Casualty Catastrophe Analytics:
Where we are now and where we should be on this critical risk

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Abstract

Despite the occurrence of numerous casualty catastrophes that have had a significant impact on the insurance industry, the state of casualty catastrophe modeling lags far behind that of property catastrophes. One reason for this lag is that casualty catastrophes develop slowly as opposed to property catastrophes that occur suddenly, so that the impact, both financial and psychological, has less of a shock element. Other reasons include the dearth of data and the relative complexity. This paper reviews the history, assesses the current state of models and suggests steps to improve the industry's analytics of casualty catastrophes.

Keywords: casualty catastrophes, catastrophe models, Risk Based Capital, Realistic Disaster Scenarios, gamma distribution

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1. Introduction

There is a joke about a man looking at the ground under a streetlight at night. Someone asks him what he is doing and he replies that he is looking for his keys. When asked if he lost them there, he says, "No, but the light is better here." The joke is funny because no person would actually do that. However, that is exactly what the insurance industry is doing on catastrophe losses. The industry is making a great effort to measure and predict property catastrophes, but is practically ignoring the risk of casualty catastrophes, despite the facts that two of the three largest catastrophes in history have been casualty losses and the principal cause of insolvency for property-liability insurers is under-reserving, which is a common element of casualty catastrophes. The objective of this paper is to encourage the industry to redirect its attention to the critical risk posed by casualty catastrophes.

To be fair, property catastrophes are an important issue for the industry and do need to be studied. However, great advances have been made in understanding and quantifying property catastrophes since the first models were developed in the 1980s. The additional efforts expended in this area now are producing only marginally better models. In contrast, the amount of information available on casualty catastrophes is limited and the attention devoted to this risk by insurers, reinsurers, rating agencies and regulators is minimal. Casualty catastrophe modeling, other than pollution, is in its infancy. If this is where the greatest risk to the industry lies, much more attention needs to be paid to this area.

The next section of this paper proposes a definition of casualty catastrophes and describes how important they are to the insurance industry. The third section explains why casualty catastrophes have been practically neglected by the industry, regulators and rating agencies, despite the impact they have had in the past and will have in the future. The next section reviews the literature on casualty catastrophes. The fifth section summarizes what information is available on historical casualty catastrophes from a variety of sources. The sixth section demonstrates the need to utilize casualty catastrophe models, rather than continuing to include these losses under traditional claims-fitting techniques. The next section addresses the key difficulties in modeling casualty cats - the dearth of data and the modeling complexity. The eighth section reviews several of the proprietary casualty catastrophe models that are currently in use to provide insight into some of the different approaches that are used to model this risk. This section also includes an estimate of the casualty catastrophe risk for the industry based on the limited publicly available information. The next section explains how regulators and rating agencies address casualty catastrophe risk, particularly in comparison with property catastrophe risk. The final section proposes a way forward that would lead to having the insurance industry measure and manage casualty catastrophe risk more appropriately than is currently done.

2. Casualty Catastrophes: Definition and Examples

Catastrophic losses emanating from occurrences covered by casualty insurance policies are a relatively recent event. Beginning in the 1940s, Hooker Chemical Company's then state-of-the-art disposal processes for toxic substances were subjected to a string of unanticipated events that eventually led to the Love Canal chemical disaster of the 1970s and the genesis of pollution liability exposure for chemical companies and insurers. The reliance on an effective but dangerous fire-resistant product during the first half of the twentieth century for numerous industrial applications led to massive asbestos related losses for both producers and insurers. The profitability to lawyers of these and similar cases created a new legal specialty, that of mass torts, attracting significant talent and spurring the generation of many additional new causes of action. The revolution that technology has brought to consumer products in the last three decades has altered individual behavior in many respects, including the ability to instantly communicate with millions of others, a tendency to more sedentary behavior and the use of unusual repetitive motions. Another social trend in many developed countries appears to be a tendency, in cases where personal choices lead to poor outcomes, to reject personal responsibility for adverse consequences and instead seek to place blame and financial responsibility to another party, preferably one that can readily pay large damages. These developments, and other related factors, have led to an increase in liability losses in general and produced a greater risk of catastrophic casualty losses in the future. Casualty catastrophes have rightfully been classified as the "most daunting threat that casualty (re)insurers face today" (Guy Carpenter, 2014b).

A recent GIRO Working Party adopted the definition of a casualty catastrophe proposed by analysts at Guy Carpenter, which is "an event that causes $100 million or more in direct insured losses from all causes to casualty policies (of all types), with one or more policies and insurers impacted" (Harding, et al, 2009, p 6). Conversely, the common definition of property catastrophes is an event that causes $25 million or more in direct insured losses, but it must affect a significant number of policyholders and insurers (III, 2014a). Massive product liability losses emanating from items produced by a single manufacturer or catastrophic environmental damage generated by a spill caused by one company are examples of casualty catastrophes that could involve just a single policy and a single insurer (although likely many reinsurers). Thus, the GIRO Working Party definition of a casualty catastrophe will be utilized in this paper.

Over the last several decades hundreds of events would qualify as casualty catastrophes. The prototypical example of a casualty catastrophe is asbestos. Asbestos has generated the largest, longest and most expensive mass tort in U.S. history. This commonly used product was found to cause numerous ailments, including its signature disease, mesothelioma, which had a very long latency period. By 2002, the case involved 730,000 plaintiffs and 8,400 defendants. Many defendants were driven to bankruptcy as a result of this litigation, thousands of jobs were lost and several innovative legal rulings have emerged (Carroll, et al, 2005). The total cost of asbestos litigation is estimated to be $250 billion, with approximately 50% of the cost going to litigation expenses (Economist, 2005). As of 2014, insured losses from asbestos claims were estimated to be $85 billion (AM Best, 2015).

Silicone breast litigation is an example of a casualty catastrophe resulting primarily from flaws in the U.S. legal system. Thousands of lawsuits with over 400,000 plaintiffs were filed starting in the 1980s that claimed adverse health effects from silicone breast implants. Despite denials that the product was unsafe (and subsequent scientific research finding no significant safety issue), the major implant and raw material manufacturers provided a settlement in excess of $3 billion in 1994 (XL Large Loss Exhibit, 1999; Schleiter, 2010). Several companies including Dow Chemical declared bankruptcy as a result of this litigation (Feder, 1995).

A casualty catastrophe can also result from a single sudden event. On April 10, 2010, the Deepwater Horizon oil rig exploded, killing workers and releasing millions of barrels of oil into the Gulf of Mexico. BP has already paid $4.5 billion in fines and penalties and estimates that it will pay another $7.8 billion to settle civil claims. In addition to BP, Transocean Ltd, the owner of the rig, Halliburton, the company that provided the cement for the project, and Cameron International, the manufacturer of the blowout preventer, have also been sued for this loss (Gregorio, 2014). The event has led to over 100 lawsuits and involves over 100,000 plaintiffs. More than five years after the event, litigation is still in process.

