# Social Inflation

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**Abstract**

Social inflation refers to steeply rising insurance rates due to social factors such as large jury awards and broader definitions of liability. This paper is the first to study the risk of social inflation and its economic consequences. Using a novel, hand-matched dataset that spans verdicts, financial statements, and insurance rate filings for commercial auto liability, I find that the number of verdicts and settlements exceeding $50 million has increased almost threefold from 2011 to 2019. To highlight the role of nuclear awards in insurance pricing, I build a model of social inflation and show that social inflation risk has a "double kick" effect on insurance price through increased effective marginal cost and heightened required reserves. I then use both a case study and a triple-difference framework to illustrate the causal impact of social inflation risk on insurance rates. Finally, I discuss implications for insurers during the COVID-19 pandemic facing social inflation: the risk of retroactive modification and extended interpretation of existing insurance policies. Ultimately, I uncover an important new source of aggregate risk that affects the stability of the insurance sector and the economic activities that depend on it.

Keywords: social inflation, litigation, nuclear verdicts, jury awards, property and casualty insurance, insurance regulation, financial stability

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# 1 Introduction

According to the insurance companies in the U.S., a specter is haunting the insurance sector – the specter of social inflation. First coined by Warren Buffet in his 1975 letter to shareholders, social inflation refers to steeply rising insurance rates due to social factors such as large jury awards and broader definitions of liability. Its risk is saliently different and novel from the traditional risks in insurance business and influences multiple lines of businesses.

While the phenomenon is not new, social inflation has become more conspicuous and prevalent in recent years. As shown in Figure 1, the number of conference calls among the largest insurers that contain the term "social inflation" has stayed essentially at zero until 2017. The number has grown to 29 in 2018 and 75 in 2019. There is also mounting anecdotal evidence of prolonged claim developments and increased severity of large liability claims that led to elevated insurance prices (SwissRe [2019]). More recently, in light of the COVID-19 pandemic, insurers face a deluge of lawsuits and legislative efforts to force payouts.

From the insurer's perspective, risk of social inflation poses a fundamental challenge to the supply of insurance. In its simplest form, the provision of insurance can be expressed as a mapping from an event to payout. Importantly, the traditional assumption is that the mapping remains stable from the time of insurance underwriting to the time of actual payout by insurers. Social inflation risk questions this assumption by introducing sizable uncertainty to the underwriting process in two key dimensions. First, the recent prevalence of "nuclear awards" – jury awards and settlements exceeding $10 million – increases the probability of an event becoming a tail event. Second, broader definitions of liability and retroactive modification of existing policies challenges the very definition of an "event." In this paper, I focus on the first dimension that is nuclear awards, but the findings and conclusions of the paper well apply to the second.

Despite the influence that social inflation exerts on the core businesses of the insurance sector, little or no academic research exists on the phenomenon. The reason, perhaps, is that social inflation has traditionally been limited to medical malpractice in the 1970s. Another possibility is that the role of interest rates and market power have played a central role in the past, while their impact has waned over the past decade. Ultimately, the role of social inflation risk in driving insurance premiums is an empirical question, to which no rigorous study is currently available.

In this paper, I analyze the risk of social inflation and its economic consequences. I focus on commercial auto liability insurance which pertains to claims that arise from the business use of automobiles. I also examine in detail the rise in nuclear awards, a major source of social inflation risk. The objective of the paper, however, is not to give the final word on whether commercial auto rates have risen due to rising verdicts and settlements. Instead, I show through a detailed study of this line of business how social inflation risk has a general material impact on the insurance sector. Im-

portantly, its reverberations seem to be felt in multiple lines including medical malpractice, directors and officers liability, casualty insurance related to the opioid crisis, and general umbrella coverage.

My analysis centers on a novel hand-matched dataset that includes detailed information on settlements and verdicts involving commercial auto liability, combined with the annual financial statements of insurers and their historical rate filings between 2001 and 2019 (See Section 3). In Section 4, I first document the rise of nuclear awards in the commercial auto liability industry. I find that their number has stayed relatively stable, but the median award size has increased substantially in the past few years. Accordingly, the total amount of jury awards and settlements has increased threefold from $300 million in 2011 to nearly $1 billion in 2019. I also document significant heterogeneity in the occurrence and magnitude of the awards across states and insurers. The cases are concentrated in a small number of states, most notably California, Florida, Georgia, Illinois, New York, and Texas. A few insurers also account for the majority of the cases.

For a subset of my sample, I observe the composition of the awards divided into economic damages, non-economic damages, and punitive damages. I show that the share of non-economic damages, which includes emotional distress and mental anguish, has risen over time. Contrary to industry anecdotes, I do not find evidence in support of rising punitive damages that are intended to punish the defendants for their misbehavior.

While interesting on its own, the rise in nuclear awards has significant economic consequences. In Section 5, I first develop a stylized model of social inflation to illustrate its impact on insurance prices. In my model, an insurance company makes a pricing decision at the beginning of the period but is subject to the reserve requirements at the end of the period. The price of a policy therefore depends on the firm's estimate of social inflation risk throughout the period, which is modeled as increased tail risk in the loss distribution of a given policy.

In the model, social inflation risk has a "double kick" to the insurance price. First, it increases the effective marginal cost of the insurer since the policy has a higher probability of becoming "nuclear." Second, it increases the amount of statutory reserves required to satisfy the requirement. Together, they imply that higher social inflation risk translates into higher prices.

In Section 6, I provide new empirical facts about social inflation, namely the impact of nuclear awards on liability insurance rates. I first use the aggregate industry data to show that rates and reserve developments of insurers respond quickly to widely publicized verdicts. The trends indicate that the commercial auto liability industry has updated their estimates of future claims upward more adversely, anticipating larger payouts than they had originally estimated a year ago. I also conduct a case study of the Zurich Insurance Group to provide more direct support to the above empirical pattern.

Having established the aggregate trends, I next examine the causal impact of social inflation on insurance rates. My identification strategy is to compare commercial and personal auto lines before

and after the famous Tracy Morgan settlement[1] in 2015, while also comparing states more exposed to nuclear awards and those less so. In essence, the empirical strategy amounts to a triple-difference estimator. I find that the magnitude of the main coefficient is positive and significant across different specifications, lending support to the role of social inflation risk in describing the rise in commercial auto liability rates.

It is generally acknowledged that medical costs and economic inflation are a large component of jury awards and insurance rates. I show that the rise in nuclear awards outpaces the rate of inflation and increases in medical care costs. The number of fatal trucking accidents in the U.S. has risen quite sharply in the past five years, a trend that may have contributed to the increase in social inflation risk.

The rising insurance costs have directly translated into rising operating costs for the trucking industry. Social inflation has also led to the exit of major providers of commercial auto liability, which has forced up premiums in the trucking industry. Now the supply of coverage has returned to a new equilibrium with higher premiums and deductibles.

In Section 7, I provide an overview of rising nuclear awards in other commercial insurance lines and evaluate the potential explanations for this trend. It is important to note that the legal system's vulnerability to large verdicts and settlements is hardly a new topic of discussion (Montgomery and Nahrstadt [2003]). I find that the changing legal climate – the rise in third-party litigation financing, limited tort reforms, and aggressive legal advertising – seems to be most pertinent. Contrary to popular opinion, the attitude towards corporate America does not seem to have become particularly harsh over the past years (Gallup [2019])

In Section 8, I discuss implications for insurers during the COVID-19 pandemic. The recent developments related to the COVID-19 pandemic has intensified social inflation risk in two key aspects. One is the risk of retroactive modification of insurance policies, pertaining mostly to business interruption policies; the other is the risk of extended interpretation of directors and officers liability. Both developments represent new forms of social inflation risk that has the potential to lead to significantly elevated insurance rates and exits of insurers.

## Contribution to Literature

This work primarily contributes to the importance of social norms in financial markets. One strand of literature starts from looking at the intersection of law and financial systems. Since the pioneering work by La Porta et al. [1998], it has addressed the role of legal institutional environments in a

[1]Morgan and five others were seriously injured on June 7, 2014 when a Wal-Mart truck crashed into his limousine van on the New Jersey Turnpike. On May 27, 2015, Walmart settled the lawsuit for an undisclosed amount taking full responsibility. Wal-Mart's payouts to Morgan and Fuqua have not been disclosed, but court documents suggest the figure to be around $90 million. The case received extensive media scrutiny including Morgan's Netflix show in 2017 where he jokes about Walmart and the lawsuit.

range of issues including long-term growth (La Porta et al. [1997], Selvin and Picus [1987], La Porta et al. [2006], Glaeser et al. [2004]), competitiveness of the economy (Zingales [2006], Kempf and Spalt [2019]), investments (Kaplan et al. [2003], Lerner and Schoar [2005]), investor protection (Atanassov and Kim [2009], Fernandes et al. [2010], Acheson et al. [2019]) and shareholder activism (Klein and Zur [2009]). A different strand of the literature also looks at the effects of culture on economic growth and development (see Spolaore and Wacziarg [2013] for a review). This paper contributes to both strands by illustrating how changing social trends, interacted with the legal system, can undermine the stability of the insurance sector.

This work – especially its theoretical framework – relates to the literature on frictions on the supply side of insurance markets. Existing literature has focused on financial and regulatory frictions (Merrill et al. [2012], Becker and Opp [2013], Becker and Ivashina [2015], Ellul et al. [2015]). In Koijen and Yogo [2015], the two key frictions are the financial friction, represented by the leverage constraint on statutory capital, and product market friction, which is a form of search friction that makes future demand increasing in statutory capital through higher ratings. In Koijen and Yogo [2018], the key frictions are the financial friction and market power, given the assumption that insurers compete by Bertrand pricing in an oligopolistic market. In my work, I retain financial frictions but introduce uncertainty in the loss distribution as another source of friction. By extending this literature on insurance supply, I effectively show that changing social norms has a profound impact on the pricing behavior and operations in the insurance market.

This work also contributes to a recent literature that examines the systemic manifestation of idiosyncratic shocks. Existing works have focused on granular micro-foundations (Gabaix [2011], Acemoglu et al. [2013], Baqaee and Farhi [2018]) and the mainstream adoption of innovative technology (Pástor and Veronesi [2009], Acemoglu et al. [2016]) as relevant channels. In this work, I contribute by documenting a new channel: idiosyncratic realizations of large verdicts have lasting aggregate consequences for other insurers in the same sector.

This work is also related to the incomplete contracts literature and its main observation that real-world contracts are incomplete. Previous work (Aghion and Bolton [1992], Rajan [1992], Hart [1995]) documents routine incompleteness in employment contracts, merger agreements, and credit contracts, and argues that incompleteness exists due to high transaction costs of writing complete agreements. In this work, I illustrate how the completeness of an agreed contract can change over time due to social factors and lead to large-scale inefficiencies.

## 2 Institutional Background

In this section, I first provide basic details on insurance rate-making and the underwriting cycle. I then explain how payouts by insurance companies are determined in civil jury verdicts. I provide a

more detailed explanation of basic insurance concepts and accounting principles in the appendix.

## 2.1 Insurance Rate-Making and Underwriting Cycles

The price of an insurance contract has three components: actuarial premium, expenses, and markup. The actuarial premium component is the amount of losses that insurers expect to pay, on average, for a given insurance contract; expenses comprise the additional costs associated with underwriting and brokers. The price-setting of insurance companies is often referred to as rate making, where rate is the cost of insurance per exposure unit that is specific to each line of insurance. For example, if the rate per $1 of coverage is $0.1 per year, and the exposure unit is a car that would be replaced for $10,000 when destroyed, then the premium is $1,000.

For property-casualty insurance, rates are determined by applying various rating factors to a base rate according to the insured's characteristics that are reflected in the rating structure (Klein [2005]). For auto liability insurance, for example, an insurer first determines the appropriate average premium for all drivers that it insures. It then adjusts this premium by looking at the type and value of vehicle, geographic location, use of vehicle, age, marital status, driving record and other variables. There are also manual adjustments that are applied to facilitate further customization such as accounting for past claims experience.

The industry regularly undergoes "hard" market conditions in which rates rise and coverage is more difficult to find (Gron [1994], Froot and O'Connell [1999]). In particular, such conditions can be explained by an upward-sloping supply curve for the P&C industry, causing prices to rise in response to a balance sheet shock (Koijen and Yogo [2015]). The insurance industry has typically recognized three distinct periods as exceptionally hard markets: 1975 – 1978, 1984 – 1987, and 2001 – 2004, an overview of which I provide in Appendix D.2.

Social inflation presents a new source of risk in rate-making and underwriting. Dramatic changes in the loss distributions due to nuclear awards can trigger pronounced changes in prices and coverage, which are rational responses to an uncertain underwriting environment.

## 2.2 Insurance Payouts in Civil Jury Verdicts

A person injured because of another person's negligence may have a ground to file a lawsuit against the party and receive compensation.[2] This lawsuit may first result in a settlement, in which case the plaintiff and the defense agree to resolve the case out of court. Otherwise, it may led to a verdict, in which a judge or jury decides on the case. In a settlement, both parties mutually decide on a one-time

[2]In the past few decades, arbitration has become more popular as a means of resolving legal disputes. A type of alternative dispute resolution, arbitration involves an impartial arbitrator who decides the amount of the award.

payment amount, which is then subject to court approval. Most cases settle out of court rather than go to verdict.

If the case goes to a jury trial[3], juries listen to the presented evidence and the arguments from each side. They then evaluate the evidence to determine if the defendant is at fault, after which they proceed to determine the level of fair compensation. When the juries announce the verdict and the amount of compensation, the insurance company usually pays up to its limit on the insurance policy. This system implies that while the insurance companies are not named in the lawsuits, the outcome of the verdict directly translates into their realized losses.

### 2.2.1 Determination of Award Amount

Juries award *compensatory* damages and *punitive* damages. Compensatory damages in a civil lawsuit come in two strands: pecuniary (economic) damages and non-pecuniary (non-economic) damages. Pecuniary damages encompass easily quantifiable damages such as medical costs, lost wages, future care costs, and physical damages. Non-pecuniary damages, on the other hand, include measures that rely on subjective interpretation of the juries. A partial list includes pain and suffering, emotional distress, impairment of life, impairment of relationships, and loss of consortium. Finally, as the name suggests, punitive damages are awarded when the defendant's behavior is found to be especially harmful.

Compensation for non-pecuniary losses is one of the most controversial components of tort liability, the process of which Leebron [1989] characterized as "procedurally simple but analytically impenetrable." A popular calculation method is the multiplier method, in which the value of pecuniary damages is multiplied two to five times to yield the final number. An often-used alternative is the daily rate method, which assigns a daily compensation rate that is multiplied by the number of days of suffering.

### 2.2.2 How much do insurers actually pay?

For various reasons, plaintiffs may not receive the jury's full award. One obvious case is when the defendant wins on appeal. Alternatively, judges can exercise ex-post oversight after the jury decision.[4] Post-verdict settlements for insurance policy limits are also quite common, possibly in response to threat of appeal or protracted legal wrangling (Bornstein and Greene [2017]).

Empirical evidence on post-verdict haircuts is scant. One notable study is Hyman et al. [2007]. In an examination of a set of medical malpractice claims in Texas from 1988–2003, authors find that

[3] Flango and Clarke [2014] estimate that between 1976 and 2009, civil jury trials fell from 3.5% of all dispositions to 0.5%. Among tort cases that do go to trial, 90% of them are decided by a jury, according to Langton and Cohen [2008]

[4] Examples include granting motions for directed verdict or for judgment notwithstanding the verdict (jnov), granting remittitur, and appellate reversal.

insurance policy limits are the most important factor in explaining the haircuts.

Despite the reduction in liability, however, insurer's realized losses can easily go beyond the limit. In other words, if an insurance policy covers up to $X$ dollars, the payout can equal $\alpha X$ where $\alpha > 1$. A common approach for attorneys to collect the award in excess of the policy limit is to obtain an assignment of claims[5] from the defendant, in exchange for a promise not to execute, and go after the defendant's insurers for the excess verdict (Le [2015]).

Another common approach invokes the bad faith on the part of the insurer. A claim of bad faith against an insurance company arises when the company allegedly had the opportunity to settle a claim for an amount within the policy limits but did not do so. In this case, the company may be held liable for the full amount of damages.

# 3 Data

Throughout the remainder of the paper, I focus on commercial auto liability, which pertains to liability that can arise from the business use of automobiles or from the operation of an employee's automobiles on behalf of the business. The impact of social inflation has been most evident in the commercial auto line, which has seen rising prices since 2012 (SwissRe [2019]). Through a detailed study of this line of business, I seek to illustrate how social inflation risk has a general material impact on the insurance sector as a whole.

## 3.1 Data Construction

Data consists of three main sources: detailed information on settlements and verdicts, balance sheet information of insurance companies, and historical rate change requests and approvals.

**Settlements and Verdicts** I collect data on cases involving commercial auto liability from 2001 to 2019. The primary data source is VerdictSearch, a major verdict-reporting outlet that actively solicits its contributions from attorneys on each side of the case. The reports are written by professional journalists and contains detailed information including date, venue, accident description, and list of insurance companies involved. I focus on verdicts and settlements with awards greater than $10 million and hand-collect the relevant information. The final sample consists of 300 verdicts, and further details of the construction are detailed in Appendix B.1.

[5] Assignment of claims is a legal process that allows one party to transfer or "assign" a claim to someone else, provided that the other party is in full knowledge of the assignment and agrees to it.

**Financial Statements** From SNL Financials, I obtain the annual financial statements for fiscal years 1996 to 2019 for insurance companies that sell commercial auto liability policies. The statements are prepared according to the statutory accounting principles and filed with the National Association of Insurance Commissioners (NAIC). The financial statements are available both at the individual company level and the group level.

**Rate Filings** The historical rate filings for calendar years 2001 to 2019 are obtained through SNL Financials. Most states require rate changes to be filed, and a majority of the states require that insurers receive prior approval before rate changes go into effect. I obtain all rate changes that have been approved, disapproved, and withdrawn as well as the amount of written premiums that the rate change applies to.

## 3.2 Summary Statistics

### 3.2.1 Commercial Auto Liability Market Structure

Table 1 reports the top 15 insurance groups for commercial auto liability insurance in terms of direct premiums written at the end of 2019. There are 314 insurance groups with positive direct written premiums. The largest provider group of commercial auto liability is Progressive Corporation, which wrote approximately $4.5 billion in direct premiums and accounted for nearly 13% of the total in 2019. The top 15 groups together account for nearly 53% of the total $34 billion of commercial auto liability premiums written in 2019.

Table 2 reports the similar statistics at the individual company level. The largest provider company is United Financial Casualty Co. – a subsidiary of Progressive – which accounts for 3.53% of the written premiums in 2019. There are 856 insurance companies with positive direct written premiums, and the top 15 account for 24% of the total premiums in 2019.

Figure 2 plots the time-series trends in direct premiums written and the Herfindahl-Hirschman Index (HHI) for the commercial auto liability industry from 2001 to 2019. The HHI index remains relatively stable around 300 in my sample period with a slight dip around 2015. The level of concentration, measured by HHI, is smaller compared to other industries[6] and does not display an upward trend. Overall, the results imply some level of concentration in the market for commercial auto liability insurance, which still seems modest compared to concentrations in other markets.

[6] According to Autor et al. [2020], the average HHI for manufacturing, utilities, finance, retail and wholesale trade are all over 2,000 between 2001 and 2019.

