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3. To make state insurance departments more aware of insurance regulatory research efforts;
4. To increase the rigor, quality and quantity of the research efforts on insurance regulatory issues; and
5. To be an important force for the overall improvement of insurance regulation.

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Contents

After the recent court case overturning the Financial Stability Oversight Council (FSOC)'s systemic importance designation of MetLife, the public raises awareness about the robustness of the identification methodology for global systemically important insurers (G-SIIs). As the G-SII identification framework proposed by the International Association of Insurance Supervisors (IAIS) lacks empirical support and relies heavily on historical accounting data, we examine how systemic risk measures constructed from credit default swaps (CDS) data, which are market-consistent and forward-looking, can supplement the IAIS' identification framework. Using a dataset of insurers' CDS spreads between 2011 and 2015, we construct three different kinds of systemic risk measures (i.e., MES^{CDS}, networks of CDS spreads and absorption ratio) and assess the G-SII designation results announced by the Financial Stability Board (FSB). We find that: 1) the systemic risk of designated G-SIIs is, on average, higher than other insurers, suggesting that the IAIS' G-SII identification methodology is, in general, sound and effective; 2) reinsurers should fall within the IAIS' G-SII assessment exercise, as some of them generate more systemic risk than the designated G-SIIs; and 3) given the non-negligible litigation risk from the designated G-SIIs, the regulators should consider supplementing their G-SII identification methodology with CDS-based systemic risk measures to substantiate their designation decisions in court.

The European Solvency II regime requires a solvency capital covering risks with a given shortfall probability of 1/200=0.5% on a one-year time horizon, which is extremely short compared to the contractual terms in traditional life insurances, as well as the settlement periods of several decades in some casualty branches. This approach undermines the importance of a high return margin and, given a risk-averse approach to management, may lead to an overall riskier business strategy in the long run. In light of this, we cannot help but ask whether such a short time horizon is capable of providing a meaningful guideline for a sustainable business and risk management that has a long-term perspective.

In response to this question, we present a new model for assessing the evolution of the equity of an insurance company and calculating the probability that the initial equity of an insurance company will be depleted during a given time period. This model demonstrates that insolvencies mostly do not occur in the first year. Therefore, if one only considers a one-year window, as is the case under Solvency II, the risk will be underestimated. Even more serious is that the business will be managed too cautiously without aiming for a suitably high profit margin, which significantly reduces the risk only in the long term.

Surplus lines insurers play a crucial role in the marketplace. These companies commonly provided coverage for high capacity, distressed or unique risks, as well as new or emerging risks for which coverage is not available in the admitted market. Though surplus lines insurers play a valuable role in the marketplace and business written by these insurers have grown over time, there has been little academic literature that focuses on this segment of the industry. In this study, we examine whether surplus lines activity differs across regulatory environments, where activity is measured by surplus lines premiums, the number of active surplus lines companies and the concentration of the surplus lines market within each state. We find a positive correlation between premiums written and several regulatory measures, such as greater capital and surplus requirements, higher premium taxes and the existence of state surplus lines associations. The positive correlation with capital and surplus requirements and surplus lines associations is also observed when examining the proportion of surplus lines insurers in states. Finally, we find strong correlations between the concentration of the surplus lines market in states and all regulatory measures considered.

In response to the policy changes to Medicaid, this research examines the impact of Medicaid expansion, diversity, and the Medicaid fee bump on Medicaid managed care. It aims to provide insights to health insurers, consumers, regulators and policymakers regarding profitability, better services, reducing expenses and improving efficiency. The results indicate that Medicaid expansion increases the profit efficiency of Medicaid managed care, but it has no significant impact on medical service efficiency or composite efficiency. The diversity of business lines, product types or payment methods does not create economies of scope for Medicaid profitability, medical service efficiency or composite efficiency. However, the diversity of product types is associated with more ambulatory encounters, while the diversity of payment methods reduces medical and administrative expenses. The Medicaid fee bump does not increase medical expenses or the utilization of medical services, and it has no significant impact on profitability or composite efficiency. "Medicaid lower reimbursement" should not be a big concern for Medicaid managed care in terms of profitability, medical services, expenses or overall efficiency. Another finding was that offering more preferred provider organization (PPO) plans improves the performance in profits, services and expenses; and managed care organizations (MCOs) also serving Medicare beneficiaries perform better in Medicaid managed care. In addition, capitation and contractual fee payments both enhance composite efficiency. The value-based payments do not have a significant impact on expenses or efficiency, but they are associated with more ambulatory encounters.

We analyze the underwriting performance of insurers operating in the individual health insurance market from 2010–2017. Our sample consists of both life and health insurance companies. First, we offer descriptive sample statistics of key financial performance measures in this market. Then, we study the difference in performance pre- and post-2014, which represents the year that state online marketplace exchanges were implemented as part of significant health care reform, namely the federal Affordable Care Act (ACA). Our analysis allows us to test whether health care reform affected insurers operating in this market and in what ways. Our results suggest that underwriting profitability was worse in the post-ACA period: Generally, loss ratios and losses per enrollee were significantly higher in the post-reform time period. On the other hand, insurer administrative expenses were significantly lower post-2014. Furthermore, we show that these effects are not uniform across all insurers in the market.

Editors' Perspective

This year's collection of articles is as diverse as the issues facing state insurance regulators across the country. Health related issues continue to be a focus as we analyze the impact of the federal Affordable Care Act (ACA) on the marketplace. Born and Sirmans (2018) looked at the individual underwriting market, finding that the effects of the ACA have not been uniform across insurers. While administrative expenses are lower after the reform, they have found that loss ratios and losses per enrollee are typically higher. This finding suggests that Medicaid expansion increases the profit efficiency of Medicaid managed care, but it has no significant impact on medical service efficiency or composite efficiency. In the coming year, we expect more research on the health insurance marketplace and related life and health issues.

This year we also visited traditional topics of interest to state insurance regulators. This includes the decision to purchase credit insurance (Durkin and Elliehausen, 2018), as well as the regulation of the surplus lines market (Baggett and Cole, 2018). Authors also explored the vulnerabilities of the Florida insurance market to future hurricanes (Nicholson, Clark, and Daraskevich, 2018), focusing on the potential failures and impacts of storms with different characteristics on public risk financing entities.

Another set of papers looked at more financial tools and their impact on insurers. For example, Santos, Richman and Wong (2018) analyzed the effects of excess-of-loss reinsurance for small insurers with respect to profitability and risk. Chang and Chen (2018) investigated the use of captive insurance subsidiaries for S&P 500 firms. Chow, Fung and Yeh (2018) analyzed credit default swaps, specifically with respect to system risk and the designation of globally systemically important insurers. The discussion of international issues continued with our paper of the year authored by Thomas Miller. He investigated the impact of time horizons, volatility and profit margins on solvency capital. Miller (2018) created a framework for state insurance regulators to better understand these issues and make decisions in terms of modeling global regulation of insurers.

We look forward to the 2019 collection of papers for the Journal of Insurance Regulation. The Center for Insurance Policy and Research (CIPR) at the NAIC provides a listing of topics and key initiatives that are important areas of research. We hope that prospective authors review these lists and consider submitting papers in these areas.

CDS Spreads, Systemic Risk and Global Systemically Important Insurers Designations

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Abstract

After the recent court case overturning the Financial Stability Oversight Council (FSOC)'s systemic importance designation of MetLife, the public raises awareness about the robustness of the identification methodology for global systemically important insurers (G-SIIs). As the G-SII identification framework proposed by the International Association of Insurance Supervisors (IAIS) lacks empirical support and relies heavily on historical accounting data, we examine how systemic risk measures constructed from credit default swaps (CDS) data, which are market-consistent and forward-looking, can supplement the IAIS' identification framework. Using a dataset of insurers' CDS spreads between 2011 and 2015, we construct three different kinds of systemic risk measures (i.e., MES^{CDS}, networks of CDS spreads and absorption ratio) and assess the G-SII designation results announced by the Financial Stability Board (FSB). We find that: 1) the systemic risk of designated G-SIIs is, on average, higher than other insurers, suggesting that the IAIS' G-SII identification methodology is, in general, sound and effective; 2) reinsurers should fall within the IAIS' G-SII assessment exercise, as some of them generate more systemic risk than the designated G-SIIs;

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and 3) given the non-negligible litigation risk from the designated G-SIIs, the regulators should consider supplementing their G-SII identification methodology with CDS-based systemic risk measures to substantiate their designation decisions in court.

1. Introduction

> *"…… the Final Determination (of MetLife as systemically important) hardly adhered to any standard when it came to assessing MetLife's threat to U.S. financial stability…… This Court cannot affirm a finding that MetLife's distress would cause severe impairment of financial intermediation or of financial market functioning…… This Court finds that the Final Determination was arbitrary and capricious."*
>
> *Extract of judgment from the court case MetLife, Inc. v. Financial Stability Oversight Council, 2016, regarding MetLife's challenge to the regulator's decision to designate MetLife as systemically important.*

The issue of identifying global systemically important insurers (G-SIIs) is controversial. From the industrial perspective, there is no consensus among practitioners as to which insurers are systemically important. For example, MetLife was designated by the Financial Stability Oversight Council (FSOC) as systemically important in 2014 and subsequently challenged that decision in federal court (MetLife, 2017). In March 2016, the court ruled in MetLife's favor and overturned MetLife's designation. The judge opined that the identification process should involve assessment of MetLife's likelihood to experience financial distress, as well as the cost of the designation to MetLife's business (Dayen, 2017). In addition, U.S. President Donald Trump also considers that the designation process needs to be improved and signed an executive order to review the designation process in April 2017 (Chiglinsky and Harris, 2017).

From the academic perspective, the G-SII identification methodology proposed by the International Association of Insurance Supervisors (IAIS) lacks empirical support. According to the IAIS' proposal (IAIS, 2016), the calculation of systemic importance score is based on five categories of indicators: 1) size (5%); 2) global activity (5%); 3) interconnectedness (49%); 4) asset liquidation (36%); and 5) substitutability (5%). Based on the systemic importance score and the regulators' assessments, the Financial Stability Board (FSB) designates a list of insurers as G-SIIs on an annual basis. However, Weiβ and Mühlnickel (2014) find empirical evidence against the argument that global activity and substitutability contribute to insurers' systemic risk. Instead, based on a sample of listed U.S. insurers, they find that insurer's size is the primary driver of systemic risk. Their conclusion is clearly against the exceptionally low weighting (5%) assigned by the IAIS to the size indicator in the calculation of systemic importance score. The inclusion of global activity and substitutability indicators in the calculation is not appropriate as well. In addition, Bierth *et al.* (2015)'s empirical study reveals that insurers' contribution to systemic risk is mainly driven by their leverages. Surprisingly, the indicators proposed by the IAIS do not cover leverage at all.

A relevant question to the G-SII identification framework is why and how insurers are systemically risky. Although many academic studies show that insurers, in general, generate less systemic risk than banks (e.g., Billio *et al.*, 2012; Chen *et al.*, 2013; Bierth *et al.*, 2015), we cannot conclude insurers are not systemically risky. In fact, the channels through which insurers generate systemic risk have been well-documented in literature. For example, Eling and Pankoke (2014) argue that the nontraditional activities of insurers, such as financial guarantees and credit default swaps (CDS), are likely to be sources of systemic risk. Cummins and Weiss (2014) suggest that insurers' non-insurance activities, such as derivatives trading, are likely to generate systemic risk. Thimann (2014) concludes that insurers cause systemic risk by assuming the role of financial intermediary and investor, and Niedrig (2015) finds that the interconnectedness between banks and insurers is driven by insurers' investment in bank bonds. A more recent study by Bobtcheff *et al.* (2016) suggests that the surrender option of insurance policies is a source of systemic risk, as earlier findings of Russell *et al.* (2013) reveal that macroeconomic variables are correlated with surrender rates.

From the industry perspective, the regulators also do not preclude the possibility that insurers are able to generate systemic risk. For example, the study by the European Systemic Risk Board (ESRB, 2015) concludes that insurers generate systemic risk by: 1) participating in nontraditional and non-insurance activities; 2) causing procyclicality in asset allocation and pricing of credit and mortgage insurance; 3) being financially vulnerable under the low interest rate environment and volatile equity market; and 4) providing insurance that is vital to the economy but lacks substitutes, such as property, liability, marine, transport and aviation insurance. In the U.S., the federal Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) was enacted in 2010 to improve stability and enhance consumer protection in the financial industry. Under the Dodd-Frank Act, the FSOC was established to address the systemic risk generated by financial institutions, including, inter alia, insurers. Given the specific channels through which insurers generate systemic risk, the Dodd-Frank Act also created the Federal Insurance Office (FIO), which is responsible for monitoring all aspects of the insurance sector and identifying potential regulation gaps and issues that contribute to systemic risk in the insurance industry.

Despite the numerous studies and policy development discussed above, whether the methodology proposed by the IAIS is effective in identifying systemically important insurers remains an unanswered question. Against this backdrop, we examine the issue of how insurers' CDS data, which is forward-looking and market-consistent, can help regulators improve their G-SII identification methodology, which is mainly based on historical accounting data.

The use of CDS spread data to measure systemic risk has been well documented in literature. Acharya *et al.* (2017) use CDS data to construct a systemic risk measure called marginal expected shortfall (MES), which is defined as the expected loss of an insurer when the overall market return is below its 95% value-at-risk. They find empirical evidence supporting the ability of MES constructed from CDS data to forecast future loss of firm value during financial crisis. Puliga *et al.* (2014) measure the systemic risk of financial institutions by the networks constructed from CDS data. These networks are taken as a proxy of interdependencies among financial institutions. They find that when supplemented with macroeconomic indicators, the network measures based on CDS data can detect systemic instabilities in the financial system. Kritzman *et al.* (2011) propose to measure systemic risk by the absorption ratio, which is the total variance of a set of asset returns that can be explained by their first principal component. A high absorption ratio indicates that the assets are tightly coupled and hence, they are more fragile in the sense that negative shocks transmit more quickly and broadly. As the type of asset class is not restricted, CDS spread returns can also be used to construct the absorption ratio as a measure of systemic risk.