As demonstrated by these examples, the underlying nature and key attributes of casualty catastrophes can vary widely, from commonly used products to a single disastrous event, but what they have in common is a massive loss. Comparable property losses would have caused immediate changes to insurance operations, including higher capital requirements, more restrictive underwriting and enhanced regulatory oversight. However, these casualty catastrophes had no such impact. The reasons for this difference will be examined in the next section.

3. Reasons for the Neglect of Casualty Catastrophes

Despite the fact that casualty catastrophes represent at least as great a risk to the insurance industry as property catastrophes, relatively little attention has been paid to them by insurers, regulators or rating agencies. There are several explanations for this. First, property catastrophes emerge suddenly, are the subject of instantaneous news coverage and are over within days, at which point reasonable estimates of the size of the loss can be calculated. Conversely, most casualty catastrophes emerge gradually, with a few tentative lawsuits generating adverse rulings for the industry, but these are often subject to lengthy appeals that delay a final disposition. The full extent of the losses is often not known for decades. Also, since payments in casualty catastrophes are made a long time after the loss emerges, insurers avoid having to generate funds immediately, and recognition of the losses in financial statements may be deferred due to under-reserving, whether intentional or unintentional. Asbestos is a clear example of insurers' recognizing ultimate costs over decades, rather than immediately.

Second, data on casualty catastrophes is sparse. It is fairly easy to locate information on the largest property catastrophes each year, but very difficult to determine the extent of insured losses on casualty catastrophes. Many settlements are out of court and include nondisclosure provisions. Since it takes so long for cases to be closed, the actual value of damages assessed by courts is not known for years. Also, property catastrophes are identified by a unique serial number, assigned by Property Claims Service, that allow for easy aggregation of insured losses from a particular event. No such identification system currently exists for casualty catastrophes.

A third reason for the relative neglect has been the presumed difficulty in modeling casualty catastrophes. While windstorms, earthquakes and floods, although extremely complex, follow particular physical patterns, the legal system is a man-made institution that changes over time, sometimes quite unexpectedly. Predicting losses from mass torts seems to be impossible. However, before property catastrophe modeling was introduced in the 1980s, predicting losses from hurricanes seemed equally imposing.

Despite these difficulties, casualty catastrophe risk is being increasingly recognized as a major problem for the insurance industry. Regulations that insurers address all significant aspects of risk require insurers to begin the process of quantifying casualty catastrophe risk. Models are available to start the process. Once the need for better data on casualty catastrophes is evident, then the industry will adapt to provide this information. The sooner this effort is made, the better.

4. Literature Review of Casualty Catastrophe Modeling

The published literature on casualty catastrophe modeling is meager. Few articles have appeared in peer reviewed journals. Most sources on this topic are professional presentations, short articles in company newsletters and summary descriptions of in-house models provided on company websites. The most complete explanation of the state of casualty catastrophe modeling to date is the presentation by Matthew Ball, Yi Jeng and Allan Cohen at the September, 2013 Casualty Loss Reserve Seminar (Ball, Jeng and Cohen, 2013).

Ball et al make several central points. First they equate the current state of casualty catastrophe modeling with windstorm modeling prior to Hurricane Andrew (1992), earthquake modeling prior to the Northridge earthquake (1994), terrorism modeling prior to the World Trade

Center attack (2001), flood modeling prior to the Thailand flood (2011) and tsunami modeling prior to the Japanese earthquake (2011). Casualty catastrophe modeling lags that for other causes despite the fact that asbestos losses emanating from 1975 totaled $71 billion ($85 billion currently, based on AM Best's latest report) and pollution losses from 1990 totaled $36 billion, two of the three largest catastrophe losses on record. The economics should have spurred extensive research into these risks. The fact that it hasn't indicates the difficulty of this issue, even compared to other quite complex systems such as windstorms and plate tectonics. Legal liability is an intricate topic and predicting changes in laws or their legal interpretations is even more complicated than predicting future hurricanes or earthquakes. However, Ball et al suggest that casualty catastrophe modeling is likely to follow a path of development similar to the property risks and within a few decades be widely accepted and technically sophisticated.

Second, Ball et al suggest that studying the features of past casualty catastrophes can provide some indication about the likely key attributes of the next mass tort the industry will face. For example, asbestos was a product that was used widely, leading to a large population exposed to loss. Additionally, a signature injury, mesothelioma, created a clear link between exposure to the product and the injury suffered. The loss was compounded by the long exposure period and legal decisions that involved extensive exposure of insurance policies running from the first exposure to the manifestation of the disease. I would add another key factor, that of no-fault type coverage, in this case workers' compensation, to pay the initial costs incurred by the plaintiffs, reducing the negotiating power of insurers to offer an early settlement and close cases on the subsequent, additional actions brought by plaintiffs under liability policy coverage.

A related paper by Ball, Jeng and Sullivan (2011) points out that a crucial aspect that complicates any attempt to model casualty catastrophes: there is no typical mass tort. While windstorms, earthquakes and floods have common elements that make future such events relatively predictable, mass torts are quite distinct from each other. Part of this unpredictability is generated by actions that companies found responsible in a mass tort take to prevent a recurrence, and by the fact that insurers will revise policy terms to limit their future liability. The authors suggest that the uncertainty regarding mass torts exceeds that of natural disasters. The diverse examples provided - asbestos, the 2008 financial crisis, Chinese drywall, the BP oil spill, fen-phen and other pharmaceutical products and the welding faults discovered in the Northridge earthquake - support this claim. In addition, the time lag between the event and when ultimate losses can be reasonably estimated is far longer for casualty catastrophes than for property catastrophes. Therefore, both modelers and users of these models should expect that it will be more difficult to develop effective casualty catastrophe models and the accuracy of these models will not be as great as property catastrophe models. The adage that, “All models are wrong, but some are useful” (Box and Draper, 1987) will hold especially true for such models. However, the difficulty of developing and applying casualty catastrophe models does not mean that such efforts should be avoided, just that care needs to be taken in their use.

In contrast to the lack of published research on modeling casualty catastrophe scenarios, there are many published articles on historical events, including asbestos, pollution and construction defects. This literature helps provide an understanding of past losses. Although future casualty catastrophes will differ markedly from past ones due to changes in insurance contracts and business practices, historical losses are integral to understand the key elements of large casualty losses in order to be prepared to deal with those that will develop in the future.

