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Federal motor carrier safety policy: reducing fatalities with increased financial responsibility

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FEDERAL MOTOR CARRIER SAFETY POLICY:
REDUCING FATALITIES WITH
INCREASED FINANCIAL RESPONSIBILITY

A dissertation presented

by

Robert D. Pritchard

to

the Law, Policy and Society Program

in the partial fulfillment of the requirements for the degree of

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Northeastern University

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ABSTRACT OF DISSERTATION

Submitted in partial fulfillment of the requirements

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Abstract

Each year about 5,000 fatal, 50,000 injury and 100,000 property-damage crashes involve large trucks resulting in social costs exceeding \$32 billion. Social costs for fatal crashes are large (\$6 to \$8 million per crash) yet rare (two to three occurrences per 100 million miles traveled). Federally-mandated liability insurance requirements established in 1983 intend to motivate safety and ensure adequate compensation for damages; hence scrutiny of the \$750,000 minimum insurance requirement is warranted and timely.

Commercial motor vehicle safety policy is designed to reduce losses—particularly the loss of life—while addressing issues of equity and efficiency. Each year more than 1,000 federal employees and \$550 million are dedicated to implementing policy ensuring large truck safety. Regulations combined with post-crash liability impact safety decision-making.

My hypothesis is that firms that boost their financial commitments to reduce crash risk will experience fewer crashes. I use a unique panel data set to test this hypothesis. The data follow 2,100 firms from 1998-2004 and include operational and financial information, crash information and government safety measures for individual motor carriers. Using well-defined motor carrier behavioral models, multivariate econometric analysis provides explanation of variability in crashes using financial and operating characteristics.

Strong evidence supports clear recommendations for federal motor carrier safety policy. These recommendations are: 1) raise the minimum insurance requirement; and, 2) improve the measurement of management safety practices. For the largest portion of the trucking industry, the general freight truckload sector, I found that increases in insurance premiums and claims paid yield decreased fatal crash rates in the future. This evidence suggests that an increase in the

minimum insurance requirement will improve safety and reduce the gap between the cost of crashes borne by injured parties and the motor carrier. Safety scores for drivers and vehicles are closely related to crashes, yet an effective management safety score is absent. An accurate and widely-available management safety score would also improve safety, equity and efficiency.

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I. Introduction

Fewer fatal crashes involving large commercial motor vehicles is the primary goal of Federal motor carrier safety policy. Substantial public resources are currently devoted to reduce all crashes and related economic losses. Both private motor carriers and the general public are impacted by these safety policies. As a result, it is essential to carefully design and regularly evaluate the effectiveness of these policies.

I find strong evidence that suggests an increase in motor carrier financial responsibility reduces the fatal crash rate. Increasing the minimum requirement to \$1,750,000 from \$750,000 is my policy recommendation. With this increase, the gap between the minimum required insurance coverage and crash liability costs is narrowed; this is an improvement in equity. The expected improvements in safety, efficiency (lower fatal crash rate) and equity strongly justify this policy prescription.

My analysis finds that boosting last year's insurance premiums and claims paid reduces the fatal crash rate this year. Unlike insurance experience rating, where past crashes affect future premiums, my findings suggest that motor carriers respond to previously increased liability by improving safety.

A unique dataset including full balance sheet, income statement and operational information for more than 2,100 motor carriers for five years (1999-2003), coupled with crash data and government-generated safety scores for seven years (1998-2004) was assembled for this analysis. Behavioral models of crash rates (dependent variables) were devised to understand the impact of changes in financial and operational measures (explanatory variables). I find that an

increase in the cost of crashes (insurance premiums and claims paid) yield fewer crashes; hence, an increase in the amount of funds required to cover crash costs will yield fewer crashes and greater safety.

Inefficient market outcomes are justification for government intervention. Called market failure by economists, prices and quantities deviate from the outcome with highest social welfare. In motor carriage, market failure is present in several forms; for example, spillover costs are borne by accident victims and asymmetric information causing mispriced insurance premiums. My policy recommendations are focused on correcting these market failures.

I also find strong evidence linking fatal crashes and government-generated carrier-specific safety scores. Substantial resources focus enforcement on high risk operations and generate safety improvements—these activities include collection, analysis and dissemination of carrier-specific crash and regulatory compliance information. The Federal Motor Carrier Safety Administration (FMCSA) is enhancing measures of vehicle, driver and crash experience, yet a measurement of management commitment lags. Focus on motor carrier management safety is both efficient and equitable—new approaches to measure and motivate management decisions are warranted.

The direction for motor carrier safety policy is set by a political calculus with the FMCSA and motor carriers at the center. Motor carrier safety is an important social issue. Current federal policy direction is favorable for implementing my policy recommendations and making the roads safer.

A. The Regulator and the Regulated

Government safety policy shapes motor carrier safety decisions. Myriad rules address all areas of commercial vehicle operations—drivers, vehicles and management, and motor carriers must comply under penalty of law. Common law courts support the adjudication of claims in tort and assign damages to responsible parties; in the case of crashes, negligence is the liability standard for damages to others. Together, ex-ante social regulations and ex-post liability define the legal environment for motor carriers. Safety policy sets this legal environment—encompassing the broad areas of laws and rulemaking. In addition, federal policy directs safety program development, operations and enforcement.

The objective of safety policy is to develop mechanisms that motivate motor carriers to enhance safety. The primary interactions are between the FMCSA and the carrier (a principal-agent relationship) where the agent has a private monopoly of information.¹ This asymmetry of information causes inefficiency and warrants regulatory intervention.

The regulatory regime is led by the FMCSA and federal policy. Congress and the FMCSA intervene in the market to correct market failures and increase social welfare. Fewer fatalities from crashes involving large commercial motor vehicles are the primary goal of federal motor carrier safety policy. To save lives and reduce all crashes and related economic losses, significant public resources are expended, and private parties are impacted with safety policy.

Commercial truck operators make safety decisions. As business enterprises operating in the United States, motor carriers move freight and passengers while rationally maximizing profit. Social regulations set operational constraints and frame the safety decision-making process.

¹ Mechanism design is a form of game theory based on a principle-agent relationship where the principle wants to realize an outcome and the agent has private information. In the case of motor carrier safety policy, the principle (the FMCSA) desires safety and only the agent (the carrier) knows its true safety posture.

Profit is the standard for assessing performance and maximizing the value of the firm over time is the goal of the business owner. Further, motor carriers will respond to changing prices (including the price of crashes)—hence, motor carriers respond to incentives. The goal for the regulator is to then devise incentives for motor carriers to act safely.

B. An Important Social Problem

The loss of life alone makes motor carrier crashes an important social problem. Issues of equity and efficiency also arise from crashes involving the millions of commercial motor vehicles operating on the nation's roadways. Because motor carrier decisions affect the odds and costs of crashes, public policy focused on motor carrier safety behavior can improve social welfare.

Safety efforts affect both the probability and severity of crashes. Motor carrier behavior—not dispatching trucks in a snow storm, hiring only experienced drivers or operating only new trucks—determine the probability of a crash occurrence. The behaviors listed above reduce crash likelihood, while the opposite set of behaviors increases crash likelihood.

My dataset allows me to quantify the financial commitment of motor carriers to address their safety risk. Included in the financial commitment are insurance premiums and liability claims paid as well as safety-related expenses. Indeed, motor carrier safety is an economic good—it is costly to produce and valuable (Lave, 1968; Savage, 1999; Dammen, 2005). Motor carriers face substantial incentives: If the motor carrier decreases its crash losses, the bottom line is improved.

Each year the 5,000 fatal and 50,000 injury crashes involving trucks result in human tragedy and personal loss—Appendix A depicts the story of a multiple fatality crash and its

impact on a family. In addition to harm to individuals, the crashes cause property losses and spillovers to others; in total, about 150,000 crashes involve large trucks (FMCSA, 2010a). Total social cost of accidents involving large trucks exceeds \$32 billion per year.²

Total social costs for fatal crashes are large (\$6 to \$8 million per crash) yet are rare (2.04 occurrences per 100 million miles traveled in 2007).³ Crashes are probabilistic: Each truck trip does not result in a crash, yet generates risk. An unsafe motor carrier could operate for a period of time without being involved in a fatal crash, while a very safe carrier could be involved in a fatal accident in a given year. True safety and crash risk may only be revealed over time and, therefore, public policy that identifies safe and unsafe carriers and insures equitable recovery of damages will improve efficiency and reduce the number of crashes.

Motor carrier safety decisions result in costs borne by others.⁴ Motor carriers that excessively discount future crash liability increase risk and cause market failure.⁵ For example, a motor carrier in financial distress may forgo scheduled maintenance or exceed speed limits. The small probability of major crash loss combined with low required responsibility may also result in an under-provision of safety.

Only motor carriers know their true level of safety, yet it is of interest to others—service providers (notably insurance providers) and shippers, as well as the public interest and the regulatory agencies. This asymmetry in information also yields inefficiency. Not being able to

²Crash cost estimates from Zaloshnja and Miller (2007) and author's calculation from crash data (FMCSA, 2010a).

³Fatal crash rates from National Highway and Transportation Safety Administration (NHTSA, 2009); vehicle miles traveled (VMT) data from the Federal Highway Administration (FHWA); recent USDOT planning guidance set the value of a statistical life at \$5.8 million (USDOT, 2009).

⁴Costs borne by third-parties (externalities) are one form of market failure. Savage (1999) details externalities and identifies other market failures: Asymmetric information, myopic behavior and bilateral crashes (responsibility of other parties inappropriately attributable to carriers). The under provision of public goods is also a market failure.

⁵Myopic behavior occurs when a carrier under provides safety because future liability costs are valued less than current cost savings from reduced safety expenditures.

initially differentiate between safe and unsafe carriers, insurance providers will charge an average premium, hence overcharging safe carriers and undercharging unsafe carriers. Similarly, shippers willing to pay a premium for safe service will not be able to easily differentiate safe from unsafe motor carriers and an inefficient pricing problem is created.

My research focuses on a specific law—the minimum financial requirement (Title 49 Code of Federal Regulations §387.7). This social regulation requires that all interstate motor carriers maintain \$750,000 in liability coverage—either in the form of insurance coverage or via a guaranteed financial commitment. It is intended to provide incentive for motor carriers to act more safely and to ensure that motor carriers compensate others for damages when liable.

Non-compliance with the minimum financial requirement regulation is an important indicator of risk and has also been linked to increased crashes. Failure to comply with §387.7 is considered so serious that it requires immediate corrective action and has recently been deemed one of the 15 “deadly sins” by safety experts.⁶ Further, recent FMCSA analysis found an association between carriers that violate §387.7 and an increased crash rate (FMCSA, 2007a).

Motor carrier safety is an important public health issue: The epidemiological problem is corrected with social regulation (rulemaking and enforcement), facilitating damage recovery by injured parties (legal recourse in state and federal courts), and with the assembly and distribution of firm- and driver-specific safety performance information.

The minimum financial requirement affects both ex-ante social regulation and ex-post liability. The regulation is part of the broad requirements affecting motor carriers: It is a

⁶ Not having minimum liability coverage (violation of §387.7(a)) is considered an “acute” violation; failure to maintain documentation (violation of §387.7(d)) is a considered “critical” violation (these are discussed below); the 15 “deadly sins” were designated as part of FMCSA’s current severity weighting for its new “safety measurement system.”

mechanism that requires liability coverage. Spending on safety activities is a substitute for insurance. With funds set aside for future liability, the nature of adjudication of claims in tort is changed.

The current low level of the financial responsibility requirement appears to create inefficiencies and distorts the provision of safety. Motor carriers bear only 41% of total crash costs (Forkenbrock, 1999).⁷ When full social costs are not borne by responsible parties, behavior is distorted and results in too little safety and too many crashes.

The following details the legal and policy environments that frame this policy analysis. The focus of this analysis is federal policy in the last ten years in the context of the longer-term trend in safety. Prior to 1999, federal policy had become more central with the rising importance of interstate freight and the coordinating role of federal agencies and funding. The last vestiges of state and federal economic regulation that defined trucking for sixty years were removed in 1995.⁸ Motor carrier experts characterize the current era as “Trucking in the Age of Information” where current policy is focused on capturing, analyzing and disseminating safety information.⁹

⁷ Forkenbrock (1999) estimated the total social costs of motor carrier crashes (\$14.8 million per 100 million miles in 1994) and the amount paid by carriers (\$6.09 million per 100 million miles); therefore, 59% of total social costs were not borne by carriers for 1994.

⁸ Prior to 1980, commercial motor vehicle activities were subject to state and federal economic regulation; by setting price and controlling entry into the industry, safety regulation was implicit. Put in place in 1935, economic regulation was believed to generate profit and capital stocks that would insure adequate safety. In fact, following deregulation motor carrier safety improved. The Motor Carrier Act of 1980 deregulated interstate trucking. The interstate trucking industry used the courts to deregulate the industry at the state level; Federal Express was successful in deregulating the California trucking industry with its judicial action. (Federal Express Corp. v. California Public Utility Com., 936 F2d. 1075 (US App. 1991) Congress then preempted all remaining state economic regulations with the Interstate Commerce Commission Termination Act of 1995. With this Act, all safety regulations were also preempted by the federal government.

⁹ Trucking in the Age of Information (Belman and White, 2005) is a compilation of analyses and reports detailing the current structure and performance (including safety and technology) of the trucking industry and is focused on the role of information and related technology.

C. A Policy Opportunity

Signals indicating forthcoming changes to the minimum financial requirement regulations are found in recent FMCSA activities and federal legislation. With the forthcoming federal surface transportation program reauthorization legislation and rulemaking in related regulatory areas, minimum financial responsibility will continue to experience public scrutiny and debate. Further, the current position of the impacted parties would suggest a policy environment supportive of an increase in the minimum level of financial responsibility.

A FMCSA advisory body has recently called for an indexing of the minimum level of financial responsibility to inflation. The current minimums were last revised in 1983, and prices have since nearly doubled. The Motor Carrier Safety Advisory Committee (MCSAC) suggested that minimum standards were outdated and may, in fact, reduce safety; further, indexing the minimum insurance requirements according to inflation was suggested. (MCSAC, 2008:11).

Recent federal legislation called for the application of the minimum financial requirements to private carriers that are currently exempt (Section 4120 SAFETEA-LU 2005). Private carriers are trucking operations not engaged in public for-hire trucking, but rather are dedicated to hauling freight as part of another operation (manufacturing, retail trade, etc.); private carriers are typically owned by the parent operation.

Emerging federal programs are focused primarily on the performance of drivers and vehicles; including a measure of management safety performance is one of my policy recommendations. A recent industry policy paper identifies the ultimate responsibility of the motor carrier for losses related to carrier operations; the American Trucking Associations asserts

that the motor carrier is ultimately responsible for managing driver performance and vehicle safety. (American Trucking Associations, 2009:20)

The recent appointment of Federal Motor Carrier Safety Administrator Anne S. Ferro—the first appointment by a national Democratic party President with both houses of Congress controlled by the Democratic Party—indicates a possible restoration of the policy goals embodied in FMCSA-1999. The goal for the number of fatalities was about 2,700 per year.¹⁰ Achieving such a dramatic reduction in crashes would require new programs and approaches.

