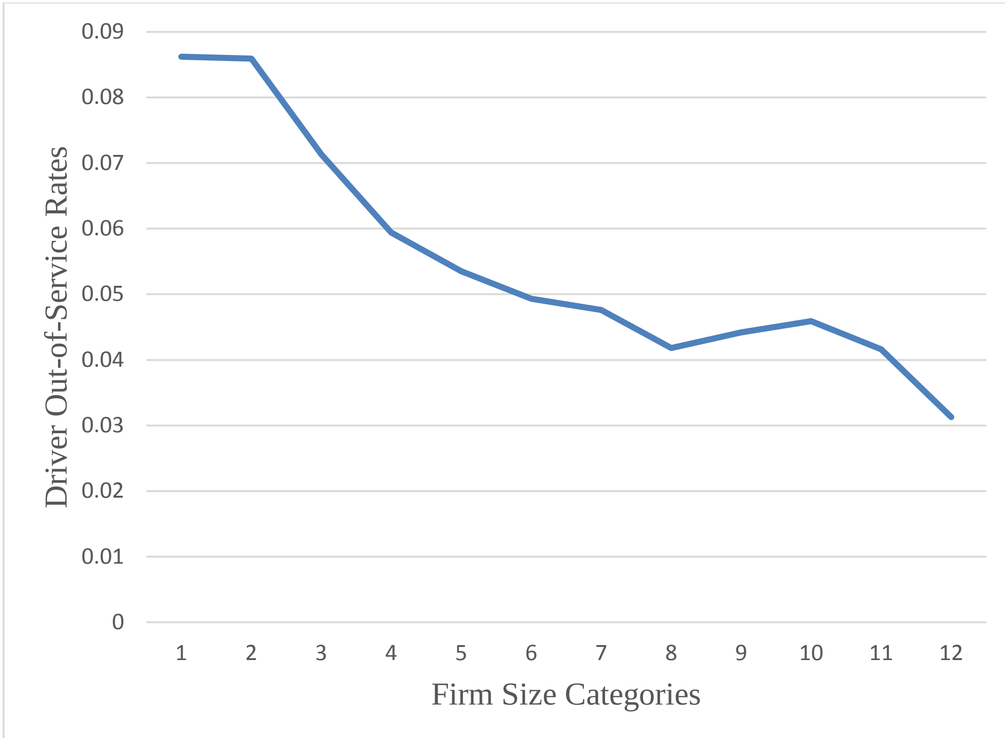

Figure 1. Firm size and driver out-of-service rates

This finding is further borne out through our analysis of variance (ANOVA) regression analysis presented in Table 9 in the appendix; all of the mean differences tables are included in the appendix. As shown in Table 9, the mean driver out-of-service rate of our smallest firm size group is 0.0862, and the mean driver out-of-service rate of our largest firm size group is 0.0313. Collectively, our results show that as firm size increases, driver out-of-service rates decline.

Vehicle Out-of-Service Rates

We now turn to examining vehicle out-of-service violation rate patterns by firm size. These patterns are similar to the driver out-of-service violation rate patterns discussed above. As previously mentioned, vehicle out-of-service rate is defined as the vehicle out-of-service violations divided by total vehicle inspections. Figure 2 shows that there is a downward trend in vehicle out-of-service rates as firm size increases. This finding is further substantiated in the ANOVA regression analysis presented in Table 9 (presented in the appendix). The mean vehicle out-of-service rate of our smallest firm size group is 0.2740, and the mean vehicle out-of-service rate of our largest firm size group is 0.1531. Our mean value results show that as firm size increases, vehicle out-of-service rates decline.

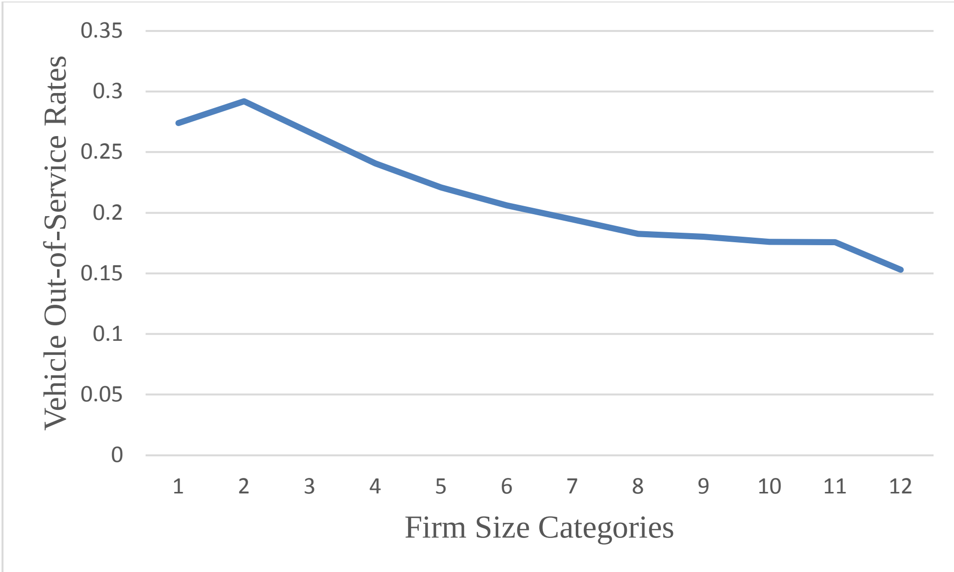

Figure 2. Firm size and vehicle out-of-service rates

Crash Rates

Our analysis also involves evaluating how firm size is related to crash rates. We examined two measures of crash rates, namely crashes divided by power units and crashes divided by annual miles travelled. Both crash measures account for the firm's level of exposure to motor crash involvement. There is an upward trend in crash rates as firm size increases, as illustrated in Figures 3 and 4. There is further evidence of this relationship in the ANOVA regression analysis presented in Table 10 in the appendix. As shown in Table 10, there is some evidence that as firm size increases, crash rates increase (e.g., group 1 mean crash rate = 0.0218, group 12 mean crash rate = 0.0366). We will discuss this finding in more detail in the discussion section.

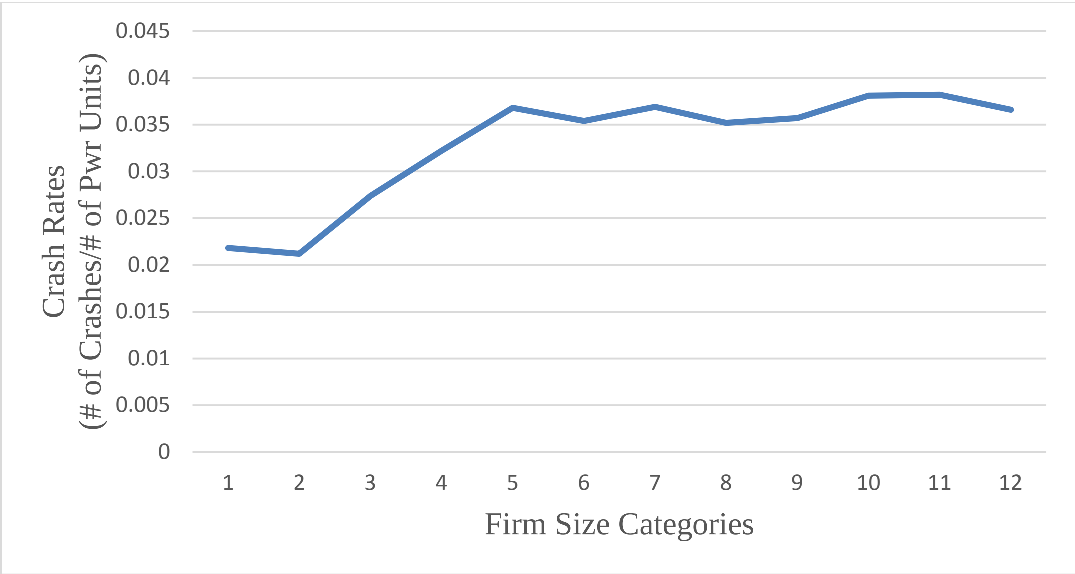

Figure 3. Firm size and crash rates by power units

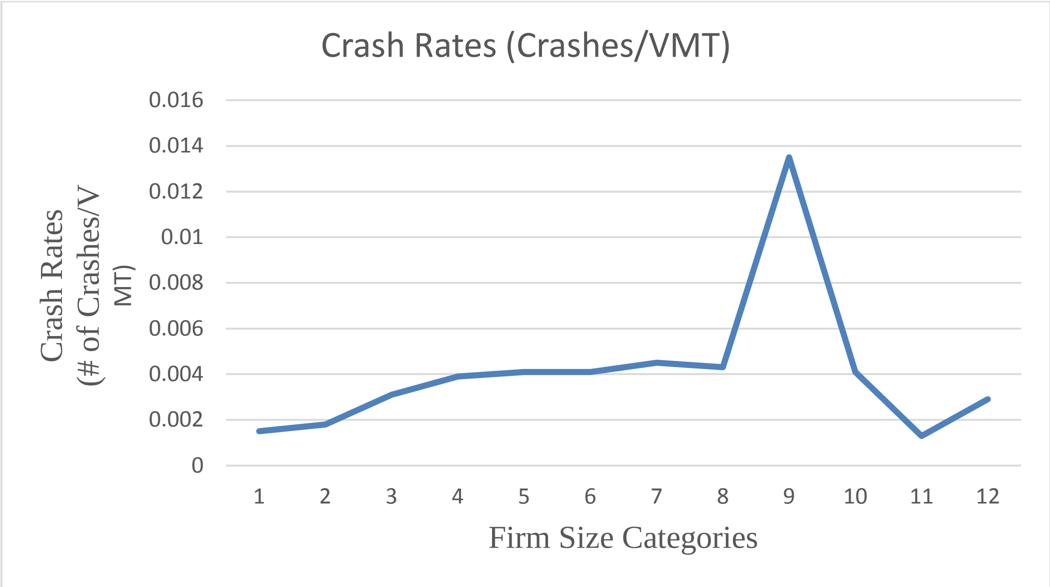

Figure 4. Firm size and crash rates by annual VMT

Behavior Analysis and Safety Improvement Categories (BASICs)

We now focus our analysis on how firm size is related to each of the seven BASICs. Briefly, the FMCSA Compliance, Safety, Accountability (CSA) program leverages data from the SMS to evaluate data from roadside inspections and crash reports. Carriers are then grouped into the BASIC with other carriers that have a similar safety profile, and then the SMS ranks carriers accordingly (FMCSA 2014b). For the purpose of our preliminary analysis, we will focus on the CSA measure scores. Our first discussion will be on the HOS compliance BASIC.

There is a pronounced downward trend in the HOS measure BASIC as firm size increases, as illustrated in Figure 5.

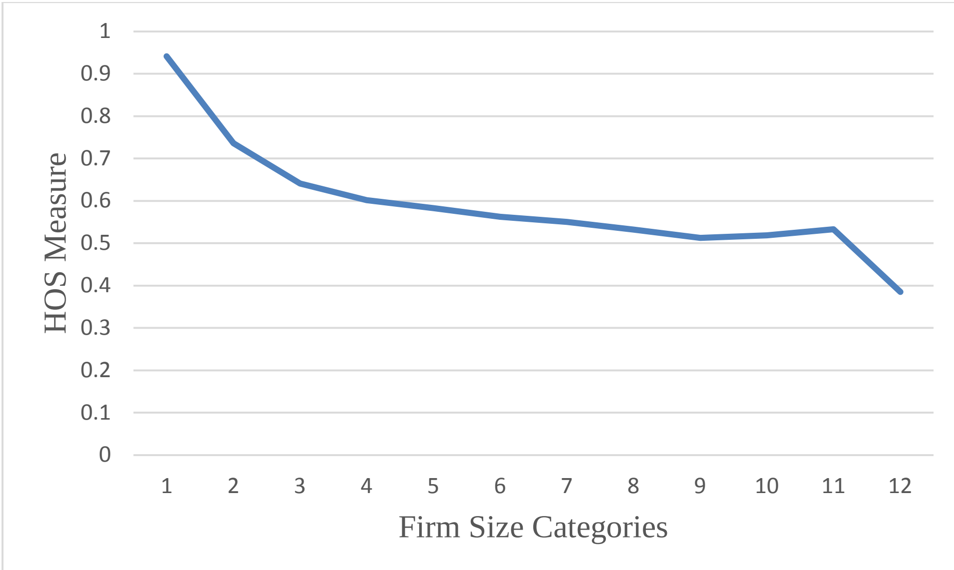

Figure 5. Firm size and HOS measure

As shown in Table 11 in the appendix, there appears to be a dramatic change in the performance of large carriers (group 12 mean = 0.3853) as compared to the smallest carriers in this sample (group 1 mean = 0.9411). We also analyzed the relationship of firm size as it relates to the driver fitness BASIC. We found no statistically significant relationships. We discovered a similar non–statistically significant finding in the controlled substances/alcohol BASIC (Table 12).

Next, we explored the relationship of firm size to the vehicle maintenance BASIC as reflected in the graph in Figure 6.

