

STC Research Project Description

Project Title: Safety Outcomes, Driver Compensation, and Trucking Firm Financial Performance

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Project Start Date: January 1, 2003

End Date: December 31, 2003

Other Milestones, Dates:

Modeling and analysis: April 1, 2003

Draft report and paper: July 30, 2003

Final report and presentation: December 1, 2003

Project Objectives:

- Synthesize the current knowledge regarding carrier operation and financial factors associated with safety performance and develop/refine hypotheses regarding the effects of explanatory variables on the outcomes of interest;
 - Combine three different sources of data to explore relationships safety performance measures and available explanatory variables at the firm level of analysis;
 - Conduct simple descriptive data analysis, e.g., use cross-tabulations to explore the data;
 - Use statistical models known as “structural equations models” to explore simultaneously the hypothesized relationships and to determine the direct and indirect effects of each explanatory variable;
 - Examine the implications of the result for firms, policy-makers, and society;
 - Deliver a finished product in a final report and prepare a paper for presentation at the *Transportation Research Board* or the *Journal of Transportation and Statistics*. Publication of the results of this research in the form of a journal article is a dissemination priority. A special effort will be made to disseminate these results to trucking firms, via trade journals, the World Wide Web, and trucking associations among others.
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Project Abstract:

This research proposes the application of structural equation models to examine the relationship between the financial performance of truckload firms, truck driver compensation, and safety outcomes of firms. The hypothesis is that firms that devote more resources to compensate drivers monetarily have better safety outcomes, after controlling for other factors such as firm size, unionization, and average driver human capital characteristics. Prior research (see for example, Corsi et al 2002) has examined these relationships using correlation analysis or ordinary least squares regression, without exploring in more detail issues of simultaneity and potential spurious effects. The structural relationships in the model will be estimated by means of data collected by a private firm (Signpost), supplemented by a survey of firms conducted by the University of Michigan Trucking

Industry Project in the year 2000, and by publicly available information supplied by truckload firms to the US Department of Transportation for the same year using the "Form M." The three sources of data are readily available to the PI for conducting the research. This research actively supports three of the five programmatic research areas highlighted by the Federal Motor Carrier Safety Administration: Driver Safety Performance, Carrier Compliance and Safety, and Crosscutting Initiatives. The results are expected to further support activities by improving the safety of trucking operations in North America. Ultimately the results will point to strategies (combinations of countermeasures and policies) that can help reduce truck-involved crashes, thereby creating tangible benefits for trucking firms and for the driving public.

Task Description:

Task 1—Data Acquisition and Preparation

The relevant data will be obtained through three different sources: a) A private firm (Signpost); b) A survey conducted by the University of Michigan Trucking Industry Project in the year 2000; c) Publicly available information supplied by truckload firms to the US Department of Transportation for the same year via "Form M". The three sources of data are readily available to the principal investigator for conducting the research. The dataset will be rich because it will contain financial indicators, human resources, operations, and safety data from approximately 200 truckload firms of various sizes.

Task 2—Data Analysis of Truck Crashes

We will conduct univariate analyses for exploring the distribution of variables and descriptive statistics. Multivariate analyses will help us understand first-order correlations in our data. In addition to uni- and bi-variate methods, we will use structural equation modeling. Structural equation modeling (SEM) grows out of and serves as an alternative to multiple regression but in a more powerful way. SEM takes into account the modeling of interaction and nonlinearities, correlated independent variables, measurement error, correlated error terms, multiple latent variables, and independent variables each measured by multiple indicators, among others. Advantages of SEM compared to multiple regression include more flexible assumptions (particularly allowing interpretation even in the presence of multicollinearity), reduction of measurement error by having multiple indicators per latent variable, the ability to model interaction terms, the SEM's graphical modeling interface (such as the one presented in figure 1), the desirability of simultaneous estimation of overall rather than individual coefficients, the ability to model mediating variables, and the ability to model multiple paths and terms.

For such reasons, SEM is a very popular methodology in social sciences. A very readable introduction to the subject, with good coverage of assumptions and SEM's relation to underlying regression, factor, and other statistical techniques can be found in Kline's book (Kline, R., 1998).

Task 3—Reporting and Dissemination (see below)

Total Budget: \$ 19,999.00 (10,002 match, 9,997 from STC)

Student Involvement (Thesis, Assistantships, Paid Employment): Marta Rocha will develop her Master's thesis on this topic.

Relationship to Other Projects: Directly related to STC-funded project: "Understanding the Role of Truck-Driver, Occupational and High-Risk Roadway Factors in Truck-Involved Collisions". Several results of the first project prompted the hypotheses being tested with this research.

Technology Transfer Activities:

- The findings will be reported to STC in a final report.
- Based on the findings, we will write a paper for presentation and publication at the *Transportation Research Board* or the *Journal of Transportation and Statistics*. (Other scholarly journals and conference venues (such as the STC large truck safety conference) will also be considered, depending on the evolution of the project and the final results.)
- The findings will be available on the Internet at the Southeastern Transportation Center and Department of City and Regional Planning websites.
- The findings will also be disseminated to the relevant federal and state agencies (e.g., Federal Motor Carrier Safety Administration). A special effort will be made to disseminate these results to trucking firms, via trade journals (e.g., Commercial Carrier Journal, Transport Topics, Traffic World), the world wide web, and special organizations (e.g., American Trucking Association, Independent Owner-Operator Association).

Potential Benefits of Project:

The project will develop a deeper and more comprehensive understanding of the key factors associated with firm's safety outcomes. The research will provide quantitative information about the firm characteristics that are correlated with the occurrence of truck-involved crashes. A more complete view of the truck driver factors developed through rigorous SEM analysis will help us identify the strategies and combinations of policies and countermeasures that are likely to be most effective for firms. With our results, policy-makers will be better equipped to formulate policies at the national and regional levels in order to improve trucking safety. The methodological contribution will come from using structural equation modeling applied on transportation safety problems. Aside from the academic contribution, the value of the research will come from the implications for driver hours, driver training, operating policy improvements, safety enforcement and technological improvements such as collision avoidance and warning. The trucking industry is likely to benefit from knowing how should they allocate their resources in order to have better safety performance. The research is also expected to provide results that will support activities by the Federal Motor Carrier Safety Administration in improving the safety of trucking operations in North America. Ultimately the results will point to strategies (combinations of countermeasures and policies) that can help reduce truck-involved crashes, thereby creating tangible benefits for trucking firms and for the driving public.

TRB Keywords: truck safety, compensation, firm performance, driver pay