A study of the relationship between Firm Size and Safety Performance in the US motor carrier industry

Dr. David Cantor
Associate Professor of Supply Chain Management
College of Business
Iowa State University

Prab Singh
Doctoral Student in Supply Chain Management
College of Business
Iowa State University

Safety performance of US motor carriers- A serious threat

In March 2007, FMCSA (Federal Motor Carrier Safety Administration)conducted a study and reported that

- costs per non-fatal injury crash averaged $195,258, and
- average cost of fatal crashes was $3,604,518 per crash

The cost estimates exclude mental health care costs for crash victims, roadside furniture repair costs, cargo delays, earnings lost by family and friends caring for the injured, and the value of schoolwork lost.

Source: FMCSA March 2007

Literature Review

1) Organizational characteristics of the firm and the relationship to safety performance

2) Characteristics of the motor carrier driver and safety performance

Literature Review

- Transportation Journal
- Transportation Research Part E
- Journal of Business Logistics
- Safety Science
- International Journal of Logistics Management

Gap in Literature

- Scant theoretical attention to the important role of firm size on motor carrier safety performance
- Lack of recent empirical attention on size and safety relationship.
- There are important implications from a societal and public policy perspective.

Theoretical Lens

Resource Based View (RBV)

Schumpeterian economics

Hypothesis

Hypothesis 1: *As firm size increases, the firm's safety performance improves*

Hypothesis 2: *The positive effect of firm size on safety performance will vary across industry operating segments*

Data & Methodology

108,780 motor carriers -- FMCSA's Management Information System Database (MCMIS) and Safety Measurement System (SMS)

SMS measures motor carrier safety performance in following Behavioral Analysis and Safety Improvement Categories (BASICs):

- **Crash Indicator-** reflects the firm's history of crash involvement.
- **Unsafe Driving-** carrier's record in the area of dangerous or careless driving violation
- **Hours-of-service compliance-** compiled from a record of a carrier's compliance with the hours-of-service regulations
- **Driver fitness-** a rating of the firm's fitness of its drivers and the carrier's compliance with the medical certification of its drivers
- **Vehicle Maintenance-** rates the firm's compliance with regulations dealing with the operating condition of the vehicle, i.e., tires, brakes, and other major engine systems

The percentile rank is a score from 0 to 100, with 100 indicating the worst performance

Predictor Variables

- Firm Size- firm's number of power units
- Carrier operating segment/commodity segment such as general freight, large machinery, passenger, intermodal etc.

Other Variables

- Fleet ownership

Owned tractors	= owned tractors/total tractors
Leased(term)tractors	= leased tractors/total tractors

Results

	Model: Crash Indicator	Model: Crash Percentile
Intercept	470.69*** (86.83)	43158.89*** (3791.22)
Firm Size	**-0.0595***** **(0.0076)**	**-2.3***** **(0.21367)**
% Owned Tractors	2.29** (0.87123)	121.38** (38.04)
% Term Tractors	-1.6* (0.88059)	-8.3 (38.38)
Model Statistics		
N	38051	17126
F-Statistics	264.22***	216.12***
R Squared (Overall)	0.0204	0.0365

Note: *p<0.10, **p<0.05, ***p<0.001

Beta coefficients are multiple of 1,000

	Crash Percentile	Vehicle Percentile	Unsafe Percentile	HOS Percentile
Firm Size X General Freight	+***	+***	+***	+***
Firm Size X Household Goods	-***	-(NS)	-***	-**
Firm Size X Building Materials	-**	-**	-**	-***
Firm Size X Large Machinery	-***	-***	-***	-***
Firm Size X Fresh Produce	-*	-***	-**	-*
Firm Size X Intermodal	-(NS)	+(NS)	-(NS)	-*
Firm Size X Passenger	+**	+**	+**	+*
Firm Size X Dry Bulk	-(NS)	-*	-**	-***
Firm Size X Refrigerated	-**	-***	-***	-***

Note: *p<0.10, **p<0.05, ***p<0.001, NS-Not Significant

Discussion-I

- Provided theoretical insights into the size and safety relationship.
- Presented new empirical evidence using latest FMCSA data.
- Found size and safety relationship controlling for tractor ownership and commodity segments.
- Equipment ownership has a significant to both the Crash Indicator measure and the Crash Indicator percentile.

Discussion-II

Firm size and interactions terms with segments household goods, building materials, large machinery, fresh produce, dry bulk, and refrigerated services had significant and negative relationship.

The interaction terms between firm size and segments: general freight and passengers group, had significant and positive relationship.

Conclusion

Our results have demonstrated that

1) There is a significant and positive relationship between firm size and improved safety performance as measured through carrier's number of crashes, its unsafe driving violations, hours-of-service compliance, vehicle maintenance violations.

2) Impact of the size of the firm on safety performance varies according to industry segment.

Questions?