Using CDS data over accounting data to measure systemic risk has several advantages. First, CDS data is forward-looking, which reflects the market's perception of future risks, while accounting data captures historical risks (Kanagaretnam *et al.*, 2016). In addition, after insurers' financial year-end dates, the regulators usually have to wait several months before getting the audited financial statements. CDS data, by contrast, does not suffer from the time-lag problem. As regulators are concerned with the risk of G-SIIs' financial distress in the future, the CDS-based systemic risk measures can supplement the IAIS' proposed identification methodology. Second, CDS spread provides a pure signal on the likelihood of a firm's default, which avoids the complications from inferring the default risk from accounting data (Kaplan, 2011). As CDS can be considered as a put option on a firm's debt, an increase in the CDS spread reflects the market expectation of the increased likelihood of the firm's financial distress or the increased volatility of the firm's assets. Third, the CDS-based systemic risk measures—such as the MES, absorption ratio, and networks aforementioned—take into account the interdependencies among insurers. On the contrary, it is difficult to quantify the co-movement of insurers' default risk with accounting data. As negative shocks transmit more quickly and broadly when insurers' assets are tightly coupled, co-movement of insurers' default risk is an important dimension in the measure of systemic risk and can be better captured by CDS data. Fourth, due to the existence of different accounting treatments and interpretations of insurance business terms in various jurisdictions, the identification methodology based on accounting data may produce inconsistent results. This is a major challenge the IAIS admitted during one of its presentations (Maroney, 2013). On the other hand, CDS spread data is market-consistent and provides a more coherent signal for insurers in different jurisdictions.

When compared to other systemic risk measures documented in literature, CDS-based systemic risk measures also have several advantages in the context of G-SII identification. For example, Kreis and Leisen (2017) construct a structural model based on Merton (1974) in a balance sheet framework and calculate the systemic risk of banks using a measure of default called conditional expected default frequency. Such a structural model involves the calculation of asset correlation. However, as previously mentioned, the regulators usually have to wait for several months before getting the audited financial statements to calculate the asset correlation and hence, the structural model based on balance sheet framework suffers from the time-lag problem. There are also other market-consistent systemic risk measures documented in literature that are free of the time-lag problem, such as Acharya *et al.* (2017)'s MES and Adrian and Brunnermeier (2016)'s ΔCoVAR, which are based on co-movement of stock returns. However, regulators and policyholders are more concerned with insurers' ability to fulfill their obligations instead of their stock performance. As CDS can be viewed as put options on insurers' debts and CDS spreads, when compared to stock returns, they can better capture insurers' ability to fulfill their obligations. We consider that CDS-based systemic risk measures are better than other market-consistent systemic risk measures in the context of G-SII identification.

Despite the advantages of using CDS data to measure systemic risk of insurers, the IAIS' proposed G-SII identification methodology only focuses on insurers' accounting data. This motivates us to supplement the G-SII identification methodology with the CDS-based systemic risk measures. Specifically, we follow Kritzman *et al.* (2011), Puliga *et al.* (2014) and Acharya *et al.* (2017) to construct CDS-based systemic risk measures, which are the absorption ratio, networks of CDS spreads and MES^{CDS}, respectively.

Our sample consists of 42 life insurers, non-life insurers and reinsurers from 11 countries. The sample period is from the beginning of 2011 to the year-end of 2015, as the FSB's first designation event in July 2013 was based on the assessment results of 2011 data. The systemic risk of insurers in our sample are then compared with the FSB's G-SII designation results. By graphical representation, one-tailed paired t-test, and multivariate regression that controls for macroeconomic variables, country-specific factors, and time-varying variables, we find that the systemic risk of G-SIIs identified by the FSB is, on average, higher than that of other insurers.

The difference is statistically and economically significant, suggesting that the regulators' G-SII identification framework is, in general, sound and effective. However, further analysis based on the rankings of CDS-based systemic risk measures reveals that such identification framework still has room for improvement. The CDS-based systemic risk measures suggest that Hannover Rück SE, Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft and Swiss Reinsurance Company Ltd., which have been excluded from the IAIS' identification methodology due to their focus on reinsurance business, have systemic risk higher than that of some insurers designated by the FSB as G-SIIs.[1] This finding raises the alarm for the IAIS to speed up the G-SII identification methodology for reinsurers.

The regulators also face substantial litigation risk from those insurers previously designated as G-SIIs but have less systemic risk than the three reinsurers aforementioned. The recent court case of MetLife is a good example.

1. A chart comparing the approaches used by the FSB and the FSOC can be found in the appendix.

Based on the CDS-based measures, we find that the systemic risk of MetLife was below the median of our sample of insurers in 2015, which is a striking finding that cannot be neglected in regulators' G-SII assessment exercise. We believe that the regulators can better substantiate their G-SII assessments in courts if the CDS-based systemic risk measures are incorporated into the identification methodology. We also examine whether the FSB's change of G-SII list in November 2015 was consistent with the results suggested by the CDS-based systemic risk measures. We find that the removal of Assicurazioni Generali SpA from the G-SII list is against our observation that this insurer has the highest systemic risk among our sample of insurers in 2015. Our analysis indicates the need for the FSB to increase transparency regarding its designation decisions so that any discrepancies on the designations can be openly discussed.

We complement the literature on systemic risk and insurance regulation by examining the FSB's G-SII designations with the CDS-based systemic risk measures. To the best of our knowledge, we are the first to identify inconsistencies between the G-SII designations and the CDS-based systemic risk measures, and to recommend several areas for improvement of the G-SII identification framework based on these inconsistencies. To be specific, our analysis raises the need for the regulators to speed up the development of G-SII identification methodology for reinsurers and increase transparency for the G-SII designations. In response to the litigation risk faced by the regulators, we recommend the regulators to supplement their identification methodologies with the CDS-based systemic risk measures. Our study sheds light on the discussion of how the G-SII identification framework can be improved by analyzing insurers' CDS data.

We organize the remainder of this paper as follows. Section 2 provides an overview of the G-SII identification methodology that the IAIS proposed. Section 3 presents the data and discusses the construction of CDS-based systemic risk measures. Section 4 discusses how the CDS-based systemic risk measures supplement the IAIS' G-SII identification methodology. Section 5 discusses the limitation of using CDS data to identify G-SIIs. Section 6 states the concluding remarks.

2. Overview of the G-SII Identification Methodology that the IAIS Proposed

In July 2013, the IAIS published the initial identification methodology for G-SIIs (IAIS, 2013), which was further updated in June 2016 (IAIS, 2016). The identification methodology is built upon the IAIS' earlier study (IAIS, 2011), which concludes that insurers engaging in nontraditional and non-insurance (NTNI) activities are more vulnerable to market fluctuations and generate more systemic risk than insurers engaging in traditional insurance business. The updated identification methodology is based on five phases.

Phase I – Annual Data Collection Phase

The IAIS collects information from insurers around the globe satisfying either one of the following conditions: 1) total assets are more than $60 billion, and the ratio of overseas premium exceeds 5%; or 2) total assets are more than $200 billion, and the ratio of overseas premium is greater than 0%. In general, around 50 insurers need to submit information for the IAIS' assessment each year.

Phase II A – Quality Control and Scoring Phase

The IAIS assesses the systemic importance of each insurer based on the data collected in Phase I. The systemic importance score is calculated with reference to 17 indicators, which are constructed from accounting data. The indicators together with their applicable weights are summarized in Table 1.

Table 1:
IAIS' Proposed Indicators for G-SII Identification

Category	Subcategory	Indicator	Weight
Size		Total assets	2.5%
		Total revenues	2.5%
Global activity		Revenues derived outside of home country	2.5%
		Number of countries	2.5%
Interconnectedness	Counterparty exposure	Intra-financial assets	6.7%
		Intra-financial liabilities	6.7%
		Reinsurance	6.7%
		Derivatives	6.7%
	Macroeconomic exposure	Derivatives trading (credit default swap [CDS] or similar derivatives instrument protection sold)	7.5%
		Financial guarantees	7.5%
		Minimum guarantees on variable products	7.5%
Asset liquidation		Non-policyholder liabilities and non-insurance revenues	7.5%
		Short-term funding	7.5%
		Level 3 assets	6.7%
		Turnover	6.7%
		Liability liquidity	7.5%
Substitutability		Premiums for specific business lines	5%

Source: IAIS, 2016

Phase II B – Determination of Quantitative Threshold

Insurers with systemic importance scores above a quantitative threshold, which is established by the IAIS following statistical and analytical approaches, are subject to further evaluation in Phases III, IV and V. Insurers with systemic importance scores below the quantitative threshold are not considered as prospective G-SIIs, unless the IAIS has analytically supported grounds to include the relevant insurers for further analysis.

Phase III – Discovery Phase

The IAIS and the relevant authorities request additional quantitative and qualitative information from the prospective G-SIIs for further analyses. Information collected by the IAIS in this phase includes data on large exposures, intra-group commitments, derivatives trading, interconnections with other financial counterparties, trading securities, debt and debt-like liabilities with provisions that can accelerate payment, minimum guarantee on variable products, liquidity of asset and liability portfolios, and reinsurance arrangements. Phase III is designed to complement Phase II, and insurers are advanced to Phase IV if the IAIS determines that their failure would cause substantial disruption to the economic activity and financial system.

Phase IV – Exchange with Prospective G-SIIs

The IAIS informs the prospective G-SIIs of the IAIS' assessment results in Phases I, Phase II and Phase III. Such information is only disclosed to the relevant prospective G-SIIs, and the IAIS does not share insurer-specific information with the public. The prospective G-SIIs have an opportunity to present information relevant to their assessment to the regulators before the final designation.

Phase V – IAIS Recommendation to the FSB

After completing Phase I through Phase IV, the IAIS recommends a list of designated G-SIIs to the FSB. Subsequently, the FSB has discretion to accept the IAIS' recommendation and to disclose the list of G-SIIs to the public.

3. Data and Systemic Risk Measures

To construct the sample of our study, we select all the insurers that are constituents of the World Datastream Insurance Index, which is developed by Thomson Reuters and consists of 250 insurers around the globe. Next, all insurers with CDS spread data unavailable for download from the S&P Capital IQ or Bloomberg database during the sample period of 2011–2015 are omitted. We choose the beginning of our sample period to be 2011 because the first designation the FSB made was based on the IAIS' assessment of 2011 data.

Table 2a:
List of Insurers in the Sample

Insurer Name	Country	Sector
Aegon NV*	Netherlands	Life and Health Insurance
Ageas SA	Belgium	Multi-line Insurance
Allianz SE	Germany	Multi-line Insurance
Allstate Corp.	United States	Property/Casualty (P/C) Insurance
American International Group Inc.	United States	Multi-line Insurance
AON Corp.	United States	Insurance Brokers
Assicurazioni Generali SpA*	Italy	Multi-line Insurance
Assured Guaranty Corp.	United States	P/C Insurance
Aviva PLC	United Kingdom	Multi-line Insurance
Axa SA	France	Multi-line Insurance
AXIS Capital Holdings Ltd.	United States	P/C Insurance
Banca Mediolanum SpA	Italy	Other Diversified Financial Services
Berkshire Hathaway Inc.	United States	Multi-Sector Holdings
Chubb Ltd	United States	P/C Insurance
CNA Financial Corp.	United States	P/C Insurance
Everest Reinsurance Holdings Inc.	United States	Reinsurance
Fairfax Financial Holdings Ltd.	Canada	Multi-line Insurance
Genworth Holdings Inc.	United States	Multi-line Insurance
Hannover Rück SE	Germany	Reinsurance
Hartford Financial Services Group Inc.	United States	Multi-line Insurance
Legal & General Group PLC	United Kingdom	Life and Health Insurance
Lincoln National Corp.	United States	Life and Health Insurance
Loews Corp.	United States	Multi-line Insurance
Marsh & McLennan Companies Inc.	United States	Insurance Brokers
MBIA Inc.	United States	P/C Insurance
MetLife Inc.	United States	Life and Health Insurance
Mitsui Sumitomo Insurance Co., Ltd.	Japan	P/C Insurance
Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft	Germany	Reinsurance
Odyssey Re Holdings Corp.	United States	Reinsurance
Old Mutual PLC	United Kingdom	Life and Health Insurance

To construct the sample of our study, we select all the insurers that are constituents of the World Datastream Insurance Index, which is developed by Thomson Reuters and consists of 250 insurers around the globe. Next, all insurers with credit default swap (CDS) spread data unavailable for download from the S&P Capital IQ or Bloomberg database are omitted. We are then left with 42 insurers from 11 countries as listed in Tables 2a and 2b. The names of the insurers and their countries are extracted from the S&P Capital IQ database and the Worldscope database, respectively. The sector of each insurer is based on the categorization of the S&P Capital IQ database. Insurers designated by the Financial Stability Board (FSB) as global systemically important insurers (G-SIIs) are highlighted.

* Based on the financial data as of year-end 2014, the Financial Stability Board (FSB) updated the G-SII list and replaced Assicurazioni Generali SpA with Aegon NV.

Table 2b:
List of Insurers in the Sample

Insurer Name	Country	Sector
Prudential Financial Inc.	United States	Life and Health Insurance
Prudential PLC	United Kingdom	Life and Health Insurance
QBE Insurance Group Ltd.	Australia	P/C Insurance
RSA Insurance Group PLC	United Kingdom	P/C Insurance
SCOR SE	France	Reinsurance
Sompo Japan Nipponkoa Insurance Inc.	Japan	P/C Insurance
Swiss Reinsurance Company Ltd.	Switzerland	Reinsurance
Tokio Marine & Nichido Fire Insurance Co., Ltd.	Japan	P/C Insurance
The Travelers Companies Inc.	United States	P/C Insurance
Unipol Gruppo SpA	Italy	Multi-line Insurance
XLIT Ltd.	United States	P/C Insurance
Zurich Insurance Company Ltd.	Switzerland	P/C Insurance

We are then left with 42 life insurers, non-life insurers and reinsurers from 11 countries after the above procedures. Among these insurers, Allianz SE, American International Group (AIG), Assicurazioni Generali SpA, Aviva plc, AXA SA, MetLife, Prudential Financial Inc. and Prudential plc were designated as G-SIIs by the FSB in July 2013.[2] Subsequent to the IAIS' review exercise based on the financial data as of year-end 2014, Assicurazioni Generali SpA. was removed from the list of G-SIIs in November 2015. Aegon N.V. was designated as G-SII on the same day. The names of insurers in our sample can be found in Tables 2a and 2b, and the corresponding descriptive statistics are reported in Tables 3a and 3b.