Sparks (2005) provides an extensive overview of construction defect claims, which have been a common source of casualty catastrophes, from the well-publicized Chinese drywall claims to less well known actions. The rapid growth of construction defect claims is based on several factors. Consumers' expectations regarding quality of construction are now higher and their awareness of legal remedies has increased. More plaintiffs' attorneys are developing an expertise in this area and are attracting new homeowners to represent. The lack of clarity in past judicial rulings and legislation is leading to uncontrolled litigation (Sparks, 2005, p. 2). In one case (Presley Homes Inc. v American States Insurance Company), the court found that the insurer had a duty to defend a policyholder despite the lack of a contractual obligation (Sparks, 2005, p. 7). The application of five different coverage triggers creates wide uncertainty and the potential for many policies to apply to a single loss (Sparks, 2005, p. 8).

Since asbestos was the first and, to date, the largest casualty catastrophe, this litigation has been widely studied (Carrol et al., 2005). Techniques used for pollution and asbestos losses can be applicable to future causes of action. The loss development patterns of these toxic torts cannot be effectively reserved based on traditional loss triangles; a technique derived from disability claims, termed Policy-Event Based Loss Estimation (PEBLE), has been shown to be a useful tool (Bouska, 1996). This reserving technique starts with a specific event that could cause a loss, then examines the characteristics of each applicable policy (e. g., location, deductible, limits) to determine an exposure-specific damage amount, and finally aggregates the individual policy values to determine the total potential loss. This approach has proven useful in developing estimates of losses for property and casualty catastrophes.

5. Historical Casualty Catastrophes

A web search for "largest catastrophe losses" yields numerous sources of information, but they invariably list property losses, not casualty losses. One excellent source of information on large losses, Sigma, an insurance reporting service provided by Swiss Re, lists the aggregate economic and insured losses from natural and man-made disasters each year, and includes a list of the largest losses. However, this report only covers property losses. Their definition of "insured catastrophe losses" is "losses caused by catastrophe covered by property insurance." Similarly, PCS (Property Claims Service) maintains an excellent database of insured catastrophic losses, but, as their name indicates, the focus is on property losses, not casualty losses.

Information on casualty catastrophes can be obtained, though. Advisen, an insurance information provider, has compiled a Master Significant Cases and Actions database (MSCAd) that currently includes over 316,000 individual "cases" affecting public and private companies, not-for-profits, or governmental entities with a total loss value of over $3 trillion. These cases have been independently researched and added to the database by Advisen, including relating the case to the business information of the parties to the case. The individual cases are also linked by a "related case" id that aggregates various types of casualty clash or casualty catastrophe events. The MSCAd database captures over 19,000 such related case events, ranging from single cases with losses to multiple defendants up to sector and global shock losses. Not all of the events included in this database are casualty catastrophes since many involve property coverage, but casualty catastrophes are included in the database and have been used to parameterize casualty catastrophe models (Advisen, 2016). Currently, the two largest losses in this database are both casualty events, the Madoff investment fraud that led to a $154.5 billion judgement and Phillip Morris tobacco liability award of $140 billion.

Several organizations have compiled proprietary lists of casualty catastrophes. Towers Watson has compiled a database of approximately 300 casualty catastrophes over a 50 year period with losses totaling almost $550 billion. The largest loss is $71 billion for asbestos claims (Ball, Jeng and Sullivan, 2013). (This amount is now valued at $85 billion by AM Best.) Willis

Re (pre-merger with Towers Watson) also developed a database of casualty catastrophe losses. Both databases are proprietary and not publicly available.

In the past, XL Insurance compiled and shared a Large Loss Exhibit that listed major liability losses that it provided to underwriters, brokers and clients to help them assess coverage needs. This listing was generated from publicly available information and included losses from around the world. In 2005, this information was made available online through LossLink to allow risk managers and brokers to assess the adequacy of insurance coverage. At the time, it consisted of over 2000 entries from 20 different countries (XL, 2005). Unfortunately, this information is no longer accessible online. However, a published version of the Large Loss report from 1999 provides some insights into the makeup of large casualty losses (XL, 1999).

Table 1: Losses over $100 million by Country and by Industry within Coverage

Country	Losses	General Liability	Losses	Employment Practices	Losses
Belarus	1	Auto/Auto Parts Manufacturers	8	Bank	1
Canada	1	Chemical	11	Insurance Company	1
England	1	Construction and Building Materials	3	Oil Company	1
France	1	Energy and Marine	10	Restaurant Chain	1
Germany	2	Hotels	3	Supermarket	1
India	1	Industrial/Consumer Manufacturers	3	Total	5
Japan	1	Mining	1		
Puerto Rico	1	Pharmaceutical and Medical Devices	10		
Spain	1	Premises	6		
Ukraine	1	Railroads	3		
United States	51	Utilities	2		
Worldwide	3	Total	60		
Total	65				

Source: XL Large Loss Report 1999

The losses included in the XL Large Loss report are not all catastrophic losses. Many are covered by a single policy covering a single entity written by one insurer (likely with reinsurance involvement). Others include multiple insureds and multiple insurers. Losses range from $10 million to $7 billion, and some entries indicate that the loss could not be accurately estimated at the time. To focus on catastrophic events, this list was pared to losses of $100 million or more (Table 1). This reduced the list to 65 losses, 60 covered under General Liability and 5 under Employment Practices. Of these, 51 occurred in the U.S., three were worldwide (all involving pharmaceutical products), two occurred in Germany and one occurred in each of nine other countries. Of the 60 General Liability losses, Chemicals, Energy and Pharmaceuticals each had ten or more of these losses. Auto/Auto Parts, Construction and Building Materials, Hotels, Industrial and Consumer Manufacturers, Mining, Premises, Railroads and Utilities also generated large losses. It is clear that large losses have occurred worldwide, although the U.S. clearly has the greatest risk of a large loss. The industries exposed to such a loss range widely.

Given the risk that casualty catastrophes represent for the insurance industry, it seems strange that there is so little information readily available on casualty losses compared with the data on property catastrophes. Two reasons help explain this situation. First, events that lead to property catastrophes are known immediately. This allows statistical agencies to assign an identification number to these events early enough so that insurers can include this identifier in claim reports, facilitating the compilation of aggregate losses. Conversely, casualty catastrophes develop slowly. Initial verdicts that are adverse to the insurance industry are likely to be appealed, with a final ruling delayed for years. Thus, there is no opportunity to use a common identifier on loss reports for a single casualty catastrophe since by the time it is recognized as a catastrophe, many of the claims have already been processed. The result is that no system of identifying casualty catastrophes in reports to statistical agencies has been developed.

Second, most liability cases are settled without a court determination, and a common feature of out-of-court settlements is a confidentiality agreement that prevents the plaintiff from revealing the amount of the award. By avoiding publicly revealing each settlement, insurers retain greater flexibility in negotiating future awards for similar cases. However, by restricting access to this information, it becomes much more difficult to measure casualty catastrophes, and without accurate measures, the ability to manage these risks is impeded.