### 3.2.2 Rate Filings: Requests and Approvals

Table 3 presents the summary statistics for commercial auto liability rate filings. For each year, I report the mean, median and standard deviation of rate changes and the amount of premiums that the change applies to. The sample is restricted to filings for which both the rate change and the premiums are observable and includes approved, disapproved, and withdrawn filings.

The average rate growth over the years is consistent with anecdotal evidence of a hard market for commercial auto liability in the early 2000s and the recent past years. Across all years, there is significant variability in rate change across insurers. There is also considerable time trend in the total number of approved rate changes with a discrete jump from 2006 to 2007 which is either due to time-varying coverage of SNL Financials data or due to radical changes in the filing requirement.

Table 4 reports the top 5 states with the lowest rate approval probability for commercial auto liability. The unconditional approval probability, defined as the the ratio of approved filings to total filings in my sample, is quite high at 96.3%. This fact is consistent with the observation that states are stricter for personal lines filing than for commercial lines filing (NAIC [2012]).[7] Across states, Arizona has the lowest approval probability at around 42.0%, followed by New Mexico, Louisiana, Colorado, and California. The remaining states exhibit high approval probability over 90%.

# 4 The Rise of Nuclear Awards

I now document the rise of nuclear verdicts and settlements in commercial auto liability. The general trend in the frequency and magnitude of nuclear awards can be considered as one particular manifestation of social inflation risk.

## 4.1 Trends in Nuclear Awards

Figure 3 shows the number and magnitude of nuclear verdicts and settlements for commercial auto liability cases from 2001 to 2019 across all states. I report the count and sum of awards greater than or equal to $50 million, those between $20 and $50 million, and those between $10 and $20 million. The number of nuclear awards between 2006 and 2019 is consistently around 15 per year; the years before 2006 exhibit a smaller frequency. While the total count seems to be stable over time, the composition has changed. Specifically, the share of awards greater than $20 million has increased substantially in the past few years. The total award amount for commercial auto liability thus has rapidly grown in the past decade from $300 million in 2011 to nearly $1 billion in 2018 and 2019.

[7] One potential reason, according to NAIC [2012] is that personal lines consumers are less sophisticated and knowledgeable about insurance than commercial lines customers. Another is that there are more societal considerations taken into account in personal lines insurance than commercial.

## 4.2 Geographic Concentration of Nuclear Awards

There is also significant heterogeneity in the occurrence and magnitude of nuclear awards across states. Tables 5 and 6 report the number and sum of verdicts and settlements greater than $20 million in each state from 2001 to 2019. The cases are concentrated in a few number of states – notably California, Florida, Georgia, Illinois, New York, and Texas. The high number of cases in Texas, California, and Florida can be partially explained by the high number of fatal crashes involving a large truck shown in the last column.

There are also states with frequent nuclear awards without a notably large number of fatal crashes, the list of which includes Georgia, Illinois, Louisiana, and New York. Interestingly, all the states are included in the top ten list of places where laws and court procedures are applied in an "unfair and unbalanced manner, generally to the disadvantage of defendants," according to the American Tort Reform Foundation in its 2019 report.

Altogether, the concentration of verdicts in a small number of states therefore hints at the possibility that drivers of nuclear awards include state- or county-specific component. Later I use this intuition to motivate my main empirical strategy in Section 6.

## 4.3 Insurance Companies and Nuclear Awards

Table 7 reports the list of insurance companies involved in nuclear verdicts and settlements from 2001 to 2019. AIG is involved in 60 nuclear awards, which accounts for 20% of my sample. The top five groups – AIG, Zurich, Chubb, Travelers, and Liberty Mutual – account for nearly half of all my sample. Most of these groups are the largest liability insurance groups as shown in Table 1, although Progressive, the largest provider of commercial auto liability insurance, seems to have been relatively less exposed to incidence of nuclear awards.

## 4.4 Composition of Nuclear Awards

As mentioned in Section 2, the jury award consists of five components: past and future pecuniary (economic) damages, past and future non-pecuniary (non-economic) damages, and punitive damages. For a majority of the verdicts, I observe the breakdown of jury awards; I do not observe it for settlements.

Table 8 provides some summary statistics on the distribution of jury award components. I exclude punitive damages and restrict to samples in which all four components – past / future economic and non-economic damages – are observable, which amounts to a final set of 133 cases. In terms of both dollar amounts and the share of total awards, future non-economic damages constitute the largest share at around $13 million or nearly 45% on average. Past economic damages, on the other hand,

are the smallest among the four components. They also exhibit smaller standard deviation across cases, consistent with the intuition that incurred economic damages such as medical costs and lost wages are relatively objectively measured.

Table 9 presents the correlations among the jury award components. The correlation is highest for past non-economic damages and future non-economic damages at 0.533, while the corresponding correlation for past and future economic damages is 0.307. The correlation between economic and non-economic damages is considerably lower at 0.284 for past damages and 0.208 for future damages. In general, the presented correlations are consistent with the following narrative: juries award future damages as multiples of past damages, while the relationship between economic and non-economic damages is more subjective and idiosyncratic to juries.

Next I examine whether the composition of awards exhibit significant time-variation. Figure 4 plots the composition of nuclear awards in commercial auto liability cases from 2001 to 2019. I provide the composition both by year and by five years. The proportion of economic damages relative to non-economic damages seems to have declined in the past two decades. The ratio of past to future damages, however, has stayed relatively stable over time. One theory that is consistent with this observation is that the applied multiple between economic and non-economic damages has increased over time.

Another particular complaint has been that punitive damages, designed to punish the corporate defendant, have become more frequent and sizable (McMichael and Viscusi [2019]). To shed some light on the veracity of such claim, I plot the total amount of punitive awards as well as number of cases involving punitive damages in Figure 5. Both plots show that there is no discernable trend in punitive damages over time. Given the small sample size, however, the lack of trend needs to be interpreted with caution and warrants further investigation.

# 5 Theoretical Framework: A Model of Social Inflation

To guide my subsequent empirical analyses, I develop a simple model of social inflation. The key assumption is that the insurance company makes a pricing decision at the *beginning* of period 1 but is subject to the reserve requirements at the *end* of period 1. The price therefore depends on the firm's estimate of social inflation risk throughout the period.

## 5.1 Setup

I adopt the basic setup from Koijen and Yogo [2015] and simplify it to a one-period setting. At the beginning of the period, an insurance company sells $Q(P)$ policies at price $P$ and incurs a fixed cost

$C$ per policy[8], which corresponds to marketing and administrative cost. Denote $A_0$ and $L_0$ as the insurance company's assets and statutory reserves, respectively, at the beginning of the period, and $R$ as the return on its assets over the same period. $V$ is the actuarial value of the sold policies, and $S$ is the amount of statutory reserves per policy set aside to pay for future policy claims. Since I focus on property and casualty (P&C) business, I assume $S = V$.[9]

Throughout the period, there is a realization of social inflation risk $\tilde{X}$, a random variable with cdf $F_X$. $F_X$ can be thought of as the insurance company's best estimate of social inflation risk. After social inflation risk is realized, the insurance company adjusts its reserves from $S$ to $\tilde{X}S$ as the actuarial value of the policy changes from $V$ to $\tilde{X}V$.

**Balance Sheet Dynamics** The insurance company's assets at the end of period 1, after the sale of new policies, is

$$A_1 = RA_0 + PQ - C \tag{1}$$

The reserves at the start of period 1 is $L_0 = SQ$. Throughout period 1, social inflation risk is realized and the statutory reserves at the end of period 1 is

$$\tilde{L}_1 = RL_0 + \tilde{X}L_0 \tag{2}$$

I then define the insurance company's statutory capital as the value of its assets relative to statutory reserves:

$$\tilde{K}_1 = A_1 - \tilde{L}_1 \tag{3}$$

Together, the equations imply that the law of motion for statutory capital is

$$\tilde{K}_1 = RK_0 + \left(P - \tilde{X}S\right)Q - C \tag{4}$$

**Risk-Based Capital Constraint** To account for the randomness in the statutory capital, I introduce the risk-based capital constraint of the following form:

$$\mathbb{P}\left(\tilde{K}_1 \geq K^*\right) \geq \alpha \tag{5}$$

where $K^*$ is some threshold capital level and $\alpha$ is a probability threshold very close to 1. The idea is that the statutory capital must be kept above a certain threshold with a very high probability. Setting $K^* = 0$ and $\alpha = 1$ yields the case without uncertainty: $K_1 \geq 0$, which is used in Koijen and Yogo

[8] While the magnitude of $C$ does not matter in this model, I include the parameter for completeness.

[9] For property and casualty insurers, the statutory reserve regulation requires that $S/V \geq 1$. Since the regulation is not the object of interest, I set $S = \phi V$ where $\phi = 1$.

[2015]. Using (4), (5) can then be rewritten as:

$$\left(P - SF_X^{-1}(\alpha)\right) Q \geq K^* + C - RK_0 \tag{6}$$

Note that $SF_X^{-1}(\alpha)$ represents the minimum amount of statutory reserves required to satisfy the leverage requirement of threshold $\alpha$ under the distribution $F(\cdot)$ at the end of period 1.

## 5.2 Optimal Insurance Pricing

Now I derive an expression for the optimal insurance price. The insurance company's profit is

$$\tilde{\Pi}_1 = \left(P - \tilde{V}\right) Q - C \tag{7}$$

The insurance company chooses the price $P$ to maximize firm value, or the present value of profits:

$$\mathbb{E}\left[M\tilde{\Pi}_1\right] \tag{8}$$

where $M$ is a one-period stochastic discount factor. Therefore, combining (6) and (8) yields the insurance company's maximization problem:

$$\begin{aligned} \max_P \quad & \mathbb{E}\left[M\tilde{\Pi}_1\right] \\ \text{subject to} \quad & \left(P - SF_X^{-1}(\alpha)\right) Q \geq K^* + C - RK_0 \end{aligned} \tag{9}$$

Let $\lambda \geq 0$ be the Lagrange multiplier on the leverage constraint. The Lagrangian is then:

$$\mathcal{L} = \mathbb{E}\left[M_1\tilde{\Pi}_1\right] + \lambda\left(\left(P - F_S^{-1}(\alpha)\right) Q - \left(K^* + C - RK_0\right)\right) \tag{10}$$

Taking the first-order condition with respect to $P$ and setting it equal to zero, we obtain the price of policy:

$$P = V\mathbb{E}\left[M\tilde{X}\right]\left(1 - \frac{1}{\epsilon_D}\right)^{-1}\left(\frac{1 + \lambda\left(\frac{SF_X^{-1}(\alpha)}{V\mathbb{E}\left[M_1\tilde{X}\right]}\right)}{1 + \lambda}\right) \tag{11}$$

where

$$\epsilon_D = -\frac{\partial \log Q}{\partial \log P} > 1 \tag{12}$$

is the elasticity of demand.

**Interpretation** With no social inflation risk $\left(\tilde{X}=1\right)$ and $\lambda=0$, the insurance price reduces to:

$$\bar{P}=V\left(1-\frac{1}{\epsilon_D}\right)^{-1} \tag{13}$$

which is the pricing formula in which price is equal to the marginal cost times a markup that is decreasing in the elasticity of demand.

When $\lambda=0$ in the presence of social inflation risk, the price equals:

$$\hat{P}=V\mathbb{E}\left[M\tilde{X}\right]\left(1-\frac{1}{\epsilon_D}\right)^{-1} \tag{14}$$

Intuitively, $V\mathbb{E}\left[M\tilde{X}\right]$ is the effective marginal cost based on the insurance company's best estimate of social inflation risk. Nuclear verdicts, one particular form of social inflation risk, puts more mass on the right tail of the distribution of $\tilde{X}$, increasing the effective marginal cost and subsequently prices.

When $\lambda>0$ in the presence of social inflation risk, the optimal price satisfies the following inequality:

$$P\lesseqgtr\hat{P}\quad\text{if}\quad SF_X^{-1}(\alpha)\lesseqgtr V\mathbb{E}\left[M\tilde{X}\right] \tag{15}$$

which is consistent with the role of financial constraints shown in Koijen and Yogo [2015]. Furthermore, note that the component of price affected by social inflation risk is the following

$$V\mathbb{E}\left[M\tilde{X}\right]\left(1+\lambda\left(\frac{SF_X^{-1}(\alpha)}{V\mathbb{E}\left[M_1\tilde{X}\right]}\right)\right)=V\mathbb{E}\left[M\tilde{X}\right]+\lambda SF_X^{-1}(\alpha) \tag{16}$$

Importantly, equation (16) illustrates the compounded effect of heightened social inflation risk in the presence of binding financial constraint. First, it increases the effective marginal cost through $\mathbb{E}\left[M\tilde{X}\right]$. Second, it increases $SF_X^{-1}(\alpha)$ as the amount of statutory reserve required to satisfy the requirement at level $\alpha$ increases. Together, they imply that higher social inflation risk translates into higher prices.

To provide a clearer intuition, Figure 6 illustrates the effect of social inflation risk on statutory reserves. The left panel plots the probability distribution of $\tilde{X}$, which captures the insurer's estimate of social inflation risk. The red solid line is a distribution with low uncertainty, while the black dotted line is the distribution with high uncertainty. Both distributions have the same mean at 1. The right panel plots $F_X^{-1}(\alpha)$ for different values of $\alpha$, and the vertical line represents the case when $\alpha=0.9$. Examining the intersections of the vertical line with the solid and dashed lines, it is clear that higher social inflation risk increases the minimum statutory reserve requirements and therefore prices.

# 6 New Facts about Social Inflation

For insurance companies, social inflation risk poses considerable uncertainty in predicting the social trends and accounting for them in pricing risk. Furthermore, it may take years for insurers to determine whether the original policy pricing was adequate, leading to further delay in updated underwriting.

In this section, I present new facts about social inflation, focusing on its consequences for the insurers and the insured. I first document trends in social inflation for commercial auto liability and present a case analysis of Zurich Insurance Group, one of the largest underwriters in the industry. I then construct a panel of insurance rates and nuclear awards and examine the impact of social inflation risk on insurance rates using a triple-difference estimator. Finally, I compare social inflation risk to other traditional sources of risk in insurance and document its effect on the trucking industry.

## 6.1 Trends in Social Inflation and Commercial Auto Liability

### 6.1.1 Aggregate Trends

Figure 7 plots the average rate growth for commercial auto liability insurance from 2001 to 2019. The rate grew at around 5% in the early 2000s, after dipping into negative territory towards the end of the decade. The rate growth increases substantially in the early 2010s, reaching and even exceeding 5% this past year.

The increases correspond to the recent developments in nuclear awards, which are indicated as shades in the figure. *Foster v. Landstar Ranger*, a 2011 case in Georgia, is considered to be one of the watershed moments for nuclear awards. The attorney that won the case allegedly went on a speaking tour, teaching other attorneys working with truck crashes to refuse settlements and take the injury claim to court (Cole [2020]). Another perhaps more widely known watershed moment is the initial settlement by Wal-Mart with Tracy Morgan over the New Jersey turnpike crash in 2014.

As shown in Figure 8, the one-year reserve development for commercial auto liability lines has also increased substantially in the past decade. The increase is consistent with the hypothesis that insurers have updated their estimates of future claims more adversely, anticipating larger payouts than they had originally estimated a year ago. At the same time, the ratio of incurred losses to written premiums has increased by more than 20% from 2006 to 2019.

It is also important to note that filed rate changes are concentrated in a small number of state and insurance companies. Figure 9 plots the total number of nuclear awards and rate changes between 2001 to 2019 across states as well as across insurance groups. In Panel A, we see that California, Texas, and New York account for more than 50% of the total nuclear awards. Rate changes are also concentrated in states such as Pennsylvania, Georgia, New York, and Texas, albeit less concentrated

than are nuclear awards. In Panel B, we see that AIG, Zurich, and Chubb are the top three insurance groups in terms of the number of nuclear awards but not necessarily the groups with the largest number of rate changes.

### 6.1.2 A Case Study of the Zurich Insurance Group

Figure 8 shows the historical growth in rates and reserve development for Zurich Insurance Group from 2001 to 2019. In Panel A, I plot the rate growth along with three major verdicts. *Foster vs. Landstar Ranger* and the Tracy Morgan settlement did not involve Zurich, while the famous 2013 Texas Verdict that yielded $281 million in award involved Zurich directly. We see that the Zurich has increased its rates steadily throughout all these periods, consistent with the intuition that social inflation risk is unlikely to be idiosyncratic to a single company or a single state.

In Panel B, I plot the one-year reserve development for Zurich's commercial auto liability line. We see that Zurich has experienced favorable reserve development between 2007 and 2012, benefiting from increased rates without any realizations of nuclear awards. Then in 2013 and onwards, Zurich has developed adverse reserve development with over $20 million in 2015. This loss of profits coincides with the 2013 Texas verdict that Zurich was involved in.

The intuition here is consistent with the interpretation of nuclear award as disaster risk. Absent the realization of disasters, an investment strategy that bets against realization of a disaster earns steady, positive returns. Upon a realization of a disaster, however, extreme losses are incurred.

After suffering adverse reserve developments, Zurich closed the transportation underwriting unit for U.S. companies and stopped renewing all transportation business in the third quarter of 2015. This particular development indicates that social inflation risk can be addressed only partly through changes in rates or deductibles. After a series of adverse shocks, it may altogether be unprofitable for the insurer to cover such liability, thereby leading to a market exit.

## 6.2 Impact of Social Inflation Risk on Insurance Rates

It is often suggested that commercial auto liability lines, which feature corporate defendants, are more exposed to social inflation risk than are personal auto liability lines (Haran et al. [2016]).[10] I also showed that the large verdicts and settlements have been historically concentrated in a few states. These insights suggest exploiting the type of auto liability lines (commercial vs. personal lines) and the exposure of states to social inflation (high award vs. no award states) as a source of variation to assess the impact of social inflation on insurance rates. For a detailed discussion motivating identification, I direct the readers to Appendix C.1.

[10] I provide more details regarding this claim in Section 7.

While settlements and verdicts have been rising since 2011, the 2014 truck collision in New Jersey involving the comedian Tracy Morgan has been pivotal in galvanizing the public's awareness of the risk. The claims were settled in May 2015, the details of which were not disclosed to the public. I therefore use the settlement date of this accident as a temporal source of variation in my empirical strategy. In Appendix C.2, I use the occurrence of the term "social inflation" in conference call transcripts of insurers to identify a different timing and find similar results, if not more significant.

I therefore employ a triple difference estimator (DDD). Given the skewed distribution of rate filings across states and to reduce measurement error, I classify each state into three groups that become my unit of observation: no-award states, low-award states, and high-award states.[11] The no-award states are states without any nuclear verdicts and settlements between 2001 and 2019. The low-award states correspond to those with less than the median number of nuclear awards between 2001 to 2019, which is equal to four. The high-award group encompasses the remaining states.