3.1 MES^{CDS} Calculated from CDS Spreads

We follow Acharya et al. (2017) to construct the MES using CDS spread data, which can be interpreted as the expected increase of an insurer's CDS spread in the tail of the whole portfolio's CDS spread distribution. Mathematically, $\mathrm{MES}^{\mathrm{CDS}}$ can be expressed as:

$$MES^{CDS}_i = E\,[\,R_i \mid R_p > VaR_\alpha] \qquad (1)$$

where MES^{CDS}_i is the MES calculated by CDS spreads of insurer i, R_i is the log-return of insurer i's CDS spreads, R_p is the average log-return of the whole sample's CDS spreads, and VaR_α is the value-at-risk of the log-return of the whole sample's CDS spreads with confidence level 1-α%.

2. Ping An Insurance (Group) Company of China Ltd was designated by the FSB as a G-SII. However, the CDS data for this insurer is not available for download from *Bloomberg* and *S&P Capital IQ* database. This is because China did not open up its CDS market until September 2016 (Mak, 2016). Hence, we do not include Ping An Insurance (Group) Company of China Ltd in our sample.

Table 3a:
Summary Statistics

Variable	Moments				Percentiles					N
	Mean	Std. dev	Skewness	Kurtosis	10^{th}	25^{th}	50^{th}	75^{th}	90^{th}	
Panel A: Systemic risk measures (%)										
MES^{CDS}	4.06	2.77	1.19	3.96	0.98	2.17	3.71	5.55	7.60	840
- G-SII	5.02	2.46	0.54	-0.09	1.93	3.26	4.77	6.62	8.62	164
- Non-G-SII	3.84	2.78	1.40	5.19	0.82	1.99	3.37	5.28	7.25	676
Networks of CDS spreads	45.49	6.96	0.06	-0.74	35.97	40.22	45.24	50.7	54.72	840
- G-SII	50.28	5.20	-0.04	-0.29	43.84	46.76	50.59	54.11	56.57	164
- Non-G-SII	44.36	6.83	0.22	-0.67	35.52	38.88	43.80	49.59	53.97	676
Absorption ratio	0.94	0.80	4.51	36.39	0.23	0.46	0.83	1.25	1.71	840
- G-SII	1.19	0.58	0.35	-0.30	0.54	0.73	1.12	1.59	1.92	164
- Non-G-SII	0.88	0.83	5.04	39.77	0.21	0.40	0.75	1.16	1.58	676
Panel B: Abnormal systemic risk measures (%)										
Abnormal MES^{CDS}	0.00	2.26	0.81	4.43	-2.56	-1.41	-0.03	1.18	2.55	820
- G-SII	0.90	1.66	0.57	0.45	-1.24	-0.16	0.80	1.77	3.03	164
- Non-G-SII	-0.22	2.33	1.00	5.09	-2.80	-1.63	-0.31	0.96	2.36	656
Abnormal networks of CDS spreads	0.00	5.7	-0.44	-0.44	-7.78	-4.22	0.43	4.59	6.92	820
- G-SII	4.75	3.28	-0.82	0.66	1.16	3.08	5.10	7.05	8.54	164
- Non-G-SII	-1.19	5.56	-0.28	-0.45	-8.41	-5.18	-1.00	3.28	6.15	656
Abnormal absorption ratio	0.00	0.70	3.68	31.21	-0.72	-0.33	-0.02	0.29	0.58	820
- G-SII	0.21	0.45	0.29	0.44	-0.39	-0.06	0.19	0.44	0.85	164
- Non-G-SII	-0.05	0.74	4.00	32.04	-0.77	-0.37	-0.10	0.23	0.54	656

Tables 3a and 3b present the summary statistics for the variables used in our analysis. The sample is constructed by first selecting all the insurers that are constituents of the World Datastream Insurance Index. Next, all insurers with credit default swap (CDS) spread data unavailable for download from the S&P Capital IQ or Bloomberg database are omitted. The final dataset consists of 42 insurers from 11 countries. All the variables are defined in Table 7.

In our study, we calculate the MES^{CDS} on a quarterly basis for each insurer with α to be 95. A higher value of MES^{CDS} represents more systemic risk. After calculating the MES^{CDS} for the 42 insurers from 2011 to 2015, we plot the time evolution of MES^{CDS} for G-SIIs and non-G-SIIs in Figure 1. As Aegon N.V. replaced Assicurazioni Generali SpA as G-SII based on the IAIS' assessment of its financial data as of year-end 2014, Aegon N.V. is only considered as G-SII for the year of 2015, and Assicurazioni Generali SpA is considered as G-SII for the whole sample period except for the year 2015.

3.2 Insurers' Networks Calculated from CDS Spreads

Following Puliga *et al.* (2014), the second systemic risk measure used in this study is based on the networks constructed by CDS spreads. These networks are taken as a proxy of interdependencies among insurers. Each insurer is considered as a "node," and all nodes are connected with each other.

Table 3b:
Summary Statistics

	Moments				Percentiles					
Variable	**Mean**	**Std. dev**	**Skewness**	**Kurtosis**	**10^{th}**	**25^{th}**	**50^{th}**	**75^{h}**	**90^{th}**	**N**
Panel C: Country-specific macroeconomic variables (%)										
GDP growth	1.58	1.08	-1.56	3.54	0.22	1.18	1.71	2.43	2.43	840
- G-SII	1.51	1.21	-1.53	3.16	0.26	1.16	1.69	2.33	2.43	164
- Non-G-SII	1.60	1.05	-1.54	3.57	0.18	1.36	1.74	2.43	2.43	676
Inflation	1.54	1.18	0.13	-0.52	0.05	0.34	1.57	2.34	3.16	840
- G-SII	1.66	1.18	0.40	-0.33	0.12	0.60	1.62	2.55	3.16	164
- Non-G-SII	1.51	1.18	0.07	-0.60	0.04	0.24	1.52	2.12	3.16	676
Interest rate	0.35	0.55	4.17	23.79	0.05	0.13	0.13	0.50	1.00	840
- G-SII	0.37	0.34	1.28	1.25	0.05	0.13	0.20	0.50	1.00	164
- Non-G-SII	0.35	0.59	4.15	22.17	0.05	0.13	0.13	0.50	1.00	676
Δ Exchange rate	1.08	5.79	-0.09	1.79	-4.90	-2.67	1.13	3.05	9.81	840
- G-SII	1.44	4.80	0.74	0.33	-4.90	-1.70	1.13	3.05	7.56	164
- Non-G-SII	0.99	6.00	-0.17	1.79	-4.90	-3.05	1.13	3.05	10.66	676
Credit-to-GDP gap	-9.12	9.12	0.62	-0.16	-15.9	-14.70	-12.15	-2.00	5.60	840
- G-SII	-10.77	9.08	0.46	0.09	-22.1	-15.00	-12.35	-7.35	4.20	164
- Non-G-SII	-8.72	9.09	0.67	-0.25	-15.80	-14.70	-12.10	-0.60	6.20	676
Credit spreads	56.69	69.73	3.85	17.31	16.54	19.56	37.64	52.19	107.55	820
- G-SII	66.30	85.05	3.16	10.95	16.81	19.97	37.66	66.05	139.24	164
- Non-G-SII	54.29	65.20	4.09	19.98	16.54	19.31	37.64	52.19	99.84	656
Market volatility	16.14	6.74	1.33	1.29	9.48	11.25	14.14	18.98	26.77	840
- G-SII	16.91	6.90	1.24	1.21	9.66	11.98	14.87	19.75	27.32	164
- Non-G-SII	15.95	6.69	1.36	1.34	9.41	10.93	14.09	18.66	26.77	676

To measure the weight of the link between node i and j (such weight is denoted as w_{ij}) and the impact of node i on other nodes, we perform the following steps:

(a) Measure the Pearson correlation ρ_{ij} between nodes i and j

$$\rho_{ij} = \frac{E[(X_i(t)-\bar{X}_i)(X_j(t)-\bar{X}_j)]}{\sigma_i\sigma_j} \tag{2}$$

where $X_i(t)$ is the log-return of insurer i's CDS spread at time t.

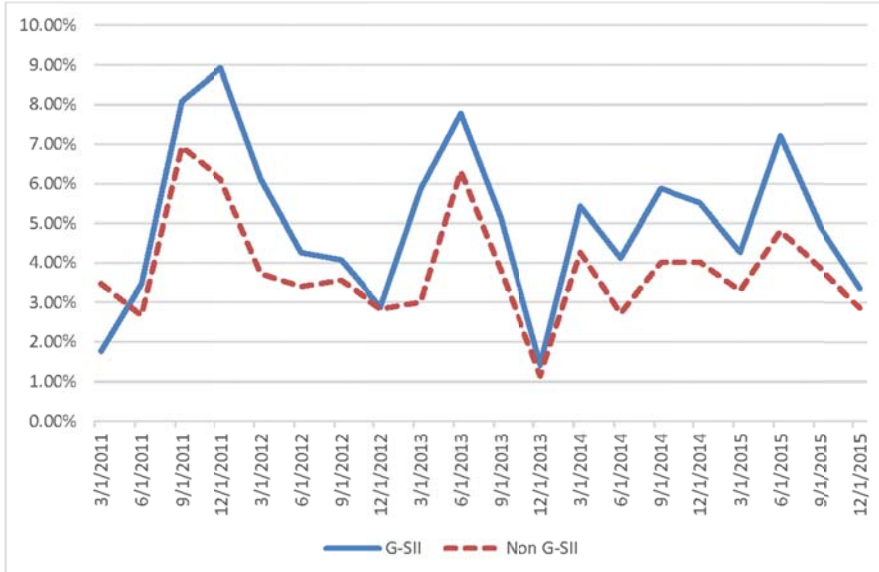
(b) As the value of ρ_{ij} in equation (2) ranges in the interval (-1, 1), we remap it into the interval (0,1) and measure the weight of the link w_{ij} as follows:

$$w_{ij} = 1 - \frac{\sqrt{2(1-\rho_{ij})}}{2} \tag{3}$$

(c) The impact of node i on other nodes is measured by the equation below:

$$Impact\ of\ node\ i = \sum_{j=1}^{42} w_{ij}v_j \tag{4}$$

Figure 1:
Time Evolution of Systemic Risk Calculated by MES^{CDS}



where v_j is a measure of the economic size of node j. Following Puliga *et al.* (2014), we take v_j as a constant 1 instead of the market capitalization of insurer j because market capitalization varies a lot, and changes in market capitalization can be affected by many factors not related to systemic risk.

(d) Finally, the systemic risk of node i is measured by the impact of node i standardized by the economic size of insurers, as described by the equation below:

$$Systemic\ risk\ of\ node\ i = \frac{\sum_{j=1}^{42} w_{ij} v_j}{\sum_{j=1}^{42} v_j} \tag{5}$$

We calculate the systemic risk measure of each insurer on a quarterly basis according to the method described above. A higher value of risk measure represents more systemic risk. The time evolution of the systemic risk measure for G-SIIs and non-G-SIIs from 2011 to 2015 can be found in Figure 2.

3.3 Absorption Ratio Calculated from CDS Spreads

For the third systemic risk measure, we follow Kritzman *et al.* (2011) to construct the absorption ratio, which is the percentage of total variance of the 42 insurers' CDS spread returns that can be explained by the first principal component, as a measure for systemic risk of the whole portfolio. The absorption ratio captures the extent to which the CDS spreads of the 42 insurers are coupled. When the 42 insurers' CDS spreads are tightly coupled (i.e., the absorption ratio is high), they are more fragile in the sense that negative shocks propagate more quickly and broadly than when they are loosely linked (i.e., the absorption ratio is low). Mathematically, absorption ratio can be expressed as:

$$Absorption\ Ratio = \frac{\sigma_p{}^2}{\sum_{i=1}^{42} \sigma_i{}^2} \tag{6}$$

$\sigma_p{}^2$ = the variance of the first principal component constructed from the 42 insurers' CDS spread returns

$\sigma_i{}^2$ = the variance of insurer i's CDS spread returns

Figure 2:
Time Evolution of Systemic Risk Calculated by Networks of Pearson Correlation

After calculating the absorption ratio for the portfolio of 42 insurers, the absorption ratio is then decomposed based on the systemic risk contribution of each insurer, which is represented by the eigenvector of the first principal component. The systemic risk of each insurer equals the absorption ratio multiplied by the adjusted eigenvalue of the relevant insurer in the first principal component.