5.1 Representative Casualty Catastrophes

Construction – Construction losses provide several useful insights into casualty catastrophes in general. For one, construction losses are a dynamic section of the law. The two types of claims are "course of construction," primarily jobsite injuries, and "completed operations," which can be bodily injury or property damage. Post-construction claims can have a lengthy tail; examples include a 2010 claim based on asbestos exposure on a project completed in the 1960s and another claim alleging building code violations brought 12 years after completion of the project. The 1981 Hyatt Regency walkway collapse is the most sensational construction defect claim and led to extremely complex litigation (Glucksman, 2014).

Glucksman attributes the rise in construction defect claims to a building boom during the mid-1990s, where unskilled labor, inadequate supervision and unrealistic demands led to many instances of substandard housing. The surge in claims created a new legal specialty in construction defects, which has led to even more litigation. One cited example was a law firm that hosted a barbeque for residents of a new subdivision and distributed solicitation forms for residents to sign, with most residents not realizing they were signing up for legal representation.

Compared to general liability, construction defect claims have more plaintiffs, more defendants, unknown loss dates, multiple types of damages, multiple policy periods and longer statutes of limitations. The focus of many claims is on the damages and coverage, rather than liability issues. One case had 500 homeowners, 25 subcontractors and 40 lawyers. One defendant had only constructed a fence, but was brought into the case based on tangential exposure.

Several elements make construction defect claims so complicated. One factor is based on a 1995 case, Montrose v Admiral Insurance Company, which created a continuous trigger for duty to defend hazardous waste actions. This has led to the situation where all insurers in construction cases, "from shovel to gravel" have potential liability. A second factor is the statute of limitations, which runs from 2-4 years for defects detectable by reasonable inspection, but 10 years for latent defects. A third factor is the combination of Self Insured Retentions (SIR), bankrupt parties and excess coverage. In many cases, judges use creative reasoning to get a claim paid, and those rulings have repercussions on many other cases (Glucksman, 2014).

The dynamics of construction defect litigation make this field especially complex. Insurers tighten contracts in response to past cases, but then legislatures change the law to give plaintiffs new causes of action, or courts make decisions that change the rules. In 2003 California adopted a Right to Repair law (SB800) that gave contractors the opportunity to repair any alleged faulty construction before a plaintiff could file a suit. However, a recent court ruling held that SB800 was not the only avenue for collecting damages, introducing more uncertainty into this area. Courts now favor arbitration, where the amount a party pays depends on their ability to pay, not just on their legal liability.[1] Glucksman observed that lawyers do not bring a case unless they are likely to be able to collect damages so many contractors now set up a separate entity to build each project, reducing their liability unless the lawyer can pierce the corporate veil. If that were to happen, insurance policies on different entities could be found to provide coverage.

Pollution – The Hooker Chemical Company case initiated pollution liability concerns for the insurance industry. As a consequence multiple changes to general liability contracts were

[1] Under traditional liability, which applies in most situations, the responsibility for paying damages is in proportion to fault. A party that is 60% at fault in a claim valued at $100,000 would pay $60,000. Under joint and several liability, which applies in environmental impairment cases, actions against members of Boards of Directors, and other specific situations, any one party can be required to pay the entire damages to the plaintiff.

enacted in an attempt to limit future pollution losses, but unexpected court rulings continued to leave insurers and reinsurers exposed to substantial losses from pollution claims. In one especially notable case, Morton International v. General Accident Insurance Company of America (1993), the New Jersey Supreme Court ruled that policy language limiting pollution coverage to sudden and accidental events actually covered all losses that were not caused by the intentional actions of the insured or an authorized agent. Insureds would be covered for gradual releases and for any pollution damage that was not intended (Meniman and DeBusk, 1993). This ruling exemplifies the uncertainty involved in court interpretations of policy language. The current estimate of insured losses for environmental liability is $42 billion (III, 2014b).

Exxon Valdez – On March 24, 1989, the Exxon Valdez oil tanker hit a reef and released approximately 11 million gallons of oil into the remote Prince William Sound area of Alaska (Exxon Valdez Oil Spill Trustee Council). This led to massive cleanup costs, estimated at $2 billion plus another $1 billion in civil and criminal charges related to the spill. Much of these losses were paid by insurers. The initial court ruling assessed $5 billion in punitive damages against Exxon. Extensive legal efforts followed, including going to the U.S. Supreme Court three times in an effort to reduce or eliminate this award. It took until 2009 for the final settlement on the issue of punitive damages, with Exxon paying $508 million (TerraDaily, 2009).

Chinese drywall – From 2004 to 2007, vast quantities of building supplies, including drywall, were imported from China to meet U.S. construction demands following the hurricane losses of 2004 and 2005. The first sign of a problem with this drywall was corrosion to the copper wiring caused by hydrogen sulfide. Further investigation concluded that in addition to property damage, exposure to sulfur fumes can cause health problems (American Home Inspectors Training Institute, Chinese Drywall Problems Affecting United States Homes). As litigation developed several conflicting rulings regarding homeowners and general liability coverage for this incident were determined, with appeals still pending. As of December, 2015, 18,403 claims have been paid under the Chinese Drywall Settlement Program, for a total of over $81 million (Chinese Drywall Settlement Administrator, 2015). Insurers, building supply firms, general contractors and sub-contractors have all been involved in this litigation.

Rhode Island nightclub fire – On February 20, 2003, a fire at The Station nightclub in Warwick, RI, led to the deaths of 100 people and injuries to another 230. The fire was caused by a pyrotechnic display that ignited foam used for soundproofing. The band, the club owner, the state of Rhode Island, the city of Warwick, the manufacturers of the foam and of the speakers, the TV station whose on-site reporter filmed the incident, a liquor company and its distributor, a building supply store, a broadcasting company and insurers were all sued. The insurers were accused of having failed to inspect the premises for fire code violations. Although the judge dismissed the insurers from the case, they settled with the plaintiffs while the case was being appealed. The total civil damages from all sources are estimated at $176 million (Tucker, 2008).

Financial practices cases – Investment banks have been found liable for a number of incidents relating to their business practices. Litigation related to illegally pumping up the prices of Initial Public Offerings (IPO) led to a settlement of $586 million (Jones, 2009). Bank of America paid $17 billion to settle charges that subsidiaries (Merrill Lynch and Countrywide Financial) mishandled mortgage lending. This brings Bank of America's total payments for problems relating to the recent financial crisis to $80 billion (Rexrode and Barrett, 2014). In addition, JP Morgan Chase, Citigroup, Goldman Sachs and other banks have paid another $33 billion in 2014 for misrepresenting mortgage-backed securities to investors (Economist, 2014a). Since these settlements represent fines, they are not covered by insurance. However, the practice of obtaining these settlements from companies, in return for dropping criminal and civil charges against individuals and the firm, has been criticized for a lack of transparency and fairness (Economist, 2014b). Therefore, future financial practices cases may reflect legal liability and insurance coverage under D&O, E&O and other liability policies.