I then run the following regression:

$$\begin{aligned}\Delta P_{ist} = \beta_0 &+ \beta_1 HighAward_s + \beta_2 IsComm_i + \beta_3 HighAward_s \times IsComm_i \\ &+ \delta_0 Post_t + \delta_1 HighAward_s \times Post_t + \delta_2 IsComm_i \times Post_t \\ &+ \delta_3 HighAward_s \times IsComm_i \times Post_t + GDPGrowth_t + IsComm_i \times GDPGrowth_t + \epsilon_{ist} \quad (17)\end{aligned}$$

where $i$ denotes the insurer, $s$ denotes the state's classification into either no-award or high-award states, and $t$ indicates the quarter in which the rate change was filed. In this particular specification, I exclude the low-award states.[12] The dependent variable is the average quarterly change in rates. As I observe the rate changes at the state-level, the dependent variable $\Delta P_{ist}$ is constructed as an average across the states with the same classification. $HighAward_s$ is equal to one if state $s$ is classified as a high-award state; $IsComm_i$ is equal to one if the insurer provides commercial auto liability coverage rather than its private counterpart; $Post_t$ is equal to one if quarter $t$ is after the initial Tracy Morgan verdict. For the purpose of this estimation, I treat the commercial and personal lines within the same insurance group as distinct insurers and focus on insurers who have filed at least once during 2001 to 2019 in at least one state. I also include contemporaneous GDP growth as a control variable and allow for differential loadings between commercial and personal lines.

Ultimately, I am interested in $\delta_3$, the coefficient of the triple interaction. The DDD estimate exploits the change over time in average rate growth for the high-award state versus the no-award states. I then net out the change in means for the commercial auto liability lines versus the personal

[11] One may worry that the classification is based on incidence of nuclear awards which are ex-post outcomes. To mitigate this concern, I consider an alternate sort based on the cumulative number of fatal truck crashes from 2004 to 2015. Repeating the analysis with this new exposure measure yields a similar estimate, the details of which are provided in the Appendix C.2.

[12] In a set of unreported results, I find that including them in the triple-difference estimator does not materially change the conclusion. I exclude them in the reported result to allow for a cleaner interpretation.

auto liability lines. I focus on four year (16 quarters) before and after the Tracy Morgan verdict.

Table 10 shows the results of estimating equation (17). In column (1), I run a panel regression including year fixed effects and controlling for contemporaneous GDP growth. In columns (2) – (4), I relax each to examine the stability of my estimates. The results show that rates have increased significantly on average – around 1% across all specifications – in states with high nuclear awards than in states without any from 2001 to 2019. The coefficient for the interaction between the indicator denoting commercial auto line and contemporaneous GDP growth is also positive and significant, consistent with the intuition that commercial auto activities are more sensitive to business conditions. The magnitude of the main coefficient is around 2, which is positive and statistically significant across all specifications. The estimate indicates that the change in commercial auto insurance rate was on average 2% higher than the change in personal auto insurance rate in states with high number of verdicts. Overall, the results lend support to the role of social inflation risk in describing the rise in commercial auto liability rates.

To further check that the differential impact on rates across states and insurers is not driven by differential trends among these groups, I graph the time-series coefficients of the following regressions:

$$\begin{aligned}\Delta P_{ist} = \lambda_i + \eta_t + \sum_{\tau \neq t_0} \beta_{1\tau} HighAward_s \mathbf{1}_{(\tau=t)} + \sum_{\tau \neq t_0} \beta_{2\tau} IsComm_i \mathbf{1}_{(\tau=t)} \\ + \sum_{\tau \neq t_0} \beta_{3\tau} HighAward_s \times IsComm_i \mathbf{1}_{(\tau=t)} + \epsilon_{it} \end{aligned} \tag{18}$$

where $\mathbf{1}_{(\tau=t)}$ is a dummy variable equal to one for year $t$. I normalize the coefficient $\beta_{2015}$ – the year of the Tracy Morgan verdict – to zero. The results of this check, summarized in Figure 11, shows that the differences in rates were close to zero or below zero prior to 2015. In other words, the pre-period saw a trend close to parallel between the treatment and control, if not higher growth for the control group. The coefficient experiences a larger increase after the time of the verdict, consistent with the rising prevalence of social inflation risk across insurers.

## 6.3 Comparison to Other Risks

It is generally acknowledged that medical costs and economic inflation are a large component of jury awards and insurance rates. To examine their ability to explain such trends, I plot the historical growth of the relevant economic series from 2004 to 2019. Specifically, I plot the cumulative growth in the following three quantities: inflation, costs of medical care, and the number of fatal motor vehicle accidents involving large trucks. Inflation and medical costs are obtained from the FRED Economic Database, and data on accidents are obtained from the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA).

Figure 12 illustrates the comparative growth of the three economic series. I normalize each series to its value in 2004, the first year for which the NHTSA data is available. From the figure, it is clear that the rise in awards is unmatched by the rate of inflation or medical care costs. The sum of nuclear awards has increased by more than 300% from 2004 to 2018, whereas the consumer price index increased by 32% and the medical care costs by 54%. The number of fatal trucking accidents in the U.S. has in fact decreased during the same period, although it has risen quite sharply in the past five years.

The presented results confirm the role of social inflation risk in driving the recent trends in insurance rates. General inflation and medical costs seems to play a little role, while the incidence of fatal trucking accidents may be more relevant for the recent years.

## 6.4 Effects on the Trucking Industry

Federal law requires trucking companies to cover drivers for a minimum of $750,000 per accident, and most shipper contracts require at least $1 million of coverage. The coverage requirement can be as high as $5 million depending on the gross weight of the vehicle. Although carriers with five or fewer trucks might stop there, larger operators often purchase additional layers of liability coverage to protect themselves from larger claim awards. Such excess coverages are often bought in $5 million increments.

Given the extensive usage of commercial auto liability coverage, rising insurance costs have directly translated into rising operating costs for the trucking industry. According to a recent report by the American Transportation Research Institute (ATRI), rising insurance costs account for the largest recent increase in operational costs for trucking firms (Murray and Glidewell [2019]).

Social inflation has also led to the exit of major providers of commercial auto liability insurance. Zurich Insurance Group and AIG unit Lexington, who are both key players in different segments of truck insurance, exited those markets in 2015. Westfield Insurance, another major motor carrier underwriter, followed suit in 2017. While the exit of Zurich did not cause a major disruption because other carriers stepped in, Lexington's departure created a huge void in the excess market given its large presence. The departure of Lexington, combined with increasing exposure to nuclear awards, has substantially forced up premiums in the trucking industry.

Today, the supply of coverage has returned to a new equilibrium with higher premiums. Many underwriters also invest significantly in improving the trucker's safety and risk profiles by mandating the installation of collision-avoidance technology and minimum safety scores on the federal government's Compliance, Safety, Accountability (CSA) program.[13]

[13]CSA scores are the Federal Motor Carrier Safety Administration's data-driven safety compliance and enforcement program designed to improve safety and prevent commercial motor vehicle crashes, injuries, and fatalities. CSA consists of three core components; the Safety Measurement System; interventions; and a Safety Fitness Determination rating

# 7 Social Inflation as Aggregate Risk

While this paper's empirics focuses on commercial auto liability, nuclear awards and the subsequent increase in rates are a salient concern across many other lines as well (West [2020]). In this section, I outline the rising nuclear awards in other commercial insurance lines and evaluate potential explanations for this phenomenon. I also cover the economic consequences of this trend.

## 7.1 Rising Nuclear Awards in Other Lines

### 7.1.1 Directors and Officers (D&O)

Directors and officers insurance, which protects board members and company leadership for their decisions and actions, has also experienced significant risk exposure to social inflation. The increase in number of suits filed is driven by a 2018 unanimous court decision *Cyan Inc. v. Beaver County Employees Retirement Fund*, which set a new precedent on the jurisdiction where securities action lawsuits can be tried. The conclusion from the case now allows the lawsuits to proceed in state courts, which eliminates the ability to consolidate cases and thereby multiplying the number of cases (Soich [2019]).

Total claim costs are also growing. The combination of attorney's fees and settlements have increased 63% to $4.5 million from 2012 to 2016. For dismissed cases, total costs have increased 162% to $2.3 million during the same period. (Chubb [2018]). In a 2018 survey, 96% of D&O insurers stated that social inflation risk from increased lawsuits is increasing and 80% of them expected rates to go up for mature public companies in the next year (Huskins [2018]).

### 7.1.2 Medical Malpractice

Medical professionals have historically argued that medical malpractice lawsuits are a leading cause of rising medical costs (Mello et al. [2010]). Reforms in the 1970s and the 1980s sought to limit both the frequency and the intensity of the suits. For example, some states limit the maximum amount of non-pecuniary losses or even total damages for which a single plaintiff can sue. Another reform has been introduced to decrease the statute of limitations for malpractice cases, currently around two to six years for most states.

Despite the attempts at reform, social inflation in medical malpractice has re-emerged. The average cost of a U.S. medical malpractice claim increased by 50% since 2009 with a sharp rise in the number of claims valued in excess of $5 million more recently (LLC [2019]). A report by S&P global also finds that the direct incurred loss ratios in the physicians' and surgeons' liability portion of the

system to determine the safety fitness of motor carriers.

business surged to 52.6% in the third quarter and 53% for the first nine months of 2019 from 46.6% and 46.1% in the same periods of 2018 (Zawacki [2019]).

#### 7.1.3 Opioid Crisis and Casualty Insurance

In 2017, the Department of Health and Human Services declared a nationwide public health emergency over the opioid crisis. Lawsuits related to opioids have since been filed by state and local governments against manufacturers, distributors and retailers. Given the wider legal trends, insurance companies have increasingly sought purchasing adverse development cover and introduced exclusions for opioids (Woleben and Ross [2019]). For example, Berkshire Hathaway Inc., the largest underwriter of medical professional liability in 2018, said it will not cover claims on doctors' offices stemming from the prescription of opioids through its telehealth offering with only a minor exceptions.

#### 7.1.4 Assignment of Benefits (AOB) Abuse in Florida

Assignment of Benefits is a legal process that allows policyholders to grant a third party to directly bill an insurer to settle a claim. Such lawsuits, especially for auto glass coverage and homeowners insurance, have been on a rapid rise in Florida. Compared to roughly 1,300 AOB lawsuits in 2000, there were more than 79,000 in 2013 and nearly 135,000 in 2018, a 70% increase in just five years (III [2018]). The lawsuits have been historically localized to a few counties such as South Florida and metro areas around Tampa Bay and Orlando. Now they have been spreading rapidly to other counties, making their manifestation a state-wide phenomenon.

The rising legal costs and settlements have translated into increasing insurance costs. The average premium for homeowners insurance in Florida has risen approximately 30% between 2007 and 2015. In 2019, Citizens Property Insurance Corp, Florida's state-owned residual property insurer, also recommended a rate increase to Miami-Dade, Broward, and Palm Beach counties nearing 10% per year, which is the statutory limit in Florida. The rates in these counties are expected to increase 30 – 60% from 2017 to 2022 (III [2018]).

### 7.2 Drivers of Nuclear Awards

It is worth noting that the legal system's vulnerability to large verdicts and settlements is hardly new. For example, the increasing frequency and size of damage awards already posed a significant concern at the end of the 20th century (Montgomery and Nahrstadt [2003]).

Below I provide some answers to the following key question: what is unique about the past decade of nuclear awards and which of the proposed explanations seem most plausible? As a preview, I find that the changing legal climate – rise in third-party litigation financing, limited tort

reforms, and aggressive legal advertising – seems to be most pertinent. Contrary to popular opinion, the attitude towards corporate America does not seem to have become particularly harsh over the past years.

### 7.2.1 Third-Party Litigation Funding

Litigation financing refers to a growing business that finances litigations upfront in exchange for a percentage of future awards and settlements. The investor covers a large portion of lawyer fees, research expenses, and medical bills. The repayment is generally contingent upon a successful outcome of the underlying claim – if the litigation is unsuccessful, the lender owes nothing.

Importantly, there is significant jurisdictional heterogeneity in the availability of litigation finance. For example, a commercial claim in Indiana proved virtually unfundable due to adverse issues with the treatment of litigation funding in the state. There are also usury laws that limit lending to individuals, which may not necessarily apply to commercial enterprises. Florida, Texas, New York, and California are considered attractive for investing in litigation, while Georgia, Alabama, Colorado, Kentucky, and Pennsylvania are deemed unattractive.

Since the late 1990s, the market for litigation finance has grown from a handful of firms to a dozen major players. The litigation finance market is made up of three major segments: commercial litigation finance, personal litigation finance, and mass tort litigation finance. Nuclear awards pertain to personal litigation finance which covers personal injury and automotive crashes. While the data on the growth in personal litigation finance is limited, the data on commercial litigation finance market provides an estimate of similar developments. For example, the percentage of law firms using litigation finance grew more than five-fold to 36% from 2013 to 2017 (Clair and Klevens [2018]).

The introduction and growth of litigation finance is relatively new. Given the jurisdictional heterogeneity and rapid increase in popularity, it seems reasonable to assume at least a partial role for the increase in nuclear awards. In economic terms, litigation financing increases the supply of potential nuclear awards by lowering the cost for an individual to take their claims to court.

### 7.2.2 Erosion of Trust in Corporate America

Another popular narrative pertinent to nuclear awards is the decline of people's trust in large companies and businesses. This conjecture, however, is hardly specific to the recent decade. For example, existing research has shown that juries do seem to exhibit an anti-corporate attitude, thereby requiring corporate defendants to pay more for the same injury than individual defendants (Hans [2000], Greene and Bornstein [2003], Haran et al. [2016]).

As further empirical evidence, I turn to Gallup's Confidence in Institutions poll which surveys the general American public for the degree of confidence in different types of institutions (Gallup

[2019]).[14] For big business, the share of respondents who place a "Great deal" or "Quite a lot" of confidence has remained quite stable around 20%. If anything, the share has increased in the past five years from 18% in 2016 to 23% in 2019. While this report is by no means a comprehensive study, they lend support to the argument that general public attitude towards corporate America has remained relatively stable over the past years.

#### 7.2.3 Limited Tort Reform

Tort reforms are proposed changes to the justice system aimed at reducing the ability of victims to litigate or to cap the damages one can receive. In the United States, a key battleground for tort reform has been medical malpractice law. The Medical Injury Compensation Reform Act of 1975, often hailed as starting a nation-wide trend in tort reform, set a $250,000 cap on non-economic damages.

Tort reform has largely been successful at curtailing medical malpractice litigation in states where caps have been put in place. In the case of ordinary personal injury, however, it has been less effective (Justia [2018]). In most states, there is no limit to the economic or non-economic damages that may be recovered by a plaintiff who can prove liability. As of June 2019, only nine states have non-economic damage cap in place.[15] In fact, five out of the remaining 41 states prohibit caps for general torts.

The limited nature of past tort reforms is consistent with the earlier observations regarding the composition of nuclear awards. The punitive damages have not seen a particular trend in the past decade, whereas share of non-economic damages has increased. Without explicit caps on non-economic damages, there seems to be potential for inflation in non-punitive components of the awards.[16]

#### 7.2.4 Availability of Attorney and Relevant Tactics

Advertising by law firms had been legal until 1908 when the American Bar Association (ABA) created the Canons of Professional Ethics that banned advertising. In the 1977 case *Bates v. State Bar of Arizona*, however, the Supreme Court ruled that commercial speech such as advertising merits First Amendment protection.

Since then, the scale of advertising for lawsuits has seen rapid growth. In 2016, lawyers, law firms, and legal-service providers spent $770 million on television advertisements (Silverman [2017]). For paid Google keyword search terms, a 2015 study by the CMAG and the U.S. Chamber of Commerce

[14] The survey is based on telephone interviews of a random sample of around a thousand adults living in all 50 U.S. states and the District of Columbia.

[15] These states are Arkansas, Colorado, Hawaii, Idaho, Maryland, Mississippi, Ohio, Oregon, and Tennessee. For a more detailed breakdown, please see for Justice and Democracy [2019].

[16] There is also the potential for a rollback of implemented reforms, the possibility of which depends critically on the political landscape. Traditionally, Republicans have been in favor of tort reform, while Democrats have been more receptive to the trial bar's interests.

Institute for Legal Reform also found that nine out of the top 10 and 23 of the top 25 were legal terms (Association [2017]). The increased availability of attorney also works to reduce the individual's cost of taking their claim to court, thereby expanding the supply of potential nuclear awards.

In addition, tactics that successfully led to large awards have been widely publicized across attorneys. One notable moment is the introduction of the Reptile Theory[17], first introduced in the book *Reptile: the 2009 Manual of the Plaintiff's Revolution* which started a popular movement that evolved into seminars, retreats and law review articles. According to the authors, plaintiffs' attorneys who successfully use the tactic have garnered over $7.7 billion in verdicts and settlements (Ball and Keenan [2009]).

## 7.3 Economic Consequences of Nuclear Awards

Nuclear awards have significant economic consequences for the broad insurance sector. First and foremost, they pose a significant challenge for underwriting and pricing risk. The inherent difficulty of predicting trends in nuclear awards is problematic for insurers who primarily rely on historical losses to estimate their future loss distributions. For example, in its 2019 Q4 earnings call, Travelers explicitly attributed its decline in profits to social inflation, further commenting that it is raising insurance prices and changing its litigation strategies in response. The sentiment is shared among other major insurers, a mathematical characterization of which I have provided earlier in Section 5.

Second, large awards likely have trickle-down effects, putting upwards pressure on smaller settlements. Especially given the decision to settle and the settlement amount are endogenous decisions, the rising nuclear awards increases the opportunity cost of settling. A personal injury claim that could have been settled for $1 million may now be settled for $10 million or be taken into court for larger verdict. Abrams and Chen [2012], which looks at the Australian market for litigation finance, provides empirical evidence consistent with this hypothesis.

Third, nuclear awards contribute to a rise in insurance fraud as the potential expected return to committing such fraud increases. The plaintiffs may bill excessive or exaggerated medical treatments, accompanied by deliberate misdiagnosis of injuries and harm. An investigation into one truck crash fraud case in Atlanta involving a medical finance investing company revealed that a doctor was billing patients from truck crashes 2.5 to 3.5 times more than the average market rates for the same medical procedures (Murray et al. [2020]).

[17]The Reptile Theory focuses on safety and security issues to subtly encourage jurors to envision themselves in the same situation as a plaintiff. It asserts that one can prevail at trial by speaking to the primitive part of jurors' brains, commonly understood as the part of the brain they share with reptiles.

# 8 Implications for Insurers During the COVID-19 Pandemic

The key aspect of social inflation risk is the elevated uncertainty in insurance payouts at the time of underwriting. The recent developments related to the COVID-19 pandemic has intensified social inflation risk in two key dimensions.

First is the risk of retroactive modification of insurance policies, pertaining mostly to business interruption policies (OECD [2020]). State legislators have introduced legislation that would require insurance companies in their states to pay out on COVID-19 loss claims brought by small businesses (Turner [2020]). Importantly, the loss claims need not be covered by the outstanding business interruption and property policies. At the federal level, the members of the House of Representatives have proposed legislation that would void any provisions in insurance policies purporting to exclude coverage for COVID-19 and related losses (Heidtke [2020]). Consequently, the National Association of Insurance Commissioner issued a statement highlighting the risks with respect to the solvency of the insurance companies (NAIC [2020]).

Second is the risk of extended interpretation of directors and officers liability. With the pandemic-induced stock market downturn, there has been a spike in shareholder litigation involving directors & officers liability, now with a focus on shortcomings by managers and boards with respect to their handling of COVID-19 issues (Mahajan and Raman [2020]). The lawsuits allege that companies as well as their directors have breached their duties to the company and therefore violated securities laws in the context of COVID-19 exposures. Subsequently, directors and officers prices are estimated to have risen by 44% in the first quarter of 2020 and are expected to experience similar increases in subsequent months (Best [2020]).

Both developments represent new forms of social inflation risk that has the potential to lead to significantly elevated insurance rates and exits of insurers. My findings on commercial auto liability rates seem to support the concern that aggressive retroactive modification and extended interpretation of outstanding insurance policies may have longer-term consequences for the stability of the insurance sector.