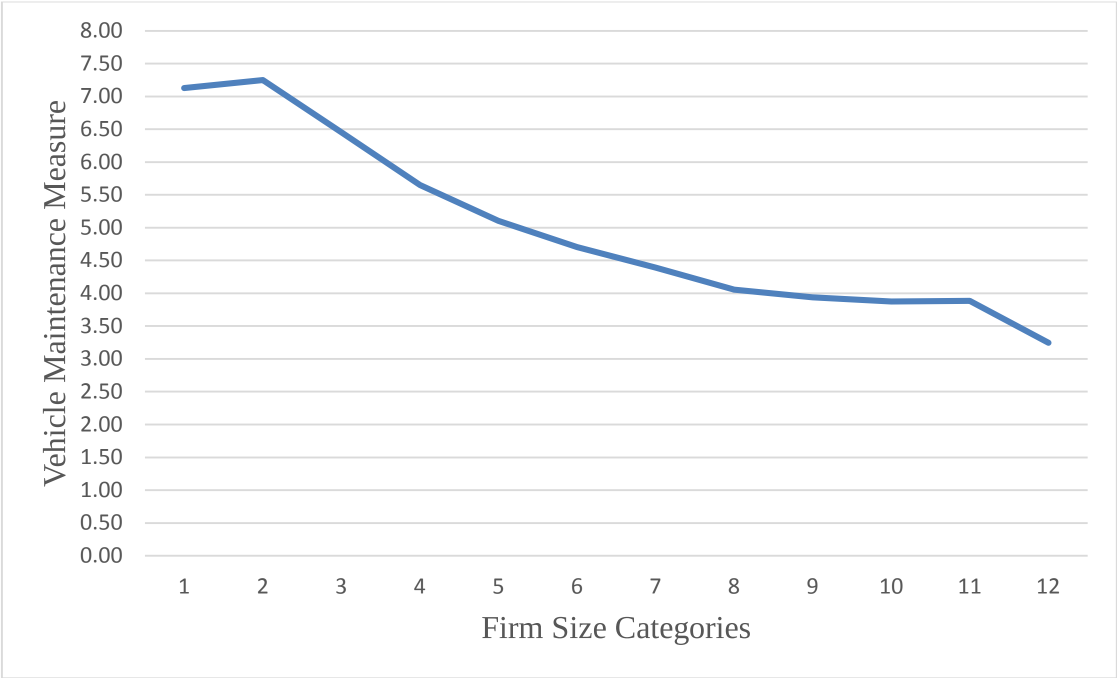

Figure 6. Firm size and vehicle maintenance measure

There is a pronounced downward trend in the vehicle maintenance measure BASIC as firm size increases. We also ran an ANOVA regression analysis on the vehicle maintenance BASIC (Table 12 in the appendix). We discovered statistically significant differences in several firm size discrete groups. For example, the smallest firm size group has a mean value of 7.1273. The largest firm size group has a mean value of 3.2458. These mean differences are statistically significant. We also discovered that there is some evidence that firm size matters in the hazardous materials compliance BASIC. As shown in Table 13 in the appendix, the smallest group has a mean value of 2.6786 whereas the largest firm size group has a mean value of 1.7417.

Lastly, in Figure 7, we noticed a similar firm size and safety performance trend in the crash indicator BASIC. As firm size increases, the crash indicator improves (group 1 mean = 2.3783; group 12 mean = 0.0986).

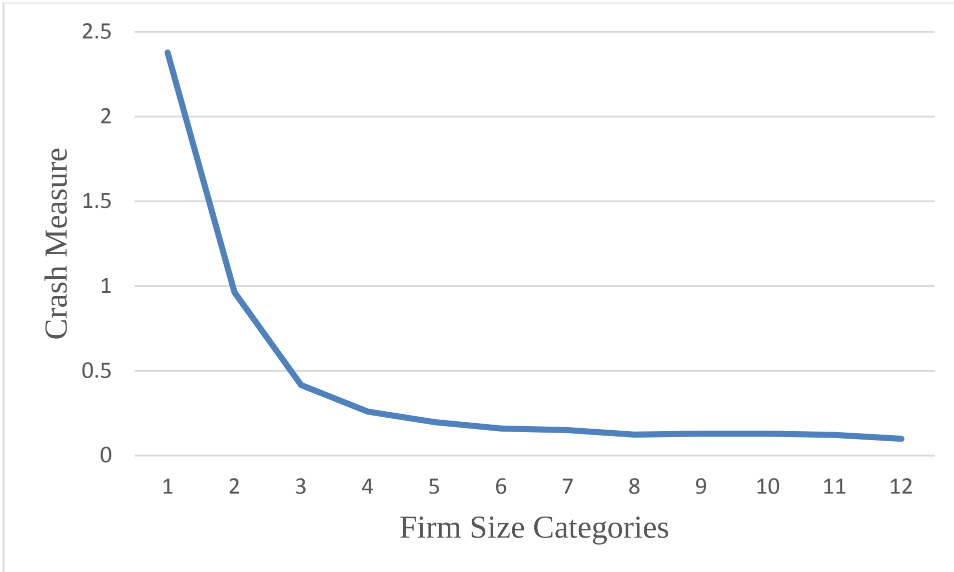

Figure 7. Firm size and crash measure

Commodity Segments and Safety Performance

We now turn to examining several of the U.S. motor carrier commodity segment categories. There are 30 commodity segments that are reported in our motor carrier database. As shown in Table 2, the top 11 of the commodity segments exhibit the most participation among the carriers in our database.

Table 2. Commodity segment representation in dataset

No.	Commodity Segment	Mean*	Min	Max
1	General Freight	0.3011211	0	1
2	Other	0.2927966	0	1
3	Construction	0.1715595	0	1
4	Building Materials	0.1672466	0	1
5	Machinery	0.1615759	0	1
6	Grain, Feed, Hay	0.1239198	0	1
7	Logs, Poles, Beams, Lumber	0.1106277	0	1
8	Motor Vehicles	0.0846821	0	1
9	Farm Supplies	0.0788406	0	1
10	Metal, Sheets, Coils, Rolls	0.0690926	0	1
11	Fresh Produce	0.0672155	0	1
12	Paper Products	0.0553195	0	1
13	Refrigerated Food	0.0529881	0	1
14	Commodities Dry Bulk	0.052014	0	1
15	Livestock	0.0467798	0	1
16	Household Goods	0.039366	0	1
17	Garbage, Refuse, Trash	0.0393639	0	1
18	Beverages	0.0368978	0	1
19	Passengers	0.0309879	0	1
20	Drive away/towaway	0.0293873	0	1
21	Liquids/Gases	0.0269649	0	1
22	Meat	0.026354	0	1
23	Oil Field Equipment	0.0224588	0	1
24	Utility	0.0205549	0	1
25	Intermodal Containers	0.0150111	0	1
26	Chemicals	0.0149067	0	1
27	U.S. Mail	0.0110587	0	1
28	Coal, Coke	0.0099688	0	1
29	Mobile Homes	0.0078046	0	1
30	Water Well	0.0076135	0	1

* Percent participation of carriers in that commodity segment group

Additionally, several of our carriers participate in multiple commodity segments, as shown in Table 3.

Table 3. Number of firms participating in multiple commodity segments

Total Commodity Segments	Number of Firms Participating
1	770,087
2	296,653
3	144,592
4	73,478
5	42,083
6	28,175
7	18,161
8	11,955
9	8,446
10	6,076
11	4,517
12	3,301
13	2,366
14	1,852
15	1,373
16	1,035
17	826
18	620
19	448
20	380
21	273
22	237
23	178
24	161
25	122
26	77
27	65
28	52
29	27
30	3

Our analysis focuses on the 11 most active commodity areas.

We now focus our analysis on how several of the U.S. motor carrier commodity segment categories are related to safety performance. We will examine the driver and vehicle out-of-service rates first and then each of the seven BASICs.

As shown in Table 14 in the appendix, 42 out of 56 driver out-of-service rate mean differences are statistically significant across the commodity segment areas. Some of the largest mean differences exist between commodity areas Motor Vehicles and Logs, Poles, Beams, Lumber; Metal, Sheets, Coils, Rolls and Motor Vehicles; and finally Logs, Poles, Beams, Lumber and Fresh Produce. We find similar findings in 48 out of 55 vehicle out-of-service rate commodity segment mean difference areas (Table 14). For example, we find in the vehicle OOS rate area that commodity areas General Freight and Logs, Poles, Beams, Lumber and General Freight and Machinery, Large Objects exhibit statistically significant mean differences.

Our analysis now turns to the seven BASICs and the relationship to commodity segment areas. First, we examine the unsafe driving BASIC. Shown in Table 15 in the appendix, the Machinery, Large Objects and Refrigerated Food; Machinery, Large Objects and Paper Products; and Refrigerated Food and Construction commodity areas exhibit the strongest highly statistically significant differences.

Turning to the HOS BASIC, we find that the Logs, Poles, Beams, Lumber and Refrigerated Food; Refrigerated Food and Construction; and Logs, Poles, Beams, Lumber and Fresh Produce commodity areas show strong statistically significant differences in the HOS measure BASIC. In the driver fitness BASIC (Table 16 in the appendix), the commodity areas that exhibit the greatest mean differences are the Refrigerated Food and Construction and Paper Products and Construction commodity areas. As shown in the controlled substances/alcohol BASIC, none of the commodity areas exhibit statistically significant differences.

In the vehicle maintenance BASIC results (Table 17 in the appendix), we find that the commodity areas with the strongest mean differences are the Motor Vehicles; Logs, Poles, Beams, Lumber; Refrigerated Food; and Paper Product segments. Unsurprisingly, in the hazmat BASIC area, the Logs, Poles, Beams, Lumber commodity area exhibited the best safety performance areas as compared to many of the other commodity segments.

In the crash BASIC performance area (Table 18 in the appendix), we find that the Logs, Poles, Beams, Lumber commodity area had the lowest crash measure scores as compared to the other commodity areas.

Ownership/Equipment Profile

This part of the analysis begins by examining firm safety performance across discrete categories of fleet ownership. We classified fleet ownership groups across four distinct quartile categories, as shown in Table 4.

Table 4. Tractor and trailer ownership profile

Fleet Ownership Group	Number of Firms	Percent
1	116,019	8.56
2	484,046	35.7
3	119,805	8.84
4	636,127	46.91

For example, ownership group 1 represents those firms where percent tractor or trailer ownership is between 0 and 25 percent; ownership group 2 contains those firms where percent tractor or trailer ownership is greater than 25 percent or less than or equal to 50 percent. Please note that the predominant number of firms in our sample is in discrete ownership groups 2 and 4.

We now analyze how the fleet ownership categories are related to safety performance. Similar to the previous discussion, we will examine the driver and vehicle out-of-service rates and then each of the seven BASICs.

As shown in Table 19 in the appendix, all fleet ownership categories exhibit statistically significant mean differences on driver out-of-service rates except for the group 2 (25 to 50 percent) versus group 4 (75 to 100 percent) fleet ownership categories. Generally speaking, up until a certain level of fleet ownership, our results show that as fleet ownership increases, safety performance decreases. We find similar findings in the vehicle out-of-service rate analysis. With regards to vehicle out-of-service rates, all mean differences are statistically significant. Further, when one takes a detailed examination of the fleet ownership group 2 versus 3 and group 3 versus 4 categories, as fleet size increases, vehicle out-of-service rates decline. This is a more pronounced finding as compared to the driver OOS rate analysis. Finally, as fleet ownership increases, crash rates decrease.

We now turn to examining the relationship between fleet ownership and the unsafe driving BASIC. As reflected in Table 19, all mean differences are statistically significant. In four of the size fleet ownership groups, as fleet ownership increases, safety performance improves. However, in the two extreme groups (groups 1 versus 2; and groups 3 versus 4), as fleet ownership increases, safety performance becomes worse.

Turning to the next BASIC, HOS, except for group 1 versus 2, we find that as fleet ownership increases, safety performance improves. All mean differences are statistically significant in the HOS BASIC category.

We now examine the vehicle maintenance BASIC. Somewhat surprisingly, we find that as fleet ownership increases up until a certain point, safety performance becomes worse. However, when fleet ownership moves from the group 2 versus 4 and group 3 versus 4 ownership categories, firm safety performance improves. In this analysis, mean differences are statistically significant.

In the driver fitness BASIC, we find that all mean differences are statistically significant. We also note that as fleet ownership increases, firm safety performance becomes worse, except when comparing fleet ownership group 3 versus 4. Unsurprisingly, we do not find any statistically significant mean differences in the controlled substances/alcohol BASIC.

Next, we turn to the hazmat BASIC analysis. In four of the size mean difference groups, we find that as percent ownership increases, hazmat BASIC performance becomes worse. In the two most extreme mean difference cases, as percent ownership increases, hazmat BASIC performance improves. All mean differences are statistically significant.

Lastly, we analyze and compare fleet ownership with our three different measures of crash performance. Regarding the crash BASIC, we do not find a consistent pattern across percent fleet ownership and safety performance. Turning to the percent fleet ownership and two alternative measures of crash performance, we generally find that as fleet ownership increases, crash performance decreases.

Ordinary Least Squares (OLS) Regression Analysis

Our next preliminary analysis involves the development of a multivariate model. The ordinary least squares (OLS) model examines each of the factors described simultaneously on the safety performance measures contained in the motor carrier database. We discuss each of these models below.

As shown in the OLS regression model results in Table 5, as fleet ownership increases relative to the base case (fleet ownership group 1), safety performance decreases in the driver out-of-service rate and vehicle out-of-service rate models. In Model C (crash rate), as fleet ownership increases, firms become involved in fewer crashes. Interestingly, we also find that as firm size increases (as measured by number of power units), safety performance improves, as reflected by the negative beta coefficient. We also find that there are safety performance differences across several of the top commodity segments in our models.