In the Bernard Madoff Investment Securities case, several participants in the scheme were sentenced to prison and ordered to forfeit a total of $155 billion, a sum “many orders of magnitude” over their ability to pay (Advisen, 2016). If available, partial payments could be made under Fidelity, Surety and Crime policies. Although the actual amount of insured damages would be well less than $155 billion, this judgement demonstrates how costly a catastrophic financial practices case could be for the insurance industry.

Business failures – Litigation relating to the collapse of Enron led to a $7.2 billion award against parties that facilitated the fraudulent practices, including banks, auditors and individuals (Hays, 2008). This is the largest settlement to date in the history of securities litigation (Stanford Law School, 2014). The second largest judgment was related to WorldCom, in which investment banks, auditors and individuals paid approximately $6.1 billion in damages (Stanford Law School, 2014). The Stanford website provides a top ten list of securities litigation based on the size of the settlement, and a ranking of law firms based on the number of cases in which they were the lead council or named in the first identified complaint. This report resembles a listing of the standings of sports teams regularly published online and in print, illustrating how legal firms are in competition to litigate successful cases for both economic and reputational reasons.

6. The Need for a Casualty Catastrophe Model

Segregating casualty catastrophe losses from other losses and using a casualty catastrophe model would provide insurers with a much more accurate estimate of losses, both those caused by catastrophes and non-catastrophe losses. In his classic text, Fooled by Randomness, Nassim Taleb discusses an attempt to measure the height of vegetation in a field that has a few trees scattered about (Taleb, 2001). Unless the grass and trees are measured separately, average values are meaningless and tail values absurd. In addition, not separating distinct classes leads to greater variance and less precise estimates of future conditions.

Currently, most insurers do not have an explicit model for casualty catastrophes other than, perhaps, pollution. These losses are not separated from other losses, but all are lumped together. This impacts the apparent accuracy of both rates and loss reserves for liability coverages. Catastrophe losses tend to develop more slowly than other liability losses due to their complexity and the intensity of the litigation as the stakes are so high. Therefore, catastrophe losses affect loss development. However, since catastrophes occur irregularly, this increases the variability of loss reserve estimates. Loss reserve ranges are affected by the variability of past loss development factors; infrequent catastrophe losses that have different payout patterns from other losses would make the loss development factors more variable and increase the ranges.

For property coverages, catastrophe losses are excluded from the underlying rating calculations and included separately. As catastrophes are not expected to occur each year, then the non-catastrophe portion of the rate can be evaluated each year to determine its adequacy. The catastrophe component of the premium is evaluated over a longer experience period.

Ideally, insurers should separate casualty catastrophe losses from other casualty losses. The standard practices for rating and reserving would apply to the non-catastrophe losses. However, catastrophe losses would be dealt with separately. To do this requires having a model for catastrophe losses, just as the industry relies on property catastrophe models. The state of casualty catastrophe models is described in the next section.

7. The Key Difficulties of Casualty Catastrophe Modeling

Two major issues impinging on casualty catastrophe modeling are the dearth of data currently available on these losses and the sheer complexity of modeling a dynamic process as the legal system. However, steps are being taken to address each of these issues. While there is little publicly available data on casualty cats, a number of organizations have taken it upon themselves to develop useful datasets. Both Towers Watson and Willis, prior to their merger in early 2016, created lists of historical casualty catastrophes which are applied in projects for clients. Advisen has taken on the enormous task of building a loss database by analyzing articles in the press and legal proceedings to generate accessible data on over 300,000 incidents, many of these consisting of casualty losses. The database includes coding to allow connections to be made among related events. Praedicat generates information from over 10,000 research publications to develop indicators of the source and magnitude of potential future legal actions.

Although the richness of the data on casualty catastrophes pales in comparison with what is now available for property catastrophes, a more relevant comparison would be to property data available 30 years ago. In the early 1990s, when the Chicago Board of Trade was developing catastrophe futures, it generated estimates of industry losses based on an incomplete set of ISO data (D’Arcy and France, 1992). This information had not been publicly available previously, which made it difficult for potential traders to evaluate these early contracts. Now, 25 years later, property catastrophe securitization plays a significant role in risk management for insurers and investors. The current data on casualty catastrophes certainly is adequate enough to allow work to progress on these models. As the use of casualty cat models increases, there will be greater financial incentives to improve the supporting databases. This process will improve and enhance the models, just as occurred for property catastrophes.

The second major issue is complexity. From the beginning of recorded history, the destructive capabilities of earthquakes, windstorms and floods were recognized. The nature of these natural disasters has not changed over the millennia. Even though it is still impossible to predict the exact path a hurricane will follow, reasonable estimates of potential pathways can be modeled. Conversely, the devastating health consequences of the use of asbestos were not recognized when this product was first put into wide scale use. Similarly, the damage caused by pollution, and the massive financial impact of the Superfund legislation, were certainly not understood when the offending chemical products were designed. The astronomical financial consequences of tobacco products, the tragic health effects of thalidomide and the financial devastation caused by misunderstood Credit Default Swaps all were much more shocking than a massive flood. The immense diversity of the causes of casualty catastrophes as well as a lack of historical antecedents makes modeling casualty cats more difficult than modeling property cats, but not impossible. The paths followed by any casualty catastrophe have many common elements, from the steps required to instigate legal action to the rules of evidence that apply in trials to the appeals process available before a final judgement is determined. These common features make it possible to model key elements of potential catastrophes, including causes, development time and the maximum probable loss. Despite the complexity, it is still possible to develop models using the current available data that allow insurers to prepare for future casualty catastrophes and for regulators to protect policyholders when these events occur. Better models will emerge as the industry pays more attention to this risk.

8. Casualty Catastrophe Models - Where are we now?

Many insurers are well aware of the risk of casualty catastrophes and make a significant effort to estimate this risk (Cundy, 2015). Some insurers have developed internal models for this purpose, but these models have not yet been presented in public forums, likely in an attempt to create a competitive advantage. However, given insurance industry connections through guaranty funds, improving industry standards for assessing casualty catastrophe risk could be more advantageous to an insurer than preserving a short term competitive advantage in this area. Other companies evaluate the effect that a few specific casualty catastrophe scenarios would have on their company. Again, the scenarios used by companies are not published or publicly available. A number of consultants have also developed casualty catastrophe models and have provided limited information about the models on their websites, in company newsletters and in industry presentations in order to attract business. Four examples, as displayed in Table 2, will be discussed in this section. This list is not intended to cover all of the available third party models. However, this section is intended, first, to show that models are available that can be used to measure and manage the risk of casualty catastrophes and, second, to illustrate some of the different approaches that can be used to model this risk. In addition, a proposed approach for estimating the cumulative distribution function for industry aggregate losses from casualty catastrophes is described. Although this estimate is based on the relatively meager publicly available data on casualty catastrophes, it provides a starting point for the essential step of incorporating this risk into economic capital models.