# 9 Conclusion

Using a novel, hand-matched dataset on nuclear verdicts and settlements in commercial auto liability, I have documented important facts about social inflation and its role in insurance rates and insurer exits. The total awards have increased from $300 million in 2011 to nearly $1 billion in 2019, and the cases are concentrated in a few number of states such as California, Florida, and Texas. I argue that the changing legal climate, interacted with state-level insurance regulation, seems to be the most pertinent cause of this trend.

Social inflation risk is an aggregate risk that affects multiple lines of insurance businesses. Importantly, it plausibly explains the rapid increase in insurance rates over the past decade and the recent exits of major insurance providers, posing a new, major source of risk for the real economy as well. Social inflation risk will likely be more pronounced with the onset of the COVID-19 pandemic, especially with increasing attempts at retroactive modification and extended interpretation of outstanding insurance policies.

Ultimately, this paper uncovers an important new source of aggregate risk in the insurance sector. One policy implication is that insurance regulators should be aware of social inflation in designing reserve requirements. Understanding its trend, geographical heterogeneity and economic consequences will therefore be key to ensuring a stable insurance sector and the economic activities that depend on it.

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Table 1: Top 15 Commercial Auto Liability Insurance Groups in 2019

| SNL Group Name | Direct Premiums Written ($ Million) | Share 2019 (in %) |
|---|---|---|
| Progressive | 4456.98 | 12.89 |
| Travelers | 2163.06 | 6.26 |
| Liberty Mutual | 1453.15 | 4.20 |
| Nationwide | 1291.93 | 3.74 |
| Berkshire Hathaway Inc. | 1282.79 | 3.71 |
| Old Republic Insurance | 1157.44 | 3.35 |
| Zurich | 1066.44 | 3.08 |
| Chubb | 850.09 | 2.46 |
| Allstate Corp | 779.79 | 2.26 |
| Auto-Owners Insurance | 761.30 | 2.20 |
| State Farm | 632.71 | 1.83 |
| The Hartford | 632.32 | 1.83 |
| Tokio Marine | 626.87 | 1.81 |
| AIG | 620.10 | 1.79 |
| W. R. Berkley Corp. | 532.88 | 1.54 |
| Total (Top 15) | 18307.87 | 52.94 |
| Total (Industry) | 34580.29 | 100.00 |

This table reports the top 15 insurance groups for commercial auto liability insurance in terms of direct premiums written. The data is from NAIC at the group level, and I use the numbers from 2019 annual filing. For 2019, there are 314 insurance groups with positive direct written premiums.

*Data Source: NAIC via SNL Financials*

Table 2: Top 15 Commercial Auto Liability Insurance Companies in 2019

| SNL Statutory Entity Key | Direct Premiums Written ($ Million) | Share 2019 (in %) |
|---|---|---|
| United Financial Casualty Co. | 1221.18 | 3.53 |
| Progressive Express Ins Co. | 717.53 | 2.07 |
| Zurich American Insurance Co. | 709.30 | 2.05 |
| Allstate Insurance Co. | 614.64 | 1.78 |
| Great West Casualty Co. | 577.28 | 1.67 |
| Ohio Security Insurance Co. | 512.85 | 1.48 |
| Progressive County Mutl Ins Co | 492.59 | 1.42 |
| Travelers Ppty Cas Co. of Am | 491.03 | 1.42 |
| Philadelphia Indemnity Ins Co. | 487.94 | 1.41 |
| ACE American Insurance Co. | 485.15 | 1.40 |
| State Farm Mutl Automobile Ins | 420.51 | 1.22 |
| Cincinnati Insurance Co. | 411.58 | 1.19 |
| National Union Fire Ins Co. | 410.43 | 1.19 |
| James River Insurance Co. | 402.96 | 1.17 |
| American Transit Insurance Co. | 349.48 | 1.01 |
| Total (Top 15) | 8304.45 | 24.01 |
| Total (Industry) | 34580.29 | 100.00 |

This table reports the top 15 insurance companies for commercial auto liability insurance in terms of direct premiums written. The data is from NAIC at the company level, and I use the numbers from 2019 annual filing. For 2019, there are 856 insurance companies with positive direct written premiums.

*Data Source: NAIC via SNL Financials*

Table 3: Summary Statistics for Commercial Auto Liability Rate Filings

| | Rate Change (%) | | | Count (Approved) | Count (All) |
|---|---|---|---|---|---|
| | Mean | Median | SD | | |
| 2001 | 12.33 | 6.74 | 31.23 | 532 | 540 |
| 2002 | 9.37 | 8.00 | 9.93 | 758 | 762 |
| 2003 | 6.82 | 5.00 | 7.73 | 818 | 830 |
| 2004 | 3.67 | 1.30 | 14.64 | 887 | 911 |
| 2005 | -0.77 | -1.20 | 9.60 | 750 | 761 |
| 2006 | -2.22 | -2.95 | 8.62 | 904 | 910 |
| 2007 | -2.32 | -1.00 | 19.81 | 2149 | 2305 |
| 2008 | -2.40 | -1.80 | 12.23 | 2526 | 2653 |
| 2009 | 0.82 | 0.90 | 11.32 | 3372 | 3499 |
| 2010 | -0.94 | -0.02 | 9.64 | 2954 | 3086 |
| 2011 | 0.03 | 0.40 | 10.46 | 3780 | 3935 |
| 2012 | 7.98 | 4.10 | 18.24 | 4640 | 4807 |
| 2013 | 5.50 | 4.70 | 9.66 | 5010 | 5162 |
| 2014 | 5.80 | 5.00 | 8.00 | 4657 | 4845 |
| 2015 | 6.23 | 5.60 | 7.46 | 4599 | 4783 |
| 2016 | 5.85 | 5.00 | 7.69 | 4570 | 4709 |
| 2017 | 7.34 | 6.20 | 8.27 | 5387 | 5591 |
| 2018 | 8.82 | 7.40 | 10.64 | 5027 | 5230 |
| 2019 | 7.50 | 6.60 | 9.12 | 5059 | 5276 |

This table presents the summary statistics for commercial auto liability rate filings. I report the statistics on rate changes and the amount of premiums that the change applies to. I restrict the sample to filings for which both the rate change and the amount of premiums are specified.

*Data Source: NAIC via SNL Financials*

Table 4: Top 5 States with Lowest Rate Approval Probability: 2001 – 2019

| State | Approved | Disapproved | Withdrawn | Approval Probability |
|---|---|---|---|---|
| Arizona | 29 | 36 | 4 | 42.0% |
| New Mexico | 153 | 2 | 57 | 72.2% |
| Louisiana | 881 | 103 | 95 | 81.6% |
| Colorado | 1,629 | 0 | 238 | 87.3% |
| California | 1,976 | 25 | 208 | 89.5% |
| Total | 58,379 | 661 | 1,555 | 96.3% |

This table reports the top 5 states with lowest rate approval probability. Approval probability is calculated as the ratio of approved filings to total filings for a given state. I first classify all rate filings into approved, withdrawn, and disapproved based on the disposition status. I then pool the filings from 2001 to 2019 and compute the unconditional rate approval probability for each state. I include the filings in which only the rate change is specified while the amount of premiums is not.

*Data Source: NAIC via SNL Financials*

Table 5: Trends in Commercial Auto Liability Awards: Number of Cases by State

| Year<br>State | 2001-2005 | 2006-2010 | 2011-2015 | 2016-2019 | Fatal Truck Crashes |
|---|---|---|---|---|---|
| Alabama | 2 | | | | 1548 |
| Arizona | | 1 | 1 | | 1129 |
| California | 6 | 7 | 7 | 7 | 4388 |
| Colorado | | | | 1 | 876 |
| Connecticut | | | | 1 | 327 |
| Florida | 3 | 3 | 1 | 3 | 3590 |
| Georgia | | 2 | 2 | 6 | 2563 |
| Illinois | 3 | 5 | 2 | 2 | 1839 |
| Indiana | | 1 | 1 | | 1710 |
| Kansas | | 1 | | | 937 |
| Kentucky | 1 | | | | 1315 |
| Louisiana | | 2 | 2 | 1 | 1282 |
| Michigan | | 1 | | | 1279 |
| Minnesota | | | | 1 | 876 |
| Missouri | 2 | 2 | | | 1530 |
| New Jersey | 1 | 1 | | | 924 |
| New Mexico | | | 2 | 1 | 700 |
| New York | 1 | 6 | 2 | 4 | 1692 |
| Ohio | | | 1 | 1 | 1988 |
| Oklahoma | | 1 | | | 1514 |
| Oregon | | | | 1 | 651 |
| Pennsylvania | | | 1 | | 2285 |
| Texas | 5 | 6 | 6 | 14 | 6654 |
| Virginia | 1 | | 3 | | 1251 |
| Washington | | 1 | | 2 | 691 |

This table reports the number of verdicts / settlements greater than $20 million in each state from 2001 to 2019. States without any during the time period are omitted. The number of fatal motor vehicle crashes involving a large truck from 2004 to 2019 for each state is also reported.

*Data Source: VerdictSearch, United States Department of Transportation*

Table 6: Trends in Commercial Auto Liability Awards: Total Sum by State

| Year<br>State | 2001-2005 | 2006-2010 | 2011-2015 | 2016-2019 | Fatal Truck Crashes |
|---|---|---|---|---|---|
| Alabama | 49 | | | | 1548 |
| Arizona | | 37.7 | 30.6 | | 1129 |
| California | 220.9 | 236.1 | 327.8 | 301.8 | 4388 |
| Colorado | | | | 26.6 | 876 |
| Connecticut | | | | 23 | 327 |
| Florida | 69.5 | 148.3 | 27.6 | 209.6 | 3590 |
| Georgia | | 74.6 | 65.2 | 524.5 | 2563 |
| Illinois | 122.7 | 115.4 | 57.2 | 89.3 | 1839 |
| Indiana | | 20 | 32.5 | | 1710 |
| Kansas | | 23.5 | | | 937 |
| Kentucky | 27 | | | | 1315 |
| Louisiana | | 53.4 | 146 | 30.4 | 1282 |
| Michigan | | 22.6 | | | 1279 |
| Minnesota | | | | 28.8 | 876 |
| Missouri | 52 | 81.3 | | | 1530 |
| New Jersey | 23.5 | 31.2 | | | 924 |
| New Mexico | | | 224 | 40.5 | 700 |
| New York | 30.3 | 181.3 | 42.3 | 231.1 | 1692 |
| Ohio | | | 42.4 | 27 | 1988 |
| Oklahoma | | 62.7 | | | 1514 |
| Oregon | | | | 26.5 | 651 |
| Pennsylvania | | | 32 | | 2285 |
| Texas | 184.2 | 285.1 | 462.5 | 810 | 6654 |
| Virginia | 60 | | 66.7 | | 1251 |
| Washington | | 30.2 | | 160.1 | 691 |

This table reports the sum of verdicts / settlements greater than $20 million in each state from 2001 to 2019. States without any during the time period are omitted. The units are in $ millions. The number of fatal motor vehicle crashes involving a large truck from 2004 to 2019 for each state is also reported.

*Data Source: VerdictSearch, United States Department of Transportation*

Table 7: Trends in Commercial Auto Liability Awards: Insurance Companies

| | Total Count | Total Amount ($MM) |
|---|---|---|
| AIG (SNL P&C Group) | 60 | 1586.87 |
| Zurich (SNL P&C Group) | 23 | 734.03 |
| Chubb (SNL P&C Group) | 22 | 493.77 |
| Travelers (SNL P&C Group) | 19 | 382.42 |
| Liberty Mutual (SNL P&C Group) | 18 | 501.38 |
| Great American Insurance (SNL P&C Group) | 9 | 157.21 |
| The Hartford (SNL P&C Group) | 9 | 311.06 |
| Berkshire Hathaway Inc. (SNL P&C Group) | 8 | 138.07 |
| Old Republic Insurance (SNL P&C Group) | 8 | 290.28 |
| Nationwide (SNL P&C Group) | 7 | 138.09 |
| Allianz (SNL P&C Group) | 6 | 138.47 |
| Progressive (SNL P&C Group) | 6 | 171.70 |
| W. R. Berkley Corp. (SNL P&C Group) | 6 | 138.80 |
| Arch Capital (SNL P&C Group) | 5 | 145.70 |
| AXA SA (SNL P&C Group) | 5 | 199.11 |
| Fairfax Financial (SNL P&C Group) | 4 | 93.08 |
| IAT Insurance (SNL P&C Group) | 4 | 49.05 |
| Protective Insurance Corp. (SNL P&C Group) | 3 | 194.48 |
| State Farm (SNL P&C Group) | 3 | 51.74 |
| Kemper (SNL P&C Group) | 3 | 107.74 |

This table reports the list of insurance companies involved in nuclear verdicts and settlements from 2001 to 2019. I report the 20 insurers with the largest number of awards.

*Data Source: VerdictSearch*

Table 8: Summary Statistics of Jury Award Components

| Award (in $M) | Min | 5th | 50th | 95th | Max | Mean | SD |
|---|---|---|---|---|---|---|---|
| Past-Econ | 0.0 | 0.0 | 0.5 | 4.0 | 16.9 | 1.1 | 2.2 |
| Past-NonEcon | 0.0 | 0.5 | 5.0 | 23.3 | 52.0 | 7.0 | 7.8 |
| Future-Econ | 0.0 | 0.0 | 4.3 | 23.7 | 60.0 | 7.1 | 9.5 |
| Future-NonEcon | 0.0 | 1.4 | 9.0 | 34.8 | 127.0 | 13.0 | 14.6 |

(a) Award Size (in Dollars)

| Share (in %) | Min | 5th | 50th | 95th | Max | Mean | SD |
|---|---|---|---|---|---|---|---|
| Past-Econ | 0.0 | 0.0 | 2.3 | 13.1 | 57.3 | 4.2 | 7.0 |
| Past-NonEcon | 0.0 | 2.9 | 23.2 | 59.0 | 92.1 | 26.4 | 17.7 |
| Future-Econ | 0.0 | 0.0 | 18.2 | 66.2 | 90.2 | 24.0 | 21.2 |
| Future-NonEcon | 0.0 | 9.4 | 46.7 | 76.0 | 84.2 | 45.5 | 19.9 |

(b) Share of Total Award (in %)

This tables provides some summary statistics on the different jury award components from 2001 to 2019. I first decompose each award amount into five components: past and future economic damages, past and future non-economic damages, and punitive damages. I exclude punitive damages since they are infrequently observed in the data. The sample is restricted to cases in which all four components (excluding punitive damages) are observable, which amounts to a final set of 133 cases.

*Data Source: VerdictSearch*

Table 9: Correlations among Jury Award Components

| | Past-Econ | Past-NonEcon | Future-Econ | Future-NonEcon |
|---|---|---|---|---|
| Past-Econ | 1.000 | 0.284 | 0.307 | 0.099 |
| Past-NonEcon | 0.284 | 1.000 | 0.190 | 0.533 |
| Future-Econ | 0.307 | 0.190 | 1.000 | 0.208 |
| Future-NonEcon | 0.099 | 0.533 | 0.208 | 1.000 |

This tables presents the correlations among the different jury award components from 2001 to 2019. I first decompose each award amount into five components: past and future economic damages, past and future non-economic damages, and punitive damages. I exclude punitive damages since they are infrequently observed in the data. The sample is restricted to cases in which all four components (excluding punitive damages) are observable, which amounts to a final set of 133 cases.

*Data Source: VerdictSearch*

Table 10: Impact of Social Inflation on Insurance Rates

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Commercial Auto | -1.046* | -1.036* | -0.0375 | -0.0402 |
| | (0.491) | (0.498) | (0.382) | (0.386) |
| High Award State | 1.140*** | 1.120*** | 1.147*** | 1.121*** |
| | (0.271) | (0.269) | (0.271) | (0.269) |
| High Award State x Comm. Auto | -0.383 | -0.326 | -0.374 | -0.301 |
| | (0.529) | (0.535) | (0.529) | (0.534) |
| postMorgan | -1.162 | 1.302*** | -1.147 | 1.305*** |
| | (0.784) | (0.231) | (0.780) | (0.230) |
| High Award State x Post Verdict | -0.160 | -0.149 | -0.164 | -0.150 |
| | (0.357) | (0.356) | (0.357) | (0.356) |
| Comm. Auto x Post Verdict | 0.780 | 0.785 | 0.745 | 0.755 |
| | (0.471) | (0.475) | (0.470) | (0.474) |
| Comm. Auto x High Award State x Post Verdict | 2.012** | 1.973** | 2.010** | 1.966** |
| | (0.669) | (0.674) | (0.669) | (0.675) |
| GDP Growth | -69.30** | -9.875 | | |
| | (26.63) | (24.92) | | |
| Comm. Auto x GDP Growth | 169.9*** | 167.9*** | | |
| | (50.13) | (50.68) | | |
| Constant | 1.814*** | 3.544*** | 1.403*** | 3.485*** |
| | (0.339) | (0.221) | (0.311) | (0.164) |
| N | 9130 | 9130 | 9130 | 9130 |
| Year FE | Y | N | Y | N |

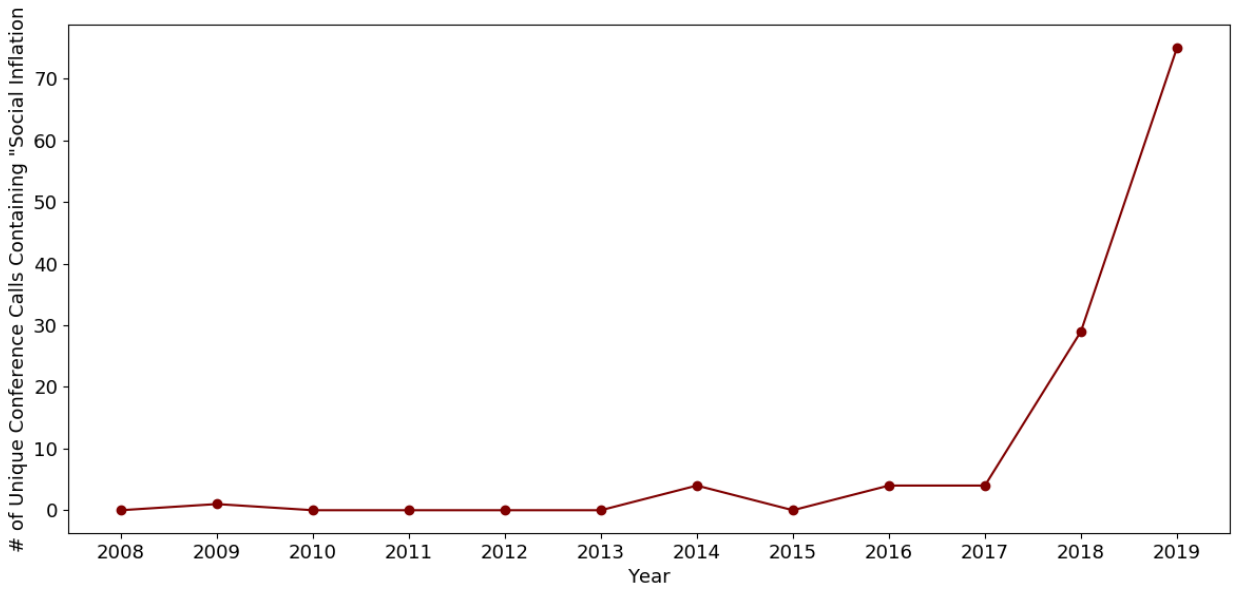
This tables reports the coefficient estimates of the regressions relating the change in insurance rates to the incidence of nuclear awards. Specifically, I run the following regression:

$$\begin{aligned}\Delta P_{ist} = \beta_0 + \beta_1 HighAward_s + \beta_2 IsComm_i + \beta_3 HighAward_s \times IsComm_i \\ + \delta_0 Post_t + \delta_1 HighAward_s \times Post_t + \delta_2 IsComm_i \times Post_t \\ + \delta_3 HighAward_s \times IsComm_i \times Post_t + GDPGrowth_t + IsComm_i \times GDPGrowth_t + \epsilon_{ist}\end{aligned}$$

where $i$ denotes the insurer, $s$ the state, and $t$ the quarter in which the rate change was filed. I treat the commercial and personal lines within the same insurance group as distinct insurers. Robust standard errors, clustered at the state-insurer level, are below the coefficients in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