Table 5. OLS regression models A, B, and C

	Driver OOS Rate (Model A)	Vehicle OOS Rate (Model B)	Crash RATE (Model C)
Fleet Ownership Group 2	0.009 (0.001)**	0.080 (0.002)**	0.004 (0.000)**
Fleet Ownership Group 3	0.009 (0.001)**	0.094 (0.002)**	-0.007 (0.001)**
Fleet Ownership Group 4	0.003 (0.001)**	0.037 (0.002)**	-0.009 (0.000)**
Firm Size	-0.007 (0.001)**	-0.013 (0.002)**	0.001 (0.001)
General Freight	-0.003 (0.001)**	-0.044 (0.001)**	0.012 (0.000)**
Metal	-0.003 (0.001)**	-0.019 (0.002)**	0.004 (0.001)**
Motor Vehicles	0.023 (0.001)**	0.013 (0.002)**	-0.001 (0.000)**
Logs	-0.022 (0.001)**	0.032 (0.002)**	0.004 (0.000)**
Building Materials	0.005 (0.001)**	0.019 (0.002)**	-0.005 (0.000)**
Machinery	0.004 (0.001)**	0.060 (0.002)**	-0.006 (0.000)**
Fresh Produce	0.006 (0.001)**	-0.008 (0.002)**	0.003 (0.001)**
Grain	-0.020 (0.001)**	-0.032 (0.002)**	-0.004 (0.000)**
Refrigerated	-0.001 (0.002)	-0.034 (0.003)**	0.014 (0.001)**
Paper Products	-0.012 (0.001)**	-0.036 (0.002)**	0.004 (0.001)**
Constant	0.078 (0.001)**	0.226 (0.002)**	0.023 (0.000)**
R^2	0.00	0.02	0.01
N	462,725	421,862	1,380,764

Note: Standard errors in parentheses. * $p<0.05$; ** $p<0.01$

Turning to the OLS regression model results in Table 6, we begin to examine how each of the carrier characteristics affects firm safety performance using the BASICs as the dependent variables of interest. Similar to the findings in Models A and B discussed above, as fleet ownership increases, the firm's unsafe driving and HOS BASIC measures improve. However, in Model F we find that as firm ownership increases, the firm's driver fitness BASIC measure score becomes worse. Across Models D through F, we find that as firm size increases, firm safety performance improves. Consistent with the findings above, there is variation in the safety performance across commodity segment areas.

Table 6. OLS regression models D, E, and F

	Unsafe BASIC (Model D)	**HOS BASIC (Model E)**	**Driver Fitness BASIC (Model F)**
Fleet Ownership Group 2	0.243 (0.025)**	0.177 (0.009)**	0.058 (0.008)**
Fleet Ownership Group 3	-0.701 (0.032)**	-0.153 (0.012)**	0.206 (0.010)**
Fleet Ownership Group 4	-0.193 (0.025)**	-0.276 (0.009)**	0.197 (0.008)**
Firm Size	-0.168 (0.033)**	-0.066 (0.012)**	-0.039 (0.011)**
General Freight	0.548 (0.017)**	0.475 (0.006)**	-0.175 (0.005)**
Metal	0.009 (0.031)	0.102 (0.011)**	-0.046 (0.010)**
Motor Vehicles	0.189 (0.028)**	0.372 (0.010)**	-0.000 (0.009)
Logs	0.080 (0.026)**	-0.253 (0.009)**	-0.109 (0.008)**
Building Materials	-0.196 (0.022)**	-0.079 (0.008)**	0.084 (0.007)**
Machinery	-0.536 (0.022)**	-0.152 (0.008)**	0.100 (0.007)**
Fresh Produce	0.254 (0.035)**	0.178 (0.013)**	0.029 (0.011)**
Grain	0.182 (0.025)**	-0.014 (0.009)	-0.139 (0.008)**
Refrigerated	0.439 (0.037)**	0.239 (0.013)**	-0.136 (0.012)**
Paper Products	0.058 (0.032)	-0.052 (0.012)**	-0.084 (0.010)**
Constant	1.833 (0.023)**	0.671 (0.008)**	0.427 (0.007)**
R^2	0.01	0.04	0.01
N	462,619	462,725	462,725

Note: Standard errors in parentheses.* $p<0.05$; ** $p<0.01$

Our last set of OLS regression analyses are discussed next (Table 7). Contrary to our earlier findings, as fleet ownership increases, safety performance as reflected in the BASIC measure scores does not improve. Rather, in Model G there is no statistical relationship between fleet ownership and the controlled substances/alcohol BASIC. In Models H and I, as fleet ownership increases, safety performance becomes worse. In Model J, it is only in fleet ownership group 3 that firms attain improved safety performance compared to the base case. In Models H and J, similar to the earlier models, as firm size increases, safety performance improves.

Table 7. OLS regression models G, H, I, and J

	Controlled Substances BASIC (Model G)	Vehicle BASIC (Model H)	Hazardous Materials BASIC (Model I)	Crash Indicator BASIC (Model J)
Fleet Ownership Group 2	0.000 (0.001)	2.240 (0.034)**	0.404 (0.096)**	0.533 (0.012)**
Fleet Ownership Group 3	-0.000 (0.002)	2.118 (0.044)**	0.465 (0.110)**	-0.074 (0.015)**
Fleet Ownership Group 4	-0.000 (0.001)	1.190 (0.035)**	0.044 (0.085)	0.476 (0.013)**
Firm Size	-0.001 (0.002)	-0.405 (0.045)**	-0.060 (0.034)	-0.087 (0.008)**
General Freight	-0.002 (0.001)*	-0.457 (0.024)**	-0.462 (0.081)**	0.103 (0.009)**
Metal	-0.003 (0.002)	-0.642 (0.043)**	-0.626 (0.156)**	-0.098 (0.016)**
Motor Vehicles	0.001 (0.001)	-0.723 (0.039)**	-0.119 (0.180)	0.047 (0.016)**
Logs	-0.002 (0.001)	1.070 (0.036)**	1.224 (0.167)**	0.159 (0.014)**
Building Materials	0.002 (0.001)	0.010 (0.031)	-0.197 (0.127)	-0.076 (0.013)**
Machinery	-0.000 (0.001)	0.469 (0.030)**	1.406 (0.099)**	-0.235 (0.012)**
Fresh Produce	-0.001 (0.002)	0.159 (0.049)**	-0.196 (0.237)	0.117 (0.018)**
Grain	-0.004 (0.001)**	0.100 (0.036)**	-0.403 (0.135)**	0.051 (0.013)**
Refrigerated	0.001 (0.002)	-0.629 (0.051)**	-0.227 (0.223)	-0.124 (0.018)**
Paper Products	-0.003 (0.002)	-0.696 (0.044)**	-0.440 (0.147)**	-0.162 (0.015)**
Constant	0.014 (0.001)**	5.445 (0.032)**	2.183 (0.071)**	0.560 (0.011)**
R^2	0.00	0.02	0.02	0.06
N	462,725	421,862	18,936	79,948

Note: Standard errors in parentheses. * p<0.05; ** p<0.01

We now turn to discuss the study's key findings and potential managerial public policy implications. We will also discuss preliminary future research plans.

5. DISCUSSION, FUTURE RESEARCH PLANS, AND CONCLUSION

Summary of Findings

The purpose of this study was to present a profile of the relationship between firm size and safety performance for firms in the U.S. motor carrier industry. As mentioned earlier, previous research has not developed a truck crash prediction model with a particular focus on the size of the carrier. Because there are challenges associated with monitoring the safety performance of carriers in the industry, the FMCSA can benefit from a firm size safety prediction model that can facilitate the targeting of the carriers who most seriously violate U.S. DOT rules and regulations. We seek to fill this void in the literature by documenting these relationships.

Motor carrier crashes continue to present a societal and public policy problem. We described a few recent examples of how motor carrier crashes result in the loss of life and injury to those involved in these unfortunate situations. To the extent that we can shed light on some of the factors that contribute to motor carrier crashes, we hope to provide insight into how motor carrier firms, employees, and public policy officials can implement changes to mitigate these safety issues.

With this goal in mind, we developed a unique database of motor carrier firms based on the latest available data at the time of this study. The firm safety database was derived from the U.S. DOT's Volpe research center. The database provides a rich source of information on several carrier characteristics as well as safety performance metrics. Our analysis presented above documents very insightful patterns about how firm characteristics affect safety performance. The analysis describes means difference patterns and a multivariate statistical analysis.

Our first finding is that the U.S. motor carrier industry continues to be dominated by very small firms. Over 700,000 firms in the U.S. motor carrier industry contain one power unit. This trend reflects how the barrier to entry into the industry remains very low and how presumably the industry is attractive to new motor carrier entrants, including independent owner-operators. Figures 1 and 2 graphically demonstrate how firm size represents an important resource in the industry. Larger firms are involved in fewer driver and vehicle out-of-service violations than smaller firms. This finding is further borne out by our multivariate models. Surprisingly, as depicted in Figure 3, we discovered that as firm size increases, crash rates increase. This finding needs to be further explored because we discovered in Figure 4 that firm size contributes to higher crash rates up until a certain peak. Moreover, in Figure 7 we found an inverse relationship. It is quite plausible that there is a curvilinear relationship between firm size and crash rates.

We now turn to discussing our findings relative to the firm size and BASIC safety performance. As shown in Figures 5, 6, and 7, there is an inverse relationship between firm size and the HOS, vehicle maintenance, and crash BASIC measures. This finding is further demonstrated in several multivariate models (Models D, E, F, H, and J). Firm resources are important to motor carriers that recognize the critical importance of safety performance. We believe that larger firms can leverage the financial resources to invest in safety practices and technologies necessary for the monitoring, management, and enforcement of sound safety behavior.

The next important determinant that we explored in this research study is the relationship between commodity segments and safety performance. Stated otherwise, there are several competitive market segments in the U.S. motor carrier industry. We explored the extent to which firm participation in competitive markets (i.e., commodity segments) contributes to firm safety performance. Our first finding is that several of our carriers participate in multiple commodity segments, as shown in Table 3. We focused our analysis on 11 of the most active commodity areas.

We found that there is substantial evidence that there are statistically significant mean differences in safety performance across several commodity segment areas. Some of the largest mean differences exist between commodity areas Motor Vehicles and Logs, Poles, Beams, Lumber; Metal, Sheets, Coils, Rolls and Motor Vehicles; and finally Logs, Poles, Beams, Lumber and Fresh Produce. We found similar findings in 48 out of 55 vehicle out-of-service rate commodity segment mean difference areas. For example, we found in the vehicle OOS rate area that commodity areas General Freight and Logs, Poles, Beams, Lumber and General Freight and Machinery, Large Objects exhibit statistically significant mean differences. We also found that there are mixed relationships regarding how commodity segment participation affects safety performance in our multivariate analysis. Collectively, these findings highlight the competitive intensity in the U.S. motor carrier industry. Future research should explore the extent to which firms are making trade-offs between the competitive intensity of the industry and firm safety performance.

The last important factor that we explored in our safety analysis was firm equipment ownership. Specifically, the U.S. DOT Volpe database contains an equipment profile for several firms in our sample. Based on these data, we classified fleet ownership groups across four distinct categories of equipment ownership, as shown in Table 4. As noted earlier, the predominant number of firms in our sample is in discrete ownership groups 2 and 4. Ownership group 2 contains those firms where percent tractor or trailer ownership is greater than 25 percent or less than or equal to 50 percent; ownership group 4 contains those firms where percent tractor or trailer ownership is greater than 50 percent or less than or equal to 100 percent.

We first discussed the fleet ownership analysis regarding the driver and vehicle out-of-service rate dependent variables. Generally speaking, up until a certain level of fleet ownership, our results show that as fleet ownership increases, safety performance decreases.

Turning to the unsafe driving and HOS BASIC means differences analysis, generally speaking we found that as firm equipment ownership increases, firm safety performance improves. Results from the multivariate analysis (Models D and E) corroborate this finding.

Overall, we found that as fleet ownership increases, the vehicle maintenance BASIC safety performance metrics becomes worse. This finding appears consistent in both the means differences and multivariate analysis. This is a surprising finding because of the critical importance of fleet maintenance to safety performance.

Driver fitness is a serious topic in the U.S. motor carrier industry. Recall that the driver fitness BASIC is a rating of the firm's CMV drivers who are unfit to operate a CMV due to lack of training, experience, or medical qualifications. Anecdotal evidence points out that many commercial drivers are not physically fit to operate a commercial motor vehicle because the employee could suffer from medical issues such as sleep apnea among other issues. Our means differences and multivariate results highlight how as fleet ownership increases, firms perform poorly on the driver fitness BASIC. This finding highlights how firms need to take more proactive action to improve the health and well-being of their drivers.

We then discussed our findings related to fleet ownership and the hazmat BASIC. As discussed earlier, in four of the size mean difference groups, we found that as percent ownership increases, hazmat BASIC performance becomes worse. This finding is also consistent with the multivariate analysis (Model I). It is quite possible that firm ownership serves a more prominent role in the hazardous goods commodity segment. Future research should explore the reasons why firm ownership is not mitigating safety concerns as it relates to this BASIC.

Lastly, we explored the relationship of firm ownership and the crash BASIC. As discussed in the means difference analysis and substantiated in the multivariate analysis (Model J), we did not find a consistent pattern across percent fleet ownership and safety performance. It appears that those firms that own 50 to 75 percent of their fleet have lower crash rates than those firms that own less than 25 percent of their fleet. This trend would suggest that owners of their equipment exhibit a strong interest in not exposing their assets to situations in which their property and equipment can be seriously damaged. Clearly, future research is needed to explore this finding in more detail.

Future Research Plans

Our earlier findings highlight how there is tremendous potential for an in-depth analysis of how motor carrier size affects safety performance. We will now describe three exciting future research opportunities.

Safety Performance Analysis of Carriers' Use of Owner-Operators versus Company Drivers

There is an increased interest in understanding how the use of owner-operators affects safety performance in the U.S. motor carrier industry. Part of the motivation to develop greater insights into the use of owner-operators is because of the flexible labor and capacity strategy afforded by these independent drivers. Furthermore, the critical shortage of qualified commercial drivers is projected to become even worse within the next 10 years. Therefore, managers have a desire to understand some of the safety challenges of contracting with the owner-operator workforce. Because of the need to further our understanding of these safety challenges, employing driver-level data, Cantor et al. (2013) found that owner-operators have more driver and vehicle out-of-service violations but fewer crashes than company drivers. Swartz and Douglas (2009) examined owner-operators' perceptions of carrier safety climate and found that independent drivers have an intention to engage in potentially unsafe driving behavior. Our findings above provide mixed initial evidence of a linkage between the use of owner-operators and safety performance. Indeed, in this study, we found that increased usage of company-owned equipment leads to higher driver and vehicle out-of-service rates but fewer crashes. These initial results suggest that further exploration is needed to uncover under which conditions the use of owner-operators from a motor carrier's viewpoint would lead to improved safety performance. Future research could explore how firm size moderates the relationship between carriers that use owner-operators and safety performance. Presumably, larger firms have the managerial and technological resources to monitor the safety practices of owner-operators.