Mathematically, the systemic risk of insurer *i* can be expressed as:

$$\textit{Systemic risk of insurer } i = \textit{absorption ratio} * a_i^{adjusted} \tag{7}$$

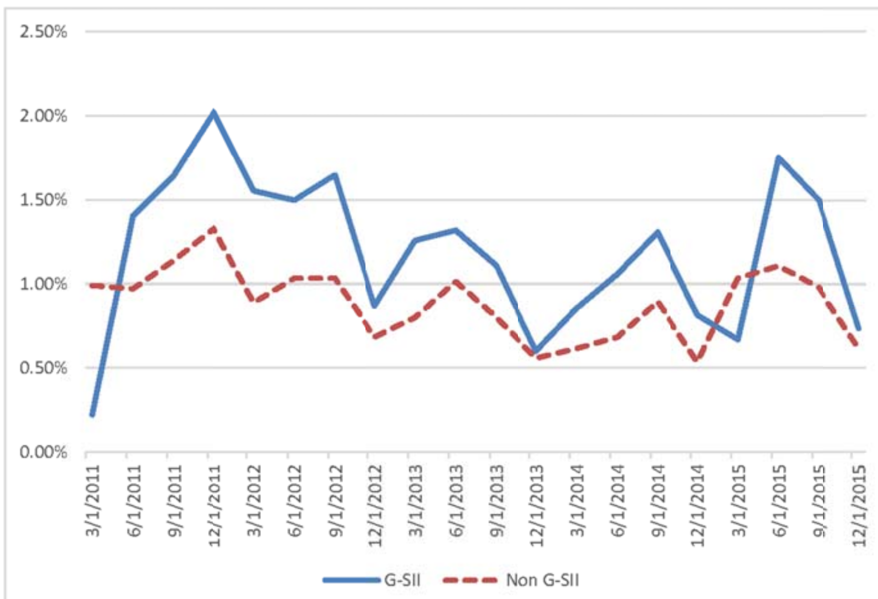
$$a_i^{adjusted} = \frac{a_i}{\sum_{j=1}^{42} a_j} \tag{8}$$

$a_i^{adjusted}$ = adjusted eigenvalue of insurer *i* in the first principal component

a_i = eigenvalue of insurer *i* in the first principal component

We calculate the systemic risk measure of each insurer on a quarterly basis according to the method described above. A higher value of systemic risk measure represents more systemic risk. We plot the time evolution of the systemic risk measure for G-SIIs and non-G-SIIs from 2011 to 2015 in Figure 3.

Figure 3:
Time Evolution of Systemic Risk Calculated by Absorption Ratio



4. Discussion on G-SII Designation and CDS-Based Systemic Risk Measures

In this section, we discuss how insurers' CDS data supplement the IAIS' G-SII identification methodology, which is mainly based on accounting data.

Specifically, we aim to identify any discrepancies for the list of G-SIIs disclosed by the FSB and the list of G-SIIs identified by CDS-based systemic risk measures.

4.1 Is the Systemic Risk of G-SIIs Identified by the FSB on Average Higher Than That of Non-G-SIIs?

To assess whether the IAIS proposed methodology accurately identifies systemically important insurers, we first examine whether the systemic risk of insurers designated by the FSB as G-SIIs is on average higher than that of other insurers. In fact, Figure 1, Figure 2 and Figure 3 offer an insight into the issue. No matter if we measure systemic risk by MES^{CDS}, networks of CDS spreads or absorption ratio, all the figures indicate that the risk measures for G-SIIs and non-G-SIIs co-moves together, suggesting that the systemic risk of these insurers is affected by some time-varying factors. More importantly, the systemic risk of G-SIIs is higher than that of non-G-SIIs for most of the time. This observation motivates us to further examine if the difference in systemic risk of G-SIIs and non-G-SIIs is statistically significant.

We conduct the one-tailed paired t-test to investigate whether the systemic risk of G-SIIs is on average higher than that of non-G-SIIs. The results are documented in Panel A of Table 4a. The t-test results indicate that when systemic risk is measured by MES^{CDS}, networks of CDS spreads and absorption ratio, the systemic risk of G-SIIs is higher than that of non-G-SIIs by 31%, 13% and 35%, respectively. Their corresponding t-statistics are 5.36, 23.91 and 4.17, respectively, which are highly statistically significant.

To control for the possibility that the one-tailed paired t test results are biased by other omitted or unobservable factors, we collect macroeconomic variables from the relevant national authorities—World Development Indicators (WDI) of World DataBank, the BIS database and the S&P Capital IQ database—and conduct the following multivariate regression to study whether the systemic risk of designated G-SIIs is higher than that of non-G-SIIs. The empirical model is described below.

$$\begin{aligned}&\textit{Systemic risk}_{it} = \beta_0 + \beta_1\, \textit{GSII}_{it} + \beta_2\, \textit{GDP Growth}_{ct} + \beta_3\, \textit{Inflation}_{ct} + \\ &\beta_4\, \textit{Interest Rate}_{ct} + \beta_5\, \Delta \textit{Exchange Rate}_{ct} + \beta_6\, \textit{Credit-to-GDP Gap}_{ct} + \\ &\beta_7\, \textit{Credit Spreads}_{ct} + \beta_8\, \textit{Market Volatility}_{ct} + f_c + s_t + e_{it}\end{aligned} \tag{9}$$

where i denotes an insurer; c denotes the country insurer i is based in; t denotes a quarter; $\textit{Systemic risk}_{it}$ is the systemic risk measured by MES^{CDS}, networks of CDS spreads or absorption ratio; $GSII_i$ is a dummy variable that equals 1 if insurer i is designated by the FSB as G-SII; and e_{it} is the error term. We use $\textit{GDP Growth}_{ct}$ and $\textit{Inflation}_{ct}$ as control variables because a previous study indicates that high inflation rates and falling GDP increase the risk of financial institutions (Baselga-Pascual *et al.*, 2015). Following Mendonca and Silva (2017), we add $\textit{Interest Rate}_{ct}$ and $\Delta \textit{Exchange Rate}_{ct}$ as control variables as the empirical results in their study suggest that higher monetary policy interest rate and currency devaluation increase systemic risk. *Interest Rate*$_{ct}$ is measured by the local monetary policy interest rate, while *ΔExchange Rate*$_{ct}$ is measured by the changes of real effective exchange rate. We use *Credit-to-GDP Gap*$_{ct}$ and *Credit Spreads*$_{ct}$ as control variables because Drehmann *et al.* (2011) find that these two variables are associated with vulnerabilities of the financial system. *Credit-to-GDP Gap*$_{ct}$ is measured by the difference between the credit-to-GDP ratio and its long-term trend, while *Credit Spreads*$_{ct}$ is measured by the CDS spread of local government bond. As Chuang (2015) finds that realized volatility of the stock market is positively associated with the financial network density, which can be a probe to systemic risk, we include *Market Volatility*$_{ct}$ as one of the control variables. To control for unobserved country-specific variables and time-specific variables, we also add the country-fixed effect f_c and time-fixed effect s_t. Standard errors are clustered at the firm level to control for heteroscedasticity. As the G-SII designation is highly correlated with firm-specific variables, we deliberately do not include any firm-specific control variables to avoid the multicollinearity problem. If the systemic risk of insurers designated by the FSB as G-SIIs is higher than that of non-G-SIIs, we expect the estimated coefficient β_1 to be positive and statistically significant. The regression results are documented in Panel B of Table 4b.

Table 4a:
One-Tailed Paired T-Test and Multivariate Regression Results

Panel A: One-tailed paired t-test results

	MES^{CDS} (%) (1)	Networks of CDS Spreads (%) (2)	Absorption Ratio (%) (3)
Average systemic risk of designated G-SIIs	5.02	50.28	1.19
Average systemic risk of non-G-SIIs	3.84	44.36	0.88
Difference	1.18***	5.92***	0.31***
	(5.36)	(23.91)	(4.17)

Panel A of the table above reports the results of running the one-tailed paired t-test on the whole sample from 2011 to 2015. The computation of MES^{CDS}, networks of credit default swap (CDS) spreads and absorption ratio is described in Section 3. T-statistics are reported in parentheses; *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively. All the variables are defined in Table 7.

Column 1, Column 2 and Column 3 of Tables 4a and 4b report the regression results with fixed effects but without macroeconomic control variables; Column 4, Column 5 and Column 6 of Tables 4a and 4b report the regression results with macroeconomic control variables but without fixed effects; and Column 7, Column 8 and Column 9 of Tables 4a and 4b report the regression results with both macroeconomic control variables and fixed effects. Based on the regression results, we note that the estimated coefficients for the *GSII*$_{it}$ dummy are positive and highly statistically significant, suggesting that insurers designated by the FSB as G-SIIs have higher systemic risk than non-G-SIIs. The magnitude of the estimated coefficients for the $GSII_{it}$ dummy is comparable to the difference between systemic risk of G-SIIs and non-G-SIIs reported in Panel A of Table 4a, suggesting that the results of one-tailed paired t-test are consistent with that of the multivariate regression.

Table 4b:
One-Tailed Paired T-Test and Multivariate Regression Results

Panel B: Multivariate regression results

	Dependent variable								
	MES^{CDS} (%)	Networks of CDS Spreads (%)	Absorption Ratio (%)	MES^{CDS} (%)	Networks of CDS Spreads (%)	Absorption Ratio (%)	MES^{CDS} (%)	Networks of CDS Spreads (%)	Absorption Ratio (%)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	3.135***	37.599***	0.839**	1.506***	39.539***	0.543***	-0.315	38.576***	-0.374
	(4.45)	(48.99)	(2.66)	(2.87)	(19.90)	(3.76)	(-0.24)	(28.00)	(-0.68)
G-SII	1.041***	5.063***	0.249***	1.055***	5.667***	0.275***	1.047***	5.049***	0.253***
	(4.66)	(5.18)	(4.57)	(3.98)	(5.89)	(4.35)	(4.67)	(5.11)	(4.70)
GDP growth (%)				-0.166	-0.403	-0.135**	-0.381*	-0.630***	-0.218***
				(-0.78)	(-0.72)	(-2.40)	(-1.84)	(-3.24)	(-2.91)
Inflation (%)				-0.033	1.731***	-0.015	-0.158	1.674***	-0.139***
				(-0.32)	(4.91)	(-0.58)	(-1.25)	(2.85)	(-2.92)
Interest rate (%)				-0.133	-0.830	-0.009	-0.868**	-0.219	-0.143
				(-0.84)	(-0.76)	(-0.15)	(-2.04)	(-0.29)	(-1.01)
Δ Exchange rate (%)				0.052	0.082	0.016*	0.083	-0.127***	0.029
				(1.28)	(0.83)	(1.76)	(1.55)	(-3.35)	(1.57)
Credit-to-GDP gap (%)				-0.012	0.076	-0.002	-0.086**	-0.176**	-0.015
				(-0.46)	(0.64)	(-0.24)	(-2.60)	(-2.65)	(-1.26)
Credit spreads (%)				-0.006**	-0.017*	-0.002**	-0.002	-0.012***	-0.001
				(-2.46)	(-1.78)	(-2.57)	(-1.30)	(-2.79)	(-1.65)
Market volatility (%)				0.179***	0.295***	0.041***	0.186***	-0.139***	0.099***
				(9.12)	(5.11)	(5.28)	(2.79)	(-2.78)	(3.26)
Country-fixed effect	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Observations	840	840	840	820	820	820	820	820	820
R^2	0.373	0.622	0.185	0.171	0.241	0.125	0.413	0.664	0.297

Panel B of the table above reports the results of running the multivariate regression on the whole sample from 2011 to 2015. The computation of MES^{CDS}, networks of CDS spreads and absorption ratio is described in Section 3. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses; *, **, and *** indicate significance at the 10%, 5% and 1% levels, respectively. All the variables are defined in Table 7.

Figures 1 to 3, the one-tailed paired t-test results and the multivariate regression results indicate that the systemic risk measures constructed by insurers' CDS data are, in general, consistent with the IAIS' identification methodology. The insurers designated by the FSB as G-SIIs are likely to have more systemic risk than other insurers. This is not surprising as the development of identification methodology involves experts from the industry, as well as references to scholastic work (e.g., see IAIS, 2011; Klein, 2011; The Geneva Association, 2010).

The IAIS also engaged various stakeholders for more than 140 hours in 2015 for the update of the assessment methodology (IAIS, 2016). Nevertheless, is the FSB's list of G-SIIs comprehensive? Are there any systemically important insurers excluded from the FSB's list of G-SIIs? We examine this issue in the next sub-section.

Table 5a:
Rank of Insurers by the Average of Systemic Risk Measures (In Descending Order)

Insurer Name	2011	2012	2013	2014	2015
Aegon NV	18	17	8	5	5
Ageas SA	41	39	34	38	35
Allianz SE	3	4	1	1	6
Allstate Corp.	9	15	22	20	12
American International Group Inc.	8	8	11	10	22
AON Corp.	26	22	32	41	32
Assicurazioni Generali SpA	12	11	9	2	2
Assured Guaranty Corp.	30	29	27	26	29
Aviva PLC	6	9	5	3	4
Axa SA	16	11	4	4	1
AXIS Capital Holdings Ltd	32	34	31	29	37
Banca Mediolanum SpA	19	24	35	31	13
Berkshire Hathaway Inc.	15	20	26	21	11
Chubb Ltd.	7	13	17	25	14
CNA Financial Corp.	31	25	38	40	31
Everest Reinsurance Holdings Inc.	34	42	33	27	25
Fairfax Financial Holdings Ltd.	42	40	40	35	39
Genworth Holdings Inc.	25	26	13	18	38
Hannover Rück SE	11	5	7	6	7
Hartford Financial Services Group Inc.	2	6	10	12	15
Legal & General Group PLC	28	27	20	15	10
Lincoln National Corp.	4	7	17	13	33
Loews Corp.	23	18	28	24	23

In Tables 5a and 5b, we rank the insurers in our sample in descending order of their systemic risk measures constructed with their credit default swap (CDS) data on a quarterly basis. To reduce the volatility of systemic risk measures, the ranks of each insurer are averaged within each year, resulting in one averaged rank for each insurer for each systemic risk measure. As there are subtle differences among the systemic risk measured by MES^{CDS}, networks of CDS spreads and absorption ratio, we further take average of the ranks indicated by these measures, and report the rank of these averaged values in this table. As our sample consists of eight insurers designated by the Financial Stability Board (FSB) as global systemically important insurers (G-SIIs), we highlight the top eight insurers with the most systemic risk for comparison with the FSB's G-SII designation.