*Data Source: NAIC via SNL Financials, VerdictSearch*

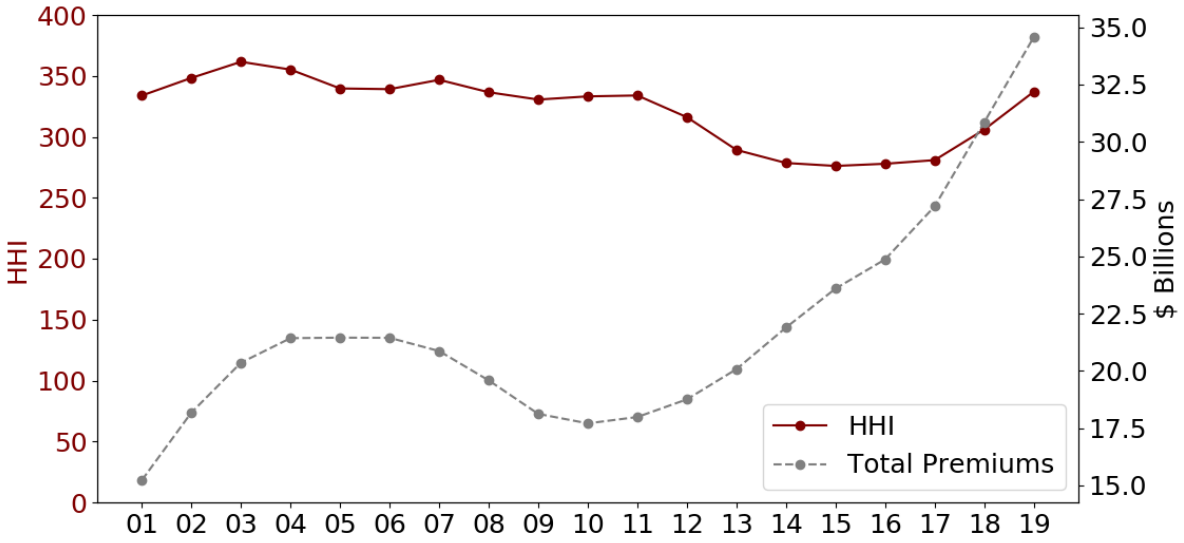
Figure 1: Social Inflation Risk in Conference Calls




This figure plots the number of unique conference call transcripts that contain the term "social inflation." I restrict the observations to the calls of 15 largest commercial auto liability insurance groups at the end of 2019.

*Data Source: Capital IQ Transcripts Data via WRDS*

Figure 2: Commercial Auto Liability: Market Size and Concentration

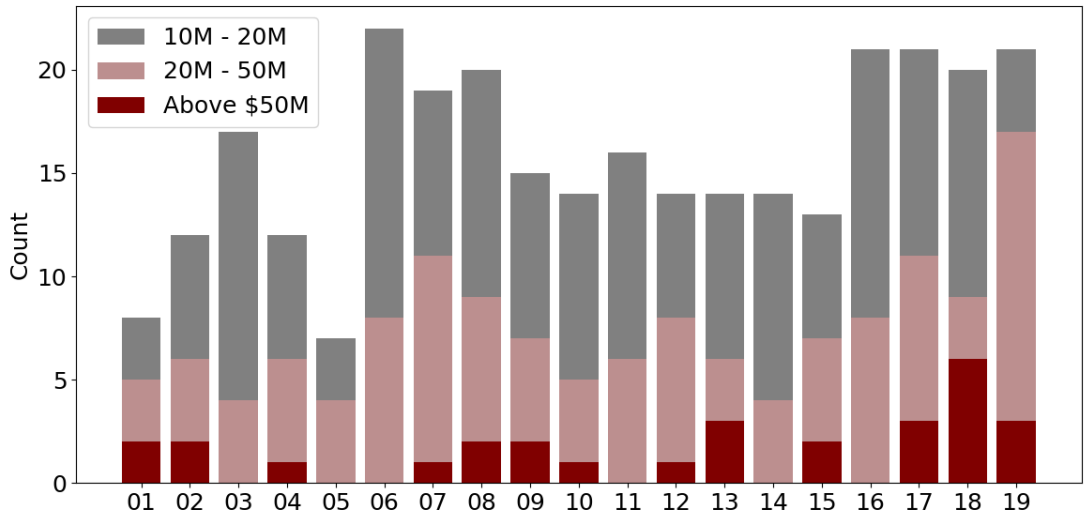



This figure documents the time-series trend in direct premiums written and the Herfindahl-Hirschman Index (HHI) for the commercial auto liability industry from 2001 to 2019. The red solid line plots the HHI calculated using each insurance group's written premiums, and the gray dotted line plots the total direct premiums written for commercial auto liability.

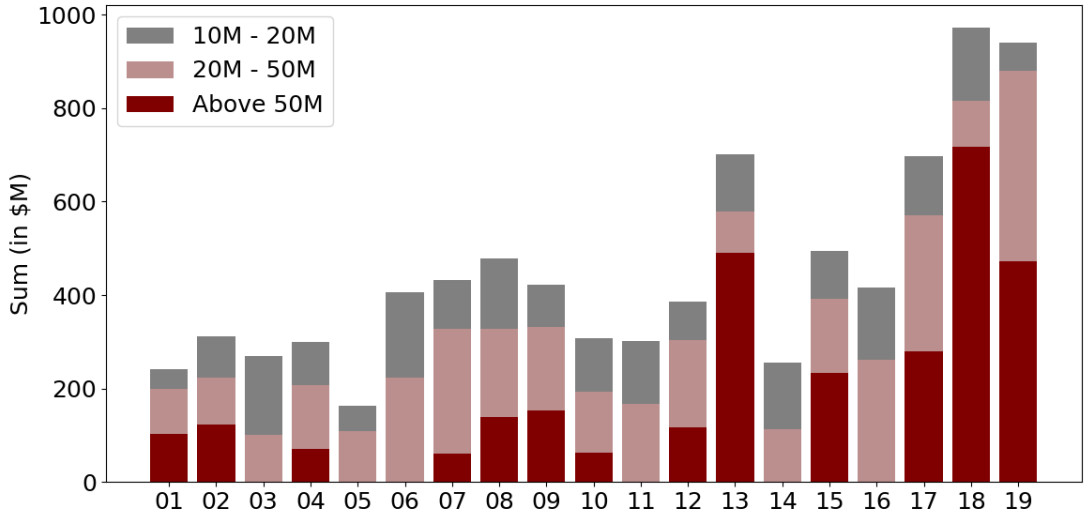
*Data Source: NAIC via SNL Financials*

Figure 3: Nuclear Awards in Commercial Auto Liability Cases

(a) Counts by Year




(b) Award Amount by Year

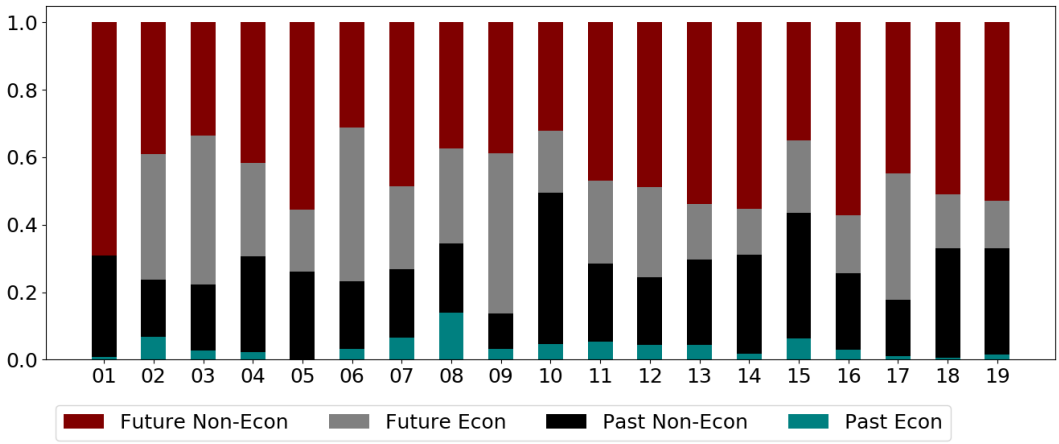



This figure plots the number and magnitude of verdicts and settlements for commercial auto liability accidents with corporate defendants. The timeline is from 2001 to 2019, and data is from VerdictSearch. In Panel (a), I report the counts of awards greater than or equal to $50 million, those between $20 and $50 million, and those between $10 and $20 million. In Panel (b), I report the sum of awards for the same categories.

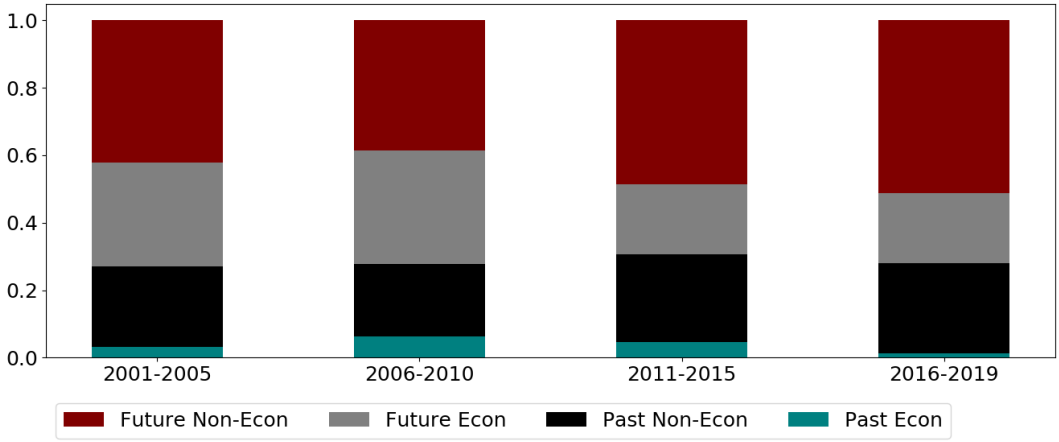
*Data Source: VerdictSearch*

Figure 4: Composition of Nuclear Awards in Commercial Auto Liability Cases

(a) Composition by Year




(b) Composition by Five Years

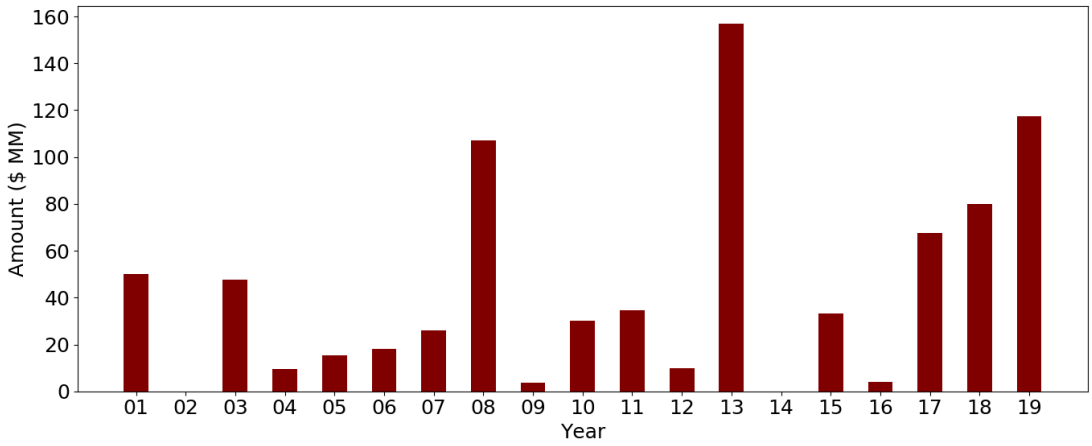



This figure plots the composition of nuclear awards in commercial auto liability cases from 2001 to 2019. I first decompose each award amount into five components: past and future economic damages, past and future non-economic damages, and punitive damages. I then sum the verdict amounts within each five-year window. I exclude punitive damages since they are infrequently observed in the data. The sample is restricted to cases in which all four components (excluding punitive damages) are observable, which amounts to a final set of 133 cases.

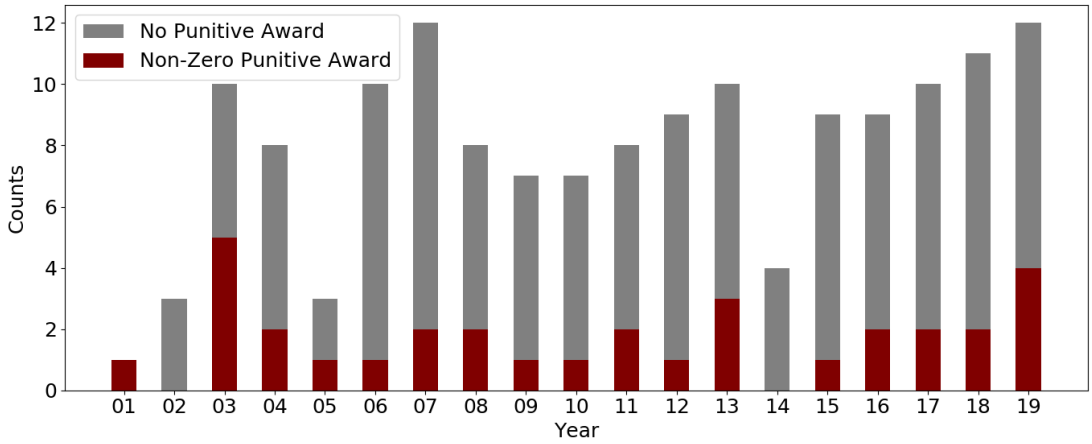
*Data Source: VerdictSearch*

Figure 5: Punitive Awards in Commercial Auto Liability Cases

(a) Total Amount By Year



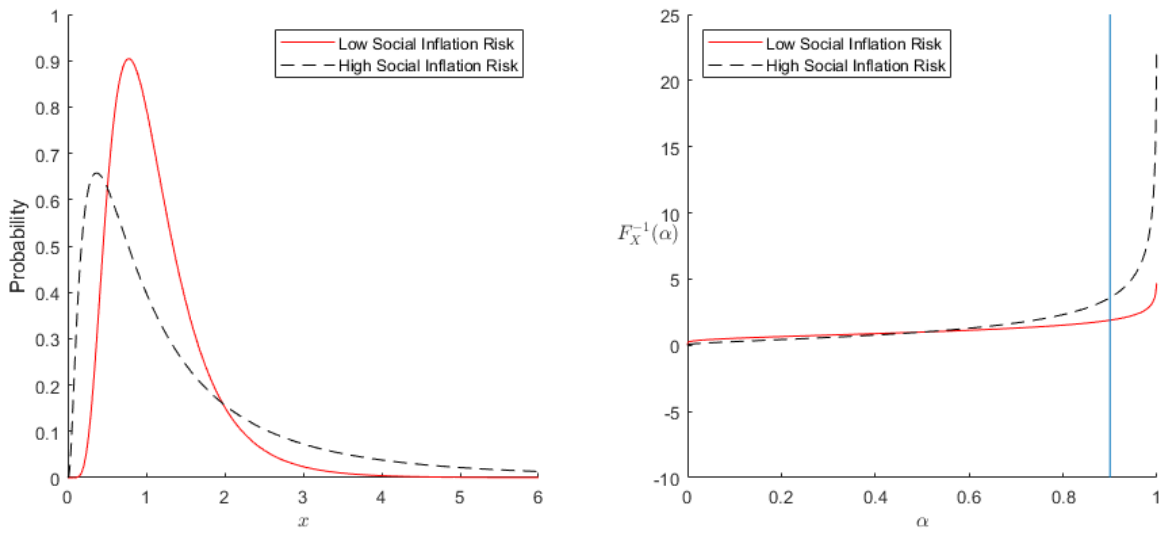

(b) Share of Cases with Punitive Damages




This figure plots the sum of punitive awards in each year for commercial auto liability cases from 2001 to 2019. I restrict the sample to cases in which the punitive damage component is observed, which amounts to a final set of 150 cases.

*Data Source: VerdictSearch*

Figure 6: Effect of Social Inflation Risk on Insurance Prices

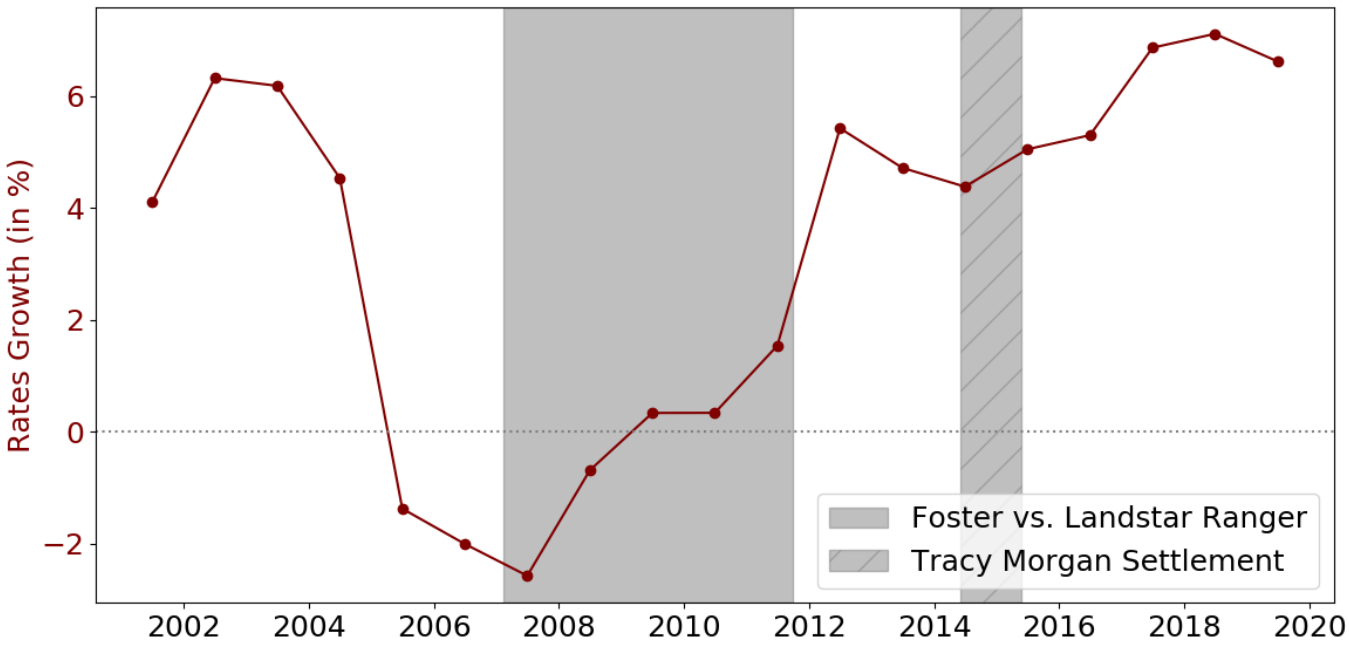



This figure illustrates the effect of social inflation risk on insurance prices. The left panel plots the probability distribution of $\tilde{X}$ introduced in Section 5.1, where $\tilde{X}$ captures the social inflation risk. The red solid line is a distribution with low risk, while the black dotted line is the distribution with high risk. Both distributions have the same mean at 1. The right panel plots $F_X^{-1}(\alpha)$ for different values of $\alpha$, where $\alpha$ appears in the statutory capital requirement for insurers:

$$\mathbb{P}\left(\tilde{K}_1 \geq K^*\right) \geq \alpha$$

and $K^*$is some threshold capital level. The vertical line represents the case when $\alpha = 0.9$. Examining the intersections of the vertical line with the solid and dashed lines, we see that higher social inflation risk increases the minimum statutory reserve requirements and therefore prices, holding everything fixed.