Linkage between Competitive Dynamics of U.S. Motor Carrier Industry and Firm Safety Performance

Firms engage in rivalrous behavior as a way to enhance their own firm's performance. Indeed, there is a steady of stream of research that shows how firms that are constantly taking positive competitive actions enhance their own market and financial performance. However, we are unaware of research that explores the linkage between firm competition and safety performance. Therefore, we seek to understand the relationship between firms' participation in highly competitive markets and their own safety performance. In this study, we would operationalize competitive intensity of market using the commodity segmentation data in our existing data. To do so, we would calculate the Herfindahl-Hirschman Index (HHI) for each commodity segment. The HHI is widely used in studies of firm-level competition. We would use firm size data to do so. Then, we would examine how competitive intensity affects safety performance at the firm level of analysis. This analysis would help managers and public policy makers further understand how competitive intensity may influence firms to allocate resources to non-safety activities because of issues of rivalry.

Analysis of FMCSA's New Entrant Program and Safety Performance: Is the New Entrant Program Working?

The FMCSA launched its New Entrant Program as a way to introduce new interstate motor carriers to its safety regulations. All carriers are considered a new entrant for 18 months when they are issued a U.S. DOT number. During the 18 month period, the new entrant carrier will undergo periodic inspections and audits of its records and safety practices to ensure that the carrier is compliant with FMCSA federal rules and regulations. The carrier must pass these inspections in order to operate in the industry.

To the best of our knowledge, scant research exists on the relationship between carriers who participated in the New Entrant Program and their safety performance. Therefore, the goal of this study is to examine the effectiveness of this program. Our analysis will based in part on the detailed new entrant data derived from the U.S. DOT Volpe database, which is presented in a summary format in Table 8. Briefly, Table 8 shows that 8.7 percent of the firms in our sample are currently in the New Entrant Program. Moreover, 30.7 percent of the sample exited the New Entrant Program with a safety audit.

Table 8. Descriptive statistics of new entrant codes

Code	Description	Obs	Mean	Std. Dev.	Min	Max
C	EXITED DUE TO CHANGE	464745	0.05818	0.234084	0	1
E	CURRENTLY IN NEW ENTRANT PROGRAM	464745	0.087282	0.282249	0	1
I	EXITED DUE TO INACTIVATION	464745	0.002199	0.046843	0	1
L	REVOKED FROM THE NEW ENTRANT PROGRAM (NO-CA EA)	464745	0.000426	0.020636	0	1
N	NEVER IN NEW ENTRANT PROGRAM	464745	0.531399	0.499014	0	1
R	REVOKED FROM THE NEW ENTRANT PROGRAM (FAILED SA)	464745	0.00097	0.031137	0	1
S	REVOKED FROM THE NEW ENTRANT PROGRAM (NO-SHOW SA)	464745	0.000508	0.022529	0	1
T	REVOKED FROM THE NEW ENTRANT PROGRAM (NO CONTACT)	464745	0.003303	0.057376	0	1
X	EXITED FROM NEW ENTRANT PROGRAM WITH SA	464745	0.306712	0.461129	0	1
Y	EXITED FROM NEW ENTRANT PROGRAM WITH CR	464745	0.008955	0.094209	0	1
Z	EXITED FROM NEW ENTRANT PROGRAM (SA EXEMPT)	464745	6.46E-05	0.008034	0	1

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APPENDIX: MEANS DIFFERENCES TABLES

Table 9. Firm size safety performance indicators – driver and vehicle out-of-service rates

Driver OOS Rate					Vehicle OOS Rate				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
1	2	0.0862	0.0859	0.0623	1	2	0.274	0.2919	2.5638
1	3	0.0862	0.0713	3.5268	1	3	0.274	0.2663	1.0874
1	4	0.0862	0.0594	6.3563*	1	4	0.274	0.2407	4.7541*
1	5	0.0862	0.0535	7.7630*	1	5	0.274	0.2209	7.5743*
1	6	0.0862	0.0493	8.7464*	1	6	0.274	0.206	9.6977*
1	7	0.0862	0.0476	9.1516*	1	7	0.274	0.1944	11.3619*
1	8	0.0862	0.0418	10.5233*	1	8	0.274	0.1825	13.0544*
1	9	0.0862	0.0442	9.9693*	1	9	0.274	0.1802	13.3877*
1	10	0.0862	0.0459	9.5674*	1	10	0.274	0.1759	14.0038*
1	11	0.0862	0.0416	10.5745*	1	11	0.274	0.1757	14.0311*
1	12	0.0862	0.0313	13.0114*	1	12	0.274	0.1531	17.2506*
2	3	0.0859	0.0713	3.4645	2	3	0.2919	0.2663	3.6512
2	4	0.0859	0.0594	6.2940*	2	4	0.2919	0.2407	7.3180*
2	5	0.0859	0.0535	7.7006*	2	5	0.2919	0.2209	10.1382*
2	6	0.0859	0.0493	8.6841*	2	6	0.2919	0.206	12.2616*
2	7	0.0859	0.0476	9.0892*	2	7	0.2919	0.1944	13.9258*
2	8	0.0859	0.0418	10.4610*	2	8	0.2919	0.1825	15.6182*
2	9	0.0859	0.0442	9.9070*	2	9	0.2919	0.1802	15.9516*
2	10	0.0859	0.0459	9.5051*	2	10	0.2919	0.1759	16.5676*
2	11	0.0859	0.0416	10.5122*	2	11	0.2919	0.1757	16.5949*
2	12	0.0859	0.0313	12.9491*	2	12	0.2919	0.1531	19.8144*
3	4	0.0713	0.0594	2.8295	3	4	0.2663	0.2407	3.6668
3	5	0.0713	0.0535	4.2362	3	5	0.2663	0.2209	6.4869*
3	6	0.0713	0.0493	5.2196*	3	6	0.2663	0.206	8.6103*
3	7	0.0713	0.0476	5.6248*	3	7	0.2663	0.1944	10.2746*
3	8	0.0713	0.0418	6.9965*	3	8	0.2663	0.1825	11.9670*
3	9	0.0713	0.0442	6.4425*	3	9	0.2663	0.1802	12.3004*
3	10	0.0713	0.0459	6.0406*	3	10	0.2663	0.1759	12.9164*
3	11	0.0713	0.0416	7.0477*	3	11	0.2663	0.1757	12.9437*
3	12	0.0713	0.0313	9.4846*	3	12	0.2663	0.1531	16.1632*
4	5	0.0594	0.0535	1.4067	4	5	0.2407	0.2209	2.8202
4	6	0.0594	0.0493	2.3901	4	6	0.2407	0.206	4.9436*
4	7	0.0594	0.0476	2.7953	4	7	0.2407	0.1944	6.6078*
4	8	0.0594	0.0418	4.1670	4	8	0.2407	0.1825	8.3002*
4	9	0.0594	0.0442	3.6130	4	9	0.2407	0.1802	8.6336*
4	10	0.0594	0.0459	3.2111	4	10	0.2407	0.1759	9.2497*

Driver OOS Rate					Vehicle OOS Rate				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
4	11	0.0594	0.0416	4.2182	4	11	0.2407	0.1757	9.2770*
4	12	0.0594	0.0313	6.6551*	4	12	0.2407	0.1531	12.4965*
5	6	0.0535	0.0493	0.9834	5	6	0.2209	0.206	2.1234
5	7	0.0535	0.0476	1.3886	5	7	0.2209	0.1944	3.7876
5	8	0.0535	0.0418	2.7603	5	8	0.2209	0.1825	5.4800*
5	9	0.0535	0.0442	2.2063	5	9	0.2209	0.1802	5.8134*
5	10	0.0535	0.0459	1.8045	5	10	0.2209	0.1759	6.4295*
5	11	0.0535	0.0416	2.8115	5	11	0.2209	0.1757	6.4568*
5	12	0.0535	0.0313	5.2485*	5	12	0.2209	0.1531	9.6763*
6	7	0.0493	0.0476	0.4052	6	7	0.206	0.1944	1.6642
6	8	0.0493	0.0418	1.7769	6	8	0.206	0.1825	3.3566
6	9	0.0493	0.0442	1.2229	6	9	0.206	0.1802	3.6900
6	10	0.0493	0.0459	0.8210	6	10	0.206	0.1759	4.3061
6	11	0.0493	0.0416	1.8281	6	11	0.206	0.1757	4.3334
6	12	0.0493	0.0313	4.2650	6	12	0.206	0.1531	7.5529*
7	8	0.0476	0.0418	1.3717	7	8	0.1944	0.1825	1.6924
7	9	0.0476	0.0442	0.8177	7	9	0.1944	0.1802	2.0258
7	10	0.0476	0.0459	0.4159	7	10	0.1944	0.1759	2.6419
7	11	0.0476	0.0416	1.4229	7	11	0.1944	0.1757	2.6692
7	12	0.0476	0.0313	3.8599	7	12	0.1944	0.1531	5.8886*
8	9	0.0418	0.0442	0.5540	8	9	0.1825	0.1802	0.3334
8	10	0.0418	0.0459	0.9559	8	10	0.1825	0.1759	0.9494
8	11	0.0418	0.0416	0.0512	8	11	0.1825	0.1757	0.9767
8	12	0.0418	0.0313	2.4881	8	12	0.1825	0.1531	4.1962
9	10	0.0442	0.0459	0.4018	9	10	0.1802	0.1759	0.6161
9	11	0.0442	0.0416	0.6052	9	11	0.1802	0.1757	0.6434
9	12	0.0442	0.0313	3.0422	9	12	0.1802	0.1531	3.8628
10	11	0.0459	0.0416	1.0071	10	11	0.1759	0.1757	0.0273
10	12	0.0459	0.0313	3.4440	10	12	0.1759	0.1531	3.2468
11	12	0.0416	0.0313	2.4369	11	12	0.1757	0.1531	3.2195

Table 10. Firm size safety performance indicators – crash rate and crash miles

Crash Rate Firm Size					Crash Miles Firm Size				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
1	2	0.0218	0.0212	0.2231	1	2	0.0015	0.0018	0.2650
1	3	0.0218	0.0274	2.1999	1	3	0.0015	0.0031	1.5140
1	4	0.0218	0.0322	4.0767	1	4	0.0015	0.0039	2.3139
1	5	0.0218	0.0368	5.9117*	1	5	0.0015	0.0041	2.5350
1	6	0.0218	0.0354	5.3632*	1	6	0.0015	0.0041	2.5308
1	7	0.0218	0.0369	5.9356*	1	7	0.0015	0.0045	2.8520
1	8	0.0218	0.0352	5.2578*	1	8	0.0015	0.0043	2.6737
1	9	0.0218	0.0357	5.4454*	1	9	0.0015	0.0135	11.5506*
1	10	0.0218	0.0381	6.4226*	1	10	0.0015	0.0041	2.5522
1	11	0.0218	0.0382	6.4487*	1	11	0.0015	0.0013	0.1988
1	12	0.0218	0.0366	5.8316*	1	12	0.0015	0.0029	1.3294
2	3	0.0212	0.0274	2.4231	2	3	0.0018	0.0031	1.2491
2	4	0.0212	0.0322	4.2999	2	4	0.0018	0.0039	2.0489
2	5	0.0212	0.0368	6.1349*	2	5	0.0018	0.0041	2.2700
2	6	0.0212	0.0354	5.5863*	2	6	0.0018	0.0041	2.2659
2	7	0.0212	0.0369	6.1588*	2	7	0.0018	0.0045	2.5870
2	8	0.0212	0.0352	5.4809*	2	8	0.0018	0.0043	2.4088
2	9	0.0212	0.0357	5.6686*	2	9	0.0018	0.0135	11.2857*
2	10	0.0212	0.0381	6.6457*	2	10	0.0018	0.0041	2.2872
2	11	0.0212	0.0382	6.6719*	2	11	0.0018	0.0013	0.4638
2	12	0.0212	0.0366	6.0548*	2	12	0.0018	0.0029	1.0644
3	4	0.0274	0.0322	1.8768	3	4	0.0031	0.0039	0.7998
3	5	0.0274	0.0368	3.7118	3	5	0.0031	0.0041	1.0209
3	6	0.0274	0.0354	3.1632	3	6	0.0031	0.0041	1.0168
3	7	0.0274	0.0369	3.7357	3	7	0.0031	0.0045	1.3380
3	8	0.0274	0.0352	3.0579	3	8	0.0031	0.0043	1.1597
3	9	0.0274	0.0357	3.2455	3	9	0.0031	0.0135	10.0366*
3	10	0.0274	0.0381	4.2226	3	10	0.0031	0.0041	1.0382
3	11	0.0274	0.0382	4.2488	3	11	0.0031	0.0013	1.7128
3	12	0.0274	0.0366	3.6317	3	12	0.0031	0.0029	0.1846
4	5	0.0322	0.0368	1.8350	4	5	0.0039	0.0041	0.2211
4	6	0.0322	0.0354	1.2864	4	6	0.0039	0.0041	0.2170
4	7	0.0322	0.0369	1.8589	4	7	0.0039	0.0045	0.5381
4	8	0.0322	0.0352	1.1811	4	8	0.0039	0.0043	0.3599
4	9	0.0322	0.0357	1.3687	4	9	0.0039	0.0135	9.2368*
4	10	0.0322	0.0381	2.3458	4	10	0.0039	0.0041	0.2383
4	11	0.0322	0.0382	2.3720	4	11	0.0039	0.0013	2.5127
4	12	0.0322	0.0366	1.7549	4	12	0.0039	0.0029	0.9845