4.2 Is the FSB's List of G-SIIs Comprehensive?

To investigate whether the FSB's list of G-SIIs is comprehensive, we rank the insurers in descending order of their CDS-based systemic risk measures on a quarterly basis. To reduce the volatility of systemic risk measures, the ranks of each insurer are averaged within each year, resulting in one averaged rank for each insurer for each systemic risk measure. As there are subtle differences among the systemic risk measured by MES^{CDS}, networks of CDS spreads and absorption ratio, we further take average of the ranks indicated by these three measures and report the rank of these averaged values in Tables 5a and 5b.

Table 5b:
Rank of Insurers by the Average of Systemic Risk Measures
(In Descending Order)

Insurer Name	2011	2012	2013	2014	2015
Marsh & McLennan Companies Inc.	28	23	30	39	26
MBIA Inc.	22	28	29	34	27
MetLife Inc.	1	10	14	11	21
Mitsui Sumitomo Insurance Co., Ltd.	38	36	41	22	28
Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft	5	2	6	8	8
Odyssey Re Holdings Corp.	40	38	39	37	42
Old Mutual PLC	37	30	24	28	24
Prudential Financial Inc.	10	16	16	16	17
Prudential PLC	21	21	19	17	16
QBE Insurance Group Ltd.	34	35	36	42	35
RSA Insurance Group PLC	24	30	21	36	20
SCOR SE	27	32	24	14	18
Sompo Japan Nipponkoa Insurance Inc.	36	41	37	23	19
Swiss Reinsurance Company Ltd.	20	3	3	9	3
Tokio Marine & Nichido Fire Insurance Co., Ltd.	39	37	42	33	41
The Travelers Companies Inc.	17	19	23	32	40
Unipol Gruppo SpA	33	33	15	30	34
XLIT Ltd.	13	14	12	19	30
Zurich Insurance Company Ltd.	14	1	2	7	9

One may be concerned that the systemic risk of G-SIIs is affected by country-specific and time-varying macroeconomic variables, which are beyond insurers' control. Hence, ranking insurers according to their systemic risk measures without controlling for these macroeconomic variables may cause bias in G-SII assessment. To address this concern, we calculate the residuals e_{it} in equation (10) for each insurer i on a quarterly basis and define these residuals e_{it} as abnormal systemic risk measures.

$$Systemic\ risk_{it} = \gamma_0 + \gamma_1\ GDP\ Growth_{ct} + \gamma_2\ Inflation_{ct} + \gamma_3\ Interest\ Rate_{ct} + \gamma_4\ \Delta Exchange\ Rate_{ct} + \gamma_5\ Credit\text{-}to\text{-}GDP\ Gap_{ct} + \gamma_6\ Credit\ Spreads_{ct} + \gamma_7\ Market\ Volatility_{ct} + s_t + e_{it} \quad (10)$$

Table 6a:
Rank of Insurers by the Average of Abnormal Systemic Risk Measures (In Descending Order)

Insurer Name	2011	2012	2013	2014	2015
Aegon NV	17	25	11	5	3
Ageas SA	31	31	39	35	23
Allianz SE	6	10	4	4	6
Allstate Corporation	10	15	23	17	12
American International Group Inc.	11	5	12	6	25
AON Corp.	27	21	33	40	36
Assicurazioni Generali SpA	3	7	8	14	1
Assured Guaranty Corp.	28	29	27	23	30
Aviva PLC	5	9	1	2	4
Axa SA	15	10	5	6	2
AXIS Capital Holdings Ltd.	34	35	32	26	38
Banca Mediolanum SpA	9	22	36	41	10
Berkshire Hathaway Inc.	14	19	26	18	11
Chubb Ltd.	7	13	17	24	16
CNA Financial Corp.	33	25	35	37	33
Everest Reinsurance Holdings Inc.	37	41	34	25	27
Fairfax Financial Holdings Ltd.*	NA	NA	NA	NA	NA
Genworth Holdings Inc.	26	24	13	14	39
Hannover Rück SE	16	12	9	9	5
Hartford Financial Services Group Inc.	2	4	6	11	17
Legal & General Group PLC	24	30	14	18	9
Lincoln National Corp.	4	3	18	12	35
Loews Corp.	23	16	28	22	25

In Tables 6a and 6b, we rank the insurers in our sample in descending order of their abnormal systemic risk measures constructed with their credit default swamp (CDS) data on a quarterly basis. To reduce the volatility of abnormal systemic risk measures, the ranks of each insurer are averaged within each year, resulting in one averaged rank for each insurer for each abnormal systemic risk measure. As there are subtle differences among the abnormal systemic risk measured by MES^{CDS}, networks of CDS spreads and absorption ratio, we further take average of the ranks indicated by these measures and report the rank of these averaged values in this table. As our sample consists of eight insurers designated by the Financial Stability Board (FSB) as global systemically important insurers (G-SIIs), we highlight the top eight insurers with the most systemic risk for comparison with the FSB's G-SII designation.

* The abnormal systemic risk measures for Fairfax Financial Holdings Ltd. are not available because one of the macroeconomic variables, credit spreads, for Canadian government bonds is missing from our dataset.

By construction, abnormal systemic risk measures e_{it} probe the systemic risk of insurers after controlling for macroeconomic variables and unobserved time-varying variables. We deliberately do not include country-fixed effect in equation (10) as firm characteristics are likely to be clustered within a country, and it is our intention for the abnormal systemic risk measures to capture firm-specific characteristics. After calculating the residuals e_{it} in equation (10), we repeat the above ranking procedure with the abnormal CDS-based systemic risk measures and report the results in Tables 6a and 6b.

Table 6b:
Rank of Insurers by the Average of Abnormal Systemic Risk Measures (In Descending Order)

Insurer Name	2011	2012	2013	2014	2015
Marsh & McLennan Companies Inc.	29	23	31	36	31
MBIA Inc.	21	28	30	31	31
MetLife Inc.	1	6	18	8	24
Mitsui Sumitomo Insurance Co., Ltd.	39	39	40	28	21
Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft	12	8	7	10	8
Odyssey Re Holdings Corp.	41	37	37	33	41
Old Mutual PLC	36	34	21	32	28
Prudential Financial Inc.	7	18	9	20	20
Prudential PLC	19	20	21	13	18
QBE Insurance Group Ltd.	38	27	24	29	15
RSA Insurance Group PLC	20	33	15	34	22
SCOR SE	32	36	29	21	19
Sompo Japan Nipponkoa Insurance Inc.	35	40	37	27	12
Swiss Reinsurance Company Ltd.	25	2	3	3	7
Tokio Marine & Nichido Fire Insurance Co., Ltd.	40	38	41	39	37
The Travelers Companies Inc.	18	17	25	29	40
Unipol Gruppo SpA.	30	32	20	38	34
XLIT Ltd.	13	14	16	16	29
Zurich Insurance Company Ltd.	22	1	1	1	14

As our sample consists of eight insurers designated by the FSB as G-SIIs, we highlight the top eight insurers with the most systemic risk in Tables 5a and 5b and Tables 6a and 6b and examine whether they are equal to those eight insurers designated by the FSB.[3] We find that Aegon N.V., Allianz SE, American International Group, Assicurazioni Generali SpA, Aviva plc, Axa SA and MetLife are occasionally ranked as the top eight insurers with the most systemic risk in the sample period. This is consistent with the FSB's assessment result, as these seven insurers have been designated by the FSB as G-SIIs. However, it is obvious that Hannover Rück SE, Swiss Reinsurance Company Ltd. And Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft have more systemic risk than

3. While it can be argued that the appropriate number of designated G-SIIs could be larger or smaller than eight, this "threshold" issue is outside the scope of our study. The appropriate number of designated G-SIIs can vary from time to time, and it is possible that none of the insurers around the globe will be designated as G-SIIs in the future if the whole insurance industry changes its characteristics to reduce systemic risk. We recommend that the "threshold" issue should be more openly discussed among insurance and finance academics, industry professionals, and regulators.

some of the designated G-SIIs, such as Prudential Financial Inc. and Prudential plc. Ironically, the former three reinsurers are excluded from the FSB's list of G-SIIs, while the latter two insurers are included in the list. Because of the different nature of insurance business between direct insurers and reinsurers, the FSB decided to postpone the decision to identify reinsurers as G-SIIs, pending further development of identification methodology specifically designed for reinsurers (FSB, 2015).

Our results indicate that reinsurers do have significant amount of systemic risk that is even higher than some G-SIIs designated by the FSB. The IAIS should speed up the development of identification methodology for reinsurers to prevent reinsurers from falling out of the G-SII supervision and becoming the source of the next financial crisis. This argument is consistent with Acharya *et al.* (2009) in the sense that the reinsurance market increases the interconnectedness of insurers and amplifies the systemic risk in the overall system, and Hufeld *et al.* (2016) in the sense that the largest global reinsurers can create systemic risk by engaging in NTNI activities.

Without disclosure of detailed explanation for including Prudential Financial Inc. and Prudential plc in the G-SII list, the regulators also face the litigation risk from these insurers as the systemic risk measures constructed by CDS data indicate that, for most of the time in the sample period, they are not among the top eight insurers generating the most systemic risk. The court ruling in March 2016 overturning the FSOC's systemic importance designation of MetLife Inc. may encourage other G-SIIs to challenge their G-SII designations in court. The exclusion of Hartford Financial Services Group Inc. and Zurich Insurance Company Ltd., which generate significant amount of systemic risk during most of the time in the sample period, from the G-SII list also puts the regulator in a difficult position to justify their G-SII designation in court. The IAIS' identification strategy may be subject to challenge due to its heavy reliance on accounting data and limited usage of market data. Given the advantages of using CDS data over accounting data to measure systemic risk,[4] we advise the IAIS to incorporate the CDS-based systemic risk measures into its identification methodology so that it can substantiate the G-SII designation in court.

4.3 Was the FSB's Change of G-SII List in November 2015 Appropriate?

Since its first designation in July 2013, the FSB has not changed its G-SII list for several rounds of annual review except for the designation in November 2015, which was based on the financial data as of year-end 2014. For that designation, Assicurazioni Generali SpA was replaced by Aegon N.V. as one of the G-SIIs. This was subsequent to Assicurazioni Generali SpA's sale of its private banking

4. A detailed discussion about the advantages of using CDS data over accounting data to measure systemic risk can be found in Section 1.

unit BSI, and the FSB opined that the removal of Assicurazioni Generali SpA from and the addition of Aegon N.V. to the G-SII list reflected the changes in the level and type of activities undertaken by these two insurers (Riemsdijk, 2015).

However, we observe from Tables 5a and 5b and Tables 6a and 6b that the systemic risk of Assicurazioni Generali SpA remains huge throughout the sample period. As the FSB removed Assicurazioni Generali SpA from the G-SII list in November 2015, we would have expected that the systemic risk of this insurer decreased substantially and remained at a low level in 2015. Surprisingly, as noted from Tables 5a and 5b and Tables 6a and 6b, Assicurazioni Generali SpA ranks the second and first, respectively, among our whole sample of insurers in 2015. Although the structural transformation taken by Assicurazioni Generali SpA seems to successfully convince the FSB to remove it from the G-SII list, the market suggests otherwise. Based on the systemic risk measures constructed from CDS data, we do not find any evidence supporting the FSB's decision.

The addition of Aegon N.V. to the G-SII list is consistent with the systemic risk measures reported in Tables 5a and 5b and Tables 6a and 6b, as we observe that there is an increasing trend for the systemic risk of Aegon N.V. in recent years. The ranking of Aegon N.V. increases from 18 in 2011 to 5 in 2015 (Tables 5a and 5b), and from 17 in 2011 to 3 in 2015 (Tables 6a and 6b). We find that the FSB made a timely decision to add Aegon N.V. to the G-SII list.

As the FSB did not disclose the concrete reasons for removing Assicurazioni Generali SpA from the G-SII list, we have no basis to examine whether the FSB's rationales are valid. Nevertheless, given the inconsistency between the FSB's removal decision and the systemic risk measures constructed by the CDS data, we urge the FSB to increase transparency regarding its designation decisions so that any inconsistencies on the designations can be openly discussed.

4.4 Should MetLife be Designated as a G-SII?

Although the recent court case overturned the FSOC's decision to designate MetLife as systemically important, the judge only opined that the regulator departed from its guidance during the G-SII assessment process and refused to consider the cost borne by MetLife for being designated as systemically important (MetLife, 2016), leaving open the controversial question of whether MetLife is systemically important. We offer some insight into the question in this sub-section.

While we acknowledge that the regulators need to consider various factors for designating insurers as G-SIIs, the CDS-based systemic risk measure can be a good reference to begin with. As noted from Tables 5a and 5b and Tables 6a and 6b, MetLife had the highest systemic risk among all insurers in our sample in 2011, no matter whether we control for macroeconomic factors and time-varying variables. This is consistent with the FSB's assessment, and it is not surprising to find MetLife on the G-SII list when the FSB first announced the designation result. However, as time goes by, the systemic risk of MetLife decreased gradually. By the end of 2015, the systemic risk of MetLife ranked 21st (before controlling for macroeconomic factors and time-varying variables) and 24th (after controlling for macroeconomic factors and time-varying variables) among all insurers in our sample in 2015. In other words, more than half of the insurers in our sample generated more systemic risk than MetLife did in 2015.

The findings naturally trigger an avoidable question of whether the regulator should continue to keep MetLife on the G-SII list. As the FSB did not disclose the concrete reasons for keeping MetLife on the G-SII list in the latest assessment, we cannot comment on whether the FSB's decision is appropriate and up-to-date. However, we urge the FSB and IAIS to take into consideration the declining trend of MetLife's CDS-based systemic risk measures in the upcoming assessment, as the regulators are unlikely to justify themselves for neglecting the fact that the value of MetLife's CDS-based systemic risk measures was below the median of our whole sample in 2015.