Table 2 - Examples of Casualty Catastrophe Models

Model	Company	Database	Source of Data
Casualty Catastrophe	Towers Watson	300+ Casualty Catastrophes	Towers Watson
eNTAIL	Willis	30 years historical losses	Willis
GC ForCasSM	Guy Carpenter	300,000 historical losses	Advisen
CoMeta	Praedicat	text mining of 10,000+ journals	Praedicat

The most widely publicized casualty catastrophe model is the Towers Watson model, which has been described in articles published in Emphasis, the firm's quarterly magazine, and in presentations at academic and industry meetings. Matthew Ball, Yi Jeng and Allan Cohen (Ball, Jeng and Cohen, 2013) provide a seven step process for creating a casualty catastrophe model that is summarized below:

1. Gather historical data on past events
2. Trend ultimate costs to a common time
3. Estimate the frequency and severity components by type of loss
4. Use a Monte Carlo simulation for future events by type of loss
5. Allocate industry-wide losses to individual insurers
6. Review results in total, by time period and by type
7. Do sensitivity testing and compare with expert judgment

In order to complete the first step of their analysis, Towers Watson compiled a database of approximately 300 casualty catastrophes over a 50 year period. The lines of business affected include aviation, directors and officers, employment practices liability, errors and omissions, general liability, marine, medical malpractice, pollution and products liability. For step two, historical losses are trended based on factors including inflation, population growth and regulatory developments. Since many insureds have taken steps to protect themselves from a recurrence of the same type of loss and insurers have revised policy forms and underwriting standards to reflect past losses, future casualty catastrophes will differ from past ones. Techniques from evolutionary biology are used to generate new losses. For step five, losses can be allocated to insurers based on market-share, or more accurately based on a policy-level approach that requires more detailed information about the loss and the policies written. Their presentation concludes with an application drawn from biological evolutionary methods to plot the relationships inherent in past losses, similar to determining the DNA of risks.

Willis Re has developed a set of proprietary casualty catastrophe scenarios based on more than 30 years of trended historical loss, together with expert judgment and analytical review. The framework used to generate these scenarios allows for all types of casualty catastrophes including currently unforeseen "black swan" events. The Willis Re model, called eNTAIL, subjects a client's portfolio to these events and incorporates parameter uncertainty. Output is generated in the form of Event Loss Tables (ELTs), which can then be used in stochastic simulation modeling. This technology directly mirrors property catastrophe analysis and output to conform to a client's current ERM processes and economic capital modeling. The eNTAIL model can be run using high-level summarized exposure data, and does not require complex calibration of correlation matrices (Newman, et al, 2014).

Guy Carpenter has an updated casualty catastrophe model, released in 2014, that is based on a variety of industry sources including the Advisen loss database. Based on this information, a series of approximately 150 sudden disaster casualty scenarios that each generated losses in excess of $100 million has been developed that recognizes linkages between industries. (Catastrophes emanating from financial events, cyber liability, products liability and mass torts will be included in an enhanced model currently under development.) The historical events have been adjusted to current levels. This model uses stochastic simulation to generate specific loss metrics. One feature of this model is that, based on market share and policy limits profiles, it allows a company to determine the relative impact an event would have on that company compared to other insurers and the industry (Guy Carpenter, 2014a).

A fourth approach to casualty catastrophe models focuses on an analysis of scientific journals and regulatory reports to identify and quantify emerging risks, particularly those that are possible sources of correlated, or systemic, risk. Praedicat has developed a casualty catastrophe model (commercially known as CoMeta) that seeks to measure the probability, severity and timing of an event becoming a casualty catastrophe. This is a forward-looking approach to casualty catastrophes, not based on historical events but examining future potential events, providing insurers and reinsurers an opportunity to prepare for these developments (Assured Briefing, 2014). Whereas excluding coverage for risks that are identified as having the potential to generate catastrophic losses seems to be the standard approach of most insurers, Praedicat's objective is to provide enough information about these risks for insurers to measure portfolio-based aggregations and, in turn, be able to price and underwrite some or all of them. Their approach starts with an analysis of the peer-reviewed literature to determine which risks scientists are concerned about and then links those risks to industries and companies so insurers can determine their total exposure. Praedicat has generated an event set of over 30,000 science-based potential events and determined the probability of each event, the expected size of the loss and the timing of claims and defense-related payments. For example, one potential event could be that a specific common food additive is found to be the cause of bodily injury after many years of being on the market. Insurers that previously wrote occurrence product liability policies on the companies involved could be liable for multiple policy limits reflecting the different years these policies were written and an aggregation effect of writing numerous companies, possibly across many industries that incorporated or sold this additive. The risk of this type of casualty catastrophe exists even in the absence of previous claims and, to the extent reasonably quantifiable, should be included in economic capital models to reflect the true risk of an insurer. In addition, by recognizing this potential risk and having a reasonable estimate of the probability, severity and latency period, insurers can better meet their policyholders' needs with tailored policies or endorsements to cover the risks specifically associated with the products, substances and processes the company makes or uses. By accurately pricing risks, insurers can play a positive social role that supplements regulation and litigation as a means of improving safety and public health. If, through insurance prices, companies know the true cost of risks they are generating, then they can adjust their operations to be economically efficient.

The proprietary models discussed above have the ability to provide a wealth of company specific information that insurers can use to reduce casualty catastrophe risk and/or to underwrite and price it more effectively. This level of detail is essential for an insurer to manage this risk effectively. However, given the current state of neglect of casualty catastrophe risk, the first step in motivating the industry, regulators and rating agencies to increase the level of attention paid to this risk is to calculate the potential losses this risk is likely to generate. The following model estimates the industry aggregate losses from a casualty catastrophe.

Despite the limited information publicly available on casualty catastrophes a simple mathematical model can be constructed to provide an estimate of the 1 in 100 year event and the 1 in 250 year event, metrics that are commonly used in enterprise risk management and economic capital models.[2] Over the last 50 years there have been approximately 300 casualty catastrophes, for a loss frequency of 6 events per year. The mean of these losses is approximately $2 billion, based on their reported aggregate of $565 billion, including an increase in the asbestos losses by approximately $15 billion based on the recent AM Best estimate of $85 billion. This loss, the largest of the 300 casualty catastrophes, would be the 99.67% level (1 in 300).