Crash Rate Firm Size					Crash Miles Firm Size				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
5	6	0.0368	0.0354	0.5486	5	6	0.0041	0.0041	0.0041
5	7	0.0368	0.0369	0.0239	5	7	0.0041	0.0045	0.3170
5	8	0.0368	0.0352	0.6539	5	8	0.0041	0.0043	0.1388
5	9	0.0368	0.0357	0.4663	5	9	0.0041	0.0135	9.0157*
5	10	0.0368	0.0381	0.5108	5	10	0.0041	0.0041	0.0172
5	11	0.0368	0.0382	0.5370	5	11	0.0041	0.0013	2.7338
5	12	0.0368	0.0366	0.0801	5	12	0.0041	0.0029	1.2056
6	7	0.0354	0.0369	0.5725	6	7	0.0041	0.0045	0.3212
6	8	0.0354	0.0352	0.1054	6	8	0.0041	0.0043	0.1429
6	9	0.0354	0.0357	0.0823	6	9	0.0041	0.0135	9.0198*
6	10	0.0354	0.0381	1.0594	6	10	0.0041	0.0041	0.0214
6	11	0.0354	0.0382	1.0856	6	11	0.0041	0.0013	2.7297
6	12	0.0354	0.0366	0.4685	6	12	0.0041	0.0029	1.2015
7	8	0.0369	0.0352	0.6778	7	8	0.0045	0.0043	0.1782
7	9	0.0369	0.0357	0.4902	7	9	0.0045	0.0135	8.6987*
7	10	0.0369	0.0381	0.4869	7	10	0.0045	0.0041	0.2998
7	11	0.0369	0.0382	0.5131	7	11	0.0045	0.0013	3.0508
7	12	0.0369	0.0366	0.1040	7	12	0.0045	0.0029	1.5226
8	9	0.0352	0.0357	0.1876	8	9	0.0043	0.0135	8.8769*
8	10	0.0352	0.0381	1.1648	8	10	0.0043	0.0041	0.1216
8	11	0.0352	0.0382	1.1909	8	11	0.0043	0.0013	2.8726
8	12	0.0352	0.0366	0.5738	8	12	0.0043	0.0029	1.3444
9	10	0.0357	0.0381	0.9771	9	10	0.0135	0.0041	8.9985*
9	11	0.0357	0.0382	1.0033	9	11	0.0135	0.0013	11.7495*
9	12	0.0357	0.0366	0.3862	9	12	0.0135	0.0029	10.2213*
10	11	0.0381	0.0382	0.0262	10	11	0.0041	0.0013	2.7510
10	12	0.0381	0.0366	0.5909	10	12	0.0041	0.0029	1.2228
11	12	0.0382	0.0366	0.6171	11	12	0.0013	0.0029	1.5282

Table 11. Firm size safety performance indicators – HOS and driver fitness

HOS Measure Firm Size					Driver Fitness Measure Firm Size				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
1	2	0.9411	0.7361	5.4099*	1	2	0.4479	0.5435	2.9647
1	3	0.9411	0.6412	7.9131*	1	3	0.4479	0.4532	0.1654
1	4	0.9411	0.6013	8.9651*	1	4	0.4479	0.3518	2.9812
1	5	0.9411	0.5828	9.4553*	1	5	0.4479	0.2791	5.2383*
1	6	0.9411	0.5624	9.9927*	1	6	0.4479	0.2642	5.6994*
1	7	0.9411	0.5505	10.3080*	1	7	0.4479	0.2401	6.4480*
1	8	0.9411	0.5321	10.7917*	1	8	0.4479	0.1928	7.9171*
1	9	0.9411	0.5129	11.2989*	1	9	0.4479	0.2192	7.0956*
1	10	0.9411	0.5185	11.1515*	1	10	0.4479	0.2165	7.1819*
1	11	0.9411	0.5331	10.7649*	1	11	0.4479	0.1433	9.4533*
1	12	0.9411	0.3853	14.6666*	1	12	0.4479	0.1384	9.6025*
2	3	0.7361	0.6412	2.5032	2	3	0.5435	0.4532	2.7993
2	4	0.7361	0.6013	3.5552	2	4	0.5435	0.3518	5.9460*
2	5	0.7361	0.5828	4.0454	2	5	0.5435	0.2791	8.2031*
2	6	0.7361	0.5624	4.5829	2	6	0.5435	0.2642	8.6641*
2	7	0.7361	0.5505	4.8981*	2	7	0.5435	0.2401	9.4127*
2	8	0.7361	0.5321	5.3819*	2	8	0.5435	0.1928	10.8819*
2	9	0.7361	0.5129	5.8890*	2	9	0.5435	0.2192	10.0603*
2	10	0.7361	0.5185	5.7417*	2	10	0.5435	0.2165	10.1466*
2	11	0.7361	0.5331	5.3550*	2	11	0.5435	0.1433	12.4181*
2	12	0.7361	0.3853	9.2567*	2	12	0.5435	0.1384	12.5672*
3	4	0.6412	0.6013	1.0520	3	4	0.4532	0.3518	3.1466
3	5	0.6412	0.5828	1.5422	3	5	0.4532	0.2791	5.4037*
3	6	0.6412	0.5624	2.0796	3	6	0.4532	0.2642	5.8648*
3	7	0.6412	0.5505	2.3949	3	7	0.4532	0.2401	6.6134*
3	8	0.6412	0.5321	2.8786	3	8	0.4532	0.1928	8.0825*
3	9	0.6412	0.5129	3.3858	3	9	0.4532	0.2192	7.2610*
3	10	0.6412	0.5185	3.2384	3	10	0.4532	0.2165	7.3473*
3	11	0.6412	0.5331	2.8518	3	11	0.4532	0.1433	9.6187*
3	12	0.6412	0.3853	6.7535*	3	12	0.4532	0.1384	9.7679*
4	5	0.6013	0.5828	0.4902	4	5	0.3518	0.2791	2.2571
4	6	0.6013	0.5624	1.0277	4	6	0.3518	0.2642	2.7182
4	7	0.6013	0.5505	1.3429	4	7	0.3518	0.2401	3.4667
4	8	0.6013	0.5321	1.8267	4	8	0.3518	0.1928	4.9359*
4	9	0.6013	0.5129	2.3338	4	9	0.3518	0.2192	4.1144
4	10	0.6013	0.5185	2.1865	4	10	0.3518	0.2165	4.2007
4	11	0.6013	0.5331	1.7998	4	11	0.3518	0.1433	6.4721*
4	12	0.6013	0.3853	5.7015*	4	12	0.3518	0.1384	6.6213*

HOS Measure Firm Size					Driver Fitness Measure Firm Size				
Group	**Group**	**Group Mean**	**Group Mean**	**HSD-test**	**Group**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**
5	6	0.5828	0.5624	0.5374	5	6	0.2791	0.2642	0.4611
5	7	0.5828	0.5505	0.8527	5	7	0.2791	0.2401	1.2096
5	8	0.5828	0.5321	1.3364	5	8	0.2791	0.1928	2.6788
5	9	0.5828	0.5129	1.8436	5	9	0.2791	0.2192	1.8572
5	10	0.5828	0.5185	1.6962	5	10	0.2791	0.2165	1.9436
5	11	0.5828	0.5331	1.3096	5	11	0.2791	0.1433	4.2150
5	12	0.5828	0.3853	5.2113*	5	12	0.2791	0.1384	4.3641
6	7	0.5624	0.5505	0.3153	6	7	0.2642	0.2401	0.7486
6	8	0.5624	0.5321	0.7990	6	8	0.2642	0.1928	2.2177
6	9	0.5624	0.5129	1.3061	6	9	0.2642	0.2192	1.3962
6	10	0.5624	0.5185	1.1588	6	10	0.2642	0.2165	1.4825
6	11	0.5624	0.5331	0.7721	6	11	0.2642	0.1433	3.7540
6	12	0.5624	0.3853	4.6738*	6	12	0.2642	0.1384	3.9031
7	8	0.5505	0.5321	0.4837	7	8	0.2401	0.1928	1.4692
7	9	0.5505	0.5129	0.9909	7	9	0.2401	0.2192	0.6476
7	10	0.5505	0.5185	0.8435	7	10	0.2401	0.2165	0.7339
7	11	0.5505	0.5331	0.4569	7	11	0.2401	0.1433	3.0054
7	12	0.5505	0.3853	4.3586	7	12	0.2401	0.1384	3.1545
8	9	0.5321	0.5129	0.5072	8	9	0.1928	0.2192	0.8216
8	10	0.5321	0.5185	0.3598	8	10	0.1928	0.2165	0.7352
8	11	0.5321	0.5331	0.0269	8	11	0.1928	0.1433	1.5362
8	12	0.5321	0.3853	3.8748	8	12	0.1928	0.1384	1.6853
9	10	0.5129	0.5185	0.1473	9	10	0.2192	0.2165	0.0863
9	11	0.5129	0.5331	0.5340	9	11	0.2192	0.1433	2.3578
9	12	0.5129	0.3853	3.3677	9	12	0.2192	0.1384	2.5069
10	11	0.5185	0.5331	0.3867	10	11	0.2165	0.1433	2.2714
10	12	0.5185	0.3853	3.5150	10	12	0.2165	0.1384	2.4206
11	12	0.5331	0.3853	3.9017	11	12	0.1433	0.1384	0.1491

Table 12. Firm size safety performance indicators – controlled substances/alcohol and vehicle maintenance

Controlled Substances/Alcohol Measure Firm Size					Vehicle Maintenance Measure Firm Size				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
1	2	0.0133	0.0142	0.1882	1	2	7.1273	7.2511	0.8983
1	3	0.0133	0.0114	0.3845	1	3	7.1273	6.4554	4.8778*
1	4	0.0133	0.0093	0.7932	1	4	7.1273	5.6487	10.7338*
1	5	0.0133	0.011	0.4603	1	5	7.1273	5.103	14.6947*
1	6	0.0133	0.0074	1.1910	1	6	7.1273	4.7028	17.5996*
1	7	0.0133	0.0077	1.1260	1	7	7.1273	4.3942	19.8397*
1	8	0.0133	0.0043	1.8113	1	8	7.1273	4.0567	22.2899*
1	9	0.0133	0.0067	1.3254	1	9	7.1273	3.9362	23.1649*
1	10	0.0133	0.007	1.2681	1	10	7.1273	3.8769	23.5949*
1	11	0.0133	0.0049	1.6848	1	11	7.1273	3.8867	23.5241*
1	12	0.0133	0.004	1.8746	1	12	7.1273	3.2458	28.1766*
2	3	0.0142	0.0114	0.5727	2	3	7.2511	6.4554	5.7761*
2	4	0.0142	0.0093	0.9814	2	4	7.2511	5.6487	11.6321*
2	5	0.0142	0.011	0.6485	2	5	7.2511	5.103	15.5930*
2	6	0.0142	0.0074	1.3792	2	6	7.2511	4.7028	18.4979*
2	7	0.0142	0.0077	1.3142	2	7	7.2511	4.3942	20.7381*
2	8	0.0142	0.0043	1.9995	2	8	7.2511	4.0567	23.1882*
2	9	0.0142	0.0067	1.5136	2	9	7.2511	3.9362	24.0632*
2	10	0.0142	0.007	1.4564	2	10	7.2511	3.8769	24.4933*
2	11	0.0142	0.0049	1.8730	2	11	7.2511	3.8867	24.4224*
2	12	0.0142	0.004	2.0629	2	12	7.2511	3.2458	29.0749*
3	4	0.0114	0.0093	0.4087	3	4	6.4554	5.6487	5.8560*
3	5	0.0114	0.011	0.0758	3	5	6.4554	5.103	9.8169*
3	6	0.0114	0.0074	0.8065	3	6	6.4554	4.7028	12.7218*
3	7	0.0114	0.0077	0.7415	3	7	6.4554	4.3942	14.9620*
3	8	0.0114	0.0043	1.4268	3	8	6.4554	4.0567	17.4121*
3	9	0.0114	0.0067	0.9409	3	9	6.4554	3.9362	18.2871*
3	10	0.0114	0.007	0.8837	3	10	6.4554	3.8769	18.7172*
3	11	0.0114	0.0049	1.3003	3	11	6.4554	3.8867	18.6463*
3	12	0.0114	0.004	1.4901	3	12	6.4554	3.2458	23.2988*
4	5	0.0093	0.011	0.3329	4	5	5.6487	5.103	3.9608
4	6	0.0093	0.0074	0.3978	4	6	5.6487	4.7028	6.8658*
4	7	0.0093	0.0077	0.3328	4	7	5.6487	4.3942	9.1059*
4	8	0.0093	0.0043	1.0181	4	8	5.6487	4.0567	11.5561*
4	9	0.0093	0.0067	0.5323	4	9	5.6487	3.9362	12.4310*
4	10	0.0093	0.007	0.4750	4	10	5.6487	3.8769	12.8611*
4	11	0.0093	0.0049	0.8916	4	11	5.6487	3.8867	12.7902*