5. Limitations of the CDS-Based Systemic Risk Measures

Although the CDS data has several advantages over accounting data regarding the measurement of systemic risk, the availability of CDS data is limited to large insurers only. For the 250 constituents of the World Datastream Insurance Index, only 42 have CDS spread data available for download from the S&P Capital IQ and Bloomberg database. It is possible that some of the insurers without CDS spread data are systemically important. In addition, the limited availability of CDS data poses practical difficulties to extend the G-SII assessment to small and medium-sized insurers. As it is an over-generalization that small and medium-sized insurers would not be systemically important, it is currently not feasible to solely rely on the CDS-based systemic risk measures to identify all systemically important insurers. Nevertheless, the G-SIIs identified by the FSB are giant financial conglomerates. Eight out of nine of them, with the exception of Ping An Insurance (Group) Company of China Ltd., have CDS data available for analysis. In other words, CDS data for the majority of potential G-SIIs are available for assessment. As the CDS market continues to develop, we believe that CDS data for more insurers will be available for examination when the market matures in the near future.

Another potential criticism of CDS-based systemic risk measures is that they reflect insurers' systemic risk perceived by market participants, who only possess public information. As some private information, which can be accessed by regulators only, is also relevant in analyzing insurers' systemic importance, we do not recommend the IAIS replace its identification methodology with CDS-based systemic risk measures. Instead, we propose that CDS-based systemic risk measures can serve as timely indicators of systemic risk and be used to supplement the IAIS' identification framework.

Table 7:
Definitions of Variables

Variables	Definitions
Δ Exchange rate	Δ Exchange rate is measured by the change of real effective exchange rate.
Abnormal absorption ratio	Abnormal absorption ratio captures the extent to which the credit default swap (CDS) spreads are coupled by principal component analysis, after controlling for macroeconomic factors and time-varying variables. Refer to Section 4.2 for detailed methodology and calculation.
Abnormal MES^{CDS}	Abnormal MES^{CDS} is the expected increase of an insurer's CDS spread in the tail of the whole portfolio's CDS spread distribution, after controlling for macroeconomic factors and time-varying variables. Refer to Section 4.2 for detailed methodology and calculation.
Abnormal networks of CDS spreads	Abnormal networks of CDS spreads measures the interdependencies among insurers by networks of Pearson correlations, after controlling for macroeconomic factors and time-varying variables. Refer to Section 4.2 for detailed methodology and calculation.
Absorption ratio	Absorption ratio captures the extent to which the CDS spreads are coupled by principal component analysis. Refer to Section 3.3 for detailed methodology and calculation.
Credit spreads	Credit spreads are measured by the CDS spreads of local government bond.
Credit-to-GDP gap	Credit-to-GDP gap is measured by the difference between the credit-to-GDP ratio and its long-term trend.
GDP growth	GDP growth is measured by the annual percentage growth of gross domestic product.
GSII (1/0)	The G-SII dummy, which equals to 1 if the insurer has been designated by the Financial Stability Board (FSB) as global systemically important, and 0 otherwise.
Inflation	Inflation is measured by the change in consumer price index.
Interest rate	Interest rate is measured by the local monetary policy interest rate.
Market volatility	Market volatility is measured by the realized volatility of the local stock market
MES^{CDS}	MES^{CDS} is the expected increase of an insurer's CDS spread in the tail of the whole portfolio's CDS spread distribution. Refer to Section 3.1 for detailed methodology and calculation.
Networks of CDS spreads	Networks of CDS spreads measures the interdependencies among insurers by networks of Pearson correlations. Refer to Section 3.2 for detailed methodology and calculation.

6. Conclusion

The recent court case overturning the FSOC's systemic importance designation of MetLife raises the public awareness of whether the designation methodology proposed by the regulators can accurately identify systemically important insurers. From the academic perspective, the identification methodology proposed by the IAIS lacks empirical support (see Weiβ and Mühlnickel, 2014;

Bierth *et al.*, 2015). The heavy reliance on historical accounting data also poses difficulties for the regulators to identify G-SIIs based on their potential systemic risk (see Kanagaretnam *et al.*, 2016). From the industry practitioners' perspective, there is no consensus as to which insurers should be designated as G-SIIs. The ruling of the MetLife court case opens the door for other G-SIIs to challenge their G-SII designations. The announcement made by the U.S. President Donald Trump stressing the need to improve the designation process (Chiglinsky and Harris, 2017) further undermines the credibility of the designation methodology proposed by the regulators. Against this backdrop, we examine how the systemic risk measures constructed from insurers' CDS data can improve the G-SII identification methodology proposed by the IAIS.

Using insurers' CDS data to construct three different systemic risk measures, we find that G-SIIs designated by the FSB, on average, have higher systemic risk than other insurers, suggesting that the G-SII identification methodology is, in general, sound and effective. However, a closer investigation reveals that there is room for improvement in the identification methodology. The IAIS should speed up the development of methodologies to identify and regulate systemically important reinsurers, as three reinsurers in our sample have systemic risk higher than some G-SIIs designated by the FSB. The systemic risk measures indicate that the IAIS should not remove Assicurazioni Generali SpA, which generated the most systemic risk in 2015, from the G-SII list. Keeping MetLife Inc. on the G-SII list is not supported by CDS-based systemic risk measures as well. The IAIS should increase transparency in the designation process so that any discrepancies between the designation results and various kinds of systemic risk measures can be openly discussed.

We shed light on the literature on systemic risk and insurance regulation by demonstrating how insurers' CDS data can supplement the IAIS' G-SII identification methodology. From a public policy standpoint, our findings have important implications for the identification of G-SIIs. Our results show that the identification methodology that the IAIS proposed is, in general, sound and effective, but can be further supplemented by the CDS-based systemic risk measures. While facing substantial litigation risk from the designated G-SIIs after the MetLife court case, the regulators can better substantiate their designation decisions in court by incorporating the CDS-based systemic risk measures into their G-SII identification framework.

Our study can lead to further studies and discussions about the applicability of CDS data on the G-SII identification methodology. Future studies can focus on studying how the CDS-based systemic risk measures introduced in this paper and other systemic risk measures documented in literature can be validated in the context of G-SII identification. Simulation models can be developed to study how G-SIIs identified by different systemic risk measures experience simulated financial distress, and the ripple effects of their distress can be assessed as they extend to other insurers and financial institutions. In addition, given the limited availability of insurers' CDS spread data, future empirical studies can analyze the factors and conditions that affect CDS spreads. These factors and conditions can be used as proxies for CDS spreads, and, hopefully, the analysis using CDS-based systemic risk measures can be extended to insurers without CDS spread data. Finally, given the broad array of tools used by regulators to assess the risks of insurers, future studies can focus on how CDS-based systemic risk measures can be used in conjunction with other tools to optimize the G-SII identification framework.[5]

5. We would like to thank the anonymous reviewer for suggesting these topics for further researches.

Appendix

Financial Stability Board (FSB)	Financial Stability Oversight Council (FSOC)
The aim of approach described below is to identify global systemically important insurers (G-SIIs). The approach consists of five phases.	The aim of the approach described below is to identify systemically important nonbank financial companies, which include insurers, brokerage firms and other companies that provide financial services. The approach consists of three stages.
Phase I	**Stage 1**
Collects annual information from insurers that satisfy either one of the following conditions: (a) Total assets are more than US$60 billion, and ratio of overseas premium exceeds 5%. (b) Total assets are more than US$200 billion, and the ratio of overseas premium is greater than 0%.	Collects quarterly information from nonbank financial companies that satisfy either two of the following conditions: (a) Total credit default swaps for which the nonbank financial company is the reference entity are more than US$30 billion. (b) Total derivative liabilities are more than US$3.5 billion. (c) Total debt outstanding is more than US$20 billion. (d) Leverage ratio is higher than 15. (e) Short-term debt-to-asset ratio is higher than 10%.
Phase II	**Stage 2**
The systemic importance score for each insurer is calculated with reference to 17 indicators constructed from accounting data. Insurers with systemic importance scores above a quantitative threshold are considered as prospective G-SIIs and are advanced to Phase III for detailed analysis.	Each nonbank financial company is assessed based on existing public information, regulatory information and information available from the company's primary financial regulatory agency or home country supervisor. However, unlike the FSB, the FSOC does not publicly disclose the exact type of information it considers for assessment. Based on the initial evaluation in Phase II, the FSOC may vote to advance the nonbank financial company for detailed analysis in Phase III.
Phase III	**Stage 3**
Additional quantitative and qualitative information is requested from the prospective G-SIIs for further analysis.	Additional quantitative and qualitative information is requested from the nonbank financial companies for further analysis.
Phase IV	
The prospective G-SIIs have opportunities to present information relevant to their assessment to the regulators before the final designation.	The prospective nonbank financial companies have opportunities to present information relevant to their assessment to the regulators before the final designation
Phase V	
The FSB formally designates G-SIIs and subsequently discloses the designation to the public.	The FSOC votes to make a formal designation and subsequently discloses the designation to the public.

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Characteristics of S&P 500 Companies with Captive Insurance Subsidiaries

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Abstract

This study examines the overall characteristics of large-cap Standard & Poor's (S&P) 500 companies that own captive insurance subsidiaries to manage and fund their retained risks. Understanding why firms choose risk retention over risk transfer is important because it offers an example of how firms make choices for risk management strategies. Using a panel data set from 2000 to 2016, the logistic regression results provide evidence that larger firms are more likely to form a captive insurance company as an alternative method of risk financing. Of relevance to the use of captives is the finding that firms with captives maintain lower cash reserves than their counterparts. This partly reveals the strategic use of capital by the parent company that allocates a portion of internal funds to its captive insurer for operation and coverage. Finally, nonfinancial companies with smaller proportions of intangible assets and capital expenditures are associated with captive utilization. The use of captives is related to the New York Stock Exchange (NYSE)-listed status, particularly for firms that formed captives before 2000.

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1. Introduction

In the face of diverse loss exposures, corporations must choose a risk-financing technique to pay for losses. The most intuitive, mainstream solution is to purchase commercial insurance as a risk transfer technique. This is the essential tool through which a firm transfers the financial responsibility of loss payments to insurance companies by paying upfront premiums. Towards the other end of the risk-financing spectrum is a captive. A captive is an insurance company owned by a parent company or group of parent companies to insure the risks of its owner(s). The momentum of using captives as a means of risk retention has been growing (Cole and McCullough, 2008).

A captive offers several benefits: 1) improved coverage; 2) access to reinsurance markets; 3) potential for a profit center; and 4) lower costs (Culp, 2006; Rejda and McNamara, 2017). The use of a captive can also increase the efficiency of insurance (*Colaizzo, 2009;* Holzheu et al., 2003). It can be cost-efficient because the parent company avoids paying an insurer for profit, overhead, state premium taxes and other charges. The parent also exercises more control over all aspects of the risk-financing program. In addition, captives help the parent mitigate market inefficiencies related to moral hazard and adverse selection. In short, the parent company retains the cost of coverage through its own insurance subsidiary instead of paying premiums to a third-party insurer for commercial insurance.

The objective of this study is to examine the overall characteristics of companies that establish a captive. According to a captive report by Marsh (2017), increasing captive formations in the past few decades reflects a long-term trend that corporations are more sophisticated and proactive in their risk management strategies. Captives help parent companies better manage a growing range of both conventional and emerging risks, such as cyber risk. Along with Hall (2012), the Marsh report indicates that the majority of Fortune 500 companies, including privately and publicly held entities, have captive subsidiaries. Captives also provide companies with tremendous flexibility in terms of how they structure risk-financing options and manage retained loss exposures. Therefore, there should be observable differences in companies that use captives relative to those that transfer risk to third-parties by insuring their risks.

Most existing studies on captive insurance focus on the tax deductibility of premiums paid to captive insurers (Cross et al., 1988; Han and Lai, 1991; Hofflander and Nye, 1984; Lai and McNamara, 2004; Lai and Witt, 1995; Smith, 1986). For instance, Scordis and Porat (1998) attributed the growth of captive insurance subsidiaries to income tax savings. This favorable tax treatment may be the main reason for captive utilization in the 1980s and 1990s. However, recent professional reports do not document tax benefits as a key incentive for captive utilization nowadays. The report by Marsh (2017) showed more than half of the captives under its management do not take a U.S. tax position. According to the Captive Insurance Companies Association's (CICA) study (2016), the benefit of income taxation is not considered one of the eight values that captives can create for firms.[1] In addition, a research report by Willis Towers Watson (2017) highlighted that captives are now an established part of the employee benefits landscape for multinational companies.[2] The extant literature falls short of explanations for the use of captive structures in practice since 2000. However, it opens an area of research for this study to explore the factors of corporate decision-making in recent captive usage.

The empirical analysis starts with a comparison of firms with and without captive arrangements in a univariate setting. On average, firms with captives are larger in size. They are more likely to pay dividends and be listed on the NYSE when compared to companies that do not use captives. On the other hand, firms with captives spend less in capital expenditures, possess less in intangible assets, have lower revenue growth, hold less in cash reserves and have lower market-to-book ratios than those without captives.

The logistic regression analysis is estimated in the multivariate condition with the full sample and a survival data set. The findings further confirm that larger firms are more likely to own captive insurers. Firms with captives also tend to have lower cash holdings. The implications suggest that the use of captives is significantly related to lower levels of the most liquid assets in the parent companies.

This study adds to the literature on the characteristics associated with a firm's decision to use a captive by providing evidence of the characteristics of large-cap U.S. companies that choose to establish captives. The results of this work complement studies concerned with tax regulations by explaining the rationale behind a firm's risk-financing choice between a traditional risk transfer technique and an alternative risk transfer (or a captive insurance structure). Understanding why firms form captives as risk-financing tools presents an important example of how firms make choices in risk management strategies that reflect their managers' risk appetite.

The remainder of this paper proceeds in the following manner. Section II presents a brief review of the literature and the empirical evidence. Section III describes the data, sample and methods used for analysis. Section IV provides statistical results based on the univariate and multivariate analysis. Section V concludes this paper and suggests avenues for future research.

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1. As noted in the 2016 CICA study, "Values created by captives (from highest to lowest) are: (1) plug holes in insurance program; (2) recapture insurance premiums; (3) unique coverage solutions; (4) access reinsurance market; (5) fund retention/centralize buying; (6) build cash reserves; (7) fund safety/risk control programs; and (8) fund risk transfer pricing."