The gamma distribution provided the best fit for the values (Gorvett, 2014). The gamma distribution is a two parameter distribution that is defined as follows (see Klugman, Panjer and Wilmott, 1998, p 579 for additional details):

[2] Rick Gorvett provided these calculations based on the gamma distribution.

$$f(x) = \frac{((\frac{x}{b})^\wedge a)e^{-x/b}}{x\Gamma(a)}$$

$$F(x) = \Gamma(a; \frac{x}{b})$$

Using the gamma distribution with parameters of a = 0.04 and b = 50 results in a mean of 2 (billion) (since the mean is just ab), and also produces a cumulative distribution function (cdf) percentile at x = 85 of 99.67%. Although this is the 1 in 300 level loss, it is not the 1 in 300 year event. Since the casualty catastrophe loss frequency, based on the Towers Watson data, is 6 per year, the 1 in 300 losses is actually the 1 in 50 year event (300/6). Thus, 85 billion is the 1 in 300 loss, but the 1 in 50 year event. The 1 in 100 year event would by extension be the largest loss expected in a sample of 6 x 100 = 600, and thus a 1-(1/600) = 99.83%-ile. At this cdf value, x = 107 billion. At a 1 in 250-year event, 1 - (1/(6 x 250)) = 99.93%, x = 141 billion.

Better estimates could clearly be developed with access to more complete data, but for a rough calculation, using $107 billion for a 1 in 100 year event and $141 billion for a 1 in 250 year event is a reasonable place to start. These values are in line with the worst case scenarios considered for earthquake and windstorm events. Since casualty catastrophes have similar risk metrics to these more closely studied causes of loss, then the current neglect of casualty catastrophes is clearly not justified.

One additional difference between casualty catastrophes and property catastrophes is increased uncertainty about where the catastrophe will occur. For property catastrophes, the mega-losses predicted as the 1 in 100 or 1 in 250 year events have a specific geographic location – East coast hurricane, California earthquake, etc. Insurers can evaluate their market share of property coverage in the specific locations to estimate their potential losses at those levels. However, there is much greater uncertainty for casualty catastrophes. The losses could be spread over an entire line of business (workers' compensation) or could hit only a niche product (a specialty manufacturer or affiliation group). Thus, while the industry as a whole could survive a casualty catastrophe of $107 to 141 billion if it were evenly spread over all casualty insurers, it is more likely that certain writers will bear a disproportionate (in relation to market share of casualty premiums) impact of this loss. Therefore, solvency concerns are greater for casualty catastrophe losses than for property catastrophe losses at the same aggregate level.

9. Rating Agencies and Regulators

Insurance is a very heavily regulated industry. In the U.S., states have the primary responsibility for insurance regulation, but various federal agencies also regulate different aspects of the industry. In most other countries, insurance is primarily regulated at the national level. In addition to requiring annual reporting of an insurer's financial condition, U.S. state regulators, coordinating their efforts through the National Association of Insurance Commissioners (NAIC), perform triennial in-depth examinations of insurers. During these examinations, regulators review a wide range of an insurer's operations. Catastrophe risk is one of the issues examined. Regulators expect an insurer to be managing both property and casualty catastrophe risk effectively. However, the level of sophistication expected for these two areas differs markedly. For property catastrophes, there are several widely accepted models that regulators have reviewed. Insurers can use these models to quantify property catastrophe risk and meet regulatory expectations. Insurers using other models or methods may be asked to benchmark their approach with these industry standards. Insurers can be expected to have very precise measures of various levels of property catastrophe risk, such as the 1 in 100 or 1 in 250 year loss values. In contrast, insurers are only expected to be "aware" of casualty catastrophe risk. Clearly, once a casualty catastrophe arises, insurers will be expected to develop more informative reports, but that is dealing with known losses and expected loss development. Risk management needs to address potential risks, not just known risks.

As there are no industry standard models available, some insurers use internally developed casualty catastrophe models to measure and manage this exposure. Other insurers use third party models. However, none of the currently used models is considered an industry standard (Bradford, 2010). A national sponsor of continuing education programs classifies the current disparity between property catastrophe models and casualty catastrophe models as "stark," comparing the information available to insurers about property catastrophe risk to a cockpit dashboard full of informative dials and gauges, but for casualty catastrophes there are only "two cloudy dials - one for speed and one for altitude" (SNL Knowledge Center, 2014). Another view of this disparity reports that risk professionals are expecting attention to turn to casualty catastrophes as property catastrophe modeling matures and that decision makers are likely to be dissatisfied when they discover that, unlike the information rich risk dashboards for property catastrophes, only a few unsophisticated gauges are available for casualty catastrophes (Assured Briefing, 2014).

In Europe, Solvency II provisions will impact insurer operations. In order to meet new regulatory requirements, insurers will have to address casualty catastrophe risk. Solvency II, when it is instituted, will require insurers to explicitly estimate the potential impact of mass torts, casualty catastrophes or "binary events" (Ball, Jeng and Sullivan, p. 11). The NAIC's Own Risk Solvency Assessment (ORSA) requirements now apply to large insurers operating in some states, including California. Although insurers have great latitude in the methodology used to assess their risks, the risk identification process is expected to identify all major categories of risk, including those, "generated externally, internally, from legal, regulatory change, weather patterns, [and] economic conditions" (Bottalico, 2014, NAIC ORSA Guidance Manual, p. 21). While the use of models to identify and measure casualty catastrophe risk is not mandated by regulation, clearly best practices will involve the use of stochastic simulation or, at the least, scenario analysis. Thus, regulation will provide an impetus to advance the science of casualty catastrophe modeling.

Although the ORSA reporting requirements for insurers are still a work in progress, this approach will not replace the Risk Based Capital (RBC) calculations that have been used as an early warning system for U.S. insurers since 1992. The RBC calculation assigns varying levels of capital to different components of an insurer (underwriting, investments, loss reserves) that reflect the relative risk of the line of business or the type of investment. An insurer's actual capital is compared to the results of the RBC calculation. For insurers with capital in excess of 200% of the RBC value, no specific action is mandated. For insurers with capital below that level various regulatory actions are taken, ranging from requiring a plan to increase capital to regulatory control of the company. Starting with 2013 RBC reports, property-casualty insurers are required to include a catastrophe risk calculation for informational purposes. The catastrophes included, though, are only hurricane and earthquake losses. Starting in 2015 or later, this risk calculation is expected to be included in the RBC calculation (NAIC, 2014). Although the inclusion of catastrophe risk is a definite improvement in the RBC formula, the fact that it ignores casualty catastrophe risk is a serious defect.

Since insurance regulators focus primarily on solvency, they do little to differentiate among insurers that meet acceptable levels of solvency. Thus, rating agencies that classify insurers into many different classes have a major influence on insurers. For some lines of business, if an insurer does not have particular rating, policyholders are unable to satisfy loan covenants. In addition, for advertising purposes, insurers seek to obtain high ratings. Rating agencies review financial data of all rated insurers at least annually, and perform examinations periodically and whenever the financial data indicate a significant ratings change is appropriate.

Standard and Poor's has published their standards for enterprise risk management ratings, which leads to a five step scale that ranges from very strong to weak. Risk models are a key aspect of this review. Risk models are judged on a number of factors, including the "robustness, consistency and completeness" of the models used (S&P, 2013). Based on conversations with S&P analysts, both property and casualty catastrophe risk would be considered as part of the modeling evaluation. However, since the development of casualty catastrophe models significantly lags that of property catastrophes, realistically, insurers are not expected to have the same level of model sophistication for casualty catastrophes.