Controlled Substances/Alcohol Measure Firm Size					Vehicle Maintenance Measure Firm Size				
Group	**Group**	**Group Mean**	**Group Mean**	**HSD-test**	**Group**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**
4	12	0.0093	0.004	1.0815	4	12	5.6487	3.2458	17.4428*
5	6	0.011	0.0074	0.7307	5	6	5.103	4.7028	2.9050
5	7	0.011	0.0077	0.6657	5	7	5.103	4.3942	5.1451*
5	8	0.011	0.0043	1.3510	5	8	5.103	4.0567	7.5953*
5	9	0.011	0.0067	0.8651	5	9	5.103	3.9362	8.4702*
5	10	0.011	0.007	0.8078	5	10	5.103	3.8769	8.9003*
5	11	0.011	0.0049	1.2245	5	11	5.103	3.8867	8.8294*
5	12	0.011	0.004	1.4143	5	12	5.103	3.2458	13.4820*
6	7	0.0074	0.0077	0.0650	6	7	4.7028	4.3942	2.2401
6	8	0.0074	0.0043	0.6203	6	8	4.7028	4.0567	4.6903*
6	9	0.0074	0.0067	0.1344	6	9	4.7028	3.9362	5.5653*
6	10	0.0074	0.007	0.0772	6	10	4.7028	3.8769	5.9953*
6	11	0.0074	0.0049	0.4938	6	11	4.7028	3.8867	5.9244*
6	12	0.0074	0.004	0.6837	6	12	4.7028	3.2458	10.5770*
7	8	0.0077	0.0043	0.6852	7	8	4.3942	4.0567	2.4502
7	9	0.0077	0.0067	0.1994	7	9	4.3942	3.9362	3.3251
7	10	0.0077	0.007	0.1421	7	10	4.3942	3.8769	3.7552
7	11	0.0077	0.0049	0.5588	7	11	4.3942	3.8867	3.6843
7	12	0.0077	0.004	0.7486	7	12	4.3942	3.2458	8.3369*
8	9	0.0043	0.0067	0.4858	8	9	4.0567	3.9362	0.8750
8	10	0.0043	0.007	0.5431	8	10	4.0567	3.8769	1.3050
8	11	0.0043	0.0049	0.1264	8	11	4.0567	3.8867	1.2341
8	12	0.0043	0.004	0.0634	8	12	4.0567	3.2458	5.8867*
9	10	0.0067	0.007	0.0573	9	10	3.9362	3.8769	0.4301
9	11	0.0067	0.0049	0.3594	9	11	3.9362	3.8867	0.3592
9	12	0.0067	0.004	0.5492	9	12	3.9362	3.2458	5.0117*
10	11	0.007	0.0049	0.4167	10	11	3.8769	3.8867	0.0709
10	12	0.007	0.004	0.6065	10	12	3.8769	3.2458	4.5817
11	12	0.0049	0.004	0.1898	11	12	3.8867	3.2458	4.6526*

Table 13. Firm size safety performance indicators – hazardous materials compliance and crash indicator

HAZ Measure Firm Size					Crash Measure Firm Size				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
1	2	2.6786	2.6384	0.2101	1	2	2.3783	0.962	67.5811*
1	3	2.6786	2.3186	1.8787	1	3	2.3783	0.4148	93.6861*
1	4	2.6786	2.3245	1.8476	1	4	2.3783	0.2579	101.1719*
1	5	2.6786	2.3873	1.5200	1	5	2.3783	0.1967	104.0924*
1	6	2.6786	2.1672	2.6683	1	6	2.3783	0.159	105.8932*
1	7	2.6786	2.2227	2.3792	1	7	2.3783	0.1488	106.3800*
1	8	2.6786	1.9453	3.8263	1	8	2.3783	0.1221	107.6555*
1	9	2.6786	1.8524	4.3110	1	9	2.3783	0.1291	107.3195*
1	10	2.6786	1.8298	4.4288	1	10	2.3783	0.1282	107.3625*
1	11	2.6786	2.0807	3.1198	1	11	2.3783	0.1205	107.7320*
1	12	2.6786	1.7417	4.8887*	1	12	2.3783	0.0986	108.7764*
2	3	2.6384	2.3186	1.6687	2	3	0.962	0.4148	26.1050*
2	4	2.6384	2.3245	1.6375	2	4	0.962	0.2579	33.5908*
2	5	2.6384	2.3873	1.3099	2	5	0.962	0.1967	36.5114*
2	6	2.6384	2.1672	2.4583	2	6	0.962	0.159	38.3121*
2	7	2.6384	2.2227	2.1692	2	7	0.962	0.1488	38.7989*
2	8	2.6384	1.9453	3.6162	2	8	0.962	0.1221	40.0744*
2	9	2.6384	1.8524	4.1009	2	9	0.962	0.1291	39.7384*
2	10	2.6384	1.8298	4.2187	2	10	0.962	0.1282	39.7814*
2	11	2.6384	2.0807	2.9097	2	11	0.962	0.1205	40.1509*
2	12	2.6384	1.7417	4.6786*	2	12	0.962	0.0986	41.1953*
3	4	2.3186	2.3245	0.0311	3	4	0.4148	0.2579	7.4858*
3	5	2.3186	2.3873	0.3588	3	5	0.4148	0.1967	10.4063*
3	6	2.3186	2.1672	0.7896	3	6	0.4148	0.159	12.2071*
3	7	2.3186	2.2227	0.5005	3	7	0.4148	0.1488	12.6939*
3	8	2.3186	1.9453	1.9475	3	8	0.4148	0.1221	13.9694*
3	9	2.3186	1.8524	2.4322	3	9	0.4148	0.1291	13.6334*
3	10	2.3186	1.8298	2.5501	3	10	0.4148	0.1282	13.6764*
3	11	2.3186	2.0807	1.2410	3	11	0.4148	0.1205	14.0459*
3	12	2.3186	1.7417	3.0100	3	12	0.4148	0.0986	15.0903*
4	5	2.3245	2.3873	0.3276	4	5	0.2579	0.1967	2.9205
4	6	2.3245	2.1672	0.8207	4	6	0.2579	0.159	4.7213*
4	7	2.3245	2.2227	0.5316	4	7	0.2579	0.1488	5.2081*
4	8	2.3245	1.9453	1.9787	4	8	0.2579	0.1221	6.4836*
4	9	2.3245	1.8524	2.4634	4	9	0.2579	0.1291	6.1476*
4	10	2.3245	1.8298	2.5812	4	10	0.2579	0.1282	6.1906*
4	11	2.3245	2.0807	1.2722	4	11	0.2579	0.1205	6.5601*

HAZ Measure Firm Size					Crash Measure Firm Size				
Group	Group	Group Mean	Group Mean	HSD-test	Group	Group	Group Mean	Group Mean	HSD-test
4	12	2.3245	1.7417	3.0411	4	12	0.2579	0.0986	7.6045*
5	6	2.3873	2.1672	1.1484	5	6	0.1967	0.159	1.8008
5	7	2.3873	2.2227	0.8593	5	7	0.1967	0.1488	2.2876
5	8	2.3873	1.9453	2.3063	5	8	0.1967	0.1221	3.5631
5	9	2.3873	1.8524	2.7910	5	9	0.1967	0.1291	3.2271
5	10	2.3873	1.8298	2.9088	5	10	0.1967	0.1282	3.2700
5	11	2.3873	2.0807	1.5998	5	11	0.1967	0.1205	3.6395
5	12	2.3873	1.7417	3.3687	5	12	0.1967	0.0986	4.6839*
6	7	2.1672	2.2227	0.2891	6	7	0.159	0.1488	0.4868
6	8	2.1672	1.9453	1.1579	6	8	0.159	0.1221	1.7623
6	9	2.1672	1.8524	1.6426	6	9	0.159	0.1291	1.4263
6	10	2.1672	1.8298	1.7605	6	10	0.159	0.1282	1.4693
6	11	2.1672	2.0807	0.4514	6	11	0.159	0.1205	1.8388
6	12	2.1672	1.7417	2.2204	6	12	0.159	0.0986	2.8832
7	8	2.2227	1.9453	1.4471	7	8	0.1488	0.1221	1.2755
7	9	2.2227	1.8524	1.9317	7	9	0.1488	0.1291	0.9395
7	10	2.2227	1.8298	2.0496	7	10	0.1488	0.1282	0.9824
7	11	2.2227	2.0807	0.7405	7	11	0.1488	0.1205	1.3519
7	12	2.2227	1.7417	2.5095	7	12	0.1488	0.0986	2.3964
8	9	1.9453	1.8524	0.4847	8	9	0.1221	0.1291	0.3360
8	10	1.9453	1.8298	0.6025	8	10	0.1221	0.1282	0.2930
8	11	1.9453	2.0807	0.7065	8	11	0.1221	0.1205	0.0765
8	12	1.9453	1.7417	1.0624	8	12	0.1221	0.0986	1.1209
9	10	1.8524	1.8298	0.1178	9	10	0.1291	0.1282	0.0430
9	11	1.8524	2.0807	1.1912	9	11	0.1291	0.1205	0.4125
9	12	1.8524	1.7417	0.5777	9	12	0.1291	0.0986	1.4569
10	11	1.8298	2.0807	1.3090	10	11	0.1282	0.1205	0.3695
10	12	1.8298	1.7417	0.4599	10	12	0.1282	0.0986	1.4139
11	12	2.0807	1.7417	1.7689	11	12	0.1205	0.0986	1.0444

Table 14. Commodity and firm safety performance – driver and vehicle out-of-service rates

Driver OOS Rate						Vehicle OOS Rate					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	0.0837	0.0611	15.1756*	1	vs	2	0.231	0.2742	16.5596*
1	vs	3	0.0837	0.1106	18.1307*	1	vs	3	0.231	0.2979	25.6476*
1	vs	4	0.0837	0.0507	22.1770*	1	vs	4	0.231	0.3543	47.2725*
1	vs	5	0.0837	0.0736	6.7843*	1	vs	5	0.231	0.2768	17.5603*
1	vs	6	0.0837	0.0853	1.1157	1	vs	6	0.231	0.3507	45.8789*
1	vs	7	0.0837	0.0875	2.5667	1	vs	7	0.231	0.2261	1.8794
1	vs	8	0.0837	0.0609	15.2938*	1	vs	8	0.231	0.26	11.1180*
1	vs	9	0.0837	0.08	2.4715	1	vs	9	0.231	0.201	11.5322*
1	vs	10	0.0837	0.0659	11.9438*	1	vs	10	0.231	0.196	13.4570*
1	vs	11	0.0837	0.0852	1.0543	1	vs	11	0.231	0.3427	42.8416*
2	vs	3	0.0611	0.1106	33.3063*	2	vs	3	0.2742	0.2979	9.0880*
2	vs	4	0.0611	0.0507	7.0014*	2	vs	4	0.2742	0.3543	30.7129*
2	vs	5	0.0611	0.0736	8.3913*	2	vs	5	0.2742	0.2768	1.0007
2	vs	6	0.0611	0.0853	16.2913*	2	vs	6	0.2742	0.3507	29.3193*
2	vs	7	0.0611	0.0875	17.7423*	2	vs	7	0.2742	0.2261	18.4390*
2	vs	8	0.0611	0.0609	0.1182	2	vs	8	0.2742	0.26	5.4416*
2	vs	9	0.0611	0.08	12.7041*	2	vs	9	0.2742	0.201	28.0918*
2	vs	10	0.0611	0.0659	3.2318	2	vs	10	0.2742	0.196	30.0166*
2	vs	11	0.0611	0.0852	16.2299*	2	vs	11	0.2742	0.3427	26.2820*
3	vs	4	0.1106	0.0507	40.3077*	3	vs	4	0.2979	0.3543	21.6249*
3	vs	5	0.1106	0.0736	24.9150*	3	vs	5	0.2979	0.2768	8.0873*
3	vs	6	0.1106	0.0853	17.0151*	3	vs	6	0.2979	0.3507	20.2313*
3	vs	7	0.1106	0.0875	15.5640*	3	vs	7	0.2979	0.2261	27.5270*
3	vs	8	0.1106	0.0609	33.4245*	3	vs	8	0.2979	0.26	14.5296*
3	vs	9	0.1106	0.08	20.6022*	3	vs	9	0.2979	0.201	37.1798*
3	vs	10	0.1106	0.0659	30.0745*	3	vs	10	0.2979	0.196	39.1046*
3	vs	11	0.1106	0.0852	17.0764*	3	vs	11	0.2979	0.3427	17.1939*
4	vs	5	0.0507	0.0736	15.3927*	4	vs	5	0.3543	0.2768	29.7122*
4	vs	6	0.0507	0.0853	23.2927*	4	vs	6	0.3543	0.3507	1.3936
4	vs	7	0.0507	0.0875	24.7437*	4	vs	7	0.3543	0.2261	49.1519*
4	vs	8	0.0507	0.0609	6.8832*	4	vs	8	0.3543	0.26	36.1545*
4	vs	9	0.0507	0.08	19.7055*	4	vs	9	0.3543	0.201	58.8047*
4	vs	10	0.0507	0.0659	10.2332*	4	vs	10	0.3543	0.196	60.7295*
4	vs	11	0.0507	0.0852	23.2313*	4	vs	11	0.3543	0.3427	4.4309
5	vs	6	0.0736	0.0853	7.9000*	5	vs	6	0.2768	0.3507	28.3186*
5	vs	7	0.0736	0.0875	9.3510*	5	vs	7	0.2768	0.2261	19.4397*
5	vs	8	0.0736	0.0609	8.5095*	5	vs	8	0.2768	0.26	6.4422*
5	vs	9	0.0736	0.08	4.3128	5	vs	9	0.2768	0.201	29.0924*