Policy change—from the direction of Congress or the FMCSA—will ultimately require federal rulemaking and is subject to public scrutiny. Safety regulators and regulated firms are linked through rulemaking processes and safety enforcement processes: models of industry capture of regulatory processes are applicable.

The opposition to my proposed increase in minimum financial responsibility to \$1,750,000 will likely come from some small motor carriers as they are faced with increased insurance costs of \$1,000-\$1,500 per truck each year. Data regarding the expected increase in premiums come from recent motor carrier industry literature and follow-on phone calls with insurance industry leaders. (Vise, 2003) Large motor carriers insure well above the minimum levels and thus will not be directly impacted; but, indirectly, large carriers will benefit as costs to their competitors rise.

The insurance industry will likely embrace an increase in the minimum financial responsibility requirements and the development of an effective safety management measure. Increased demand for insurance industry products and services will likely result and insurers will

¹⁰ One goal of federal safety policy focuses on fatal crashes: the Clinton administration set the goal of reducing the number of fatalities by 50%; the Bush administration set a goal of reducing the rate of fatal accidents (fatalities per mile traveled) by 50%.

not be subject to increased costs; the impact of more motor carrier information from government sources would only decrease insurance companies' costs.¹¹

Broad dissemination of safety information about motor carrier crash and safety scores is embraced by both government and industry. Additional information reduces the negative costs related to adverse selection for safe firms and increase costs to unsafe firms; government also uses enhanced information to target their enforcement efforts. Safe firms will signal their safety; industry representatives will promote more information in order to advance safe firms and discipline unsafe firms. Safety is a public good: Safety information is also a public good.¹²

II. Background

A. Politics: The Primordial Soup of Safety Policy Formation

Political forces forge motor carrier safety policy. Many models of political interactions and policy formation can be effectively applied: Kingdon's (1984) primordial soup from which policies emerge as interests position their agenda items and await the opportunity to advance their cause. The interaction between the individual regulated entity (the motor carrier and their industry representatives) and the regulating agency (FMCSA) is at the core of this analysis; other parties affect motor carrier safety policy via access to the FMCSA and the United States Congress.

Roadway crashes involving large trucks are the unintended byproducts of our freight transportation system. Between 1987 and 2007, the number of vehicle miles traveled by commercial motor vehicles increased by 67% and the number of fatal crashes declined by

¹¹ The actual amount of insurance purchased following an increased minimum will depend on the price elasticity of demand.

¹² Public goods are non-rival and non-excludible and suffer from free rider problems and under provision: government provision of public goods can add to social welfare.

10%—a reduction in the rate of fatal crashes greater than 50% which is touted by industry as indicative of its exemplary safety performance while it provides a vital role in the nation's economy.

The motor carrier industry portrays the nation's roads as the workplace for more than two million large trucks (typically, a five-axle tractor semi-trailer combination) operating freely interstate. These vehicles carry 87% of the nation's total freight comprising more than nine billion tons and generating trucking revenues exceeding \$610 billion per year (American Trucking Associations, 2006:19). An increasing number of truck vehicle miles traveled represent a growing economy—supporting essential services, job growth and tax revenues.

With the advent of new transportation and information technologies, motor carriage has supported economy-changing just-in-time inventory systems, on-demand manufacturing, on-line retail, etc.: Motor carriers have become efficient logistics players and support improving productivity nationwide. The highly competitive nature of the trucking industry has spawned low-profit margins yet safety has improved (decreasing numbers of crashes and declining crash rate).

Safety advocates portray the nation's roads as the site of carnage—the equivalent of 26 commercial passenger aircraft crashes each year (Claybrook, 2003:3). They argue the death toll of 100 fatalities per week is far too great. The risk to a member of the public—the probability of dying in a crash involving a truck—is the same as the chance of dying in a fire (Savage, 1999:533). Aligned with the safety advocates is the plaintiff's bar—legal advocates for recovery of damages by injured parties—the efficient role is to remedy externalities.

While the current safety policy with its targeted efforts to continue to incrementally reduce the crash rate is fine for industry and regulators, safety advocates object. The same safety data can be used to tell different stories. Motor carrier safety can be measured in terms of actual crashes and the crash rate and can represent different messages: 1) the roads are safe and getting safer; 2) there are too many deaths. The duality of the message and two ends of the policy spectrum define the range of the political issue. The central position is the regulator with direct link to motor carriers (at the roadside; in the terminal; courtroom; in the rulemaking docket).

The three primary policy institutions are: 1) motor carriers (which group together into industry segments based on common operational or organizational characteristics and issues; also, collectively the industry); 2) the FMCSA; and, 3) the United States Congress. The other stakeholders include safety advocates (crash survivors and professional safety advocates), states, and related federal agencies (for example, the National Highway Transportation Safety Administration (NHTSA) and the Occupational Safety and Health Administration (OSHA), etc.).

The central motor carrier safety question is: How much safety is socially and politically optimal? Economic theory indicates that zero fatalities are not optimal: The number of fatalities where marginal cost and marginal benefits are equal is greater than zero. The safety policy goal (5,000 fatalities? 2,500? 1,000? or zero?) is set by political calculus and not economic analysis; it is developed through the interactions of state and federal government officials, a large and disparate industry and other stakeholders.

Economic efficiency—the optimal level of activity where social welfare is greatest—ought to be one of the fundamental criteria for evaluating proposed safety regulations (Arrow et al., 1996:221). Motor carriage generate both social benefits and costs—costs are

directly associated to crashes. Assessing the level and distribution of these benefits and costs is the fundamental public policy exercise and can be effectively analyzed using economic tools.¹³

B. Policy Components

To reduce losses—particularly the loss of life—and address issues of equity and efficiency, federal social regulation defines allowed and prohibited motor carrier activities: ex-ante regulations are intended to prevent crashes before they happen and are focused on drivers, vehicles and safety management. Courts facilitate restitution for liability borne of negligent actions after crashes. Ex-post liability damages are assigned in contract and tort.

Problems with motor carrier safety can be expressed with economists' focus on inefficiencies (externalities, adverse selection and moral hazard). In the political realm, who cares? Those who are affected by the loss of life become the faces and voices for policy change. Truck drivers and those injured in crashes involving large trucks have become the voices for change. Truck driving is a hazardous occupation and has garnered the attention of occupation safety rules and regulations. Victims have aligned with safety advocates.

The policy development problem is as follows: Society selects from a broad set of choices involving the appropriate role of government regulation and tort liability (Viscusi et al., 2005). Further, incentives created by regulation and liability frame motor carrier decision-making and are key to effective policy formation. Incentives are the basis of policies including rules and institutions designed to induce economic agents to exert high levels of effort (for

¹³ Benefits are realized by society and include decreased transportation costs, improved service quality, economic growth and service industries' profits, etc. Some operators can benefit from transferring costs to other parties constituting market failure (externalization of costs and/or misallocation of costs due to asymmetric information). Costs include economic losses and damage related to crashes, expenditures by motor carriers on safety systems and regulatory compliance, government costs for regulatory development and implementation. In addition, costs are also borne by motor carriers and drivers, road operators, injured parties, taxpayers and the rest of society.

example, motor carrier safety efforts) and to reveal truthfully all socially relevant information (Laffont, 1996).

Government regulation creating incentives for efficient safety decisions and social insurance to provide appropriate compensation for spillovers has been the cornerstone of safety policy (Broder and Morrall, 1991). The optimal combination of ex-ante regulation and ex-post liability comprises an extensive literature (Shavell, 1984a and 1984b; Kolstad et al, 1988; Cooter and Ulen, 2005). By assigning fault and full responsibility within the legal standard of negligence, efficiency can be realized—hence setting a standard of behavior and prescribing a minimum level of safety.

Posner asserts that regulation is warranted for activities that cause death (Posner, 1986:351). The well-defined role for government is to increase social welfare: Savage (1999) asserted that the optimal level of safety cannot be determined by free-market interaction; this is evidenced by the long history of government safety regulation.

In discussing the trade-off between equity and efficiency, Okun (1975) identifies the limitations of the federal bureaucracy and acknowledges the difficulty between accountability and flexibility. The essential question in selecting the components of safety policy boils down choices between the market and bureaucracy (Okun, 1975:63).

C. Role of Government

Addressing the misallocation of resources from market failures—externalities, myopic behavior and asymmetric information—is a well-established role for government regulatory activities (Lave (1968); Posner (2007); Stigler (1975); Wolf (1979); Viscusi et al. (1995)). Motor carrier safety regulations are developed, implemented and enforced by the FMCSA.

Federal regulatory activities range from prescribed, allowed and prohibited behaviors to administrative case actions. Private services (notably insurance) and civil litigation also affect motor carrier safety.

Setting the minimum financial requirement below the optimal level will also distort incentives for firms and yield a suboptimal provision of both financial responsibility and safety.¹⁴ If the minimum were set at the optimal level, carriers involved in a crash found to be non-compliant with relevant regulations (such as financial requirements) would be negligent per se and liable for damages; with the minimum set below the optimal, a carrier involved in a crash would not be negligent per se as a regulation is not violated by having the minimum financial requirement and, as a result, the carrier may avoid liability. Clearly, the minimum requirement set too low will cause inefficiency.

Safety is the level of socially acceptable risk and can be measured by the total costs of accidents and other mishaps—defining acceptability is a normative and political process (Lowrance, 1976). The essential policy question boils down to the choice between the market and bureaucracy (Okun, 1975). The market was unleashed with economic deregulation, and the focus of the bureaucracy has been placed on the explicit issue of safety. Public policy is centered on regulating motor carrier processes ex-ante to ensure a reduction in fatalities and, also, the ex-post assignment of damages when accidents do occur. Government regulation creating incentives for efficient safety decisions and social insurance to provide appropriate compensation for spillovers has been the cornerstone of safety policy (Broder and Morrall, 1991).

¹⁴Cooter and Ulen (2007) present a model of optimal safety effort and discuss the impact of a safety regulation set below the socially optimal level and its impact on safety behavior. Further, government actions distort market outcomes: Okun (1975) described the “leaky bucket” of government’s reallocative activities.

The establishment of minimum safety standards and increased levels of enforcement is one explanation for this safety improvement as well as general engineering and technological advances (Moses and Savage, 1996). Safety standards are set by public policy to increase social welfare: Minimum standards for safety and operational activities allow carriers with poor equipment and staff to be identified before crashes occur (Savage, 1999:551). The overall social movement towards enhanced product safety of recent decades and continuing today with the efforts of organizations like Public Citizen has motivated improved safety and impacted trucking.¹⁵ Further, an active plaintiff's bar has been effective in holding negligent parties responsible and reducing the spillovers from injurers to crash victims.

In crashes where there is no fault and involved carriers are not negligent, crash costs are borne by each individual party. There is a role for government to mitigate these costs by putting in place ex ante regulations and strive to reduce the number and severity of crashes and the related social costs.

Because of the multidisciplinary nature of motor carrier safety, the Law, Policy and Society approach effectively frames this empirical analysis and its recommendations. Policy and government program are driven by the United States Congress, administrative agencies, industry and other interested parties (states, public interest groups, the plaintiff's bar, etc.). Administrative law is the basis for safety regulation, and common law is the basis for claims of damages; there is a broad legal foundation for efforts to achieve the social goal of reduced fatalities and related spillover and inefficiency

¹⁵ The link between motor carrier safety and the efforts of advocates like Ralph Nader is embodied in Joan Claybrook of Public Citizen; prior to running Public Citizen, Ms. Claybrook was the leader of the Citizen for Reliable and Safe Highways (a truck safety watchdog).

D. The Role of Insurance and the Insurance Industry

Insurance for commercial motor vehicle operators comprises three areas of activity: 1) activities that reduce the expected loss related to accidents (ex-ante safety activities designed to reduce the probability and magnitude of loss); 2) allocating funds for liability related to accidents (self-insurance); and, 3) contracting with third-party commercial insurance firms to make payments for liability in exchange for providing resources in the case of crashes.

Commercial liability insurance is a financial commodity: Premiums are paid in exchange for liability claims to be paid in the future. The insurer accepts the uncertain value of losses and distributes the risk across time and carriers. The insurance industry allows firms to protect its value in the face of large risk related to crashes and reduce profit volatility (Posner 2007:471).

The commercial insurance industry also establishes de facto requirements for motor carriers (Gramlich, 1990; Lave, 1968). These requirements are embodied in the contractual relationship between the insurer and motor carrier; ultimately, these requirements affect the safety decision-making by motor carriers.

Insurance premiums and claims paid by carriers vary based on the individual firm's experience as well as commodity hauled, scale of operation and much more. Insurance costs for operating activities are typically between two and six percent of total expenses and include cargo, liability and other insurance. These expenses include third-party insurance premiums paid as well as claims paid (self-insurance); both of these expenses are losses related to crashes. Hence, these losses represent the potential gains (benefits) to the carrier; and the magnitude of these losses is monotonically related to the level of safety effort (via carriers' crash experience).

Recent court decisions have extended liability from motor carriers to the organizations that hire them. Other motor carriers, brokers and shippers are exposed to liability for the negligent acts of hired motor carriers. In *Schramm v. Foster*, 341 F.Supp.2d 536 (D.Md.2004), for example, a federal court allowed liability to extend to a broker that did not use reasonable means to conduct background checks on a carrier before hiring it. In March 2009, an Illinois jury awarded \$23.7 million against a third-party logistics provider (CH Robinson): the driver and carrier were found to be negligent and responsible for an interstate crash that killed two and injured five people. The driver was found to be an agent of the broker and, as such, CH Robinson was liable for damages resulting from the carrier's negligence. Shippers and brokers that hire carriers will engage in a higher level of due diligence and demand greater safety in order to avoid increased liability.

Insurance companies play an important role by setting a relative price of safety. When presented with insurance premiums for coverage, motor carriers then determine their level of safety by trading off insurance premiums for preventative measures (Savage, 1999:549). Lave (1968) asserts that the combination of liability laws and insurance creates incentives for behavior that is near the optimal level of transportation safety.

Corsi and Infanger (2004) suggest insurance and safety are related. While higher insurance spending suggests greater safety, poor safety practices and subsequent crashes will yield higher insurance payments. The relationship between insurance and crashes is recursive. This complexity can be solved by relating crashes and insurance payments over time: Crashes in the past determine today's insurance premiums; faced with new costs, motor carriers act to determine tomorrow's crashes.

At a given time, insurers cannot know a motor carrier's true level of safety effort (it can only observe past crash experience and some indicators of current performance): Insurers do expend effort to determine the true safety posture in order to 1) charge the correct premium ex-ante; 2) select carriers to insure for a given price; and, 3) provide de facto regulation. Motor carriers' true safety postures are known over time based on its actual ex-post crash experience.

Information asymmetry in the insurance market creates inefficiency. A related source of inefficiency is the under-provision of safety information. Each insurer collects its own safety information and does not share it. Safety information is valuable to many—for example, other insurers, shippers and regulators—yet by keeping safety information private, positive spillovers are not realized because too little information is produced. Currently, social welfare is enhanced with the public provision of some safety information and the provision of more information to the insurance industry should further increase social welfare.