2. This report is based on data submitted by 203 multinational companies operating multinational pools and/or benefit captive programs. The number of employee benefit captives has doubled in the last five years. There are now approximately 85 (i.e., 42% of the participating companies). Using captives for employee benefits was not permitted before 2000. According to Lai and McNamara (2004), Columbia Energy Group is the first U.S.-based company to be granted by the U.S. Department of Labor (DOL) in 2000 to use its captive insurance subsidiary for the coverage of its long-term disability income risk. The year 2000 can be viewed as a regulatory turning point in the history of captive formations.

2. Literature Review

Risk financing is concerned with the payment of losses via risk transfer and/or risk retention techniques. Companies may prefer to reduce cost certainty for their loss exposures by purchasing insurance policies because premiums are paid in advance of losses. On the other hand, some companies may prefer to handle loss exposures through forming captives, which can be more cost-efficient. Deciding which technique should be used is an indispensable subject of risk management for all managers with varying levels of risk preference.

Risk management can create shareholder value when the benefits outweigh the costs. For example, by lowering the cash-flow volatility, risk management can reduce the expected cost of financial distress (Mayers and Smith, 1982; Smith and Stulz, 1985). It can also reduce expected taxes due to the convex tax structure (*Dionne and Garand, 2003;* Graham and Smith, 1999; Mayers and Smith, 1982; Smith and Stulz, 1985). Alternatively, risk management can increase firm value via increased debt capacity (Graham and Rogers, 2002; Leland, 1998). It can also relieve the problem of underinvestment when external cost of financing is more expensive than internal cash flows and when investment opportunity is inversely related to cash flows (Froot et al., 1993).

Risk management decisions can be affected by managerial motives and attitude toward risk. Nocco and Stulz (2006) suggested that a firm should implement its risk management based on its risk appetite to reach the organizational benefits between risk and return. Managers may take on risk management activities if their wealth is concentrated in their firm's equity, thus reducing the volatility of the firm's value and personal wealth (Smith and Stulz, 1985; Stulz, 1984).

Nevertheless, using captives for retained risks comes at a price. Perhaps the most complicated self-funding mechanism, captives tie up the parents' internal funds. Companies risk the capital required to form a captive instead of simply paying commercial insurance premiums in exchange for coverage promised by third-party carriers. Furthermore, parent companies are engaged in both their core business and insurance operation. The potential benefits relative to traditional commercial insurance should be substantial enough to justify the outlays of operating a captive insurance subsidiary.

The key value driver for forming captives is to fund corporate retained risks. With a captive insurance subsidiary, companies have a great deal of latitude to adjust risk retention strategies in response to changing market environments. According to the CICA, "Captives create value in the following ways: 1) plug holes in the insurance program; 2) recapture insurance premiums; and 3) provide unique coverage solutions." As a result, firms with captives should be characterized by features that distinguish them from their counterparts because of divergent strategies in capital allocation.

3. Data, Sample, Method

This empirical study is intended to test whether some characteristics are linked to captive utilization using financial data from COMPUSTAT for companies that comprise the S&P 500 index. The initial data set included annual observations for all S&P 500 firms in COMPUSTAT from 2000 to 2016. Those with missing data on basic accounting variables and stock prices that are used to calculate market-based measures were removed. This left 7,780 observations. Finally, following Laeven and Levine (2007), extreme outliers were excluded by eliminating observations where the basic accounting variables were more than four standard deviations from the sample mean. The final panel data set contained 7,513 firm-year observations for large-cap S&P 500 companies from 2000 to 2016.

The information on whether firms have captive insurance subsidiaries is obtained from the Captive Insurance Database (CID) managed by Captive Review.[3] This database contains details on captive parents, date licensed and captive type. Table 1 presents the distribution of all captives formed by S&P 500 companies by year and by type. This sample includes five captives structured in the form of either group or special purpose vehicle (SPV) ownership. A group captive is an insurer owned by a group of companies and used to insure the risks of its member companies. SPVs are captives created for reinsurance, securitization or reserve financing. Pure captives are the dominant type of ownership; more than half were formed before 2000. The growth of captives has been steady.[4] This observation is in line with the 2007 Aon report that the growth in the number of captives formed by Global 1500 firms (i.e., firms with revenues of at least $4 billion) has been constant despite changes in underwriting cycles.

The analytical method of this work employs a logistic regression model to explore the relationship between captive utilization and firm characteristics. The specification of the regression model is formulated as follows:

$$Captive_{it} = f\ (Operating\ Characteristics,\ Financial\ Characteristics,\ Market\ Characteristics,\ Control\ Variables)_{it} + \varepsilon_{it}$$

where a captive insurance subsidiary dummy (*Captive*) is the binary dependent variable that takes the value of one if a firm has a captive insurance subsidiary in a year and zero otherwise. Thus, it is equal to one for firm-years starting with the year that a firm creates a captive insurer. It is equal to zero in all prior firm-years. The explanatory variables, hypothesized to be indicators of a firm's choice to have a captive insurance subsidiary and discussed thereafter, are classified into operating, financial and market characteristics.

3. Special thanks to Courtney W. Claflin, executive director of Captive Programs at the University of California, who guided the author to locate this database on May 2, 2018.

4. According to Table 1, 83 out of 170 pure captives (i.e., 49%) are licensed after 2000 in comparison with 87 pure captives (i.e., 51%) licensed before 2000.

Table 1:
Captives Licensed by Year and by Type

Year \ Type	Pure[a]	Group/Cell[b]	SPV[c]	NA[d]	Dormant[e]
1967–1974[f]	11	0	0	1	0
1975–1979	13	0	0	0	1
1980–1984	9	0	0	0	0
1985–1989	12	2	0	0	1
1990–1994	18	0	0	2	0
1995–1999	24	0	0	5	0
2000–2004	48	0	0	3	1
2005–2009	23	0	2	2	0
2010–2016	12	0	1	0	0
Total	170	2	3	13	3

Throughout this study, a captive is referred to as any captive insurance company in the types of pure, group/cell, special purpose vehicle (SPV) and unknown (NA) ownership. [a]A pure captive is an insurance company owned by one parent company and formed to insure the risks of its parent. [b]A group captive is an insurance company owned by a group of parent companies and formed to insure the risks of its parents. A cell captive is an insurer in which one or more sponsors segregate each participant's liability through protected cells or separate accounts where those assets are not subject to the liabilities of the other cells. [c]SPVs refer to captives created particularly for reinsurance, securitization or reserve financing purposes. [d]NA represents captives with missing data on the type of ownership. [e]As of Feb. 10, 2018, three captives are dormant. Captives in dormant status can buy insurance from the traditional market but return to the captive when the market fluctuates. Firms with a dormant captive are not treated as firms with a captive insurance company. [f]1967 is the earliest year in which a captive insurance subsidiary was formed by Ford Motor Co. (a Standard & Poor's [S&P] 500 company in the sample).

Operating Characteristics

Size

Firm size is an important factor for risk retention (Chang, 2008; Chang, 2013a, b; Chang and Weiss, 2011; Chang et al., 2018; Feldman, 2012). Larger corporations are more capable of putting aside capital to form a captive and experiencing the cost-effectiveness of scale economy. The proxy is the natural logarithm of the book value of assets. The sign of this variable should be positive.

Capex

Capital expenditures are indicative of how firms invest capital for future investment opportunities. The proxy used is the ratio of capital expenditures to total assets. The expected sign for this variable is negative because a firm with a higher ratio may be less likely to establish a captive due to the constraint on its financial resources.

Opacity

A firm's asset structure may affect its risk-financing decisions. According to Pagach and Warr (2011), assets that are opaquer are more difficult to liquidate at the time of financial distress. Opacity, which is used as a measure of tangibility of corporate assets, is calculated as the ratio of intangible assets to the book value of total assets. It is expected to have a negative coefficient because a firm with more intangible assets should be less likely to retain its risks.

Sales Growth

Firms with higher growth rates may focus most of their operating attention on generating revenues. Thus, captives may be favored by firms with stable growth rates. This measure is the percentage growth in annual sales from the prior year to the current year. The coefficient is expected to be negative.

Financial Characteristics

Cash

The level of a firm's cash holdings is associated with the use of a captive finance subsidiary among U.S. industrial firms (Bodnaruk et al., 2016). Thus, the ratio measures the amount of cash and cash equivalents that the firm has on hand. It is computed by cash and marketable securities divided by total assets. A negative sign of this variable is expected because companies must use some of their internal funds to operate their captives.

Dividend

Firms are more likely to have the capital to form a captive by keeping internal funds without paying out as dividends. A dividend dummy equals one if the firm pays dividends on common equity in that year. The sign of this variable is expected to be negative.

Leverage

A firm's capital structure may affect its decision to own a captive. Highly levered firms are more likely to suffer from financial distress than lowly levered ones. Thus, captives may be out of favor by firms with greater leverage that would rather transfer risks than retain on their own. A leverage variable, defined as the book value of long-term debt over the market value of common equity, is expected to have a negative sign.

Profitability

Profitable firms are more likely to generate cash flows available for the establishment of a captive insurer. The return on assets (ROA) is used as a proxy, calculated as the ratio of net income to total assets. A positive coefficient is expected on this variable.

Market Characteristics

Market-to-Book (MB)

A higher MB ratio suggests that the firm has been more effective at investing and added value for shareholders. Cross et al. (1986) asserted that the stock price of a parent company reacts positively when a captive is formed. Thus, a positive sign is expected for this variable.

Price-to-Earnings (PE)

A firm with a higher PE ratio shows greater confidence among investors. However, it remains to be observed whether a higher ratio is associated with the use of captives. Therefore, no priors are expected on the sign of this variable.

NYSE

Firms listed on the NYSE are well-established and financially strong. This dummy variable takes the value of one if a firm is listed on the NYSE and zero otherwise. This variable is expected to have a positive sign.

Control Variables

Age

A firm with a lengthy business history is more experienced with handling its commercial risks. Therefore, it is more likely to set up a captive as a risk retention tool. Following Kieschnick and Moussawi (2018), the authors used the length of time that a firm has been a public firm as a proxy for firm age. This variable is the log of the number of years since a firm's initial public offering. Firms with a greater number of years as publicly traded businesses should be more confident to form captives.

Foreign Tax

Taxes may play a role as one of the incentives for captive utilization.[5] Firms with foreign tax burdens may be motivated to use captive structures. This dummy variable equals one if the firm pays foreign income taxes in that year.

Diversification

Following Hann et al. (2013) and Pagach and Warr (2011), the authors include the number of operating segments to control for diversification of various risks within the firm. This variable can capture substitution effects between captive use and diversification as tools for risk management.

Finally, the equation controls for time and industry fixed effects. Year dummies are included to control for the impact of cyclical, economic trends on the use of

5. Due to the high correlation between a firm's assets and its domestic taxes paid, the study uses this variable as the best alternative to control for tax incentives.

captives over the sample period. Industry dummies are based on the two-digit North American Industry Classification System (NAICS) codes.[6] All variables are defined in Table 2. Their expected signs and sources are also displayed.

Table 2:
Variable Definitions

Variable	Definition	Sign	Source
Captive	= 1 if a firm has a captive insurance subsidiary in a given year, and 0 otherwise		Captive Insurance Database
Operating characteristics			
Size	Ln(assets) = Ln(AT)	+	Compustat
Capex	Capital expenditure/total assets = CAPX/AT	-	Compustat
Opacity	Intangible assets/total assets = INTAN/AT	-	Compustat
Sales growth	Percentage growth in annual sales (REVT) from the prior year to the current year	-	Compustat
Financial characteristics			
Cash	Cash and short-term investments/total assets = CHE/AT	-	Compustat
Dividend	= 1 if the firm paid dividends (DVT) in that year, 0 otherwise	-	Compustat
Leverage	Book value of long-term debt/Market value of equity = DLTT/(PRCC_C*CSHO)	-	Compustat
ROA	Net income/total assets = NI/AT	+	Compustat
Market characteristics			
Market-to-book (MB)	Stock price per share /Book value per share = PRCC_C/((AT-LT)/ CSHO)	+	Compustat
Price-to-earnings (PE)	The year-end stock price/earnings per share for the fiscal year = PRCC_C/(NI/CSHO)	+/-	Compustat
NYSE	= 1 if a firm is listed on the New York Stock Exchange, and 0 otherwise	+	Compustat
Control variables			
Age	Ln (the number of years since a firm's initial public offering)	+	CRSP
Foreign Tax	= 1 if a firm paid foreign income taxes (TXFO) in that year, and 0 otherwise	+	Compustat
NoSeg	The number of operating segments reported in Compustat	+/-	Compustat

Summary statistics are reported in Table 3. As can be seen in this table, firms with captive structures make up 35% of all firm-year observations. Firms, on average, have 12.2% of assets in cash and cash equivalents. About three-quarters of S&P 500 companies are listed on the NYSE.

6. Industries with the two-digit NAICS codes 81 (other services except public administration), 92 (public administration) and 99 (unclassified) are left out of the industry fixed effects. Most industry dummies are positive and significant in the multivariate analysis.