Figure 7: Average Rate Growth in Commercial Auto Liability Insurance Rates: 2001 – 2019

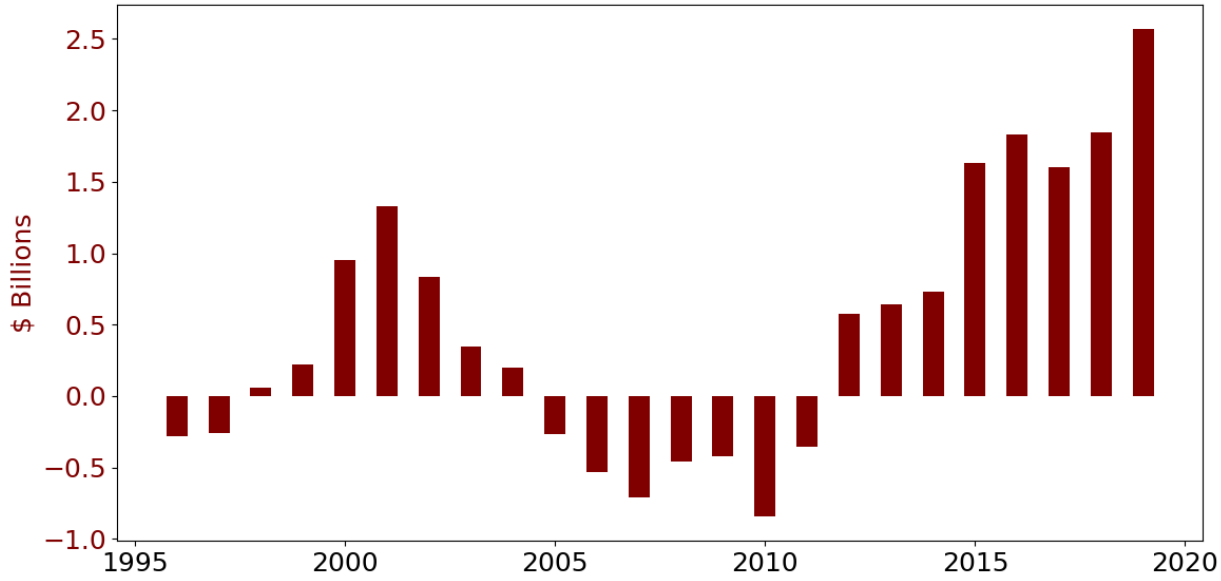



This figure documents the average rate growth in commercial auto liability insurance rates from 2001 to 2019. Data is annual and obtained from the National Association of Insurance Commissioners (NAIC). For each state, I compute the average rate growth weighted by the amount of premium that the rate change applies to. I then average the numbers across all states to arrive at the nationwide average. The shaded regions correspond to famous nuclear awards: Foster vs. Landstar Ranger and the Tracy Morgan settlement.

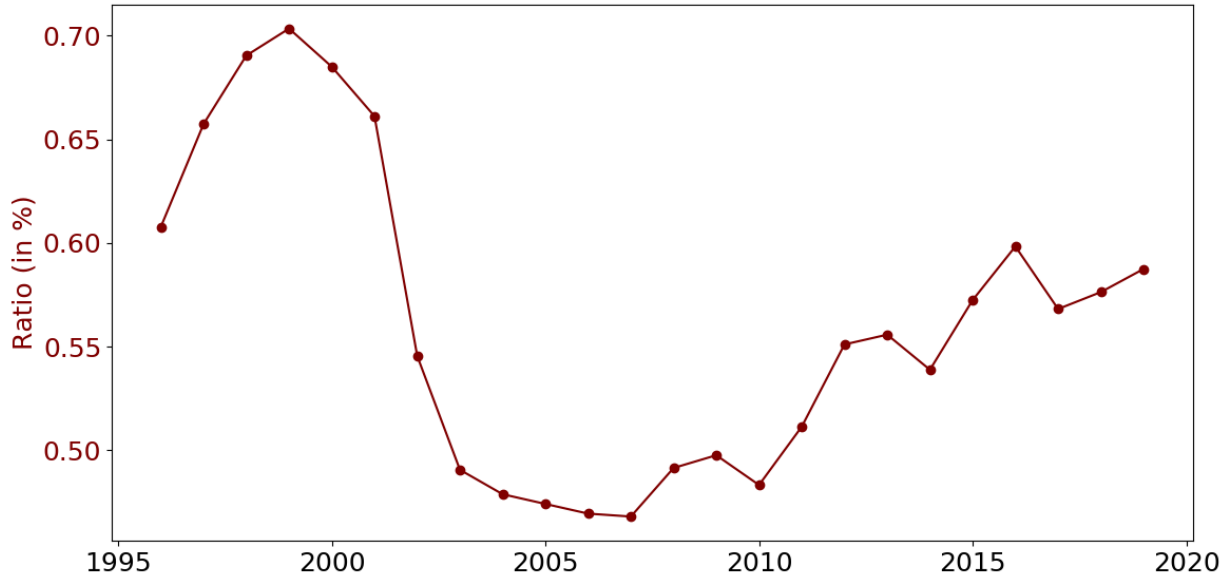
*Data Source: NAIC via SNL Financials, VerdictSearch*

Figure 8: Incurred Losses & Reserve Development in Commercial Auto Liability: 1996 – 2019

(a) One-Year Reserve Development




(b) Ratio of Incurred Losses Incurred to Written Premiums

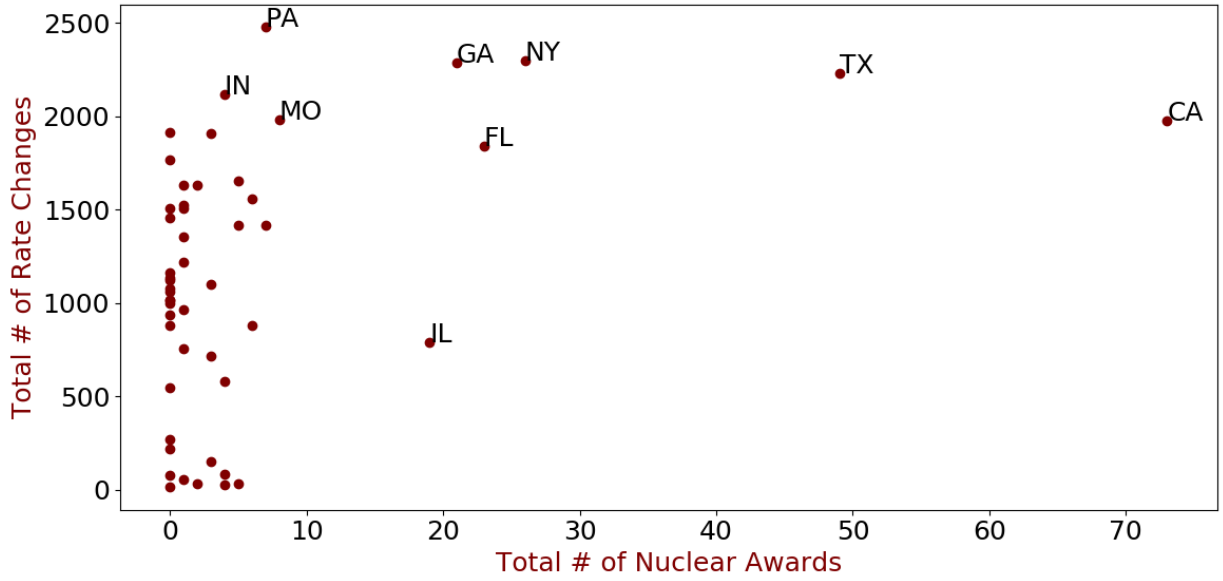



This figure documents trends in commercial auto liability insurance industry from 1996 to 2019. Data is annual and obtained from the National Association of Insurance Commissioners (NAIC). Panel A plots the one-year commercial auto liability reserve development reported in calendar year. Panel B plots the ratio of losses incurred to written premiums for the aggregate commercial auto liability industry.

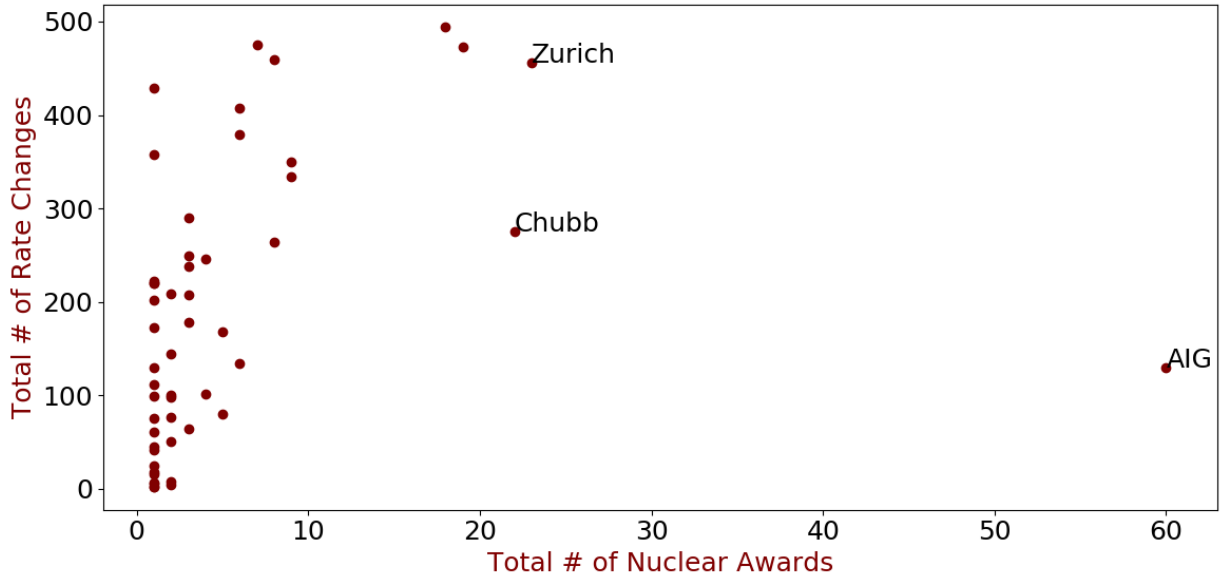
*Data Source: NAIC via SNL Financials*

Figure 9: Distribution of Rate Changes and Nuclear Awards: 2001 – 2019

(a) Across States




(b) Across Insurance Groups

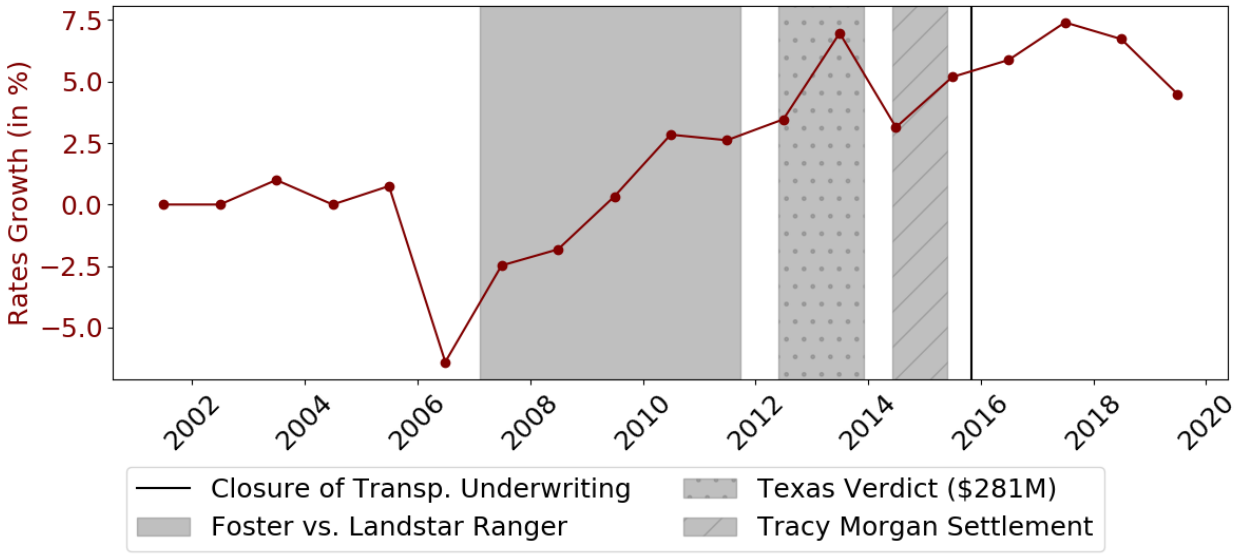



This figure documents the distribution of rate changes and nuclear awards across states and insurers. Data is annual and obtained from the National Association of Insurance Commissioners (NAIC) and VerdictSearch. Panel A plots the distribution across states, and Panel B plots the distribution across insurers.

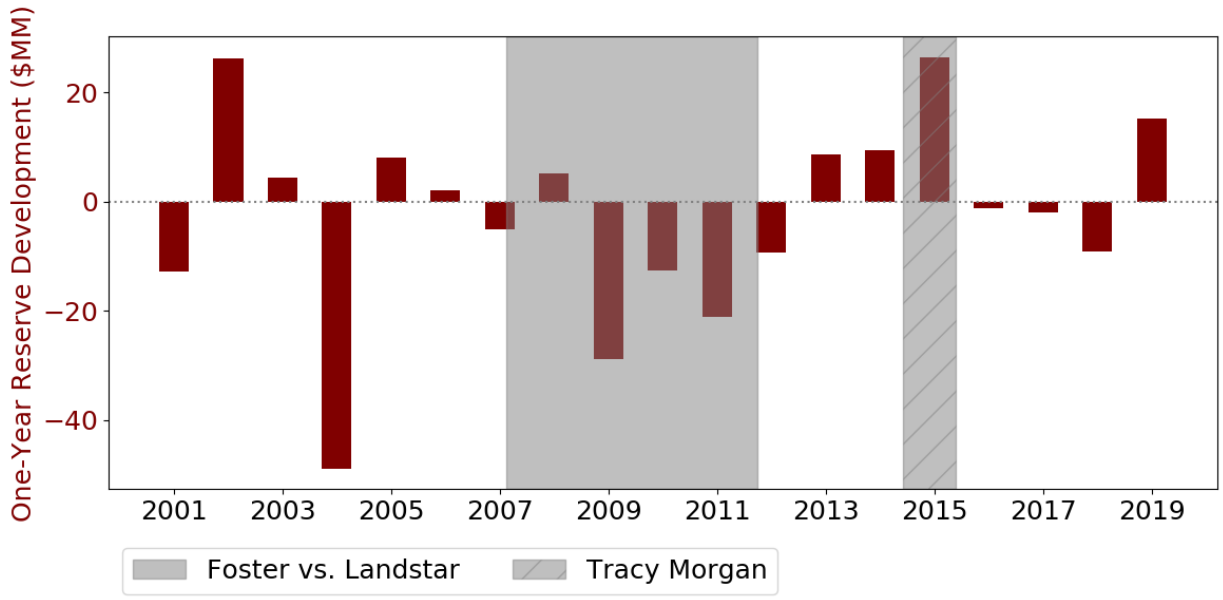
*Data Source: NAIC via SNL Financials, VerdictSearch*

Figure 10: Case Study of Zurich Insurance Group: 2001 – 2019

(a) Rate Growth



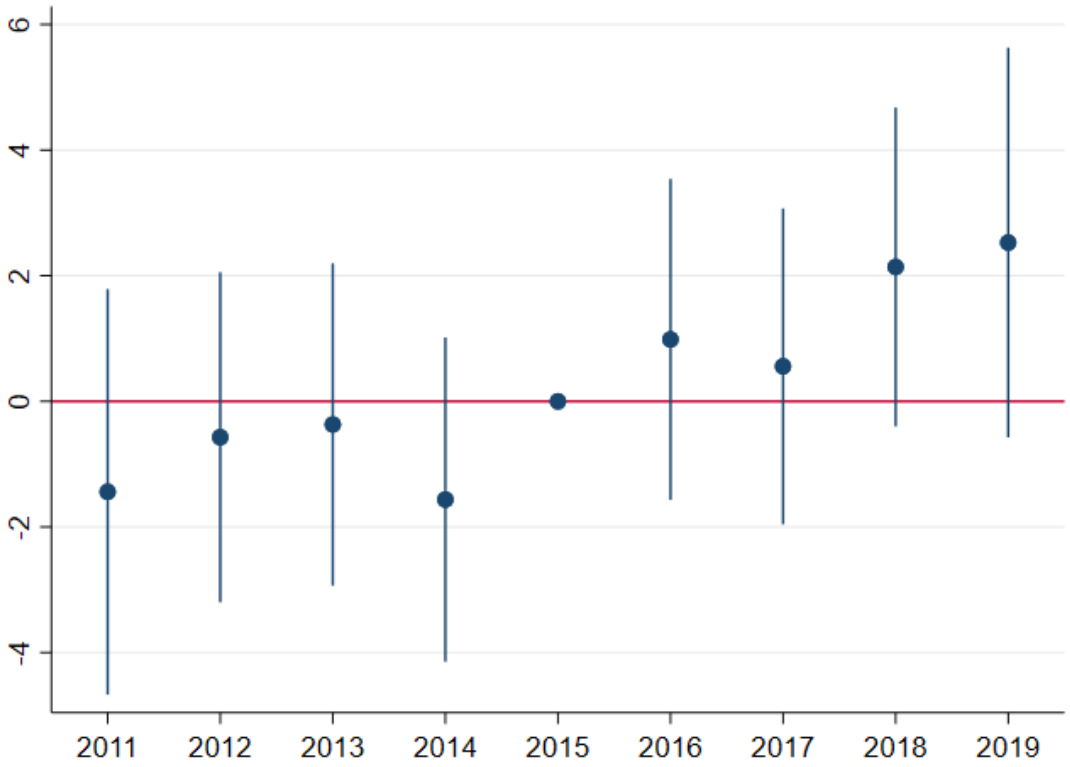

(b) One-Year Reserve Development




This figure illustrates rate growth and reserve development for Zurich Insurance Group from 2001 to 2019. The data on insurance rates is aggregated at the annual level based on the submitted date and excludes disapproved or withdrawn rate changes. The data on one-year reserve development is annual. Panel A plots the average commercial auto liability rate growth for Zurich in each year. Panel B plots the one-year commercial auto liability reserve development reported in calendar year.