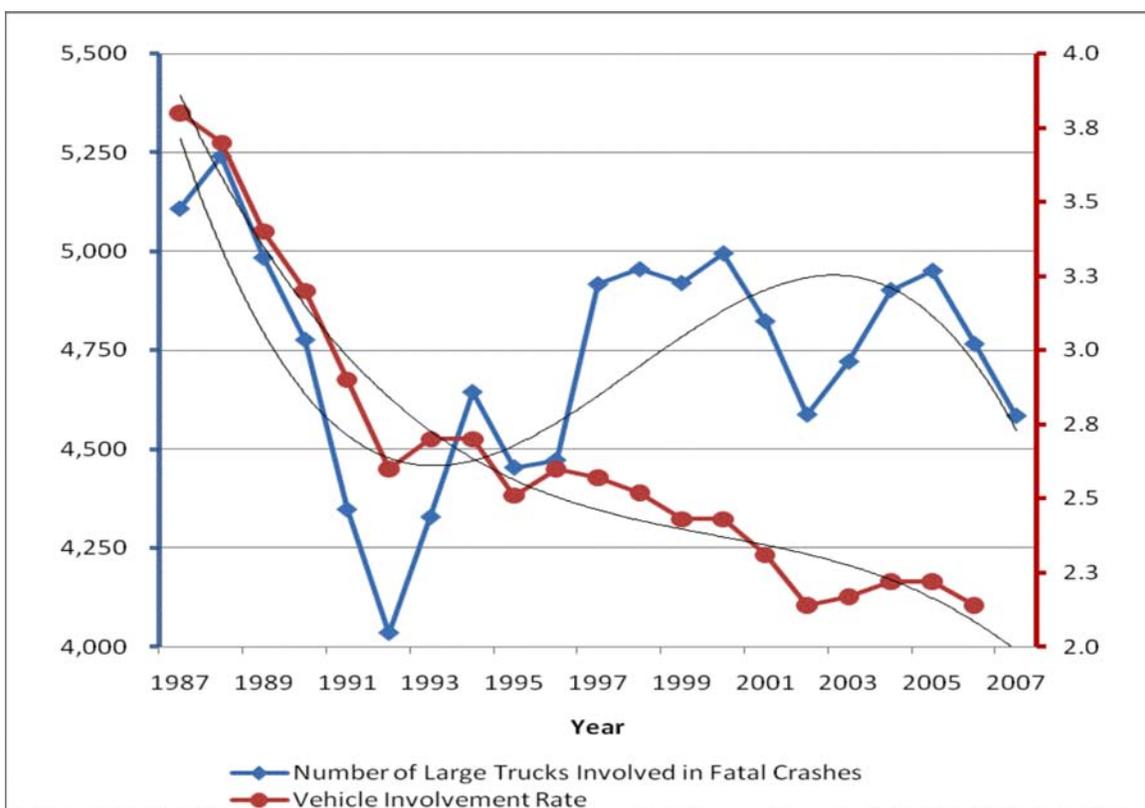
The market for commercial insurance is comprised of many firms competing to deliver a product which is effectively a commodity. Each insurance provider selects which carriers it will insure and charges premiums based on motor carrier experience; some carriers engage in service-based non-price competition. Insurance companies benefit from the regulatory activities of government: minimum standards are set, and some firm-specific information is available. Accordingly, the insurance industry is not a leader in policy development but rather focuses on selecting safe carriers and working with its clients to reduce risk.

E. Safety: Measured on the Road

Overall commercial motor vehicle safety has been improving. The crash rate has been dramatically reduced since 1980 and has declined faster than other vehicle types and more than

roads in general (Savage, 1999). Further, Figure 1 displays the number of crashes (4,538 in 2007) and rate of crashes per 100 million miles traveled (2.04 in 2007); also depicted are the trend lines (cubic regression estimation) which show a clear downward trend in the crash involvement rate and volatile (and more slowly declining) number of crashes.

Figure 1
Fatal Crash Involvements and Involvement Rate for Large Trucks, 1987-2007



Vehicle involvement rate per 100 million vehicle miles traveled.
Source: National Highway Traffic Safety Administration.

Even with declining fatal accidents (more than 50% reduction in the number and rate) Savage observed that the substantial number of fatalities each year and the spectacular nature of many crashes keeps commercial transportation safety an important public policy issue (Savage, 1999).

Driving a truck is a very dangerous occupation: truck drivers have one of the highest fatality rates (48 fatalities per 100,000 workers) and rank first in total number of fatalities (United States Bureau of Labor Statistics, 2009). While many of the accidents involving large trucks result from actions of other road users, the causes of truck accidents range from vehicle failure and driver error to negligent activities like operating an overloaded truck or a driver operating excessively long hours. An important social cost of motor freight is the impact on the driver: The United States District Court of Appeals for the District of Columbia suspended new hours-of-service rules based on lack of consideration for the impact on drivers.

For any driver, truck or truck trip, the risk value is the expected value of a crash measured by the number of crashes normalized for the number of drivers, trucks or vehicle miles traveled. At any point in time, the probability of a truck crash can be estimated by dividing the number of crashes by the number of trucks or vehicle miles traveled. Risk is then defined as the likelihood of having a crash and the expected severity (cost) of the crash spread across the population of individuals on or near the nation's roadways; this risk constitutes a significant public health issue.

III. The Trucking Industry

Freight movement is an essential part of our national and global economies. Trucks are the leading freight mode in the United States. The following describes the trucking industry and its safety record, as well as the behavioral model that is central to my analysis and primary hypothesis.

A. What do they do? And, are they safe?

Under economic regulation, the trucking industry was segmented by regulatory groups into resultant operational categories. Following deregulation, the industry has evolved into four broad groups based on operational characteristics: 1) less-than-truckload; 2) truckload; 3) package; and, 4) integrated logistics.¹⁶ The typology of the industry has also been defined based on the primary operational objective of the motor carrier, in addition to the primary product hauled.¹⁷ Broad economic and technological advancements have profoundly affected motor carriers generating great productivity gains. The highly competitive nature of the industry—particularly the truckload segment—has resulted in relatively low profitability.

In total, about 700,000 motor carriers are known to operate in the United States accordingly to the FMCSA's Motor Carrier Management Information System (MCMIS): this dataset is derived primarily from inspection results for carriers with federal operating authority (that is, a USDOT number), and most firms are small (less than ten trucks). Because only larger motor carriers (operating revenue greater than \$3 million in 2003) were required to submit financial and operating statistics, the panel dataset assembled for my research includes only these motor carriers.

Three segments—truckload, less-than-truckload and package—represent nearly three-quarters (73%) of total revenue of the motor carriers in my dataset. General freight truckload represents about half of the firms (1,064 out of 2,122 in 2003) with an average revenue of \$26.7

¹⁶ This basic typology is defined in Belman and White (2005) and an analysis of each segment is presented: truckload (Corsi, 2005b), less-than-truckload (Swan and Burks, 2005), packages (Hough and Nowak, 2005) and logistics service providers (Langley, 2005). Two overview discussions (McMullen, 2005 and Peoples, 2005) present trend analysis supporting this typology as well as several operational discussions related to inventories, technology, drivers and safety.

¹⁷ This typology was developed by the ATA Foundation and Cambridge Systematics in a three part study conducted for Federal Highway Administration (1997). DTFH61-93-C-00084.

million per firm; less-than-truckload and package are more concentrated in fewer, larger firms. The average number of trucks per truckload carrier is about 150—this is much larger than the typical truckload carrier (with closer to a dozen trucks) and owner-operators who typically own and operate a single tractor.

Industry Segment	Number of Firms	Total Revenue (\$ Billions)	Average Revenue Per Firm (\$ Millions)
Building Materials	85	\$1.21	\$14.26
Bulk	140	\$1.48	\$10.59
Container	55	\$1.00	\$18.16
Truckload (General Freight)	1,064	\$28.41	\$26.70
Heavy Machinery	71	\$2.93	\$41.26
Household Goods	79	\$4.93	\$62.35
Less-than-Truckload	191	\$21.82	\$114.25
Motor Vehicles	22	\$1.69	\$77.03
Other Specialized	183	\$7.36	\$40.24
Package Courier	20	\$21.68	\$108.39
Refrigerated	60	\$1.72	\$28.61
Tank	152	\$4.42	\$29.05
Total	2,122	\$98.65	\$46.49

Motor carrier crash rates and FMCSA-generated safety assessment scores are important measures of safety. Crash rates are calculated by summing crashes (fatal and total (fatal, injury and property damage only)) and scaling the number for the number of trucks operated by each motor carrier or by total number of highway miles traveled. Safety policy focuses on crashes: relative crash rates and changes in crash rate drive policy development. One goal of this research is to understand the change in crash rate with changes in the explanatory variables: profit, debt and different safety-related expenditures.

Motor carrier crash rate analysis has traditionally been faced with two challenges: 1) there are many carriers that have no crashes (particularly fatal crashes) during a period of time, and 2) the referent variables (number of truck or vehicles miles traveled) have frequently been missing or inaccurate. My data set and approach address these issues: 1) techniques are used to incorporate the zero crash rates; and, 2) the referent variables have been carefully checked for accuracy.

FMCSA Safety Evaluation Areas (SEAs) are one measure carriers' relative safety performance in accident, vehicle, driver and management outcomes.¹⁸ Accident SEA is based on the severity and timing of crashes. Vehicle and driver SEAs are calculated from information collected from roadside and terminal inspections; the number and type of regulatory violations, as well as the frequency that carriers' vehicles or drivers are placed out-of-service, are reflected in the carriers' scores. SEAs are percentile scores with a maximum of 100: as a carrier's SEA score increases, it is indicative of poorer performance. (Corsi, 2005:35)

The safety scores presented in Table 2 suggest that the motor carriers in my dataset are better than the median performance for accidents (the truckload SEA of 41 would suggest that these firms are safer than 59% of the carriers in the MCMIS dataset). Similarly, for the truckload carriers in the dataset, driver safety score are about the median (SEA of 55), and vehicle safety scores are better than the median (SEA of 42). The management score is based on very few observations and is unreliable.

¹⁸ The FMCSA is developing a new methodology to evaluate the safety performance of drivers and carriers through a quantitative approach that yields safety scores called "BASICS" – Behavior Analysis and Safety Improvement Categories. There are seven BASICS in the CSA 2010 operational model: (1) Unsafe Driving, (2) Fatigued Driving, (3) Driver Fitness, (4) Drug & Alcohol, (5) Vehicle Maintenance, (6) Cargo/Load Securement, and (7) Crash/Incident Experience. These measures will support a new regulatory model targeting safety problems and applying a progressive intervention scheme.

Table 2: Financial and Operating Statistics for All Segments and Truckload, 2003			
		All	Truckload
Crashes	Fatal per 1,000 Trucks	5.74	7.13
	Total per 1,000 Trucks	156.27	118.54
	Fatal per One Hundred Million Highway Miles	3.03	2.55
	Total per One Hundred Million Highway Miles	878	955
Safety Scores (SEAs)	Accident	38	41
	Vehicle	43	42
	Driver	50	55
	Management	67	67
Size	Revenue	\$98.65 Billion	\$28.41 Billion
	Number of Firms	2,122	1,064
	Average Revenue	\$46.49M	\$23.7 Million
Profit	Net Profit Margin	1.67%	1.57%
	Return on Assets	5.4%	5.12%
	Return on Equity	7.01%	6.50%
Debt	Debt to Equity	1.10	1.21
	Debt Ratio	0.659	0.691
	Fixed Asset Turnover Rate	3.16	3.24
Expenses (% of total)	Insurance and Claims Paid	4.56%	4.74%
	Maintenance	7.7%	7.57%
	Purchased Transportation	30.97%	32.82%
	Driver Wages	35.01%	32.28%

Profit margins are slim for motor carriers with net profit margin (net income/total revenue) not reaching two percent (1.57% for truckload carriers in 2003), return on assets (net income/total assets) and return on equity (net income/total owner equity and capital) at 5% and 7% respectively (for truckload carriers in 2003). Three different debt measures are calculated, and their median values are presented: debt-to-equity ratio (total liabilities/total owners equity

and capital); debt ratio (total liabilities/total assets); and, fixed-asset-turnover rate (total operating revenue/total operating assets).

The expenditure areas of interest are related to safety spending: Total insurance premiums and claims paid/total operating expenses; spending on parts, tires, outside maintenance and other/total operating expenses; spending on rentals (with and without drivers) and purchased transportation /total operating expenses; and, spending on wages and salary/total operating expenses.

B. Decision-Making and Safety

Commercial truck operators make safety decisions. Will an increase in the funds that truckers must commit to safety practices change their operating decisions and result in fewer crashes? Indeed, crashes involving an operator's trucks carry a liability monetized at between one and five million dollars per incident. Motor carrier operators must decide how to incorporate this risk into the financial balance sheet. They can purchase insurance from established insurance carriers, they can self-insure a portion of the risk (for example, one million dollars) and take an insurance policy against claims in excess of this amount, or they can take definite steps to minimize risk through pro-active management practices.

The central hypothesis of this thesis is that increased financial commitments by motor carrier managers to minimize crash risk will, in fact, result in their experiencing fewer actual crashes. To test the hypothesis—increased financial commitment decreases crashes—a unique panel data set and explanatory behavioral models have been developed. The dataset comprises multiple years of operational and financial information, crash data and government safety measures for individual motor carriers. Using well-defined motor carrier behavioral models, a

multivariate econometric analysis of the cross-sectional and time-series data will explain variability in crashes with financial characteristics.

Analyzing panel data with an explanatory model is a new and significant contribution to the existing literature of transportation safety and financial performance. The most noteworthy contributions are the addition of time and the inclusion of a multivariate data analysis. The results will inform public policy and present the opportunity to improve regulatory efficiency and reduce inequitable spillovers to third parties.

C. Panel Data

The panel dataset (composed of cross-sectional and time-series data) with safety and financial data for 2,100 motor carriers of freight for five years (1999-2003) has been assembled from two core data sources: 1) FMCSA Motor Carrier Management Information System (MCMIS), which contains firm-specific crash data and FMCSA-generated safety ratings; and, 2) Bureau of Transportation Statistics (BTS) Financial and Operating Statistics (F&OS) which includes full balance sheet and income statement data for firms with annual operating revenues greater than \$3 million.^{19,20,21} The data set allows for extensive consideration of the financial decision—full balance sheet and income statement information is included—creating great understanding of the performance of these large truckload carriers; the fact that the analysis is focused only on this one segments limits the findings to only this industry segment. Further, a

¹⁹ The MCMIS Crash File and safety score data were obtained from FMCSA via a Freedom of Information Act request. (FOIA#09-0758; July 10, 2009).

²⁰ BTS is a bureau of the USDOT Research and Innovative Technology Administration.

²¹ F&OS data are publically available and located at http://www.transtats.bts.gov/DatabaseInfo.asp?DB_ID=170&Link=0

panel data set allows for analysis of related variables over time: For example, crashes this year may affect profits next year, or safety spending this year may affect crashes next year.

To create the dataset for this analysis, crash data and government-generated safety measures were captured for the firms in the F&OS dataset. For each of seven years—1998-2004—all crashes with a fatality or an injury or that required the vehicle to be towed away, that involved these firms were identified, assembled and sorted according to the unique firm identifier—the USDOT number. Government-generated safety measures (FMCSA’s SEAs) were also assembled for these firms. This panel dataset allows for consideration of correlations between variables over time. For example, crashes in 1998 affect insurance premiums and profits in 1999; with higher insurance premiums for 1999, the crash rate for 2000 is expected to decline.