Driver OOS Rate						Vehicle OOS Rate					
Group	**Vs**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**	**Group**	**Vs**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**
5	vs	10	0.0736	0.0659	5.1595*	5	vs	10	0.2768	0.196	31.0173*
5	vs	11	0.0736	0.0852	7.8386*	5	vs	11	0.2768	0.3427	25.2813*
6	vs	7	0.0853	0.0875	1.4510	6	vs	7	0.3507	0.2261	47.7583*
6	vs	8	0.0853	0.0609	16.4095*	6	vs	8	0.3507	0.26	34.7608*
6	vs	9	0.0853	0.08	3.5871	6	vs	9	0.3507	0.201	57.4110*
6	vs	10	0.0853	0.0659	13.0595*	6	vs	10	0.3507	0.196	59.3359*
6	vs	11	0.0853	0.0852	0.0613	6	vs	11	0.3507	0.3427	3.0373
7	vs	8	0.0875	0.0609	17.8605*	7	vs	8	0.2261	0.26	12.9975*
7	vs	9	0.0875	0.08	5.0382*	7	vs	9	0.2261	0.201	9.6527*
7	vs	10	0.0875	0.0659	14.5105*	7	vs	10	0.2261	0.196	11.5776*
7	vs	11	0.0875	0.0852	1.5123	7	vs	11	0.2261	0.3427	44.7210*
8	vs	9	0.0609	0.08	12.8223*	8	vs	9	0.26	0.201	22.6502*
8	vs	10	0.0609	0.0659	3.3500	8	vs	10	0.26	0.196	24.5750*
8	vs	11	0.0609	0.0852	16.3481*	8	vs	11	0.26	0.3427	31.7235*
9	vs	10	0.08	0.0659	9.4723*	9	vs	10	0.201	0.196	1.9248
9	vs	11	0.08	0.0852	3.5258	9	vs	11	0.201	0.3427	54.3737*
10	vs	11	0.0659	0.0852	12.9982*	10	vs	11	0.196	0.3427	56.2986*

1-General Freight, 2 –Other, 3-Construction, 4- Building Materials, 5 –Machinery,6-Grain, Feed, Hay, 7- Logs, Poles, Beams, Lumber, 8-Motor Vehicles, 9-Farm Supplies, 10- Metal, Sheets, Coils, Rolls, 11 -Fresh Produce

Table 15. Commodity and firm safety performance – unsafe driving and HOS

Unsafe Measure						HOS Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	2.4702	1.869	15.8019*	1	vs	2	1.1902	0.6426	39.1631*
1	vs	3	2.4702	2.2224	6.5121*	1	vs	3	1.1902	1.1329	4.0953
1	vs	4	2.4702	2.1641	8.0451*	1	vs	4	1.1902	0.3241	61.9425*
1	vs	5	2.4702	1.7546	18.8066*	1	vs	5	1.1902	0.5694	44.3966*
1	vs	6	2.4702	1.4219	27.5529*	1	vs	6	1.1902	0.6124	41.3216*
1	vs	7	2.4702	2.5571	2.2825	1	vs	7	1.1902	1.2102	1.4324
1	vs	8	2.4702	2.1876	7.4287*	1	vs	8	1.1902	0.8118	27.0614*
1	vs	9	2.4702	2.9361	12.2449*	1	vs	9	1.1902	1.4273	16.9601*
1	vs	10	2.4702	2.6538	4.8241*	1	vs	10	1.1902	1.1498	2.8910
1	vs	11	2.4702	1.4939	25.6586*	1	vs	11	1.1902	0.5382	46.6283*
2	vs	3	1.869	2.2224	9.2898*	2	vs	3	0.6426	1.1329	35.0678*
2	vs	4	1.869	2.1641	7.7568*	2	vs	4	0.6426	0.3241	22.7794*
2	vs	5	1.869	1.7546	3.0046	2	vs	5	0.6426	0.5694	5.2335*
2	vs	6	1.869	1.4219	11.7509*	2	vs	6	0.6426	0.6124	2.1584
2	vs	7	1.869	2.5571	18.0845*	2	vs	7	0.6426	1.2102	40.5955*
2	vs	8	1.869	2.1876	8.3732*	2	vs	8	0.6426	0.8118	12.1017*
2	vs	9	1.869	2.9361	28.0469*	2	vs	9	0.6426	1.4273	56.1233*
2	vs	10	1.869	2.6538	20.6261*	2	vs	10	0.6426	1.1498	36.2722*
2	vs	11	1.869	1.4939	9.8566*	2	vs	11	0.6426	0.5382	7.4651*
3	vs	4	2.2224	2.1641	1.5330	3	vs	4	1.1329	0.3241	57.8472*
3	vs	5	2.2224	1.7546	12.2944*	3	vs	5	1.1329	0.5694	40.3013*
3	vs	6	2.2224	1.4219	21.0407*	3	vs	6	1.1329	0.6124	37.2262*
3	vs	7	2.2224	2.5571	8.7947*	3	vs	7	1.1329	1.2102	5.5277*
3	vs	8	2.2224	2.1876	0.9166	3	vs	8	1.1329	0.8118	22.9661*
3	vs	9	2.2224	2.9361	18.7571*	3	vs	9	1.1329	1.4273	21.0555*
3	vs	10	2.2224	2.6538	11.3363*	3	vs	10	1.1329	1.1498	1.2044
3	vs	11	2.2224	1.4939	19.1464*	3	vs	11	1.1329	0.5382	42.5329*
4	vs	5	2.1641	1.7546	10.7615*	4	vs	5	0.3241	0.5694	17.5459*
4	vs	6	2.1641	1.4219	19.5078*	4	vs	6	0.3241	0.6124	20.6210*
4	vs	7	2.1641	2.5571	10.3276*	4	vs	7	0.3241	1.2102	63.3749*
4	vs	8	2.1641	2.1876	0.6164	4	vs	8	0.3241	0.8118	34.8811*
4	vs	9	2.1641	2.9361	20.2901*	4	vs	9	0.3241	1.4273	78.9027*
4	vs	10	2.1641	2.6538	12.8692*	4	vs	10	0.3241	1.1498	59.0516*
4	vs	11	2.1641	1.4939	17.6135*	4	vs	11	0.3241	0.5382	15.3143*
5	vs	6	1.7546	1.4219	8.7463*	5	vs	6	0.5694	0.6124	3.0751
5	vs	7	1.7546	2.5571	21.0891*	5	vs	7	0.5694	1.2102	45.8290*
5	vs	8	1.7546	2.1876	11.3779*	5	vs	8	0.5694	0.8118	17.3352*
5	vs	9	1.7546	2.9361	31.0515*	5	vs	9	0.5694	1.4273	61.3568*

Unsafe Measure						HOS Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
5	vs	10	1.7546	2.6538	23.6307*	5	vs	10	0.5694	1.1498	41.5057*
5	vs	11	1.7546	1.4939	6.8520*	5	vs	11	0.5694	0.5382	2.2316
6	vs	7	1.4219	2.5571	29.8354*	6	vs	7	0.6124	1.2102	42.7540*
6	vs	8	1.4219	2.1876	20.1242*	6	vs	8	0.6124	0.8118	14.2601*
6	vs	9	1.4219	2.9361	39.7978*	6	vs	9	0.6124	1.4273	58.2817*
6	vs	10	1.4219	2.6538	32.3770*	6	vs	10	0.6124	1.1498	38.4306*
6	vs	11	1.4219	1.4939	1.8943	6	vs	11	0.6124	0.5382	5.3067*
7	vs	8	2.5571	2.1876	9.7112*	7	vs	8	1.2102	0.8118	28.4938*
7	vs	9	2.5571	2.9361	9.9624*	7	vs	9	1.2102	1.4273	15.5277*
7	vs	10	2.5571	2.6538	2.5416	7	vs	10	1.2102	1.1498	4.3234
7	vs	11	2.5571	1.4939	27.9411*	7	vs	11	1.2102	0.5382	48.0607*
8	vs	9	2.1876	2.9361	19.6736*	8	vs	9	0.8118	1.4273	44.0216*
8	vs	10	2.1876	2.6538	12.2528*	8	vs	10	0.8118	1.1498	24.1705*
8	vs	11	2.1876	1.4939	18.2299*	8	vs	11	0.8118	0.5382	19.5668*
9	vs	10	2.9361	2.6538	7.4208*	9	vs	10	1.4273	1.1498	19.8511*
9	vs	11	2.9361	1.4939	37.9035*	9	vs	11	1.4273	0.5382	63.5884*
10	vs	11	2.6538	1.4939	30.4827*	10	vs	11	1.1498	0.5382	43.7373*

Table 16. Commodity and firm safety performance – driver fitness and controlled substances/alcohol

Driver Fitness Measure						Controlled Substance Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	0.3535	0.3882	3.0923	1	vs	2	0.0127	0.0082	2.6964
1	vs	3	0.3535	0.5362	16.2884*	1	vs	3	0.0127	0.0137	0.5910
1	vs	4	0.3535	0.3555	0.1803	1	vs	4	0.0127	0.0109	1.0643
1	vs	5	0.3535	0.5064	13.6266*	1	vs	5	0.0127	0.0107	1.1955
1	vs	6	0.3535	0.5767	19.8934*	1	vs	6	0.0127	0.012	0.4205
1	vs	7	0.3535	0.443	7.9807*	1	vs	7	0.0127	0.0123	0.2761
1	vs	8	0.3535	0.3179	3.1651	1	vs	8	0.0127	0.0087	2.3799
1	vs	9	0.3535	0.2344	10.6067*	1	vs	9	0.0127	0.0124	0.1865
1	vs	10	0.3535	0.2177	12.0979*	1	vs	10	0.0127	0.0093	2.0306
1	vs	11	0.3535	0.6135	23.1711*	1	vs	11	0.0127	0.0135	0.4432
2	vs	3	0.3882	0.5362	13.1961*	2	vs	3	0.0082	0.0137	3.2874
2	vs	4	0.3882	0.3555	2.9120	2	vs	4	0.0082	0.0109	1.6321
2	vs	5	0.3882	0.5064	10.5343*	2	vs	5	0.0082	0.0107	1.5009
2	vs	6	0.3882	0.5767	16.8011*	2	vs	6	0.0082	0.012	2.2759
2	vs	7	0.3882	0.443	4.8884*	2	vs	7	0.0082	0.0123	2.4203
2	vs	8	0.3882	0.3179	6.2574*	2	vs	8	0.0082	0.0087	0.3165
2	vs	9	0.3882	0.2344	13.6990*	2	vs	9	0.0082	0.0124	2.5099
2	vs	10	0.3882	0.2177	15.1902*	2	vs	10	0.0082	0.0093	0.6658
2	vs	11	0.3882	0.6135	20.0788*	2	vs	11	0.0082	0.0135	3.1396
3	vs	4	0.5362	0.3555	16.1081*	3	vs	4	0.0137	0.0109	1.6553
3	vs	5	0.5362	0.5064	2.6618	3	vs	5	0.0137	0.0107	1.7865
3	vs	6	0.5362	0.5767	3.6050	3	vs	6	0.0137	0.012	1.0115
3	vs	7	0.5362	0.443	8.3077*	3	vs	7	0.0137	0.0123	0.8671
3	vs	8	0.5362	0.3179	19.4535*	3	vs	8	0.0137	0.0087	2.9709
3	vs	9	0.5362	0.2344	26.8951*	3	vs	9	0.0137	0.0124	0.7775
3	vs	10	0.5362	0.2177	28.3863*	3	vs	10	0.0137	0.0093	2.6216
3	vs	11	0.5362	0.6135	6.8827*	3	vs	11	0.0137	0.0135	0.1478
4	vs	5	0.3555	0.5064	13.4463*	4	vs	5	0.0109	0.0107	0.1312
4	vs	6	0.3555	0.5767	19.7131*	4	vs	6	0.0109	0.012	0.6439
4	vs	7	0.3555	0.443	7.8004*	4	vs	7	0.0109	0.0123	0.7882
4	vs	8	0.3555	0.3179	3.3454	4	vs	8	0.0109	0.0087	1.3156
4	vs	9	0.3555	0.2344	10.7870*	4	vs	9	0.0109	0.0124	0.8778
4	vs	10	0.3555	0.2177	12.2782*	4	vs	10	0.0109	0.0093	0.9663
4	vs	11	0.3555	0.6135	22.9908*	4	vs	11	0.0109	0.0135	1.5075
5	vs	6	0.5064	0.5767	6.2668*	5	vs	6	0.0107	0.012	0.7750
5	vs	7	0.5064	0.443	5.6459*	5	vs	7	0.0107	0.0123	0.9194
5	vs	8	0.5064	0.3179	16.7918*	5	vs	8	0.0107	0.0087	1.1844

Driver Fitness Measure						Controlled Substance Measure					
Group	**Vs**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**	**Group**	**Vs**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**
5	vs	9	0.5064	0.2344	24.2333*	5	vs	9	0.0107	0.0124	1.0090
5	vs	10	0.5064	0.2177	25.7245*	5	vs	10	0.0107	0.0093	0.8351
5	vs	11	0.5064	0.6135	9.5444*	5	vs	11	0.0107	0.0135	1.6387
6	vs	7	0.5767	0.443	11.9127*	6	vs	7	0.012	0.0123	0.1444
6	vs	8	0.5767	0.3179	23.0585*	6	vs	8	0.012	0.0087	1.9595
6	vs	9	0.5767	0.2344	30.5001*	6	vs	9	0.012	0.0124	0.2339
6	vs	10	0.5767	0.2177	31.9913*	6	vs	10	0.012	0.0093	1.6101
6	vs	11	0.5767	0.6135	3.2777	6	vs	11	0.012	0.0135	0.8636
7	vs	8	0.443	0.3179	11.1458*	7	vs	8	0.0123	0.0087	2.1039
7	vs	9	0.443	0.2344	18.5874*	7	vs	9	0.0123	0.0124	0.0896
7	vs	10	0.443	0.2177	20.0786*	7	vs	10	0.0123	0.0093	1.7545
7	vs	11	0.443	0.6135	15.1904*	7	vs	11	0.0123	0.0135	0.7193
8	vs	9	0.3179	0.2344	7.4416*	8	vs	9	0.0087	0.0124	2.1934
8	vs	10	0.3179	0.2177	8.9328*	8	vs	10	0.0087	0.0093	0.3493
8	vs	11	0.3179	0.6135	26.3362*	8	vs	11	0.0087	0.0135	2.8231
9	vs	10	0.2344	0.2177	1.4912	9	vs	10	0.0124	0.0093	1.8441
9	vs	11	0.2344	0.6135	33.7778*	9	vs	11	0.0124	0.0135	0.6297
10	vs	11	0.2177	0.6135	35.2690*	10	vs	11	0.0093	0.0135	2.4738