*Data Source: NAIC via SNL Financials, VerdictSearch, Zurich Investor Presentations*

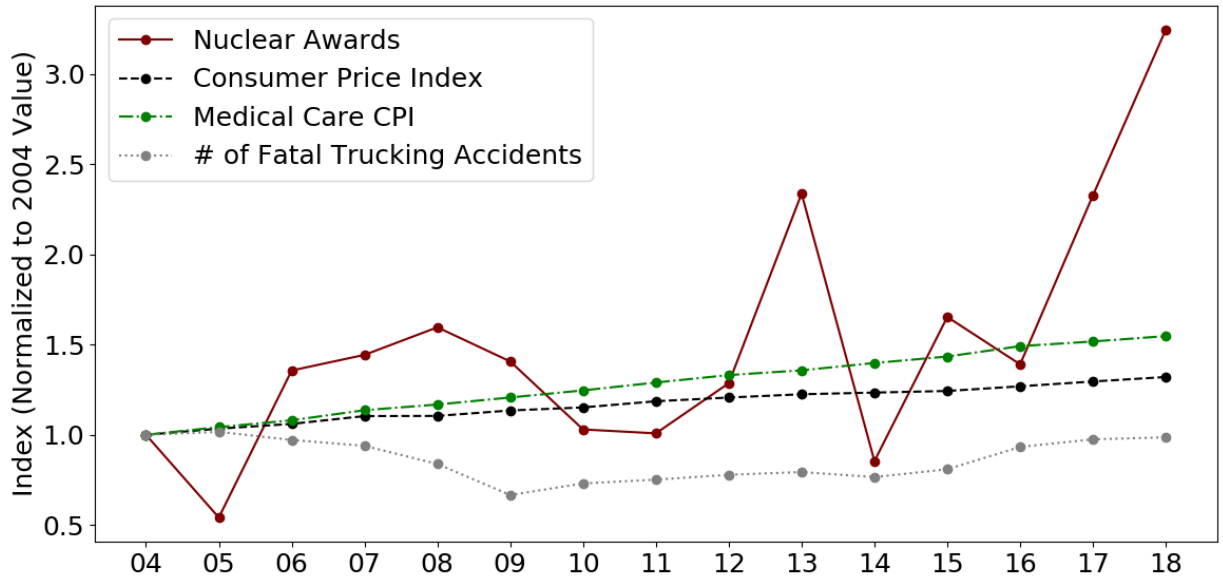
Figure 11: Pre- and Post-Trends: Yearly Coefficients on Interaction Term




This figure plots the coefficient between an indicator denoting a high-award state, an indicator denoting the commercial auto liability line, and a yearly dummy. The coefficient for the year closest to the Tracy Morgan verdict, 2015, is normalized to zero.

*Data Source: NAIC via SNL Financials, VerdictSearch, Zurich Investor Presentations*

Figure 12: Comparison to Other Risks in Insurance




This figure plots the historical growth of three economic time series: inflation, costs of medical care, and the number of fatal motor vehicle accidents involving large trucks. I plot their cumulative growth after normalizing the series to the 2004 level for each series. For comparison, I also include the change in the cumulative sum of nuclear awards that pertain to commercial auto liability.

*Data Source: VerdictSearch, FRED,* U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA)

# Appendix to "Social Inflation"

## A Proofs

**Solution to Model of Insurance Supply** In this section, I provide detailed step for the model solution. Recall that the Lagrangian is given as:

$$\mathcal{L} = \mathbb{E}\left[M_1 \tilde{\Pi}_1\right] + \lambda\left(\left(P - SF_X^{-1}(\alpha)\right)Q - \left(K^* + C - RK_0\right)\right)$$

Taking the first-order condition with respect to $P$ and setting it equal to zero yields:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial P} &= \frac{\partial \mathbb{E}\left[M_1 \tilde{\Pi}_1\right]}{\partial P} + \lambda\left(Q + \left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P}\right) \\
&= \mathbb{E}\left[M_1 \frac{\partial \tilde{\Pi}_1}{\partial P}\right] + \lambda\left(Q + \left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P}\right) \\
&= \mathbb{E}\left[M_1\left(Q + \left(P - \tilde{X}V\right)\frac{\partial Q}{\partial P}\right)\right] + \lambda\left(Q + \left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P}\right) \\
&= \mathbb{E}\left[M_1 Q\right] + \mathbb{E}\left[M_1 P\frac{\partial Q}{\partial P}\right] - \mathbb{E}\left[M_1 \tilde{X}V\frac{\partial Q}{\partial P}\right] + \lambda\left(Q + \left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P}\right) \\
&= Q + P\frac{\partial Q}{\partial P} - \frac{\partial Q}{\partial P}\mathbb{E}\left[M_1 \tilde{X}V\right] + \lambda\left(Q + \left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P}\right) = 0
\end{aligned}$$

Rearranging above, we have:

$$\begin{aligned}
P\frac{\partial Q}{\partial P} &= \frac{\partial Q}{\partial P}\mathbb{E}\left[M_1 \tilde{X}V\right] - \lambda\left(Q + \left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P}\right) - Q \\
P &= V\mathbb{E}\left[M_1 \tilde{X}\right] - \frac{\partial P}{\partial Q}\lambda\left(Q + \left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P}\right) - \frac{\partial P}{\partial Q}\frac{Q}{P}P \\
&= V\mathbb{E}\left[M_1 \tilde{X}\right] \underbrace{-\lambda\frac{\partial P}{\partial Q}\frac{Q}{P}}_{=\lambda/\epsilon_D} P - \lambda\frac{\partial P}{\partial Q}\left(P - SF_X^{-1}(\alpha)\right)\frac{\partial Q}{\partial P} \underbrace{-\frac{\partial P}{\partial Q}\frac{Q}{P}}_{=1/\epsilon_D} P
\end{aligned}$$

Rearranging:

$$
\begin{aligned}
P\left(1-\frac{1+\lambda}{\epsilon_D}\right) &= V\mathbb{E}\left[M_1\tilde{X}\right]-\lambda\left(P-SF_X^{-1}(\alpha)\right)\\
P\left(1+\lambda-\frac{1+\lambda}{\epsilon_D}\right) &= V\mathbb{E}\left[M_1\tilde{X}\right]+\lambda SF_X^{-1}(\alpha)\\
P(1+\lambda)\left(1-\frac{1}{\epsilon_D}\right) &= V\mathbb{E}\left[M_1\tilde{X}\right]+\lambda SF_X^{-1}(\alpha)\\
P(1+\lambda)\left(1-\frac{1}{\epsilon_D}\right) &= V\mathbb{E}\left[M_1\tilde{X}\right]\left(1+\lambda\frac{SF_X^{-1}(\alpha)}{V\mathbb{E}\left[M_1\tilde{X}\right]}\right)\\
P &= V\mathbb{E}\left[M_1\tilde{X}\right]\left(1-\frac{1}{\epsilon_D}\right)^{-1}\left(\frac{1+\lambda\left(SF_X^{-1}(\alpha)/V\mathbb{E}\left[M_1\tilde{X}\right]\right)}{1+\lambda}\right)
\end{aligned}
$$

Therefore, we have:

$$
P = V\mathbb{E}\left[M_1\tilde{X}\right]\left(1-\frac{1}{\epsilon_D}\right)^{-1}\left(\frac{1+\lambda\left(\frac{SF_X^{-1}(\alpha)}{V\mathbb{E}\left[M_1\tilde{X}\right]}\right)}{1+\lambda}\right)
$$

□

# B Data Construction

## B.1 Nuclear Awards for Commercial Auto Liability

I collect data on settlements and verdicts for motor vehicle accidents involving commercial auto liability from VerdictSearch. The details of the construction process are below.

I first search for all cases with type "Motor Vehicle – All" from January 1st, 2001 to December 31st, 2019 for all state and federal courts. The search results span decisions, arbitrations, settlements, and verdicts, and I restrict my search to award amounts greater than $10 million. This step yields a total of 802 cases.

I manually read through the case details to identify accidents with corporate defendants that involve commercial auto coverage. In doing so, I exclude the following common types: product liability cases against car manufacturers, personal injury cases between individuals, and workplace negligence such as negligent service of alcohol at eateries or improper repair at auto shops. I also exclude cases involving city transit and local departments of transportation. I also exclude cases in which the defendant on the case is an insurance company. This step yields a total of 300 cases.

The set of 300 cases is the final set of verdicts in my sample. For each verdict, I collect the data on

type (verdict, settlement), state and county, basic descriptions of the case, the insurance companies involved, and award amounts.

## B.2 Computing Reserves from Schedule P

Schedule P, which is the actuarial portion of the annual statement, allows one to evaluate an insurer's losses and reserve development by accident year. Reserves flow through both the balance sheet and the income statement, so reserve development can have a dramatic impact on both income and surplus during any given period. Below I describe the basic terminology and the structure of Schedule P.

### B.2.1 Basic Terminology

*Loss reserves* refers to the amount that insurers set aside to cover claims incurred but not yet paid. *Reserve development* refers to the amount of change in a company's prior year loss reserves. Positive reserve development is an *unfavorable* development while reserve release is a *favorable* one.

*Accident year* refers to the year in which the premiums were earned and losses were incurred. *Reporting date* is when the claim is filed to the insurance company, while the *occurrence date* is when the incident that caused the claim actually occurred. *Short-tailed* lines are lines where reporting and occurrence dates are generally very close, while *long-tailed* lines feature a long gap between reporting and occurrence dates. Toyota recall in 2009 and injuries related to Asbestos are well-known examples of long-tail lines.

### B.2.2 Using the Schedule P

Part 1 summarizes a company's loss and LAE experience as of December 31 of the current year. Since we are interested in historical data, Part 1 is not relevant. Part 2 provides a historical display of a company's net ultimate loss and DCC estimates. This enables the user to see how the company's ultimate loss and DCC estimates have developed over time. In a perfect world, the company's ultimate estimate of the cost of incurred claims would remain the same at each evaluation point.

Part 3 shows a historical array of the company's net paid loss and DCC experience as of each of the past 10 years. Actuaries can use this information to project unpaid claims using methods such as the paid loss development technique. The difference between Part 2 (ultimates) and Part 3 (paids) provides a historical array of the company's net loss and DCC reserves as of each of the past 10 years.

Part 4 displays a company's recorded net IBNR for loss and DCC before tabular discount. The difference between Parts 2 and 4 provides a historical array of the company's net reported loss and DCC experience as of each of the past 10 years. Part 5 provides a historical array of claim counts as of each of the past 10 years, including claims closed with payment, open claims and reported claims.

Part 6 displays the earning of premium over time, separately on a direct plus assumed and ceded basis, and Part 7 provides loss and premium data on loss sensitive contracts, separately for primary and reinsurance contracts, for those lines of business where such contracts are written.

Note that net incurred losses in Part 2 include paid losses, case reserves, and bulk reserves. Therefore, total outstanding reserves can be computed as numbers in Part 2 minus numbers in Part 3. Further subtracting numbers in Part 4 yields the outstanding case reserves. As years progress, outstanding reserves should converge to zero.

# C Additional Empirical Results

## C.1 Nature of Social Inflation Risk

An extension of the model in Section 5 serves as a useful empirical framework for describing how insurance companies respond to social inflation. Specifically, I introduce two modifications to the preceding framework. First, I consider a two-period setting where the pricing decision in period 2 depends on the realization of social inflation risk in period 1. Second, social inflation risk differs across states and across firms. All other assumptions remain the same, which implies that the expression for insurance prices in each period remains identical but now with state and firm subscripts:

$$\forall j, \forall s : P_{t,js} = V\mathbb{E}\left[M\tilde{X}_{t,js}\right]\left(1-\frac{1}{\epsilon_D}\right)^{-1}\left(\frac{1+\lambda\left(SF^{-1}_{X_{t,js}}(\alpha)\,/\,V\mathbb{E}\left[M\tilde{X}_{t,js}\right]\right)}{1+\lambda}\right) \tag{19}$$

where $P_{t,js}$ denotes firm $j$'s insurance price in state $s$ in period $t$ and $\tilde{X}_{t,js}$ is the perceived social inflation risk of firm $j$ in state $s$ at time $t$.

For simplicity, suppose $\tilde{X}_{t,js}$ is lognormally distributed with mean 0 and standard deviation $\sigma_{t,js}$. Under this parametrization, higher $\sigma$ corresponds to higher perceived social inflation risk. In period 1, all firms in all states have the same estimate of social inflation risk equal to $\tilde{X}_1$:

$$\forall j, \forall s : \tilde{X}_{1,js} = X_1 = \text{lognormal}\,(0, \sigma_1) \tag{20}$$

In period 2, firm $j$ in state $s$ forms a new estimate of social inflation risk based on realizations of period 1 social inflation risk. Importantly, the firm may learn from other realizations of social inflation that occurred to other firms or in other states:

$$\forall j, \forall s : \sigma_{2,js} = \underbrace{\zeta_1\left(\sum_{j'\neq j}^{J}\sum_{s'\neq s}^{S} X_{1,j's'}\right)}_{\text{national}} + \underbrace{\zeta_2\left(\sum_{j'\neq j}^{J} X_{1,j's}\right)}_{\text{regional}} + \underbrace{\zeta_3\left(\sum_{s'\neq s}^{S} X_{1,js'}\right)}_{\text{firm-level}} + \underbrace{\zeta_4 X_{1,js}}_{\text{idiosyncratic}} \tag{21}$$

Equation (21) says that the firm's estimate of social inflation risk in period 2, summarized by $\sigma_{2,js}$, depends on four types of realizations in period 1:

1. *National* social inflation ($\zeta_1$): $\sigma_{2,js}$ depends on nuclear awards that affected *other firms* in *other states* in the previous period

2. *Regional* social inflation ($\zeta_2$): $\sigma_{2,js}$ depends on nuclear awards that affected *other firms* operating in state $s$ in the previous period

3. *Firm-level* social inflation ($\zeta_3$): $\sigma_{2,js}$ depends on nuclear awards that affected firm $j$ operating in *other states* in the previous period.

4. *Idiosyncratic* social inflation ($\zeta_4$): $\sigma_{2,js}$ depends on nuclear awards that affected firm $j$ operating in state $s$ in the previous period

The magnitudes and signs of $\zeta_1$ through $\zeta_4$ provide insight into the nature of social inflation risk and how insurers respond to incidence of nuclear awards. Industry anecdotes suggest that social inflation is largely regional and national, i.e. $\zeta_1 > 0$ and $\zeta_2 > 0$. It may also manifest itself at the firm-level. For example, Ge [2019] documents that shocks to divisions' financial conditions affect other divisions' product pricing within the same insurance business group. In a similar vein, a nuclear award in a given state may affect the same insurer's estimate of social inflation risk in other states.

I next provide suggestive evidence that is consistent with the aggregate nature of social inflation risk. Motivated by these two insights, I consider a panel regression of the following form:

$$\Delta P_{t,js} = \zeta_0 + \zeta_1 \left( \sum_{j' \neq j}^{J} \sum_{s' \neq s}^{S} X_{t,j's'} \right) + \zeta_2 \left( \sum_{j' \neq j}^{J} X_{t,j's} \right) + \zeta_3 \left( \sum_{s' \neq s}^{S} X_{t,js'} \right) + \zeta_4 X_{t,js} + \mathbf{\Gamma}' \mathbf{Z}_t + \epsilon_{t+1,js} \quad (22)$$

where $\Delta P_{t,js}$ is the average change in insurance rate for firm $j$ in state $s$ and $X_{t,js}$ is the count (or sum) of nuclear verdicts. $\mathbf{Z}_t$ are the control variables which include contemporaneous interest rate and GDP growth. Anecdotal evidence suggests that $\zeta_1$ is positive and significant, while the null hypothesis is that $\zeta_1 = \zeta_2 = \zeta_3 = \zeta_4 = 0$.

As illustrated in Section 7, there are many state-quarter pairs in which there are no rate increases. Fully balancing the panel and estimating Equation (22) therefore yields insignificant results. State or insurer fixed-effects, which can circumvent this issue, help little in this case because they are highly collinear with my independent variables. Therefore, I estimate the model on the unbalanced panel and instead standardize the dependent variable to have mean 0 and standard deviation 1. By doing so, I am estimating the impact of nuclear awards on the magnitudes of the rate changes among the filed rate changes.

Table 11 contains the results of the regression. The coefficient on the regional manifestation of social inflation risk is significant and positive across all specification, consistent with the interpretation that nuclear awards are heavily influenced by state-specific legal system. The coefficient is also highly significant on the proxy for national manifestation of social inflation risk across all specifications.

## C.2 Impact of Social Inflation on Insurance Rates

### C.2.1 Alternate Timing

Given that there is no single "policy shock" that cleanly differentiates the treated from the control, I re-estimate the triple difference regression (17) using an alternate source of temporal variation. According to Figure 1, the term "social inflation" starts to appear in the transcripts of major insurers' earnings calls after 2017. Therefore, I use the end of 2017:Q4 as the date after which insurers start responding to social inflation risk. I focus on two years (eight quarters) before and after this date as my time period.

Table 12 shows the results of the triple-difference estimation. In column (1), I run a panel regression including year fixed effects as well as the controls. In columns (2) – (4), I relax each to examine the stability of my estimates. Just as the main results, the magnitude of the main coefficient is positive and significant across all specifications, lending support to the role of social inflation in describing the rise in commercial auto liability rates.

### C.2.2 Alternate Exposure Variable

In my baseline estimate, I classify each state into three groups that become my unit of observation: no-award states, low-award states, and high-award states. One may worry, however, that the classification is based on incidence of nuclear awards which are ex-post outcomes.

To mitigate this concern, I consider an alternate sort based on the cumulative number of fatal truck crashes from 2004 to 2015. Specifically, I group the top / bottom five states with the highest number of fatal truck crashes together. The remainder of the estimation setup is identical.

Table 13 shows the results of the triple-difference estimation. Just as the main results, the magnitude of the main coefficient is around 1.4, positive and significant across all specifications.

# D Additional Institutional Background

## D.1 Basics of Insurance Operations, Market, and Regulation

In this section, I discuss basics of insurance operations and regulation that are relevant for this paper. I do not discuss investment or reinsurance, both of which are essential to a healthy insurance sector. This section is borrowed heavily from Klein [2005].

### D.1.1 Basic Functions of Insurers

**Insurance Pricing (Rating)** Pricing involves determining the amount the insured must pay to finance the loss protection or the potential insurance benefits the insured will receive, as well as necessary administrative expenses and the insurer's cost of capital. The price of insurance is usually divided into two components: the *pure premium* and *expenses*. The pure premium is the amount of losses or benefits that insurers expect to pay, on average, on a given insurance contract, while expenses comprise all of the additional costs incurred by insurers in providing coverage and servicing a policy.

For property-liability insurance, which is the most relevant in this paper, rating is done by applying various rating factors to a base rate according to the insured's characteristics that are reflected in the rating structure. For auto insurance, for example, an insurer determines the appropriate average premium for all drivers that it insures and adjusts this premium for a particular insured using factors for the insured's selection of coverage provisions, type and value of vehicle, geographic location, use of vehicle, age, marital status, driving record and other variables.