D. Motor Carrier Behavioral Models

According to neoclassical theory of the firm, profit-maximizing motor carriers will select additional safety activities where the marginal benefit exceeds marginal cost, up to the level of activity where the marginal benefit is equal to the marginal cost. Accordingly, with an increase in the marginal benefit of safety (as measured by the increase cost of crashes, for example), more safety will be selected. When applied to safety selection, the law of demand holds that with higher prices of crashes (as with increased crash losses), fewer crashes will be realized with all else assumed constant.

Following the theory of the firm and building upon the efforts of Savage (1995), McCarthy (2001) and Cooter and Ulen (2007), the following details the behavior of motor carriers in order to explain their crashes with several explanatory variables.

Crashes—Dependent Variable

Crashes with fatality, injury or property-damage only (requiring vehicle tow-away) number approximately 5,000, 50,000 and 100,000 respectively each year (FMCSA, 2010). The total number of crashes for the motor carriers in this dataset numbered from 20,219 in 1998 to 27,113 in 2004. The FMCSA Crash File is the source of these data and composes state police crash reports and 80 data elements pertaining to the motor carrier, driver, vehicles and circumstances of a crash (FMCSA, 2010b). For each motor carrier for each year, the following values have been calculated: 1) the number of fatal crashes; 2) the number of injury crashes; and, 3) the number of crashes requiring the vehicle to be towed away. In addition, 1) the number of fatalities and 2) the number of injures have been calculated.

Explanatory Model

Following McCarthy and other analyses detailed in the supporting literature above, the general functional form explaining crashes is:

$$(1) \quad C_{it} = f(I_{it}, \pi_{it}, D_{it}, V_{it}) + \epsilon_{it}$$

C_{it} —the dependent variable—is crashes for firm i in year t ($t=1999-2003$), I_{it} is liability premiums and claims paid, π_{it} is a profit measure and D_{it} is debt and V_{it} is a vector of various other explanatory variables. Financial responsibility (I_{it}) reflects what motor carriers pay for crashes—effectively the price of crashes. The amount carriers pay for insurance is a function of their past safety experience. Profit (π_{it}) is revenue less expenses and debt (D_{it}) is the amount of funds owed to bondholders and non-equity institutions. For both profit and debt, I consider various measures in my analysis. Profit and debt measures are detailed below.

$$(2) \quad s^* = s(x, r, _, mc)$$

Following McCarthy (2001), the safety behavioral characteristics (s) frame motor carrier profit maximizing behavior. Safety is a function of the firm's operating environment [x], regulatory environment [r], the decision-makers' risk preference [ρ] and the marginal cost of safety [mc]. Profit-maximizing carriers will spend on safety improvement up to the profit-maximizing quantity (s^*) where marginal costs (mc) is equal to marginal benefit (for example, decrease in loss claims and decreased expected future insurance premiums).

These safety characteristics are largely controlled for in this model by the decision to analyze the fairly narrow category of motor carriers (general freight truckload). Operating environment is defined by industry segment, commodity carried as well as a measure of activity (fleet size and/or miles traveled). In general, regulatory environment is an indicator of impact of regulations (rules and enforcement): For this analysis, the impact of government is measured with each motor carrier's government-generated safety assessment score. Risk is the level of uncertainty a motor carrier is willing to accept; this impact is captured in both the cost of insurance and time value of money (the opportunity cost of safety spending or setting aside funds for future crashes). The marginal cost of safety is measured by the opportunity cost of not being safe—the cost of one more crash. Cooter and Ulen (2007) depict the benefit of safety as the expected value of crashes—the combination of probability of crashes (which declines with an increase in safety) and the cost of crashes. Motor carrier costs are detailed in a broad literature.

In accordance with the literature outlined above, various other explanatory variables (V_{it}) are expressed here.

$$(3) \quad V_{it} = M_{it}, OO_{it}, W_{it}, SEA_{it}^b, C_{it-1}$$

M_{it} =Maintenance spending: Parts, tires, outside maintenance and other;

OO_{it} =Purchased transportation services (use of owner-operators);

W_{it} =Driver and helper wages and salary;

SEA_{it}^b =safety score for four behavioral categories; b ={accident, driver, vehicle, management}; and,

C_{it-1} : Lagged number of fatal crashes per truck.

These values for carriers would increase as firms expend resources in order to reduce the probability of crashes. To account for difference stemming from fleet size and operational and regulatory constraints, these safety variables are normalized by total operating expenditures. I include lagged crash rate to help capture the unobservable firm-specific influence.²²

Explanatory Variables

The primary explanatory variable of interest is (I_{it}) financial responsibility (insurance premiums and claims paid): These carrier costs represent out-of-pocket expenses for crashes and over time will reflect expected value of the uncertain costs. Profit (π_{it}) and debt (D_{it}) are financial measures related to the safety decision determining the number of crashes and crash rate.

Financial Performance and Debt

The basic measure of profit is net income—the difference between revenues and costs—when combined with operational or capital values, meaningful information for decision-making is available. Financial and operational questions (for example, debt versus equity

²² Adding the lagged dependent variable as a regressor will almost certainly cause serial correlation and omitted variable bias. Nevertheless, adding it is a reasonable step toward enhancing the model. In future work, adding firm-specific characteristics as additional regressors (such as firm's location) will ameliorate this bias, and reduce the serial correlation.

finance, expenditure on new capital equipment versus maintenance, etc.) require different measures. Three broad areas of firm value—assets and equity—are considered.

Net profit margin (income after taxes/total operating revenue) is the basic measure of financial performance representing return on sales: The performance of operational management is assessed with this ratio. Low returns can result from: 1) inefficiency and high costs; 2) heavy use of debt because net income includes interest payments (Brigham and Houston, 2007:112). Net profit margin has been used in the following analyses: Corsi (2002); Filer and Golbe (2003); Raghavan and Rhoades (2005); and, Silverman et al (1997). Also of interest to management is net return on assets: Silverman et al (1997) assessed net income per total assets.

Net return on total assets also represents financial performance relative to assets. Low return on assets could be from a conscious decision to use large amounts of debt for investment in plant and equipment and does not necessarily reflect poor performance (Brigham and Houston, 2007). The bottom-line accounting ratio is the return on common equity. This ratio tells stockholders how well the firm is performing in an accounting sense. (Brigham and Houston, 2007)

Three measures of debt are considered: 1) debt-to-equity ratio; 2) debt ratio; and, 3) fixed-asset turnover rate. Debt ratio measures the percentage of funds provided by creditors. Total debt includes current and longer term liabilities. Creditors prefer low debt ratios because the lower the ratio, the greater the cushion against creditors' losses in the event of liquidation. Fixed asset turnover rate is a measure of how effectively the firm uses its plant and equipment (intensity of use of assets). These are problems in interpretation with inflation of asset costs; because balance sheets show historical and not current value terms, a new firm has a larger

denominator and, therefore, will have a lower turnover rate (relative to an old firm) without reflecting inefficiency.

Table 3: Profitability and Debt Measures	
Profitability and Debt Measures	Specification
1) Net profit margin	Net operating income/total operating revenue
2) Net return on total assets	Net operating income/total assets
3) Net return on total investment and equity	Net operating income/net carrier operating property and total owner equity and capital
4) Debt-to-equity ratio	Total liabilities/total owner equity and capital
5) Debt ratio	Total liabilities/total assets
6) Fixed-asset turnover rate	Total operating revenue/total operating assets

Other Explanatory Variables

Different motor carrier operational environments yield different financial and safety outcomes. Substantive operating differences stem from the different commodities hauled: The core function of motor carriage is the movement of goods, and the industry is segmented by goods hauled and resultant vehicle configuration. These commodity types (and resultant industry segments) include: Building materials; bulk; general freight truckload; less-than-truckload; household goods; heavy machinery; motor vehicles; other specialized; package courier; refrigerated; tank.

Major industry segments have different operational and regulatory constraints and, hence, affect carrier safety decisions and crash outcomes. Operational and regulatory constraints are defined by commodities hauled and industry segment—for example, carriers that move household goods are very different from those that haul gasoline or carry agricultural products. When subject to economic regulation, industry segmentation was based on the definitions by regulatory area. Other descriptors include: Geographic range of operation; fleet size; routing variability; time sensitivity of deliveries.

The other explanatory variables are related to safety activities—spending on maintenance, purchased transportation services (the use of independent owner-operators or other transportation firms) and wages. It is expected that each of these variables has an inverse correlation with crashes. Chow (1989) found that additional use of owner-operators had a positive impact on safety. Rodrigues et al. (2004) found evidence indicating an increase in driver compensation increases safety by decreasing crashes.

Maintenance spending would differ, depending how frequently a motor carrier replaces its trucks. One motor carrier could safely operate older vehicles if it spent more on maintenance, while another could safely operate trucks with relatively little maintenance if vehicles are replaced more frequently. The explanatory power of maintenance would be impacted by the debt variables.

Table 4: Explanatory Variables	
Crash Explanatory Variables	Specification
1) Liability Insurance Spending	Insurance premiums and claims paid/total operating expenses
2) Maintenance Spending	Spending on parts, tires, outside maintenance, and other/total operating expenses
3) Equipment and Purchased Transportation	Spending on rentals (with and without drivers) and purchased transportation /total operating expenses
4) Wages	Spending on wages and salary/total operating expenses
5) Safety Effectiveness Areas (SEAs)	Relative safety score across carriers—higher score represents less safety

Measures of regulatory compliance are derived from inspection results: These inspection include compliance reviews (in-terminal operational audit), roadside inspections and traffic enforcement (enforcement activities focused on driver performance violations). Each year nationwide there are about 10,000 compliance reviews, 2,000,000 roadside inspection and

1,000,000 traffic enforcement inspections. FMCSA has generated two basic measures of safety from its inspection processes. A safety rating for motor carriers is assessed after a carrier compliance review.

For each motor carrier, the following data have been retrieved from MCMIS: 1) four SEAs and one overall safety score—these data are from a snapshot taken at one point during each year for the year 1998-2004; 2) safety ratings (satisfactory, conditional or unsatisfactory) and date of the most recent compliance review (required for rating) for each year 1998-2004.

The following data limitations exist: 1) There are no SEA data for 1998 and data for 1999 are limited; 2) SEA data (accident, driver and vehicle) are plentiful (more than 2,500 observations each year) yet the management data are fewer (about 800 observations each year).

E. Literature

Crashes are the core of the motor carrier safety social problem. Transportation economics has been applied to the commercial transportation safety problem defining behavioral models and market failure (McCarthy et al., 2001; Savage, 1999; Boyer, 1997; Viscusi et al., 1995).

The law and economics literature frames public policy formation focused on individual decisions made in response to incentives and effectiveness measured according to overall efficiency of the government intervention. In the area of social regulation, Cooter and Ulen (2007) discuss the role of information, as well as the activities of regulatory bodies and courts in addressing harm and allocating liability. Viscusi et al. (2005) assert that three sets of influences define the safety environment: 1) the market through consumer behavior, 2) government regulation, and 3) tort liability (Viscusi et al., 2005:790). Shavell (1984a,b), Kolstad et al.

(1990), and Glaeser and Shleifer (2003) identify efficiency as the standard for assessing impact and prioritizing regulatory approaches to improve safety.

Several analyses demonstrate the correlation between crashes (or proxy safety measures) and financial measures. Chow (1989) demonstrated that an increase in insurance and maintenance spending improved safety; further, more profitable trucking firms were found to be safer firms. Other studies of crash rates indicated that profit has a positive impact on safety (Bruning (1989); Rodriguez et al (2004)). Using safety proxies, other research linked increased profit with enhanced safety (Beard (1992); Corsi et al. (2002); Mixon and Upadhyan (1996a)). Mixon and Upadhyan used motor carrier damages as a proxy for safety in defining the relationship between operational activities; the study used a panel dataset with a small number of carrier observations (80 for four years). This research addresses panel data with a large number of cases (more than 3,500 firms for five years).

The link between safety and profit was also explored in the passenger air industry. Filer and Golbe (2003) explained safety (measured by compliance with on-site safety regulations) with profit measures (operating margin and debt ratio): more profitable firms had fewer violations. Silverman et al. (1997) found evidence of a relationship between profit (net income per total revenue and net income per total assets) and business mortality. Dionne (1997) related profit (debt/equity ratio and maintenance expenditure per departure) and accident frequency (accidents involving an air carrier/total flight hours). Raghavan and Rhodes (2005) in revisiting Golbe (1988) applied a panel dataset and found an inverse relationship between crashes and financial performance. They recommended increased monitoring of airlines' financial performance as a consequence of their findings.

The existing literature does not effectively explain the reverse causality between crashes and financial measures. While an increase in profit can be associated with a decrease in crashes, causality is ambiguous—there is a feedback loop between the two variables; the relationship is recursive. Hence, motor carriers with fewer crashes will be more profitable. Insurance as an explanatory measure of crashes also suffers from reverse (dual) causality: insurance premiums are determined by motor carrier losses (hence, the expected cost that insurance companies incur—a determinant of supply in the insurance market) but also by motor carriers desire to reduce uncertainty and preserve their capital value (hence, a determinant of demand in the insurance industry).

This analysis tests the impact of increasing financial responsibility—while holding profit, debt and various other things constant—on crashes. Using a unique panel data set assembled for this analysis, a dynamic analysis using variable values across time will provide insight. For example, crashes in 2000 result from financial commitment in 1999 which is determined by crashes in 1998. The results of these analyses will add to the body of motor carrier safety knowledge.

F. Hypothesis: Increasing Financial Commitment will Decrease Crashes

Will a minimum financial responsibility requirement of \$1,750,000 yield fewer crashes?²³ Motor carriers will pay for crashes up front, correcting for possible market failures

²³ My \$1,750,000 proposal comes after considering three different methods of inflation and/or externalities adjustments. First, since the last increase in the minimum in 1983, the producer price index has increased by about 80%; therefore, adjusting for inflation only, the current minimum would be about \$1,350,000. Second, from the crash externality estimate by Forkenbrock (1999), motor carriers in total pay only pay 41% of the total social costs of crashes; therefore, adjusting the minimum liability requirement based on this aggregate experience, would yield an adjusted minimum of \$1,830,000. Third, adjusting for inflation, the Forkenbrock (1999) estimate of total social cost of crashes for 2010 is \$24 million per 100 million miles. For a relatively small carrier operating 750,000 miles per years, the expected total social cost is \$1.8 million.

(externalities and myopic decision-making): with no crashes, motor carriers retain their funds. There is a significant incentive for motor carriers to act safely. With an increase in the expected cost of future crashes, profit maximizing motor carriers will act to reduce crashes. Absent any operational changes, impacted carriers would realize lower profits over time as costs of insuring against increased liability are increase over time—therefore, motor carriers have an incentive to enhance safety and reduce crashes. The change in the required financial commitment should increase the cost of crashes (hence, decrease the number) and reduce the relative cost of safety activities (hence, increase safety); further, motor carrier safety costs borne by others should be decreased (reduce externalities).