AM Best's Capital Adequacy Ratings (BCAR) specifically include a provision for potential catastrophe losses. Traditionally, this has been applied to property catastrophes, since sophisticated models are available to quantify this risk. Best's has the ability to include a casualty catastrophe by incorporating a probable maximum loss (PML) from a hypothetical event. Some insurers, such as medical malpractice insurers, have been assigned a casualty catastrophe charge based on their portfolio of high limit policies or policies for related entities (doctors and hospitals in which they operate). To date, casualty PMLs do not reflect the same level of detail as for property catastrophes. They represent a potential shock loss based on a specific event, not a mathematical model of this risk. However, casualty catastrophe exposure does show up in another area of the BCAR calculation. The Reserve Capital Factors reflect the risk a line of business represents and the variability of an insurer's loss development. Asbestos and environmental claims (A&E) have generated significant adverse loss development, as have many incidents of casualty catastrophes. Thus, even if a loading for casualty catastrophe risk is not explicitly included, an insurer with a book of business that has been exposed to past casualty catastrophes would have the net required capital increased due to adverse reserve development.

Lloyd's oversees the financial condition of participating syndicates to assure their financial viability. One aspect of that oversight is the requirement that each syndicate reports the financial impact of a number of Realistic Disaster Scenarios (RDS) (Lloyd's, 2014). There are fourteen compulsory scenarios on which each syndicate must report the financial impact. Each of these compulsory scenarios is a property catastrophe: windstorm, earthquake, flood or terrorism. The industry aggregate level of each of these scenarios ranges from approximately $10 billion to $125 billion and each event has a clearly defined impact and specific damage factors. Syndicates are also required to report two additional events that would have a significant impact on their operations. Liability risk is included as one type of risk that could be reflected; however, no specific guidance on the event is provided and these events are subject to *de minimis*, rather than full, reporting. Examples of the types of events that could be considered include, for professional liability lines, mis-selling a financial product, failure of a major corporation, failure of a merger, failure of a construction project or recession-related losses. Examples of other liability losses include an industrial or transport incident or multiple product losses. While each of these could be a significant loss to the industry and to a syndicate, they do not approach the levels reached by the largest property catastrophes included in the RDS, or the size of the largest past casualty catastrophes. Based on the number of scenarios syndicates are required to report, the size of those losses and the level of detail included in the reports, casualty catastrophes are given far less attention than property catastrophes by the RDS process of Lloyd's.

Regulators and rating agencies, both in the United States and other countries, pay far less attention to casualty catastrophe risk than to property catastrophe risk, despite the greater risk that casualty catastrophes pose to the industry. Fortunately, it is possible to change this focus, and the change can be initiated by a single innovative regulator or insurer.

10. Casualty Catastrophe Risk - Where we need to go

Ignoring casualty catastrophe risk is clearly not an acceptable way to deal with this risk, but this is what many insurers currently do. Many practitioners, when asked about measuring their casualty catastrophe exposure, reply that it is impossible to measure. However, that is not entirely true. This risk can be measured (although not extremely accurately as of now) and, once measured, can be managed. There just needs to be the proper incentive to do so.

Ideally, the first step in dealing with casualty catastrophe risk would be to have a regulatory requirement that property-casualty insurers estimate their casualty catastrophe exposure in a manner similar to their estimates for property catastrophe risk. Insurers should list their 1 in 100 year and 1 in 250 year events for casualty catastrophes just as they do for property catastrophes. Realistically, the first reports of these values will not be very precise; think back to the early 1990s estimates of hurricane losses. However, several consultants have models that can generate these values for companies or insurers can use available databases to develop their own internal models. Such information could be included in the catastrophe risk formula for RBC as an informational item for several years, just as the property catastrophe components were introduced in 2013. The major benefit of this requirement would not be the numbers themselves, but getting casualty catastrophe risk addressed by insurers. However, regulators did not provide the incentive to develop property catastrophe models; initially models were developed and then regulators adopted requirements for the use of these models.

If regulators do not take the first step, then an insurer could take the lead and release its own metrics for casualty catastrophes. This could have several benefits for the insurer. First, some well capitalized insurers have been criticized for holding excess capital (Hunter, 2012). By including realistic estimates for casualty catastrophes, an insurer will demonstrate the need for this capital. Second, once one insurer releases details on the approach used to estimate casualty catastrophes, rating agencies will begin to expect other insurers to do the same. The insurer that does this first will be setting the standard for the way casualty catastrophes are addressed industrywide. This insurer will be ahead of the curve, rather than having to develop an approach that meets externally imposed requirements. Finally, the first major insurer to publicly release its casualty catastrophe metrics will be recognized as an industry leader in this area, enhancing its reputation both within the industry and with the public. This could be a far more effective use of resources than advertising expenditures.

The second step is to generate more and better information on casualty catastrophes that have occurred. Using property catastrophes as a model, some common identifier that could be used to report claims would allow statistical agencies to provide more accurate information about the aggregate losses from a common event. Liability settlements, even if covered by a confidentiality agreement, do need to be reported to a statistical agency if covered by insurance. Making this information available, in an aggregate basis, would increase the usefulness of models and generate more accurate estimates of exposure. Although the assignment of this common identifier would, by necessity, take place after some claims have already been settled, subsequent reporting requirements could help generate relatively complete reports on these catastrophes, although, unlike property catastrophes, it will take a long time for the ultimate losses to develop.

The third step will be to improve casualty catastrophe models. This will occur when demand for these models increases due to additional regulatory requirements and when better information is available on historical losses. Improved models will allow insurers to more effectively manage their casualty catastrophe exposure by avoiding risk concentration, by excluding excessively risky coverages or by pricing the risks more accurately. Actuarial associations can advance this process by holding seminars and call paper programs on casualty catastrophes; universities can encourage research by hosting conferences on this subject (California State University Fullerton, 2014; Casualty Actuarial Society, 2016).

The insurance industry is in the business of taking risk. One of the greatest risks companies face is liability, whether one unique to their business or in common with other enterprises. Mass torts and multi-$100 million judgments are relatively common events today. If insurers are to provide the protection that policyholders need, then understanding casualty catastrophes will be essential. Although this risk is arguably considerably more complex than any other risk that the industry faces, it can be modeled, at least at a rudimentary level now. Some data are available to parameterize this risk. Several proprietary models are available to help quantify this risk. The only questions that remain are why the industry is not dealing with this risk in an effective manner and what event it will take to galvanize the industry to address this risk. Hopefully, this paper will help motivate some actuaries, insurers, reinsurers, regulators and rating agencies to take action before a mega-catastrophe impairs the industry once again.

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