Various adjustments are also applied manually to further customize the premiums for an insured. They include experience rating (past claims experience), schedule rating (providing credits or debits for certain qualitative factors such as whether the insured has an established loss-prevention program), discounts, retrospective rating (adjusting an insured's premiums based on incurred losses), and judgment rating (additional subjective determination of premiums). In the rating process, typically a combination of the insurer's historical data as well as the entire industry's data is used.

**Underwriting** Underwriting refers to the risk assessment, classification and selection of insureds to achieve an insurer's desired portfolio of risks and determine appropriate premiums. The objective is to match each risk with an appropriate policy and premium.

**Loss Settlement** Loss settlement is the process of paying claims or benefit obligations arising out of the insurance contract according to the provisions of the contract. The settlement process typically involves several steps. First, the insurer must determine that a covered loss has occurred, that a

specific person or property is covered under the policy and the extent of the coverage. Second, the company must provide for fair and prompt payment of valid claims under its contracts. If the insured disputes the settlement offered by the insurer, the insurer and insured may negotiate a settlement to avoid litigation. Otherwise, the insured may file a complaint with the insurance department and/or sue the insurer in court.

### D.1.2 Insurance Lines and Products

I next outline basic types of insurance products sold by insurers and the perils they cover. I focus on property-liability insurance, the policies of which protect insureds against losses stemming from damage to or loss of property and legal liability.

**Auto Liability Insurance** In states in which accident victims can sue in tort to collect damages, auto liability insurance typically covers liability for bodily injury (BI) and property damage (PD), as well as uninsured / underinsured motorists losses (UM/UIM).

In the 1970s, a number of states enacted *no-fault* auto insurance laws intended to lower costs and expedite benefit payments to accident victims. Under the purest form of no-fault, insureds would have no legal right to sue in tort for damages caused by another driver. In this system, accident victims would be covered by their own insurance policy for medical expenses and wage loss, regardless of who was at fault. Realistically, no state has implemented a pure no-fault system, and restrictions on lawsuits vary widely among the states.

**Workers' Compensation Insurance** Workers' compensation insurance differs from other insurance lines in that benefits are set by state law and most employers are required to have coverage. The workers' compensation system is designed to provide a statutory-based set of benefits that must be accepted by employees as their exclusive remedy for work-related injuries. Because workers' compensation benefits are set by law, insurers compete on price and different services associated with workers' compensation coverage, such as loss prevention and case management.

**Medical Malpractice Insurance** Medical malpractice insurance covers health providers' liability for medical accidents caused by their negligence. The scope and cost of medical malpractice insurance has expanded over time as medical care has become more complex and given rise to more adverse outcomes for which providers have been sued.

### D.1.3 Policy Purchases

A *primary* insurance is a coverage that kicks in upon the occurrence of an event giving rise to potential liability, where as *excess* coverage and *umbrella* policy is only obligated to provide coverage over a limit stated in the primary policy.

**Policy Stacking** Stacking of policies refers to the ability to add the primary coverage on top of the excess coverage when determining the total amount available for the claim. For example, a primary coverage of $250,000 and an excess coverage of $1M would provide $1.25M in total available policy limits. Currently, 17 states allow stacking to some extent.[18]

### D.1.4 Market Structure

The level of market concentration within the insurance industry is considerably below levels that most economists consider necessary for firms to begin acquiring market power. Entry and exit barriers are also generally considered to be low – for example, the state fixed minimum capital requirements average in the area of $2 million, which most insurers easily meet. Low entry and exit barriers are also reflected in the high percentage of entries into and exits out of these lines since 1990.

One of the most significant developments in the commercial lines market has been the emergence of what is generally described as the "alternative market." In reality, the alternative market is not a single market, but a collection of risk-management and financing options that offer commercial buyers an alternative to traditional commercial insurers. These options include surplus lines or non-admitted insurers, direct purchase from non- licensed foreign insurers, risk-retention groups and purchasing groups, captive insurers and self-insurance. The principal lines of commercial insurance that have flowed to alternative markets have been workers' compensation, general liability and professional liability insurance.

### D.1.5 Regulation

Each of the 50 states, the District of Columbia and five of the U.S. territories has a chief government official who is responsible for regulating insurance companies and markets. This individual has the authority and responsibility to ensure that insurance companies do not incur excessive insolvency risk, nor treat policyholders unfairly. She also governs insurers' admission and licensing; solvency and investments; reinsurance activity; transactions among affiliates; products; prices; underwriting; claims handling; and other market practices. Regulators also control producer licensing and market practices, along with certain other areas related to insurance company and market functions.

[18] See https://insurancelawhelp.com/primary-vs-excess-insurance-personal-injury-claims/ for the list of states.

Most commissioners are appointed by the governor for a set term subject to legislative confirmation. Elected commissioners directly seek voters' political support, while appointed commissioners do this indirectly as part of the governor's administration.

The National Association of Insurance Commissioners (NAIC) serves as an organization of state regulators that facilitates and coordinates governance across the U.S. The NAIC itself, however, is not a regulator; regulatory authority remains with the individual states.

The federal government has affected state insurance regulatory policy and institutions in several ways. In a number of instances, Congress has instituted federal control over certain insurance markets or aspects of insurers' operations that were previously delegated to the states. Another instance is when the federal government sets regulatory standards that the states are expected to enforce.

**Capital Requirements** All states have fixed minimum capital and surplus requirements, as well as risk-based capital (RBC) requirements. The states' fixed minimum capital and surplus requirements range from $500,000 to $6 million, depending on the state and the lines that an insurer writes. Multi-line insurers are generally required to hold more capital than monoline insurers, and capital requirements also tend to be higher for insurers writing casualty lines. The typical fixed minimum capital requirement for a multi-line insurer is approximately $2 million. RBC is intended to be a minimum regulatory capital standard and not necessarily the full amount of capital that an insurer would want to hold to meet its safety and competitive objectives. Under the RBC model, certain company and regulatory actions are required if a company's total adjusted capital falls below a certain level of risk-based capital.

**Reserve Requirements** In addition to capital requirements, insurers are subject to other regulations with respect to their financial structure and operations. A principal requirement is that insurers maintain adequate reserves for their liabilities for future claims and benefit payments. The primary challenge for property-liability insurers is to determine reserves for claims that have been incurred but not yet paid. The factors affecting property-liability insurers' obligations for future claims payments tend to vary and are more subjective (than for life insurers), particularly for long-tail lines where claims obligations can extend many years beyond the termination of policy.

### D.1.6 Financial Reporting

In the U.S., property/casualty insurance companies report their financial results to state insurance regulators in what is called the Annual Statement. The first eight schedules (Schedules A through E) of the Annual Statement provide further transparency of the company's assets, as displayed in the balance sheet of the statutory financial statements. The purpose of these schedules is to assist

stakeholders and regulators in identifying and analyzing risks inherent in those assets, changes in those assets and differences in their valuation.

Property-liability insurers tend to spend more time focusing on liabilities of the balance sheet than on assets. Schedules F and P are most relevant for this purpose – Schedule F pertains to reinsurance accounting, and Schedule P pertains to loss and loss adjustment expense reserves. The remaining two schedules, Schedule T and Schedule Y, provide details on the insurance company's premium writings by state and organizational structure, respectively. For details on each schedule, I recommend Odomirok et al. [2013].

**Schedule P** Schedule P provides details underlying the recorded loss and loss adjustment expense (LAE) reserves on the reporting entity's statutory balance sheet, including 10 years of the company's historical loss and defense and cost containment (DCC) experience. For the purpose of this paper, the schedule shows how loss reserves have developed over time and enables the reader to decipher whether development is attributed to a specific year or line of business. It also shows the split between a company's reserves for known claims and those actuarially determined (i.e., IBNR reserves).

### D.1.7 Rate and Form Filings

Most states require rates to be filed, and a majority of the states require that insurers receive prior approval before rate changes go into effect. Several states also have "flex-rating" laws that do not require prior approval for rate changes unless they exceed certain parameters with respect to the relative magnitude of a change (e.g., 10 percent). The nature of the review of rates, rating rules and policy forms varies somewhat among the states depending on their laws and regulations and the specific requirements that must be met, as well as the resources available to perform the review. Table 11.1 of Klein [2005] presents a detailed summary of state rate filing requirements for property-liability.

**Rating Laws** Rating laws are often classified as prior approval, file and use or use and file (competitive), no file (open competition), or flex rating. The terms of the classification can vary by state, but generally, the following definitions are used.

Prior approval rating laws are those where rates must be filed with and approved by the state insurance department before they can be used. Competitive rating laws typically allow use of rates so long as they are filed. Two variations of competitive rating laws are 1) file and use; and 2) use and file. File-and-use rating laws are those where the rates can be introduced into the market at the same time as they are being filed with the insurance regulator. Specific approval is not required, but the department retains the right of subsequent disapproval. In most instances, the subsequent disapproval is on a prospective basis only. In some states, refunds can be required. Use-and-file

rating laws are those where the rates can be introduced into the marketplace and, at a specified later date, must be filed with the regulator.

No file, or open competition, rating laws do not require the rates to be filed with or approved by the state insurance department. However, the company must maintain records of experience and other information used in developing the rates and make these available to the commissioner upon request. Rates can be modified without notification to the insurance department. Flex rating is a system where prior approval of rates is required only if the rate change would be greater than (and sometimes less than) a certain percentage (e.g., 7%).

## D.2 Past Hard Markets in Property and Casualty Insurance

### D.2.1 1975 – 1978

This period is characterized by a famous Newsweek article[19]:

> Like measles in a nursery, doctors' strikes seem to be erupting all across the nation. What the doctors are protesting is the skyrocketing cost of their malpractice insurance premiums.

The 1970s saw a rapid rise in medical malpractice insurance claims and contemporaneous increase in the insurance premiums. In 1974 alone, there was a nearly 200% increase in malpractice suits filed in State courts. Between 1975 and 1975, the average award per injury increased 70% from $26,565 to $45,187; even with adjusting for inflation, the increase is over 40% (Sowka [1980]).

Combined with the weak financial conditions of the many insurance companies, the unpredicted increases in both claims filed and the size of the awards caused many companies to draw down their reserve funds. Together with a sharp decline in companies' investment portfolios in 1974, many companies were either forced to go bankrupt or to withdraw from the malpractice insurance market, creating a shortage in the availability of coverage in many states (Greenspan [1979]).

The crisis ended when broad organizational and legislative changes added new insurance companies and extra capacity to the system. For example, nearly forty malpractice insurance companies were formed between 1975 and 1982 with the sponsorship of state medical societies and other physician groups. Eleven state hospital associations also formed insurance companies. Furthermore, many state governments enabled a broader pooling of risks through entities such as the Patient Compensation Funds (PCFs) and Joint Underwriting Associations (JUAs). The mid-1970s also saw a widespread movement by miedum-sized and large hospitals to underwrite their own malpractice risks.

[19] See "Malpractice - Doctors in Revolt," *Newsweek*, June 9, 1975

#### D.2.2 1984 – 1987

Insurance rates skyrocketed for most commercial customers of liability insurance including manufacturers, municipalities, doctors, and non-profit groups. For example, a survey of the U.S. General Accounting Office indicated that most business were able to find liability coverage during 1985 and 1986, but many experienced significant premium increases and some saw their limits decreased and/or deductibles increased. The medical malpractice insurance has also taken a center stage in the crisis, albiet concentrated in a small number of states and for a few surgical specialties (Posner [1986]).

After this period, insurance crisis became a frequent topic of the general public and prompted intense debates about the competitiveness of insurance markets and the efficacy of state regulation. Industry critics blame the cartel behavior on the part of insurers; insurers sought reform to the tort liability system.

A variety of policy responses emerged in this era. They include prior approval and "flex-rating" rate regulation, stricter solvency measures, increased data reporting requirements, and changes to the tort liability system. Contemporaneously, liability insurance rates fell and coverage became easier to obtain (NAIC [1991]).

#### D.2.3 2001 – 2004

During the 2001 – 2004 hard market, commercial lines premiums increased, on average, 55% from 2000 Q4 to 2002 Q4. The hard market from was largely precipitated by the events of 9/11 and the massive losses associated with Hurricane Katrina (Jamison and Co [2015]). Other important factors also include the largest investment losses in the early 2000s as well as legacy of continuing losses from asbestos, environmental, and tort claims.

Just like previous hard markets, the crisis was met with major tort reforms. One of them is the Class Action Fairness Act of 2005. It expanded federal court jurisdiction over multi-state class and mass actions seeking more than $5 million and also prohibited lawyers from receiving large fees when their clients receive only coupon settlements.

Table 11: Nature of Social Inflation Risk

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Idiosyncratic | 0.0179 | -0.00266 | -0.965 | -1.288 |
| | (0.0924) | (0.0940) | (2.031) | (2.075) |
| Regional | 0.0212* | 0.0281** | 0.851* | 1.013** |
| | (0.0104) | (0.0106) | (0.336) | (0.343) |
| Firm-Level | 0.0497*** | 0.0644*** | 0.328 | 0.527 |
| | (0.0147) | (0.0149) | (0.347) | (0.354) |
| National | 0.00919*** | 0.0214*** | 0.479*** | 0.771*** |
| | (0.00168) | (0.00156) | (0.0652) | (0.0644) |
| Constant | -0.260*** | -0.229*** | -0.312*** | -0.204*** |
| | (0.0290) | (0.0275) | (0.0313) | (0.0292) |
| Controls | Y | N | Y | N |
| RHS Measure | Counts | Counts | Amount | Amount |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This tables reports the estimates of the following panel regression:

$$\Delta P_{t+1,js} = \zeta_0 + \zeta_1 \left( \sum_{j' \neq j}^{J} \sum_{s' \neq s}^{S} X_{t,j's'} \right) + \zeta_2 \left( \sum_{j' \neq j}^{J} X_{t,j's} \right) + \zeta_3 \left( \sum_{s' \neq s}^{S} X_{t,js'} \right) + \zeta_4 X_{t,js} + \mathbf{\Gamma}' \mathbf{Z}_{t+1} + \epsilon_{t+1,js}$$

where $\Delta P_{t+1,js}$ is the average change in insurance rate for firm $j$ in state $s$ and $X_{t,js}$ is the count (or sum) of nuclear verdicts. $\mathbf{Z}_t$ are the control variables which include contemporaneous interest rate and GDP growth.

*Data Source: NAIC via SNL Financials, VerdictSearch*

Table 12: Estimates from Triple-Differences with Alternate Timing

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Commercial Auto | -1.582* | -1.598* | -0.724 | -0.709 |
| | (0.670) | (0.669) | (0.383) | (0.385) |
| High Award State | 1.479*** | 1.480*** | 1.477*** | 1.482*** |
| | (0.323) | (0.323) | (0.322) | (0.325) |
| High Award State x Comm. Auto | 0.517 | 0.528 | 0.515 | 0.549 |
| | (0.508) | (0.509) | (0.508) | (0.510) |
| Post Increase in Frequency | -1.213 | -1.079** | -0.759 | -0.634 |
| | (0.758) | (0.388) | (0.689) | (0.348) |
| High Award State x Post | -1.135* | -1.113* | -1.137* | -1.132* |
| | (0.497) | (0.498) | (0.497) | (0.499) |
| Comm. Auto x Post | 2.583*** | 2.615*** | 2.958*** | 2.982*** |
| | (0.635) | (0.636) | (0.584) | (0.587) |
| Comm. Auto x High Award State x Post | 2.470** | 2.411** | 2.502** | 2.428** |
| | (0.909) | (0.909) | (0.913) | (0.913) |
| GDP Growth | 174.6 | 201.0** | | |
| | (90.88) | (70.41) | | |
| Comm. Auto x GDP Growth | 176.3 | 179.5 | | |
| | (115.0) | (114.9) | | |
| Constant | 4.235*** | 4.248*** | 4.353*** | 5.202*** |
| | (0.381) | (0.387) | (0.294) | (0.233) |
| N | 4428 | 4428 | 4428 | 4428 |
| Controls | Y | Y | N | N |
| Year FE | Y | N | Y | N |

This table reports the impact of social inflation risk on insurance rate growth for commercial and personal auto liability lines. I estimate a triple-differences regression of the following form:

$$\begin{aligned}\Delta P_{ist} = \beta_0 + \beta_1 HighAward_s + \beta_2 IsComm_i + \beta_3 HighAward_s \times IsComm_i \\ + \delta_0 Post_t + \delta_1 HighAward_s \times Post_t + \delta_2 IsComm_i \times Post_t \\ + \delta_3 HighAward_s \times IsComm_i \times Post_t + GDPGrowth_t + IsComm_i \times GDPGrowth_t + \epsilon_{ist}\end{aligned}$$

where $i$ denotes the insurer, $s$ the state, and $t$ the quarter in which the rate change was filed. I treat the commercial and personal lines within the same insurance group as distinct insurers. Robust standard errors, clustered at the state-insurer level, are below the coefficients in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 13: Estimates from Triple-Differences with Alternate Exposure Variable

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Commercial Auto | -1.484*** | -1.467*** | -0.437 | -0.410 |
| | (0.431) | (0.433) | (0.307) | (0.307) |
| High Truck State | 1.258*** | 1.247*** | 1.261*** | 1.247*** |
| | (0.267) | (0.265) | (0.268) | (0.265) |
| High Truck State x Comm. Auto | 0.206 | 0.258 | 0.212 | 0.274 |
| | (0.539) | (0.541) | (0.539) | (0.541) |
| postMorgan | -1.025 | 1.303*** | -1.137 | 1.301*** |
| | (0.813) | (0.201) | (0.809) | (0.200) |
| High Truck State x Post Verdict | 0.0421 | 0.0435 | 0.0441 | 0.0433 |
| | (0.365) | (0.363) | (0.365) | (0.363) |
| Comm. Auto x Post Verdict | 1.408*** | 1.404*** | 1.374*** | 1.373*** |
| | (0.381) | (0.382) | (0.380) | (0.381) |
| Comm. Auto x High Truck State x Post Verdict | 1.364 | 1.321 | 1.373 | 1.334 |
| | (0.721) | (0.723) | (0.722) | (0.724) |
| GDP Growth | -42.55 | 8.446 | | |
| | (23.59) | (21.74) | | |
| Comm. Auto x GDP Growth | 176.1*** | 177.7*** | | |
| | (48.59) | (49.00) | | |
| Constant | 2.214*** | 3.845*** | 1.940*** | 3.895*** |
| | (0.325) | (0.205) | (0.296) | (0.160) |
| N | 10957 | 10957 | 10957 | 10957 |
| Controls | | | | |
| Year FE | Y | N | Y | N |

This table reports the impact of social inflation risk on insurance rate growth for commercial and personal auto liability lines. I estimate a triple-differences regression of the following form:

$$\begin{aligned}\Delta P_{ist} = \beta_0 + \beta_1 HighAward_s + \beta_2 IsComm_i + \beta_3 HighAward_s \times IsComm_i \\ + \delta_0 Post_t + \delta_1 HighAward_s \times Post_t + \delta_2 IsComm_i \times Post_t \\ + \delta_3 HighAward_s \times IsComm_i \times Post_t + GDPGrowth_t + IsComm_i \times GDPGrowth_t + \epsilon_{ist}\end{aligned}$$

where $i$ denotes the insurer, $s$ the state, and $t$ the quarter in which the rate change was filed. I treat the commercial and personal lines within the same insurance group as distinct insurers. Robust standard errors, clustered at the state-insurer level, are below the coefficients in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.