An experimental research design in a controlled environment—increase the minimum financial responsibility requirements, control for other factors and observe the impact on safety—can directly answer the question, but only after the fact. An alternative quasi-experimental approach requires two components: 1) establishing how financial requirements affect motor carrier profits and related financial measures; and, 2) establishing how changes in motor carrier finances affect crashes.

Motor carrier crash rate (crashes per truck or per mile) are the values to be explained (the dependent variables): the unit of analysis is the motor carrier in one year. The variable of social interest is number of motor carrier crashes and crash rate. The primary explanatory variables are financial responsibility, profit (for example, return on transportation assets and return on equity) and the level of debt (for example, debt ratio). Different measures are considered and represent indicators for motor carrier financial decision-making.

Two related hypotheses are: 1) increased crashes decrease profit; decreased crashes increase profit...therefore, to increase profit, firms will decrease crashes; and, 2) increased crashes increase debt; decreased crashes decrease debt. The hypotheses will be tested with a multivariate econometric model: in addition to profit and debt, other explanatory variables will be incorporated and the relationship controlled for other factors such as operational characteristics, size of fleet, commodity type, regulatory compliance, etc.

Hypothesis	Dependent Variable	Independent Variable
1a) Higher financial responsibility requirement yields fewer crashes	Crash rate (crashes/truck)	Minimum financial responsibility requirement
1b) Higher insurance and claims paid in the past	Crash rate (crashes/truck) today	Insurance premiums and claims paid lagged by one year
2) Higher profit yields fewer crashes	Crash rate (crashes/truck)	Profit (net income)(cash flow in the future)
3) Higher debt yields higher crashes	Crash rate (crashes/truck)	Debt (debt ratio, debt to equity, fixed-asset turnover)

An explanatory model frames the answer to the question: the focus is on the safety and financial decision-making by motor carriers and the resultant crashes. Based on the behavior model developed by McCarthy (2001), safety decisions made by motor carriers are a function of operational and regulatory constraints and dependent on risk preference and costs. The safety outcome of interest is crash involvement; hence, the unit of analysis is the motor carrier in each year and crashes is the variable of interest. Both the number of crashes and crash rate are addressed. Each crash is an important event for the motor carrier involved (representing an important operational and cost component) and society (representing life and limb and significant social welfare). The crash rate allows for comparison across firms by reflecting a

measure of exposure (number of trucks in a motor carrier fleet and/or the total vehicle miles traveled by a motor carrier), hence normalizing for truck or miles traveled.

IV. Empirical Results

Built upon the well-defined behavioral model detailed above, two analyses have generated 1) a clear distinction between the explanatory variables for safe and unsafe motor carriers, and 2) strong evidence of the impact of increased financial requirements on motor carrier safety. The mean values of the explanatory variables for 2003 were calculated, and the difference in mean values tested for statistical significance. A regression analysis of the multivariate explanatory model of fatal crash rate has yielded results to support the policy recommendations and to define additional analyses of this data set.

The panel dataset allows for use of time-lagged variables in order to partially mitigate the recursive relationship between the explanatory variables—insurance premiums and claims paid, and profit—and the fatal crash rate. An additional analytical challenge is presented by the large number of zero-value fatal crash rates: in any year, 80% of the carriers are not involved in a fatal crash. The solutions are 1) an ordinary least squared regression analysis of the carriers with non-zero fatal crash rate; and, 2) a Tobit, and a random-effects Tobit regression model of the fatal crash rate.

A. Difference of Means

Table 6 below present the p-values for various difference of means t-tests. For each variable (column 2) I test whether the mean of that variable in the safe category is statistically

different from the mean of the variable in the unsafe category. I categorize safe, vs. unsafe in four ways:

- 1) Accident safety ratings (SEA) top 5% vs. bottom 5% (column 3)
- 2) Accident safety ratings (SEA) top 25% vs. bottom 25%, (column 4)
- 3) Fatal crashes per truck top 25% vs. bottom 25%, (column 5)
- 4) Fatal crashes per mile top 25% vs. bottom 25%, (column 6).

The mean values for each of the explanatory variable for safe and unsafe carriers given each of these four categories are presented in Tables B1-B4 (in Appendix B); in addition, the differences of means are tested and the results presented as a p-value. The p-values for results that estimate the probabilities of the means are not different as 20% or less are presented in Table 6.

Table 6: Summary of Difference of Means Tests for Explanatory Variables: p-Values					
Functional Explanatory Areas	Explanatory Variables	Accident Score (SEA) (Top 5% vs. Bottom 5%)	Accident Score (SEA) (Top 25%)	Total/ Trucks (Top 25%)	Total/ Miles (Top 25%)
		Blank Cells Indicate P-Values Greater than 0.2 **Indicate Significance at 5%; *Indicates Significance at 10%			
Crash Rates	Fatal per 1,000 Trucks	0.0246**	0.0103**	0.0005**	0.0000**
	Total per 1,000 Trucks	0.0128**	0.0228**	Used for ranking	0.0000**
Safety Scores (SEAs)	Vehicle			0.0399**	0.0000*
	Driver	0.0000**	0.0089**	0.0000**	0.1009
	Management				
	Accident	Used for ranking	Used for ranking		0.0000*
Profit	Net Profit Margin				
	Return on Assets		0.1306		
	Return on Equity	0.1061	0.1775		0.1859
Debt	Debt to Equity			0.1507	
	Debt Ratio		0.0754*	0.0004**	0.0033*
	Fixed Asset Turnover Rate		0.1743		
Expenses (% of total expenses)	Insurance and Claims Paid	0.0325**	0.1370	0.0641*	0.0058**
	Maintenance				0.0302**
	Purchased Transportation	0.0003**	0.0008**		0.0000**
	Driver Wages			0.0105**	0.0000**

The main finding in Table 6 (fourth row from bottom) is that insurance and claims paid as a percentage of total expenses—the primary explanatory variable of interest—is greater (statistically significant) for unsafe firms. Other findings include the following: Safer motor carriers 1) purchased more transportation services as a percentage of total expenses, 2) dedicate a greater share of their expenses to driver wages, 3) have a lower vehicle SEA and 4) have a lower debt ratio. The relative size of the mean values of these variables is consistent across all tests, but the differences are not statistically significant in all tests.

More profitable carriers are expected to be safer carriers, and while return on equity is consistently higher for safe carriers for all three tests, it is not significant. The other two profit measures (net profit margin and return on assets) are higher for safe firms in two of three tests: return on assets approaches significance once and net profit margin is consistently not statistically significant. Similarly, maintenance share of total expenses is very close for safe and unsafe carriers.

Table 6 also shows that that average crash rates and average safety scores (100=least safe, 0=safest) are statistically different for unsafe versus safe carriers. These results are consistent with expectations since firms with fewer crashes and driver regulatory violations are likely assigned a lower safety SEA.

These differences of means results suggest that multivariate analysis would improve the analysis to alleviate the potential for substantial omitted variable bias. For example, suppose maintenance and driver wages are positively correlated—those firms spending more on maintenance tend to spend more on wages. Without controlling for maintenance spending, the measured crash rate decline that occurred as a result of the wage increase will appear too large in

size and statistical significance—it will include some of the impact from improved maintenance. Further, the recursive time-series relationship between the price of crashes, I_{it} (insurance premiums and claims paid) and crash rates is partially addressed by using lagged insurance as the key explanatory variable.

B. Econometric Analysis

In light of the existing literature findings discussed above, an empirical analysis of crash rates should incorporate the price of crashes (I_{it}). Combining equation (1) with (3), the general form is:

$$(4) \quad C_{it} = f(I_{it}, I_{it-1}, C_{it-1}, \square_{it}, D_{it}, M_{it}, OO_{it}, W_{it}, SEA_{it}^b) + _it.$$

C_{it} : Number of fatal crashes per truck.

I_{it} : Liability insurance and claims paid.

\square_{it} : Return on equity.

D_{it} : Debt to equity ratio.

M_{it} : Maintenance spending/total expenses.

OO_{it} : Purchased transportation/total expenses.

W_{it} : Drivers' wages/total expenses.

SEA_{it}^b : Drivers' safety rating (1 is safest, 100 is least safe)

Table 7 presents two results of an ordinary least square regression (OLS) of Equation

(4).²⁴ Regression 1 uses the entire panel (1999-2003) that includes approximately 78% zero

²⁴ The 1999-2003 panel dataset begins with 9,591 observations, 9,013 of which are general freight truckload; 5,027 of those have non-missing values for number of trucks and number of fatal crashes.

values of the dependent variable fatal crashes per truck.²⁵ Regression 2 uses only the non-zero values, and yields the same qualitative results. The negative coefficient on *lagged liability insurance to expense ratio* in both regressions suggests a decline in fatal crashes per truck this year as last year's liability insurance increases.²⁶

I change the dependent variable to the count variable *number of fatal crashes*, and re-run the regression using Poisson estimation. I do this to investigate potential bias of the OLS results given the large number of zeros, and the very few non-zero integer values of the dependent variable ranging from 0 to 24.

²⁵ Using one-year lagged liability insurance and claims paid as the key explanatory variable exploits the panel nature of the data.

²⁶ Following Wooldridge (2009), I first present informative linear regression results.

Table 7: Ordinary Least Square Regression Results					
Dependent Variable: Fatal Crash Rate (Per Truck)		Regression 1: All Observations		Regression 2: Non-zero Crash Rate	
		Coefficient	p-Value	Coefficient	p-Value
Liability Insurance Premiums and Claims Paid (% Total Expenses): Lagged One Year		-.0930049	0.106	-.3483506	0.162
Liability Insurance and Claims Paid		-5.38e-11	0.89	-8.23e-10	0.334
Fatal Crash Rate: Lagged One Year		.0974939	0.000	.8693145	0.000
Safety Score	Driver	-.000012	0.792	-.0002498	0.258
Profit	Return on Equity	-.0004189	0.493	-.019646	0.000
Debt	Debt to Equity Ratio	-6.07e-07	0.886	-.000034	0.767
Expenses (% of total expenses)	Maintenance	-.0334142	0.089	-.1531941	0.057
	Purchased Transportation	-.0129855	0.110	-.061056	0.065
	Driver Wages	-.0330487	0.003	-.1387003	0.004
Constant		.0171561	0.000	.0881192	0.000
		N=2,412 F(9,2,412)=4.55 Adjusted R2=0.0131		N=522 F(9,512)=8.50 Adjusted R2=0.1147	

Table 8, Poisson Regression 1 replicates the specification in Table 7, yet includes the *number of fatal crashes* as the dependent variable. The same qualitative results again suggest that motor carriers may behave more safely if the price of a fatal crash rises.²⁷ Table 8, Poisson Regression 2 includes the variable *lagged liability insurance per truck* in favor of the insurance

²⁷ Appendix C, Table C1 shows two alternative specifications of equation (4). I enter lagged liability insurance as a quadratic to test for the possibility of a moral hazard bias. Crashes may initially rise with lagged insurance payments and eventually fall as increases in premiums and outlays (with increasingly large losses) catch up with the true value of the loss. Both specifications in table C1 provide strong preliminary evidence that this is true. The coefficients on lagged liability and lagged liability squared are positive and negative respectively with statistical significance. Specification 2 replicates Specification 1, while adding the number of truck as an explanatory variable.

to expense ratio in order to control for number of trucks in the key explanatory variable. I again obtain the same qualitative result suggesting that increasing lagged insurance may enhance safety.

Dependent Variable: Fatal Crash Rate (Per Truck)		Regression 1: All Observations		Regression 2: Insurance per truck	
		Coefficient	p-Value	Coefficient	p-Value
Liability Insurance Premiums and Claims Paid (% Total Expenses): Lagged One Year		-3.245347	0.102		
Liability Insurance Premiums and Claims Paid Per Truck: Lagged One Year				-6.94e-06	0.140
Liability Insurance and Claims Paid		1.21e-07	0.000	1.21e-07	0.000
Fatal Crash Rate: Lagged One Year		-.3321108	0.696	1.713067	0.299
Safety Score	Driver	-.0046747	0.003	-.0050641	0.001
Profit	Return on Equity	.0684721	0.197	.065364	0.217
Debt	Debt to Equity Ratio	-.0003135	0.504	-.000294	0.523
Expenses (% of total expenses)	Maintenance	1.485436	0.002	1.410871	0.004
	Purchased Transportation	.2430903	0.329	.2572549	0.298
	Driver Wages	-1.662136	0.000	-1.792067	0.000
Constant		-.6656423	0.000	-.6747635	0.000
		N=2,412; LR Chi (9)=1100.15; Pseudo R2=0.2156		N=2,412; LR Chi (9)=1100.01; Pseudo R2=0.2155	

The difference of means and preliminary econometric results suggest that today's insurance premiums and claims paid inversely impact fatal crashes tomorrow. It may be that increasing the insurance minimum today will affect crash rate tomorrow. An increase in the minimum will only affect those firms which currently do not maintain a financial commitment of \$1,750,000.

The affected firms will be faced with an increased insurance expenditure and will need to adjust their safety practices.

V. Policy Formation

My analysis focused on the environment in which motor carriers make decisions. Motor carrier safety activities are governed by three sets of influences: Markets, tort liability and government regulations. Markets and their outcomes are discussed in the context of motor carrier behavioral models. Tort liability (as well as the legal foundations of social regulation) is discussed in the context of laws. The regulatory environment is defined by public policy which is political by definition.

Government and private-sector analysts focus on the occurrence and severity of crashes; the FMCSA works with state agencies to assemble and analyze crash and violations records. Improving information and deploying new technologies is a focal point for policy development and enforcement.²⁸ Safety is defined by two very distinct activities: Measuring the probability and severity of harm which is an empirical and scientific activity; and, judging the acceptability of risk which is a normative, political activity (Lowrance, 1976). Congress, industry and other interested parties engage in the political process, giving rise to legislation and rulemaking that define the level of socially acceptable risk.

Hence, successful motor carrier safety policy implementation requires definition and consideration of the political and legal environments. The following presents a broad

²⁸ The Clinton/Gore (1993) administration launched an aggressive technology development and deployment agenda that set the direction for information technology in the federal government; a 1996 Clinton Executive Order (13011) directed the deployment of enterprise systems in federal agencies and has led to FMCSA's current COMPASS initiative.

consideration of the political environment from which federal motor carrier safety policy emerges.²⁹

A. Model of Interaction

Policy is developed in waves: in response to a catastrophic crash, landmark legislation or major crash or other defining event, government will act. From the status-quo of the established safety regime, slow evolution of safety policy is punctuated by brief revolution and leads to a new regime (Lorento, 2007). Each policy wave requires action by transportation officials (Baumgartner and Jones, 1993).

FMCSA is the central institution: it conducts rulemaking, policy and program development, enforcement and adjudication of initial appeals. Motor carrier safety policy results from the interaction of four broad groups: FMCSA, Congress, industry and other interested parties. The regulated motor carriers are represented by several trade associations (American Trucking Associations, Owner-Operator and Independent Drivers Association, etc.) and by the efforts of several large firms. Individual and combined agendas will determine policy direction.

The regulator and the regulated are the core relationship for this analysis; yet, the US Congress will ultimately determine policy with its lawmaking authority. The three principal parties—the industry, FMCSA and the relevant committees of the US Congress—have the common focus on the arcane and technical details of motor carrier safety and are interconnected.