Table 17. Commodity and firm safety performance – vehicle maintenance and hazardous materials compliance

Vehicle Maintenance Measure						HAZ Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	6.4802	6.5009	0.3988	1	vs	2	2.0155	2.205	0.5971
1	vs	3	6.4802	6.2231	4.9724*	1	vs	3	2.0155	2.4069	1.2330
1	vs	4	6.4802	9.3795	56.0582*	1	vs	4	2.0155	8.489	20.3935*
1	vs	5	6.4802	6.5714	1.7622	1	vs	5	2.0155	2.1875	0.5419
1	vs	6	6.4802	7.5245	20.1922*	1	vs	6	2.0155	3.8461	5.7672*
1	vs	7	6.4802	6.692	4.0953	1	vs	7	2.0155	2.0612	0.1440
1	vs	8	6.4802	7.4182	18.1363*	1	vs	8	2.0155	2.2109	0.6158
1	vs	9	6.4802	6.0648	8.0327*	1	vs	9	2.0155	1.4124	1.8999
1	vs	10	6.4802	5.6774	15.5222*	1	vs	10	2.0155	1.7398	0.8685
1	vs	11	6.4802	7.9357	28.1420*	1	vs	11	2.0155	3.6179	5.0481*
2	vs	3	6.5009	6.2231	5.3712*	2	vs	3	2.205	2.4069	0.6359
2	vs	4	6.5009	9.3795	55.6593*	2	vs	4	2.205	8.489	19.7964*
2	vs	5	6.5009	6.5714	1.3633	2	vs	5	2.205	2.1875	0.0552
2	vs	6	6.5009	7.5245	19.7934*	2	vs	6	2.205	3.8461	5.1701*
2	vs	7	6.5009	6.692	3.6965	2	vs	7	2.205	2.0612	0.4531
2	vs	8	6.5009	7.4182	17.7375*	2	vs	8	2.205	2.2109	0.0187
2	vs	9	6.5009	6.0648	8.4315*	2	vs	9	2.205	1.4124	2.4970
2	vs	10	6.5009	5.6774	15.9211*	2	vs	10	2.205	1.7398	1.4656
2	vs	11	6.5009	7.9357	27.7432*	2	vs	11	2.205	3.6179	4.4510
3	vs	4	6.2231	9.3795	61.0306*	3	vs	4	2.4069	8.489	19.1605*
3	vs	5	6.2231	6.5714	6.7346*	3	vs	5	2.4069	2.1875	0.6912
3	vs	6	6.2231	7.5245	25.1646*	3	vs	6	2.4069	3.8461	4.5342
3	vs	7	6.2231	6.692	9.0677*	3	vs	7	2.4069	2.0612	1.0890
3	vs	8	6.2231	7.4182	23.1087*	3	vs	8	2.4069	2.2109	0.6172
3	vs	9	6.2231	6.0648	3.0603	3	vs	9	2.4069	1.4124	3.1329
3	vs	10	6.2231	5.6774	10.5498*	3	vs	10	2.4069	1.7398	2.1015
3	vs	11	6.2231	7.9357	33.1144*	3	vs	11	2.4069	3.6179	3.8151
4	vs	5	9.3795	6.5714	54.2960*	4	vs	5	8.489	2.1875	19.8516*
4	vs	6	9.3795	7.5245	35.8659*	4	vs	6	8.489	3.8461	14.6263*
4	vs	7	9.3795	6.692	51.9629*	4	vs	7	8.489	2.0612	20.2495*
4	vs	8	9.3795	7.4182	37.9219*	4	vs	8	8.489	2.2109	19.7777*
4	vs	9	9.3795	6.0648	64.0909*	4	vs	9	8.489	1.4124	22.2934*
4	vs	10	9.3795	5.6774	71.5804*	4	vs	10	8.489	1.7398	21.2620*
4	vs	11	9.3795	7.9357	27.9162*	4	vs	11	8.489	3.6179	15.3454*
5	vs	6	6.5714	7.5245	18.4301*	5	vs	6	2.1875	3.8461	5.2253*
5	vs	7	6.5714	6.692	2.3332	5	vs	7	2.1875	2.0612	0.3978
5	vs	8	6.5714	7.4182	16.3741*	5	vs	8	2.1875	2.2109	0.0740

Vehicle Maintenance Measure						HAZ Measure					
Group	**Vs**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**	**Group**	**Vs**	**Group**	**Group Mean**	**Group Mean**	**HSD-test**
5	vs	9	6.5714	6.0648	9.7949*	5	vs	9	2.1875	1.4124	2.4418
5	vs	10	6.5714	5.6774	17.2844*	5	vs	10	2.1875	1.7398	1.4104
5	vs	11	6.5714	7.9357	26.3798*	5	vs	11	2.1875	3.6179	4.5063
6	vs	7	7.5245	6.692	16.0969*	6	vs	7	3.8461	2.0612	5.6231*
6	vs	8	7.5245	7.4182	2.0559	6	vs	8	3.8461	2.2109	5.1513*
6	vs	9	7.5245	6.0648	28.2249*	6	vs	9	3.8461	1.4124	7.6671*
6	vs	10	7.5245	5.6774	35.7145*	6	vs	10	3.8461	1.7398	6.6357*
6	vs	11	7.5245	7.9357	7.9498*	6	vs	11	3.8461	3.6179	0.7190
7	vs	8	6.692	7.4182	14.0410*	7	vs	8	2.0612	2.2109	0.4718
7	vs	9	6.692	6.0648	12.1280*	7	vs	9	2.0612	1.4124	2.0439
7	vs	10	6.692	5.6774	19.6175*	7	vs	10	2.0612	1.7398	1.0126
7	vs	11	6.692	7.9357	24.0467*	7	vs	11	2.0612	3.6179	4.9041*
8	vs	9	7.4182	6.0648	26.1690*	8	vs	9	2.2109	1.4124	2.5157
8	vs	10	7.4182	5.6774	33.6585*	8	vs	10	2.2109	1.7398	1.4843
8	vs	11	7.4182	7.9357	10.0057*	8	vs	11	2.2109	3.6179	4.4323
9	vs	10	6.0648	5.6774	7.4895*	9	vs	10	1.4124	1.7398	1.0314
9	vs	11	6.0648	7.9357	36.1747*	9	vs	11	1.4124	3.6179	6.9480*
10	vs	11	5.6774	7.9357	43.6642*	10	vs	11	1.7398	3.6179	5.9166*

Table 18. Commodity and firm safety performance – crash indicator

Crash Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	1.0424	0.8455	9.5307*
1	vs	3	1.0424	1.0962	2.6087
1	vs	4	1.0424	1.3304	13.9476*
1	vs	5	1.0424	0.7952	11.9681*
1	vs	6	1.0424	0.6836	17.3707*
1	vs	7	1.0424	1.1144	3.4893
1	vs	8	1.0424	0.9926	2.4110
1	vs	9	1.0424	0.8901	7.3755*
1	vs	10	1.0424	0.7135	15.9255*
1	vs	11	1.0424	0.7894	12.2516*
2	vs	3	0.8455	1.0962	12.1394*
2	vs	4	0.8455	1.3304	23.4783*
2	vs	5	0.8455	0.7952	2.4373
2	vs	6	0.8455	0.6836	7.8400*
2	vs	7	0.8455	1.1144	13.0200*
2	vs	8	0.8455	0.9926	7.1197*
2	vs	9	0.8455	0.8901	2.1552
2	vs	10	0.8455	0.7135	6.3948*
2	vs	11	0.8455	0.7894	2.7209
3	vs	4	1.0962	1.3304	11.3389*
3	vs	5	1.0962	0.7952	14.5767*
3	vs	6	1.0962	0.6836	19.9794*
3	vs	7	1.0962	1.1144	0.8806
3	vs	8	1.0962	0.9926	5.0196*
3	vs	9	1.0962	0.8901	9.9842*
3	vs	10	1.0962	0.7135	18.5342*
3	vs	11	1.0962	0.7894	14.8603*
4	vs	5	1.3304	0.7952	25.9156*
4	vs	6	1.3304	0.6836	31.3183*
4	vs	7	1.3304	1.1144	10.4583*
4	vs	8	1.3304	0.9926	16.3585*
4	vs	9	1.3304	0.8901	21.3231*
4	vs	10	1.3304	0.7135	29.8731*
4	vs	11	1.3304	0.7894	26.1992*
5	vs	6	0.7952	0.6836	5.4026*
5	vs	7	0.7952	1.1144	15.4573*
5	vs	8	0.7952	0.9926	9.5571*

Crash Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test
5	vs	9	0.7952	0.8901	4.5926*
5	vs	10	0.7952	0.7135	3.9574
5	vs	11	0.7952	0.7894	0.2836
6	vs	7	0.6836	1.1144	20.8600*
6	vs	8	0.6836	0.9926	14.9597*
6	vs	9	0.6836	0.8901	9.9952*
6	vs	10	0.6836	0.7135	1.4452
6	vs	11	0.6836	0.7894	5.1191*
7	vs	8	1.1144	0.9926	5.9003*
7	vs	9	1.1144	0.8901	10.8648*
7	vs	10	1.1144	0.7135	19.4148*
7	vs	11	1.1144	0.7894	15.7409*
8	vs	9	0.9926	0.8901	4.9645*
8	vs	10	0.9926	0.7135	13.5145*
8	vs	11	0.9926	0.7894	9.8407*
9	vs	10	0.8901	0.7135	8.5500*
9	vs	11	0.8901	0.7894	4.8761*
10	vs	11	0.7135	0.7894	3.6739

Table 19. Ownership classification – firm safety

Driver OOS Rate						Vehicle OOS Rate					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	0.0687	0.0817	17.3124*	1	vs	2	0.223	0.2906	51.9638*
1	vs	3	0.0687	0.0857	22.6184*	1	vs	3	0.223	0.3318	83.5818*
1	vs	4	0.0687	0.081	16.3329*	1	vs	4	0.223	0.259	27.6718*
2	vs	3	0.0817	0.0857	5.3061*	2	vs	3	0.2906	0.3318	31.6180*
2	vs	4	0.0817	0.081	0.9795	2	vs	4	0.2906	0.259	24.2920*
3	vs	4	0.0857	0.081	6.2855*	3	vs	4	0.3318	0.259	55.9100*

Unsafe Measure						HOS Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	2.2635	2.3536	4.8905*	1	vs	2	0.9436	1.0794	20.1082*
1	vs	3	2.2635	1.099	63.2068*	1	vs	3	0.9436	0.5704	55.2864*
1	vs	4	2.2635	1.7568	27.5049*	1	vs	4	0.9436	0.5217	62.4889*
2	vs	3	2.3536	1.099	68.0972*	2	vs	3	1.0794	0.5704	75.3947*
2	vs	4	2.3536	1.7568	32.3953*	2	vs	4	1.0794	0.5217	82.5972*
3	vs	4	1.099	1.7568	35.7019*	3	vs	4	0.5704	0.5217	7.2025*

Vehicle Measure						Driver Fitness Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	5.6531	7.4912	71.6030*	1	vs	2	0.298	0.3671	12.0065*
1	vs	3	5.6531	7.6071	76.1188*	1	vs	3	0.298	0.6061	53.5181*
1	vs	4	5.6531	6.5006	33.0166*	1	vs	4	0.298	0.5777	48.5883*
2	vs	3	7.4912	7.6071	4.5157*	2	vs	3	0.3671	0.6061	41.5116*
2	vs	4	7.4912	6.5006	38.5865*	2	vs	4	0.3671	0.5777	36.5818*
3	vs	4	7.6071	6.5006	43.1022*	3	vs	4	0.6061	0.5777	4.9298*

Controlled Substance Measure						Crash Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test	Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	0.013	0.0126	0.4387	1	vs	2	0.541	1.0901	60.1603*
1	vs	3	0.013	0.0129	0.1234	1	vs	3	0.541	0.4309	12.0538*
1	vs	4	0.013	0.0134	0.4265	1	vs	4	0.541	1.0272	53.2649*
2	vs	3	0.0126	0.0129	0.3153	2	vs	3	1.0901	0.4309	72.2141*
2	vs	4	0.0126	0.0134	0.8652	2	vs	4	1.0901	1.0272	6.8954*
3	vs	4	0.0129	0.0134	0.5499	3	vs	4	0.4309	1.0272	65.3187*

HAZ Measure					
Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	1.8874	2.5784	9.3496*
1	vs	3	1.8874	2.9313	14.1254*
1	vs	4	1.8874	2.2638	5.0930*
2	vs	3	2.5784	2.9313	4.7758*
2	vs	4	2.5784	2.2638	4.2566*
3	vs	4	2.9313	2.2638	9.0324*

Crash Rate (Miles)					
Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	0.0026	0.0024	1.0171
1	vs	3	0.0026	0.0016	6.5595*
1	vs	4	0.0026	0.0014	7.4563*
2	vs	3	0.0024	0.0016	5.5424*
2	vs	4	0.0024	0.0014	6.4392*
3	vs	4	0.0016	0.0014	0.8968

Crash Rate					
Group	Vs	Group	Group Mean	Group Mean	HSD-test
1	vs	2	0.0324	0.0312	3.7461*
1	vs	3	0.0324	0.016	50.5932*
1	vs	4	0.0324	0.0162	49.8994*
2	vs	3	0.0312	0.016	46.8471*
2	vs	4	0.0312	0.0162	46.1533*
3	vs	4	0.016	0.0162	0.6938