²⁹ “A complete theory of regulatory politics—indeed a complete theory of politics itself—requires that attention be paid to beliefs as well as interests.” (Wilson 1980:372) Wilson asserts that when the economic stakes are high, the need for assembling a majority legislative coalition requires a broad appeal; arguments need to assemble broader constituencies.

B. Institutions in Policy Making

As the regulatory and enforcement body charged with ensuring motor carrier safety, the FMCSA is charged with day-to-day interaction and the administration of complex requirements and rulemakings. The arcane nature of motor carrier safety has given rise to closeness between the regulators and the regulated: Technical experts and management on both sides share a common field and experience, and personnel tend to move between government and industry. The experience of the FMCSA and the industry is consistent with the literature about the interdependence of the entities and the ability of the regulated to manipulate the regulatory process: an iron triangle of congressional committees, the industry and the regulatory agency. The close working relationships, common technical expertise and a shared group of issues among the industry, FMCSA and congressional committees, suggest an “industry capture” model of regulatory interaction. The industry’s agenda can control the joint agenda and maintain the status quo. In this type of model, the relationships are simultaneously adversarial and symbiotic (Stone, 1997:5).

Justice Breyer (1993) details a five-part approach to maintaining an independent and publicly-focused regulatory regime in Breaking the Vicious Circle: Toward Effective Risk Regulation. The “industry capture” model suggests a lack of independence by the government players with a focus on private interests versus the public health. Justice Breyer’s approach is addressed below.

The lines of communication are well-established among industry, agency and the appropriate congressional committee and subcommittees. Other interests must rely on public

access procedures for rulemaking and legislative actions. When other interests oppose the status quo or specific administrative programs or legislative interpretation, litigation is often employed.

FMCSA

As an agency within the executive branch, the FMCSA has broad powers to develop and enforce regulations and set and implement policy. The FMCSA is responsive to federal legislation, executive orders and directives from the Secretary of the Department of Transportation, and subject to both Congressional and executive agency oversight.³⁰ Further, the FMCSA's activities in rulemaking and applying rules to motor carriers are subject to appeal to the United States Court of Appeal for the District of Columbia.

The primary mission of the FMCSA is to reduce crashes, injuries and fatalities involving large trucks and buses. Thousands of Federal and state regulators and millions of dollars are dedicated to developing and enforcing these regulations in order to enhance safety, and reduce the number and severity crashes and associated costs.³¹

FMCSA has identified five strategies for safety enhancement: 1) increase compliance with federal motor carrier safety regulations; 2) promote safe operations and best practices through partnerships and education; 3) improve driver qualifications credentialing and licensing systems; 4) improve safety information, research and analysis to advance innovation and technical solutions; 5) modernize and optimize operational effectiveness to improve safety (FMCSA, 2010).

³⁰ In addition to its committee and subcommittee oversight activities, Congress relies on the Congressional Budget Office to conduct research and policy analysis; Executive branch oversight is provided within the Department of Transportation by the Inspector General, and also by the Office of Management and Budget.

³¹ More than \$500 million; \$530 and \$541 million was enacted for 2008 and 2009, respectively; and, \$550 million was proposed for 2010.

Within the classes of institutional mechanisms there are important decisions for policymakers with respect to the particular mechanism for intervention. (Viscusi et al, 2005). The political process establishes the overarching goal, and the administrative processes of the FMCSA develop and enforce ex ante social regulations. Justice Breyer asserts that the identification of a new safety goal assists the regulatory regime: Once a policy goal becomes the norm, the path of least resistance for the regulated is pursuing it. (Breyer, 1993:41).

In addressing the “industry capture” model of policy development, Breyer detailed five characteristics of a structure that is less susceptible to manipulation by interested parties. These five characteristics include: 1) a well-defined goal and mission; 2) jurisdiction in all areas necessary for achieving the goal and mission; 3) political insulation; 4) prestige; and, 5) authority (Breyer, 1993:60).

The formation of FMCSA established many, but not all, of the attributes prescribed by Breyer to improve the effectiveness in regulation. The FMCSA was given the same status as the Federal Railroad Administration and National Highway and Transportations Safety Administration (NHTSA); it is an agency with prestige based on its Administrator being a presidential appointee and with broad regulatory authority (subject to executive and legislative oversight). Its congressional prescribed mission is quite clear; its goal for reducing fatalities is ambiguous. FMCSA’s jurisdiction related to general issues of safety does overlap with other administrations (notably, the Federal Highway Administration and NHTSA), yet its role in truck safety is preeminent. The weakest area is political insulation: the FMCSA is subject to political pressure from the industry through congressional direction, executive intervention, and direct influence in programmatic operation and rulemaking. Further insulation would enhance the

effectiveness of its regulatory regime by allowing the FMCSA to advance its safety agenda with less interference.

The FMCSA was formed with the purpose of advancing safety by legislation passed by a Republican Congress and signed by President Clinton and was charged with an aggressive safety goal. Secretary of Transportation Rodney Slater set the goal of reducing the number of fatalities in crashes involving large trucks by 50% by 2009. According to the special report by the DOT Inspector General, the target was 2,700 deaths per year. (Mead, 1999a) The federal legislation included direct references to reducing crashes: “The current rate, number and severity of crashes involving motor carriers in the United States are unacceptable.” The legislation also called for implementation of the recommendations of the Inspector General’s report: notably, targeting “unsafe” carriers, increased enforcement and increased rulemaking. Further, MCSIA called for specific program enhancements and increased funding for inspections and enforcement.

With the election of President George W. Bush, the safety regime changed. The focus on reducing the number of fatalities was replaced with a focus on reducing the fatal crash rate: “In cooperation with our partners and customers, we strive to reduce the large truck fatality rate by 41% from 1996 to 2008. This reduction translates into a rate of 1.65 fatalities in truck crashes per 100 million miles of truck travel.” (FMCSA, 2006) Aggressive inspection and enforcement of safety rules and regulation is the federal government’s approach to realize the prescribed lower level of safety.

At the core of FMCSA’s safety efforts is the team of federal and state officials working at the roadside and at carriers’ facilities. Decentralized operations (roadside and office-based regulatory activities conducted by more than 1,000 state and federal professionals) with a

common objective (efficient, effective and equitable safety regulation) can benefit from information and communications tools and actionable information for broadened safety outcomes. The “Comprehensive Safety Analysis” (CSA 2010) is a process evaluation designed to increase the value of existing personnel by combined technology upgrades, process enhancements and enhanced information analysis and dissemination.

Launched in 2005, COMPASS (the FMCSA’s enterprise application) coupled with CSA2010 represent both a process reengineering and information technology upgrade. FMCSA was directed to deploy enterprise application technology along with all government agencies.³² The use of information technologies, targeted and escalating enforcement activities are the foundation of FMCSA-led policy and programs.

The United States Congress

In addition to providing broad direction, Congress also requests specific programs and directs the development of specific regulations. For example, legislation called for the creation of a system to ensure that commercial drivers have only one driver’s license; in response the multi-state Commercial Drivers’ License Information System was created.³³ Both the safety advocates and industry executives are focused on affecting the rules promulgated by the FMCSA and legislation advanced by Congress.

Two committees in Congress—one in the House and one in the Senate—have jurisdiction over motor carriers and their regulation; these are listed in Table 10. Both committees hold public hearings before major legislative actions (primarily program authorizations and

³² The E-Government Act of 2002 (H.R. 2458/S. 803) was signed by President Bush on December 17, 2002, with an effective date for most provisions of April 17, 2003.

³³ The Commercial Drivers’ License Information System was created by Interstate Commerce Commission Termination Act—1995 (Public Law 104-88, 109 Stat. 803)

appropriations); hearings related to major transportation system disasters typically occur before the National Transportation Safety Board.

Chamber	Committee	Subcommittee	Chairman
House	Committee on Transportation and Infrastructure	Subcommittee on Highways and Transit	Peter A. DeFazio, D(OR)
Senate	Senate Committee on Commerce Science and Transportation	Surface Transportation and Merchant Marine Infrastructure, Safety and Security Subcommittee	Frank R. Lautenberg D(NJ)

The primary legislative mechanisms include surface transportation authorization legislation, annual appropriations and ad hoc legislation (like the MCSIA-1999). An authorization is a statutory provision that establishes or continues a federal agency, activity or program, and can be for either a fixed or indefinite period of time. New surface transportation authorization acts amend Title 23 of the United States Code.

The two authorizations that preceded MCSIA-1999 were the Surface Transportation Efficiency Act (ISTEA) of 1991 and the Transportation Equity Act for the 21st Century (TEA-21) of 1998; they were unlike earlier laws: These programs were multimodal, authorized the use of highway funds for non-highway transportation projects and required significant planning by the affected modal agencies. Safe, Accountable, Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) of 2005 followed this tradition and dedicated an increasing budget to FMCSA. Congress is currently developing the next authorization legislation.³⁴

Congress has long focused on the use of motor carrier information as a means to target and focus enforcement. Recent Government Accountability Office (GAO) reports about motor

³⁴ Schedule to end in 2009, the Hiring Incentives to Restore Employment Act (H.R. 2847) extended SAFETEA-LU through December 31, 2010.

carrier safety in last five years detail Congress' concerns: Several have directly addressed motor carrier safety data and its application.³⁵

The Motor Carrier Industry

While the trucking industry is not monolithic, there is a common objective of reducing the regulatory compliance costs. The key separation between carriers in the industry is between safe and unsafe. Safe operators are those that incur costs to comply with rules and regulations; while unsafe operators accept greater risk and, hence, share it with others on the roads.

A recent industry policy paper identifies the ultimate responsibility of the motor carrier for losses related to the operation of their for-profit commercial enterprise: “the motor carrier ultimately has the responsibility for managing driver performance and optimizing vehicle safety” (American Trucking Associations, 2009:20).

The industry interests led by the American Trucking Associations and the Owner-Operator and Independent Driver Association with the support of pro-business interests like the United States Chamber of Commerce call for safe roads by allowing the market to work well using price to reflect socially desirable levels of safety.³⁶

The industry standard for motor carrier financial responsibility is \$1,000,000: this is the coverage generally required by firms hiring motor carriers. Depending on experience and industry segments, motor carriers pay between \$2,500 and \$6,000 for \$1,000,000 in general liability coverage. For a \$1,000,000 increase in coverage (from \$1,000,000 to \$2,000,000), carriers pay an additional \$1,000 to \$1,500.

³⁵ The U.S. Government Accountability Office (GAO) is an independent, nonpartisan agency that works for Congress.

³⁶ The American Trucking Associations (ATA) is a federation of state trucking associations and groups that represent specific segments with the industry; ATA asserts that the federation represents 35,000 member companies.

The response by the trucking industry will likely be mixed: larger carriers and carriers that purchase excess insurance firms will support the increase; and smaller carriers and carriers that purchase the minimum coverage will oppose the increase. Smaller carriers are concerned that additional insurance coverage will give rise to increased activity by plaintiff's attorneys and larger payouts: currently, few payouts by smaller carriers exceed their general liability coverage. These insights have been captured from motor carrier industry publications and from follow-on phone calls with insurance and motor carrier industry professionals. (Vise, 2003)

Other Interested Parties

The basic difference in the mass between a half-ton passenger car and 40-ton truck creates a unique risk for motorists: 86% of the fatalities involving large vehicles are the occupants of the other vehicle. Because of this fact, many public and private organizations call for action to reduce the number of crashes involving large trucks. These include federal agencies and advocacy organizations.

Organized labor has a limited role in motor carrier safety policy—a small portion of trucking employees are union members—and government agencies have rules and regulations that address major labor issues (for example, the Occupational Safety and Health Administration within the United States Department of Labor has broad jurisdiction). States also play an active role in supporting federal policy.

The National Highway Transportation Safety Administration points out that one out of eight (12 percent) traffic fatalities involves a large truck, yet large trucks are only three percent of registered vehicles and seven percent of miles traveled (NHTSA, 2009). Other government entities, the Federal Highway Administration and the Government Accountability Office, support

the portrayal of commercial motor vehicles as disproportionately involved in fatal crashes. Further, the National Transportation Board identified the safety of motor carrier operations as one of its “Most-Wanted Transportation Safety Improvements.” In 2003, FMCSA harmonized its commercial motor vehicle safety goal in a consolidated Department of Transportation's highway safety goal with NHTSA and FHWA (USDOT, 2004).

The federal policy approach follows the traditional model of addressing public health issue: Husting and Biddle (2005) detail the scientific public health model applied to federal motor carrier policy. Five stages are presented and linked to the current policy approach: 1) identification and prioritization of problems (surveillance); 2) quantification and prioritization of risk factors (analytic research); 3) identification of existing strategies or development of new strategies to prevent injuries (prevention and control); 4) implementation of the most effective injury control measures (communication/ dissemination/technology transfer); and 5) monitoring the results of the intervention activities (Husting and Biddle, 2005:248).

The public interests promoting more aggressive highway safety policy, led by Public Citizen with CRASH and PATT, have generally called for a reduction in the number of fatal crashes through more comprehensive and restrictive rules: This effort has been comprised of congressional outreach and judicial challenges of the FMCSA rulemaking process. Safety advocates sued the FMCSA in 2002 to act upon six rules that were required by Congress.³⁷ The petition sought to direct the FMCSA to fulfill the “mandatory duty to promulgate regulations that

³⁷ Citizens for Reliable and Safe Highways et al. v. Mineta, No. 02-1363 (D.C. Cir.)

enhance commercial motor vehicle safety.”³⁸ The FMCSA and the plaintiffs reached a settlement when the FMCSA specified a rulemaking timetable.

The public interest groups spread alarm to the public and Congress. This strategy is illustrated in an October, 2005 Public Citizen press conference with an announcement of its legal challenge to FMCSA rulemaking and a coordinated series of congressional visits.³⁹ Crash facts and regulatory violations were detailed but reinforced with a “Travelers’ Alert” describing the high risk from the new rules. Families of crash victims were assembled and visited the halls of the Capitol to call for truck safety legislation.

In the case of truck crashes, the litigation process appears to be relatively effective: Motor carriers do not have a significant advantage. The plaintiffs’ bar has access to a well-developed body of materials and information about “how to sue a trucking company,” and there are few impediments for individuals seeking damages in a large truck-involved crash.

Less than one third of Teamster members (about 300,000 of the union-members) are employed in the freight, package and other sectors of the trucking industry. When compared to the more than one million owner-operators, the relative size and the influence of the union have been reduced. Yet, as a well-established Washington, DC-based lobbying organization with broadly disbursed and well-organization local unions, the Teamsters are heard and have sway in labor-issues.

Truck safety is an area of long-standing federal and state cooperation: it began in the 1930s when states began to enforce federal truck safety regulations (Campbell, 1995:104). This

³⁸ The regulations were required by Congress for the following: 1) minimum driver background checks; 2) staffing standards for international borders; 3) hours-of-service; 4) minimum training requirements; 5) rules related to the transport of hazardous materials. The Department of Transportation reached a settlement agreement with CRASH and set a schedule for rulemaking.

³⁹ Petition for Reconsideration of the Final Rule

relationship continues today as states receive about 60% of total federal expenditures in the form of grants. US Supreme Court decisions have established the supremacy of federal rules in interstate commerce: Two decisions Kassel v. Consolidated Freightways and ATA v. Scheiner held that federal safety laws preempt state laws.^{40,41}

C. Hours-of-Service Example

Recent federal rulemaking expanded the hours that truck drivers can operate commercial vehicles in a day—from ten to 11 hours—while increasing the required time off—from eight to ten continuous hours; the trucking industry and business interests applauded the new rules, but safety advocates were outraged and sued. In Public Citizen, the United States Court of Appeals for the District of Columbia deemed the rule “capricious and arbitrary” and vacated it because the impact on the health of drivers was not considered, as federal legislation required.^{42,43}

Congress put in place legislation which kept the new rules in place while the FMCSA followed the court’s order, considered the impact on drivers and conducted a new rulemaking process.^{44,45} Virtually identical rules were promulgated in 2005: The FMCSA defined the

⁴⁰ An environment of uniform national operational and safety regulation was established. The industry challenged an Iowa state law prohibiting a specific type of large truck (65-foot double trailer combination) and the state defended its statute by asserting that these vehicles were less safe. In Kassel, the court held that the “State’s safety interest [was] found illusory, and its regulation impairs significantly the federal interest in efficient and safe interstate transportation.” Kassel v. Consolidated Freightways Corp., 450 U.S. 662 (1981)

⁴¹ In addition to establishing safety rules, states have traditionally developed different taxation mechanisms to fund safety and other programs. The Commonwealth of Pennsylvania instituted a flat axle-tax in 1980-1982 for large trucks. In Scheiner, the Pennsylvania flat tax was deemed unconstitutional. American Trucking Assns., Inc. v. Scheiner, 483 U.S. 266 (1987). Based on the dormant commerce clause, the Court ruled that the flat tax unduly infringed upon interstate commerce by providing unfair competitive advantage to in-state carriers. The Court Holding limited states’ funding mechanisms and further centralized funding for safety and enforcement activities.

⁴² 68 Federal Register 22456, 2003

⁴³ Public Citizen, et al v. Federal Motor Carrier Safety Administration, 374 F.3d 1209

⁴⁴ Surface Transportation Extension Act of 2004, Public Law 108-310, 118 Stat. 1144

⁴⁵ As a regulatory agency, the FMCSA must follow the rulemaking process set out in the Administrative Procedure Act (Title 5, CFC §5 511-599). Reagan’s 1981 Executive Order 12291 limited the breadth of rulemaking by requiring a cost-benefit consideration for new regulations; Clinton’s Executive Order 12866 redressed the earlier

impact on the health of drivers (and presented volumes of research results). The plaintiffs' Petition for Reconsideration to the Court was denied.^{46,47}

A new rule for drivers hours was clearly needed: The old rule put in place in 1935 created strange and unsafe operational behavior in the competitive environment dominated by over-the-road trucking companies (specifically for the growing segment of the industry: The long-haul truckload carriers).^{48,49} The rule limited drivers to ten hours in a single duty-cycle and required an eight-hour off-period, thus motivating drivers to begin a new duty-cycle in the middle of the night. For example, if a driver started the work week on Monday at 6 AM, Tuesday would begin at 2 AM, Wednesday at 6 PM, etc. If drivers followed the letter of the law, the impact on sleeping patterns would clearly be troubling and would not be good for safety.

Hours-of-service are important because they affect business costs and can give rise to diminished safety. For companies operating large trucks, economic deregulation unleashed fierce competition within the industry: As shippers of freight can use competitive pressures to push down price, motor carriers are very cost-sensitive when profit margins are squeezed.⁵⁰ As

order and mandated agencies to analyze regulatory circumstances to find both innovative and less burdensome ways to accomplish public objectives.

⁴⁶ 70 Federal Register 49978, 2005

⁴⁷ The International Brotherhood of Teamsters, the Advocates for Highway and Auto Safety, and the Trauma Foundation (a small organization formed by an emergency room doctor) joined as named plaintiffs; the Insurance Institute for Highway Safety filed a separate Petition for Reconsideration.

⁴⁸ The Motor Carrier Act of 1935 and U.S.C. 31502 (b)(1)

⁴⁹ Long-haul truckload carriers have grown rapidly and carry an increasing share of freight; as opposed to the labor-intensive terminal-based hub-and-spoke system of less-than-truckload carriers which do not have significant hours-of-service issues.

⁵⁰ Prior to 1980, commercial motor vehicle activities were subject to state and federal economic regulation; by setting price and controlling entry into the industry, safety regulation was implicit. The Motor Carrier Act of 1980 deregulated interstate trucking. The interstate trucking industry used the courts to deregulate the industry at the state level; Federal Express was successful in deregulating the California trucking industry with its judicial action. (Federal Express Corp. v. California Public Utility Com., 936 F2d. 1075 (US App. 1991) Congress then preempted all remaining state economic regulations with the Interstate Commerce Commission Termination Act of 1995. With this Act, all safety regulations were also preempted by the federal government.

driver costs represent two-thirds of total operating costs, the number of allowable hours can be the difference between profit and loss.⁵¹

This example illustrates several key parts of policy making in the trucking industry. Each rule is subject to administrative procedures that require public review and comment, and the judiciary can be used to clarify or challenge the rules made by FMCSA. For issues of common importance, disparate parties can align and pursue changes. Now, in the case of hours of service, the rules can only be changed at Congress' direction.

D. Law: Common and Administrative

Motor carrier safety involves two broad areas of law: common law frames adjudication of claims in tort, and administrative law frames ex-ante social regulation. The broad civil legal system is the infrastructure which allows individuals to seek recovery of losses from the negligence of others or breach of contract. Given legislative direction, the requirements of administrative law constrain the activities of agencies and ensure an open public process in developing and implementing public policy and programs. Table 9 depicts these areas of law, policy area and role for government.

Area of Law/ Jurisprudence	Policy Mechanism	Role for Government/Market Failure
Common Law	Ex-post liability	Equity: Correct externalities
Administrative Law	Ex-ante social regulation	Equity: Prohibit acts that yield negative impacts Efficiency: Correct adverse selection, moral hazard and public goods problems

⁵¹ ATA Financial & Operating Statistics

Federal legislation and rulemaking define the legal environment. The landmark Motor Carrier Safety Improvement Act of 1999 (MCSIA-1999) created the Federal Motor Carrier Safety Administration (FMCSA)—a separate modal administration within the USDOT—which is testament to the social importance of motor carrier safety. The primacy of federal regulations, federal coordination of investigations and enforcement and centralized funding define the leading role of FMCSA in motor carrier safety. Further, with MCSIA-1999, Congress charged the FMCSA to reduce the number of fatal crashes.

Common Law and Civil Litigation

Injured parties are entitled to recover damages from roadway accidents: This is evidenced by laws obliging operators to make financial provisions for accidents in advance (Schelling, 1984). The legal environment is bounded by direct controls (where prescribed or prohibit behaviors are set), liability standards and torts (actions by injured parties to secure money damages). Road users and other individuals have the right to not be harmed by commercial vehicle operators; development and enforcement of laws then establish protections against harm and an avenue for recovering damages when harm occurs.

Glaeser and Shleifer (2003) assert that property rights are secured by institutional arrangements comprised of alternative combinations of private litigation, government regulation and doing nothing. With property rights established, law and order is set in place; incentives for motor carriers and enforcement actions by government frame motor carrier law.

Calabresi (1970) applied economic efficiency analysis to torts, defining three goals for laws related to accidents: The primary goal is the reduction of the number and severity of

accidents; the secondary goal is the reduction in the social costs; and, the tertiary goal is the reduction in efficiency costs of accidents.

Common law establishes liability. Adjudication by the courts of claims by injured parties against commercial vehicle operators is an important part of motor carrier safety . In ex-post liability, the relevant areas of jurisprudence include tort and contract. The liability standard is one of negligence (strict liability for the value of cargo). The social goal is for the injurer to internalize the “spill-over” costs borne by crash victims.

Individual action to recover accident losses and the supporting broad social system comprise the system of deterrence (specific and general deterrence) to establish roadway safety. Calibresi (1970) asserts that a mixed system for accident reduction is more effective than only a fault system and more consistent with our ideals of justice. Efficiency motivates allocation of accident costs to those parties that can most cheaply avoid them while being sufficiently broad in order to spread the costs adequately enough to meet our secondary cost-avoidance goals. Further, enforcement combined with the assessment of non-insurable fines, penalties and taxes can deter or reduce the occurrence of particular acts and activities society chooses to punish or reduce the amount below what the market alone would yield (Calibresi, 1970:312).

Administrative Law and the Regulatory Process

The body of truck safety law is embodied in the Code of Federal Regulations. (Title 49 Code of Federal Regulations 301-399). These regulations are the sole safety standard by which truck drivers and operators are required to follow in the operation of commercial motor vehicles. These regulations originate with federal legislation, executive order or through administrative rulemaking. These regulations fall into the area of administrative law and represent the specific

social deterrence to harm caused by accidents. The general deterrence is found in common law which allows for ex post recovery of damages related to crashes.

The foundation of social regulation is government's police power. Focusing on individual injury or loss by others, laws and regulations are put in place: examples range from traffic control measures to seat belt or motorcycle helmet laws. Based on the interstate nature of commercial motor carriage, federal law prevails.

As a regulatory agency within the executive branch, the FMCSA must follow the rulemaking process set out in the Administrative Procedure Act (Title 5 United States Code §511-599).⁵² FMCSA rules carry the full force of law much like official acts of Congress, the President and the Supreme Court. (Balla, 2004:60). In addition to its role through the FMCSA, the executive branch has affected regulation via executive order: Examples include the requirement that benefits of regulation exceed the cost (Executive Order 12291, 1981) and the requirement that federal agencies deploy advance information technology (Executive Order 13011, 1996).

Social regulation, specifically "protective regulatory policy" is intended to "prevent certain types of private activity and require private activities in explicit terms," therefore social regulations are "more ostensibly concerned with the quality of life, individual welfare and the common good" (Tatalovich and Daynes, 1988:3).

"Efficiency requires choosing a liability rule so that the party whose activity level most affects accidents bears the residual costs of accidental harm" (Cooter and Ulen, 2007:333). If not for the catastrophic nature of accidents, economic efficiency would be best served by ex-post

⁵² "Congress establishes broad legislative guidelines for regulatory policy that define the objectives that should be promoted by the regulations that will be issued by the various regulatory agencies within the executive branch." (Viscusi:121)

assignment of “payment equal to the full amount of the damage so inflicted” (Vickrey, 1968:466). “Systems which require payments by the actors only in case of fault and only to the extent of the compensation received by others (even with the expenses of adjudication and administration added) fail to give an adequate incentive for seeking out alternatives not involving the increased risk of vehicular accident.” (Vickrey, 1966:467)

Why both ex-post liability and ex-ante social regulation? Liability is ex-post (enforcement by victims) and social regulation is ex-ante (enforcement by administrators): The two have different information and impacts. Courts can assemble valuable information: Trials show facts; courts have fewer political motives; courts will focus on facts and less on standards. Administrators have access to extensive information, technical expertise and power: “By accepting safety regulations as defining the legal standard of care for tort liability, courts defer to administrators” (Calibresi, 1970:353). “If safety regulation and liability law impose the same standard of care, then potential injurers will conform to that standard in order to avoid both ex-ante fines and ex-post liability” (Calibresi, 1970:353).

Kolstad et al. (1990) and Shavell (1984a) address the use of common law as a method to ensure socially desirable outcomes and deem it inefficient while safety regulations “are public in nature and modify behavior in an immediate way.” (Shavell, 1984a:357) The basis of Shavell’s analysis is built upon the valuation of the four key determinants in solving the optimal choice of liability and social regulation. The four determinants of the problem include: 1) difference in knowledge about risky activities; 2) private parties might be incapable of paying for the full magnitude of harm done; 3) parties would not face the threat of suit for harm done; and, 4) the

magnitude of the administrative costs incurred by private parties and by the public in tort litigation. (Shavell, 1984a)

Ex-ante social regulation and ex-post liability are not substitutes. Relying on liability, high transaction costs can be borne by the victims; ex-ante regulation can correct the inefficiencies. Glaeser and Shleifer (2003:422) conclude that the “optimal choice of a law enforcement strategy depends crucially on the vulnerability of law enforcement in a country to subversion by powerful interests that might be affected.” In the context of commercial motor vehicles, the prospect of significant influence by industry in the regulatory process is very real. Accordingly, increased motor carrier financial responsibility effectively increases ex post liability and will encourage motor carriers to improve safety performance.

Financial Requirement Regulation

Regulations requiring financial responsibility (maintenance of minimum liability insurance) and requiring documenting compliance are found in 49 CFR §387.7(a) and 49 CFR §387.7(d) made effective January 6, 1983, in accordance with the requirements as the minimum was increased from \$500,000 to \$750,000 for the movement of freight.⁵³

The current financial responsibility requirements appear to create inefficiencies: 1) externalities—with low financial responsibility requirements, crash victims may not recover the full value of their loss; as firms do not face the full cost of crashes, too many crashes occur as there is an under-provision of safety; 2) adverse selection—as the true safety posture of a motor carrier is unknown ex-ante, unsafe firms underpay and safe firms overpay for their safety efforts (and insurance); therefore, this market failure has likely resulted in an under-provision of safety.

⁵³49 CFR § 387.7(a) No motor carrier shall operate a motor vehicle until the motor carrier has obtained and has in effect the minimum levels of financial responsibility as set forth in Sec. 387.9 of this subpart; 49 CFR § 387.7(d) Proof of the required financial responsibility shall be maintained at the motor carrier's principal place of business.

From FMCSA MCMIS, data from 2003-2006 indicate that more than 500 motor carrier operational inspections generated citation of failure to maintain the minimum financial requirement. This is considered an “acute” violation. There were also 1,500 cited violations of associated reporting requirements: These are “critical” violations.⁵⁴

FMCSA research has identified a correlation between carrier citations for non-compliance with insurance requirements and an increased frequency of crashes. (FMCSA, 2007a) In total for 2003-2006, there were 1,120 regulations where violations were cited at least once; 180 regulations were cited more than 100 times.⁵⁵ Failure to maintain minimum financial responsibility was cited 513 times. (FMCSA, 2007a)

Extending insurance minimums to private carriers was directed by federal legislation and its expected impact was assessed in a recent FMCSA-sponsored study. It was asserted that “higher insurance requirements [have] an effect on safe operations:” Increased costs should force additional precaution and focus more on safety in order to keep their rates as low as possible. Unsafe operators may not be able to afford the minimum insurance required to comply and will be removed from the population. (Leposfsky et al., 2007: 5-13) Private carriers are only affected by part of the FMCSRs and should be more affected by the cost of insurance. Further, private carriers are presumably owned by larger and better capitalized companies; this financial position should affect their level of safety in the face of lesser regulation.

⁵⁴ Acute regulations are identified as those where non-compliance is so severe as to require immediate corrective actions by motor carrier regardless of the overall safety posture of the motor carrier. Critical regulations are identified as those where noncompliance relates to management and/or operational control. These are indicative of breakdowns in a carrier’s management controls.

⁵⁵ Federal and state inspectors conduct approximately 10,000 compliance reviews each year; these carrier-specific inspections by state and federal investigators focus on carrier regulatory compliance activities and are conducted at carriers’ headquarters or other places of business.

“Insurance requirements are assumed to have a strong effect in encouraging safe operating practices.” (Leposfsky et al., 2007:6-1) and it is believed “expanded insurance requirements [eliminate losses] resulting in benefits associated with enhanced safety totaling \$2.3 to \$3.8 billion over the ten-year analysis time.” (Leposfsky et al., 2007:6-1)

Assuming actuarially fair liability insurance premiums (premiums are direct reflection of loss experience plus mark-up), insurance premiums plus current claims paid are linked one-to-one with crash losses. Therefore, crash losses are directly related to crashes.

For those affected carriers operating below the increased minimum costs of crashes will increase as externalized costs are internalized, and, adverse selection and moral hazard are reduced. Accordingly, efforts to reduce losses (increased level of safety activities) will be expended, and fewer crashes should occur. Carriers operating above the minimum are not directly affected; indirect benefits are realized: 1) cost disadvantage is removed as underinsured competitors increase their level of responsibility; and, 2) ex-post liability is equalized as underinsured carriers incur greater liability.

The fact that the minimum financial responsibility requirement has not been changed in thirty years is telling: it suggests that the Congress, the industry and the FMCSA have not found it compelling. There are two indicators that Congress may act soon: 1) Congress called for the application of insurance minimums to private carriers; and, 2) the FMCSA advisory committee has called for indexing of the minimum financial requirements to inflation. Approximately 400,000 carriers could be affected; the total increase in costs to the industry amounts to \$350-\$450 million. This is a transfer from negligent carriers to injured parties; total social costs do not rise.

E. Safety Information

Led by the FMCSA, state and government agencies inspect carriers, measure compliance with regulations and, hence, assess the safety of individual motor carriers. The FMCSA has established a methodology to measure and relatively assess motor carrier safety. Based on roadside and terminal inspections, a carrier-specific rating has been emerging for several years—launched in 1995, the SafeStat system has measured and created relative scores for four areas: accident, driver, vehicle and safety management. The recent CSA 2010 efforts are refocusing this system with IT and operational enhancements. Seven measurement areas focused on behavioral considerations are emerging: measurements and applications are forthcoming.

FMCSA motor carrier safety assessment systems are used to target enforcement resources and also provide information to interested parties. “More and more shippers and insurance companies are using a carrier’s safety rating as a measuring stick to determine whether the carrier is an acceptable risk with whom to do business.” (Wiseman, 2006:245) Motor carrier safety information creates positive spillovers for shippers and service providers: Safety information is a public good. In addition to shippers and service providers, these data are useful to plaintiff’s attorneys and investors.

When assembled by private enterprise, these data, which are valuable and costly to provide, are underprovided; hence, these are best provided by the government to address the market failure in the provision of public goods (“free rider” problem) and other the other inefficiencies. FMCSA’s emerging information systems and methods to analyze and disseminate safety performance information is the engine driving the provision motor carrier safety data. Its potential is in creating transparency (all can see carriers’ ratings) and in supporting targeting of

resources (capturing disparate inspection information and ensuring compliance), but as important, providing information to allow effective policy formation. Further, Justice Breyer points out “targeted enforcement would generate improvements without incurring increased administrative costs.” (Breyer, 1993:41)

Poor-information processing often occurs in cases of low-probability, high-consequence events, and “when it is time-consuming or costly for consumers to evaluate complex information about products or services (e.g. medical therapies), they may expect government to ensure that minimum quality standards are met” (OMB, 2003:5). Information is central in policy formation. “Data on truck crashes, costs and possible interventions inform regulatory decisions such as hours-of-service rules or rules regulating training for entry level drivers” (Husting and Biddle, 2005:261).

VI. Motor Carrier Safety Policy Recommendations

The results of this research are sufficient to recommend an increase in the minimum financial requirement. This recommendation is based on my finding that fatal crashes decline today, if yesterday’s insurance premiums and claims paid increase, controlling for firm specific financial and operating characteristics. The proposed level of minimum financial commitment—\$1,750,000—should improve equity by requiring those who are liable to pay a larger portion of the total social cost of a fatal crash. It should also enhance efficiency by improving safety, i.e. a lower fatal crash rate. With a boost to both efficiency and equity, this policy recommendation will surely improve social welfare.

My research demonstrates that management safety decisions affect fatal crash rates. Crash rates decline in direct response to enhanced safety-related expenditures (insurance,

maintenance, driver wages and purchased transportation). Further understanding of these responses would help determine if a higher minimum would be warranted on efficiency grounds.

FMCSA-generated safety scores for accidents, drivers and vehicles are closely related to crash rates and effectively allow for the identification of safe and unsafe carriers—this information has become the cornerstone of federal safety policy. As I have demonstrated that specific management decisions affect fatal crashes in my research, it follows that the effective development and deployment of a management safety score would improve safety. Clearly, management safety scores lag behind driver and vehicle scores and represent an area for great improvement.

The impact of profit, debt and safety expenses on the fatal crash rate have been modeled, and initial estimates suggest some measures of these variables that can be strong predictors of carrier safety performance. Additional research should be conducted to refine these estimates in order to define the management safety score.

In general, including incentives that motivate motor carrier safety in policy and programs is recommended. In an environment of more accurate and timely safety information, motor carriers have incentive to improve and demonstrate their safety commitment. My research helps to explain motor carrier decision-making. Continued analysis of panel data and behavioral models can help to focus safety policy and reduce fatal crashes.

Appendix A
Excerpt from Dallas Morning News Truck Safety Expose

“On a sunny December afternoon, Kim Hughes turned onto State Highway 114 in Wise County and headed west toward home in Paradise, [Texas]. Christmas was eight days away. Four generations were crammed into her GMC Yukon after a morning of holiday shopping.

“In the cab of an 18-wheeler leased to TXI Transportation Co., Richard Rodriquez drove east on Highway 114, riding herd on 73,000 pounds of truck and a trailer load of sand. An illegal immigrant from Mexico, Mr. Rodriquez had used a fake Social Security number to get a Texas commercial driver’s license six years earlier. He had found steady work around North Texas driving rock trucks and other 18-wheelers, his history of immigration arrests and truck safety violations ignored or overlooked.

“Just east of Paradise, on a flat stretch of road, the mom and the trucker met.

“Mr. Rodriquez crossed the center line of the two-lane road and barreled head-on toward Mrs. Hughes at 60 to 65 mph, a civil jury later concluded. With trees and creek bed blocking her escape to the right, Ms. Hughes turned left into oncoming eastbound lane. Just then Mr. Rodriquez turned back toward his lane. Too late, Ms. Hughes swerved right. The Yukon struck the big rig on the driver’s side, scraped along the trailer and spun off the back. A Ford pickup behind the truck smashed into the Yukon, injuring the pickup’s occupants and nearly tearing apart the SUV.

“Ms. Hughes 14-year-old son, Shiloh, and 70-year old mother, Joyce Watkins, died almost instantly. Ms. Hughes, 38, and her 17-year old daughter, Afton Hughes Royce, pregnant with twins, died later in a Fort Worth hospital, never regaining consciousness. Amid the Christmas presents and holiday treats, the only sounds of life from the shattered SUV were the screams of Afton’s 14-month old son, Jagr Royce. And the frantic shouts of a female voice on Shiloh’s cell phone.

“Mr. Rodriquez climbed from the truck, uninjured.”

(Jones et al, 2006)

Appendix B
Difference of Means Test Results for
Four Specifications of Safe and Unsafe Motor Carriers

Table B1: Summary Statistics for Safe (Top 5%) and Unsafe (Bottom 5%) Motor Carriers, 2003 Accident SEA Scores					
		Safe (Top 5%)	Unsafe (Bottom 5%)	Combined	p-value
Crashes	Fatal per 1,000 Trucks	0.23	3.5	1.9	0.0103*
	Total per 1,000 Trucks	4.66	148.3	98.6	0.0228*
Safety Scores (SEAs)	Vehicle	42.53	48.78	45.69	0.2252
	Driver	44.84	58.68	51.83	0.0089*
	Management	69.50	68.83	68.97	0.9373
Size	Number of Firms	52	50	102	
	Average Revenue	\$12.4 Million	\$68.6 Million	\$40.0 Million	.0733*
Profit	Net Profit Margin	3.24%	1.95%	2.61%	0.4256
	Return on Assets	20.2%	4.76%	12.63%	0.1306
	Return on Equity	134.2%	13.87%	75.21%	0.1775
Debt	Debt to Equity	1.089	3.087	2.068	0.4813
	Debt Ratio	0.599	0.7457	0.6713	0.0754*
	Fixed Asset Turnover Rate	4.809	3.953	5.236	0.1743
Expenses (% of total)	Insurance and Claims Paid	4.44%	5.45%	4.89%	0.1370
	Maintenance	8.03%	7.88%	7.95%	0.9465
	Purchased Transportation	44.70%	26.04%	35.07%	0.0008*
	Driver Wages	28.74%	31.27%	29.98%	0.4338

Table B2: Summary Statistics for Safe (Top 25%) and Unsafe (Bottom 25%) Motor Carriers, 2003 Accident SEA Scores					
		Safe (Top 25%)	Unsafe (Bottom 25%)	Combined	p-value
Crashes	Fatal per 1,000 Trucks	6.47	14.637	3.925	0.0246*
	Total per 1,000 Trucks	58.77	217.999	141.326	0.0128*
Safety Scores (SEAs)	Vehicle	41.69	43.57	34.61	0.3563
	Driver	47.80	61.76	54.6	0.0000*
	Management	65.28	66.71	66.28	0.7297
Size	Number of Firms	259	243	502	
	Average Revenue	\$18.6 Million	\$39.3 Million	\$18.7 Million	.0137*
Profit	Net Profit Margin	2.02%	1.51%	1.76%	0.4959
	Return on Assets	7.77%	6.86%	7.33%	0.9087
	Return on Equity	55.49%	-41.00%	8.79%	0.1061
Debt	Debt to Equity	1.664	4.649	3.109	0.4467
	Debt Ratio	0.67649	0.74638	0.7104	0.6894
	Fixed Asset Turnover Rate	4.6742	4.297	4.4912	0.3968
Expenses (% of total)	Insurance and Claims Paid	4.70%	5.10%	4.89%	0.0325*
	Maintenance	7.67%	8.16%	7.91%	0.4532
	Purchased Transportation	37.55%	28.82%	33.28%	0.0003*
	Driver Wages	30.66%	31.92%	31.26%	0.3543

Table B3: Summary Statistics for Safe (Top 25%) and Unsafe (Bottom 25%) Motor Carriers, 2003 Total Crash Rate (Number of Total Crashes/Truck)					
		Safe (Top 25%)	Unsafe (Bottom 25%)	Combined	p-value
Crashes	Fatal per 1,000 Trucks	0.47	8.63	4.501	0.0005*
Safety Scores (SEAs)	Vehicle	40.11	44.38	42.26	0.0399*
	Driver	47.29	63.7113	55.574	0.0000*
	Management	69.74	69.58	69.63	0.9535
	Accident				
Size	Number of Firms	250	244	494	
	Average Revenue	\$20.0 Million	\$22.8 Million	\$21.4 Million	0.7145
Profit	Net Profit Margin	0.72%	1.15%	0.93%	0.517
	Return on Assets	3.75%	3.94%	3.85%	0.9486
	Return on Equity	22.06%	-15.65%	3.36%	0.4757
Debt	Debt to Equity	1.66	6.5614	4.091	0.1507
	Debt Ratio	0.5749	0.83	0.7026	0.0004*
	Fixed Asset Turnover Rate	4.208	4.687	4.445	0.2626
Expenses (% of total)	Insurance and Claims Paid	4.75%	5.12%	4.94%	0.0641*
	Maintenance	7.54%	7.47%	7.51%	0.9169
	Purchased Transportation	34.45%	33.56%	34.00%	0.7008
	Driver Wages	32.39%	28.92%	30.67%	0.0105*

Table B4: Summary Statistics for Safe (Top 25%) and Unsafe (Bottom 25%) Motor Carriers, 2003 Total Crash Rate (Number of total crashes/highway miles traveled)					
		Safe (Top 25%)	Unsafe (Bottom 25%)	Combined	p-value
Crashes	Fatal per 1,000 Trucks	0.804	4.991	2.9074	0.0000*
	Total per 1,000 Trucks	28.59	127.25	78.148	0.0000*
Safety Scores (SEAs)	Vehicle	37.05	47.23	42.17	0.0000*
	Driver	53.24	57.09	55.19	0.1009
	Management	66.59	68.03	67.44	0.6771
	Accident	27.88	49.99	39.38	0.0000*
Size	Number of Firms	222	222	444	
	Average Revenue	\$19.2 Million	\$11.1 Million	\$15.2 Million	0.0226*
Profit	Net Profit Margin	1.163%	1.042%	1.102%	0.8787
	Return on Assets	7.79%	2.45%	5.119%	0.2048
	Return on Equity	386.07%	-39.13%	17.25%	0.1859
Debt	Debt to Equity	9.128	6.084	7.599	0.7302
	Debt Ratio	0.5935	0.7792	0.6866	0.0033*
	Fixed Asset Turnover Rate	4.8091	4.692	4.751	0.8104
Expenses (% of total)	Insurance and Claims Paid	4.636%	5.223%	4.932%	0.0058*
	Maintenance	6.81%	8.36%	7.597%	0.0302*
	Purchased Transportation	39.91%	28.18%	33.96%	0.0000*
	Driver Wages	28.71%	33.26%	30.997%	0.0000*

Appendix C
Poisson Regression Results for
Two Alternative Specifications of Equation 4

Table C1: Poisson Regression Results: Two Alternative Specification of Equation 4					
Dependent Variable: Number of Fatal Crashes		Regression 1: Quadratic Lagged Liability		Regression 2: Quadratic Lagged Liability with Trucks	
		Coefficient	z-Value	Coefficient	z-Value
Liability Insurance Premiums and Claims Paid: Lagged One Year		2.48e-07	0.0000	2.46e-07	0.0000
Liability Insurance Premiums and Claims Paid Squared: Lagged One Year		-7.38e-15	0.0000	-8.28e-15	0.0000
Liability Insurance and Claims Paid		2.86e-08	0.002	2.16e-08	0.017
Number of Fatal Crashes: Lagged One Year		.164417	0.0000	.0801375	0.0000
Safety Score	Driver	-.0012506	0.446	.0006879	0.686
Profit	Return on Equity	.0732981	0.166	.0761292	0.152
Debt	Debt to Equity Ratio	-.0001874	0.603	-.0002046	0.578
Expenses (% of total expenses)	Maintenance	1.240123	0.028	1.305427	0.027
	Purchased Transportation	.4931959	0.057	.5011755	0.060
	Driver Wages	-.949038	0.007	-.4981376	0.172
Scale	Number of Trucks			.0002046	0.000
Constant		-1.369712	0.000	-.6747635	0.000
		N=2,412; LR Chi (9)=1771.83; Pseudo R2=0.3472		N=2,412; LR Chi (9)=1795.69; Pseudo R2=0.3519	

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