Table 3:
Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Captive	7,513	0.000	1.000	0.350	0.476
Operating characteristics					
Size	7,513	1.586	6.410	4.086	0.673
Capex	7,513	0.000	0.236	0.040	0.040
Opacity	7,513	0.000	0.907	0.198	0.207
Sales growth	7,513	-0.927	2.790	0.098	0.227
Financial characteristics					
Cash	7,513	0.000	0.715	0.122	0.135
Dividend	7,513	0.000	1.000	0.768	0.422
Leverage	7,513	0.000	640.8	0.571	7.645
ROA	7,513	-0.394	0.503	0.059	0.068
Market characteristics					
Market-to-book	7,513	-280.4	321.7	3.746	12.36
Price-to-earnings	7,513	-694.3	697.5	19.77	49.57
NYSE	7,513	0.000	1.000	0.759	0.428
Controls					
Age	7,513	0.000	4.182	1.503	0.314
Foreign tax	7,513	0.000	1.000	0.680	0.467
NoSeg	1,530	2.000	22.000	6.170	2.664

Captive is a dummy variable that equals 1 for a firm-year in which a captive is used, and 0 otherwise. *Size* is measured as the natural log of the book value of total assets. *Capex* is computed as capital expenditure divided by total assets. *Opacity* is measured as the ratio of intangible assets to total assets. *Sales growth* is the percentage growth in annual sales from the prior year to the current year. *Cash* is computed as cash and short-term investment divided by total assets. *Dividend* dummy equals 1 if the company paid out dividends for that year, and equals 0 otherwise. *Leverage* is equal to the ratio of book value of long-term debt divided by the market value of equity. *Return on assets (ROA)* measures accounting performance and is equal to net income divided by total assets. *Market-to-book (MB)* is the ratio of market equity to book equity. *Price-to-earnings (PE)* is the ratio of stock price to earnings per share for the fiscal year. The *New York Stock Exchange (NYSE)* equals 1 if a firm is listed on the NYSE, and 0 otherwise. *Age* is the log of the number of years of a firm's initial public offering. *Foreign tax* is a dummy variable that takes a value of 1 if a firm paid foreign income taxes in that year, and 0 otherwise. *NoSeg* is the number of operating segments for each self-reported firm.

Table 4 shows the correlation matrix of captive use and its determinants. The use of captives is negatively correlated with all explanatory variables except for size, dividend and the NYSE. Additionally, multicollinearity does not pose an issue in the regression analysis due to a lack of high correlation coefficients between the independent variables.[7]

7. Variance inflation factors (VIFs) for all variables are examined if the problem of multicollinearity exists. VIF statistics are below two, indicating no existence of multicollinearity.

Table 4:
Correlations among Regression Variables

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Captive	(1)	1														
Size	(2)	0.386**	1													
Capex	(3)	-0.140**	-0.163**	1												
Opacity	(4)	-0.041**	-0.128**	-0.225**	1											
Sales growth	(5)	-0.101**	-0.167**	0.035**	0.051**	1										
Cash ratio	(6)	-0.135**	-0.205**	-0.084**	-0.096**	0.113**	1									
Dividend	(7)	0.223**	0.366**	-0.071**	-0.127**	-0.215**	-0.311**	1								
Leverage	(8)	-0.007	0.033**	0.009	0.003	-0.016	-0.026*	-0.017	1							
ROA	(9)	-0.055**	-0.234**	0.125**	0.047**	0.097**	0.230**	-0.013	-0.097**							
MB	(10)	-0.039**	-0.061**	0.032**	0.016	0.015	0.066**	-0.029*	-0.013	0.083**	1					
PE	(11)	-0.037**	-0.058**	-0.012	0.02	0.073**	0.051**	-0.029*	-0.015	0.091**	0.032**	1				
NYSE	(12)	0.211**	0.246**	-0.031**	-0.036**	-0.135**	-0.427**	0.361**	-.023*	-0.119**	-0.051**	-0.045**	1			
Age	(13)	0.181**	0.188**	0.075**	-0.122**	-0.126**	-0.136**	0.287**	-.049**	0.014	-0.039**	-0.050**	0.213**	1		
Foreign tax	(14)	0.048**	-0.075**	-0.02	0.354**	-0.018	0.220**	-0.086**	-0.046**	0.232**	0.055**	0.008	-0.090**	-0.023*	1	
NoSeg	(15)	0.253**	0.288**	-0.038	-0.170**	-0.02	-0.050*	0.115**	0.165**	-0.143**	-0.059*	-0.05	0.101**	0.179**	-0.023	1

Captive is a dummy variable that equals 1 for a firm-year in which a captive is used, and 0 otherwise. *Size* is measured as the natural log of the book value of total assets. *Capex* is computed as capital expenditure divided by total assets. *Opacity* is measured as the ratio of intangible assets to total assets. *Sales growth* is the percentage growth in annual sales from the prior year to the current year. *Cash* is computed as cash and short-term investment divided by total assets. *Dividend* dummy equals 1 if the company paid out dividends for that year, and equals 0 otherwise. *Leverage* is equal to the ratio of book value of long-term debt divided by the market value of equity. *Return on assets (ROA)* measures accounting performance and is equal to net income divided by total assets. *Market-to-book (MB)* is the ratio of market equity to book equity. *Price-to-earnings (PE)* is the ratio of stock price to earnings per share for the fiscal year. The *New York Stock Exchange (NYSE)* equals 1 if a firm is listed on the NYSE, and zero otherwise. *Age* is the log of the number of years a firm's initial public offering. *Foreign tax* is a dummy variable that takes a value of 1 if a firm paid foreign income taxes in that year, and 0 otherwise. *NoSeg* is the number of operating segments for each self-reported firm. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). The number of observations for each variable is the same as in Table 3.

4. Results

Univariate Analysis

This section compares firms with and without the presence of a captive insurance subsidiary. These univariate results are presented in Table 5. In general, firms with captive structures are larger in size, more likely to pay dividends and NYSE-listed. They also tend to become publicly traded earlier, pay foreign taxes and manage more operating segments.

It is noteworthy that capital expenditures and opacity make a crucial distinction between firms that use and those that do not use captives. Consistent with the hypothesis, firms with captives have a smaller proportion of capital expenditures and intangible assets than firms without captives. Firms with captives also have lower growth rates and cash and cash equivalents than their counterparts. Consistent with the negative correlation between captive usage and profitability from Table 4, firms with captives tend to be less profitable in this analysis. Finally, firms with captives have lower MB and PE ratios. It remains to be seen whether these univariate findings can hold up in the multivariate settings.

Table 5:
Mean Comparison of Firms with and Without Captives

Variable	N	Firms with Captives	N	Firms Without Captives	Mean Difference	*p*-value
Operating characteristics						
Size	2,610	4.443	4,903	3.897	0.546	0.000***
Capex	2,610	0.032	4,903	0.044	-0.012	0.000***
Opacity	2,610	0.186	4,903	0.204	-0.018	0.000***
Sales growth	2,610	0.067	4,903	0.244	-0.048	0.000***
Financial characteristics						
Cash	2,610	0.097	4,903	0.135	-0.038	0.000***
Dividend	2,610	0.897	4,903	0.700	0.198	0.000***
Leverage	2,610	0.499	4,903	0.610	-0.111	0.418
ROA	2,610	0.054	4,903	0.061	-0.008	0.000***
Market characteristics						
Market-to-book	2,610	3.088	4,903	4.097	-1.008	0.000***
Price-to-earnings	2,610	17.26	4,903	21.11	-3.846	0.000***
NYSE	2,610	0.882	4,903	0.693	0.190	0.000***
Controls						
Age	2,610	0.710	4,903	0.660	0.047	0.000***
Foreign tax	2,610	1.581	4,903	1.462	0.119	0.000***
NoSeg	683	6.920	847	5.570	1.355	0.000***

Captive is a dummy variable that equals 1 for a firm-year in which a captive is used, and 0 otherwise. *Size* is measured as the natural log of the book value of total assets. *Capex* is computed as capital expenditure divided by total assets. *Opacity* is measured as the ratio of intangible assets to total assets. *Sales growth* is the percentage growth in annual sales from the prior year to the current year. *Cash* is computed as cash and short-term investment divided by total assets. *Dividend* dummy equals 1 if the company paid out dividends for that year, and equals 0 otherwise. *Leverage* is equal to the ratio of book value of long-term debt divided by the market value of equity. *Return on assets (ROA)* measures accounting performance and is equal to net income divided by total assets. *Market-to-book (MB)* is the ratio of market equity to book equity. *Price-to-earnings (PE)* is the ratio of stock price to earnings per share for the fiscal year. The *New York Stock Exchange (NYSE)* equals 1 if a firm is listed on the NYSE, and 0 otherwise. The *p*-value is based on a *t*-test on the difference in means that assumes unequal variances. *Age* is the log of the number of years of a firm's initial public offering. *Foreign tax* is a dummy variable that takes a value of 1 if a firm paid foreign income taxes in that year, and 0 otherwise. *NoSeg* is the number of operating segments for each self-reported firm.

Multivariate Analysis

To test whether the firm's decision to use a captive insurance subsidiary for retained risks is associated with certain operating, financial and market characteristics, a logistic regression is conducted in a multivariate condition with time and industry fixed effects. Table 6 presents the results for the full sample with various sets of variables.

Table 6:
Logistic Regression Results for the Characteristics of Firms with Captives

Variable	(1)	(2)	(3)
Operating characteristics			
Size	1.484***	1.409***	1.282***
	(0.000)	(0.000)	(0.001)
Capex	-11.14***	-11.94***	-8.407
	(0.004)	(0.003)	(0.323)
Opacity	-1.349**	-1.458**	-2.864*
	(0.040)	(0.025)	(0.090)
Sales growth	-0.291	-0.180	-0.270
	(0.101)	(0.297)	(0.479)
Financial characteristics			
Cash	-2.092**	-2.273**	-2.448
	(0.021)	(0.013)	(0.179)
Dividend	0.333	0.231	-0.025
	(0.192)	(0.375)	(0.957)
Leverage	-0.073	-0.049	-0.029
	(0.174)	(0.292)	(0.815)
ROA	1.423	1.130	1.463
	(0.261)	(0.353)	(0.470)
Market characteristics			
Market-to-book	-0.005	-0.005	-0.005
	(0.113)	(0.103)	(0.423)
Price-to-earnings	-0.000	-0.000	-0.002*
	(0.503)	(0.731)	(0.072)
NYSE	0.784***	0.734**	0.154
	(0.009)	(0.014)	(0.775)
Controls			
Age		0.747**	0.746
		(0.044)	(0.328)
Foreign tax		0.422	-0.500
		(0.130)	(0.367)
NoSeg			0.132
			(0.112)
Intercept	-8.786***	-9.936***	-4.939**
	(0.000)	(0.000)	(0.010)
No. of observations	7,513	7,513	1,530

Captive is a dummy variable that equals 1 for a firm-year in which a captive is used, and 0 otherwise. *Size* is measured as the natural log of the book value of total assets. *Capex* is computed as capital expenditure divided by total assets. *Opacity* is measured as the ratio of intangible assets to total assets. *Sales growth* is the percentage growth in annual sales from the prior year to the current year. *Cash* is computed as cash and short-term investment divided by total assets. *Dividend* dummy equals 1 if the company paid out dividends for that year, and equals 0 otherwise. *Leverage* is equal to the ratio of book value of long-term debt divided by the market value of equity. *Return on assets (ROA)* measures accounting performance and is equal to net income divided by total assets. *Market-to-book (MB)* is the ratio of market equity to book equity. *Price-to-earnings (PE)* is the ratio of stock price to earnings per share for the fiscal year. The *New York Stock Exchange (NYSE)* equals 1 if a firm is listed on the NYSE, and 0 otherwise. *Age* is the log of the number of years a firm's initial public offering. *Foreign tax* is a dummy variable that takes a value of 1 if a firm paid foreign income taxes in that year, and 0 otherwise. *NoSeg* is the number of operating segments for each self-reported firm. The model also controls for year and industry dummies at the two-digit North American Industry Classification System (NAICS) level. Standard errors are adjusted for firm-level clustering. P-values are in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Specification (1) of Table 6 reports the results for the entire sample without control variables. Three operating variables (*Size*, *Capex* and *Opacity*) are significantly related to the use of captives. Consistent with the hypothesis that size should be positively related to captive formation, the result shows that larger firms are more likely to use captives. Also consistent with the hypotheses are the findings that the use of captives is inversely related to capital expenditures and opacity.

The level of cash holdings is the only financial characteristic significantly associated with the use of captives. The coefficient for *Cash* is significant and negative. This finding is consistent with the hypothesis that firms with captives should have lower cash reserves. The implication may indicate that firms using captive structures can maintain lower cash balances in operation. This result reveals a difference between firms with and without captives related to capital allocation strategies. At first glance, a firm provides capital to form a captive and pays premiums to its captive subsidiary. As a result, the firm with a captive operates with a lower level of cash and its equivalents. The lower level of the most liquid assets could indicate that the firm is susceptible to liquidity problems. In reality, the firm with a captive can readily handle these problems because some of the cash holdings are strategically stored in its captive subsidiary. Captive shareholder funds can serve as backstops for a variety of risk management needs from the parent company. This is evidenced by the 2017 Marsh report in that its managed captives currently have more than $110 billion in shareholder funds.[8] In other words, with some cash reserved in its captive, the parent company protects the cash for future risk management needs and reduces the agitation for distributing cash from its shareholders.[9] In addition, the coefficients for *Dividend*, *Leverage* and *ROA* variables are not significant.[10] These findings suggest that the use of captives is not driven by corporate dividend policies, leverage structure and profitability.[11]

The market characteristics are insignificant except for the NYSE variable. Firms that are listed on the NYSE are more likely to have captives. Neither the market-to-book ratio nor price-to-earnings ratio come into play in the choice of captive formation. A reasonable inference to be drawn is that the use of captives may not serve as a driving force toward the firm's long-term stock price, although the stock price reacts positively to the formation of a firm's captive (Cross et al., 1986).

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8. This report suggests that captive shareholder funds provide their parent companies with the means to reduce their total cost of risk in creative ways. For example, parent companies can use captive shareholder funds to underwrite an array of new and nontraditional risks, including cyber, supply chain, employee benefits and terrorism.

9. Special thanks to Harold A. Weston for this insightful comment made on Feb. 27, 2018.

10. As a robustness test, two variations of the dividend dummy are considered. First, "dividend dummy" is defined as one if the firm has paid dividends in the past two years and zero otherwise. Next, it is defined using a three-year window. The results hold true for the relation between *Dividend* and the use of captives.

11. The authors only keep ROA as a measure of profitability throughout the paper. The results do not change when the return on equity (ROE) is used as an alternative measure of profitability.

Specification (2) of Table 6 shows the results for the full sample, with *Age* and *Foreign Tax* included as control variables. They continue to support the findings in column (1). The firm age variable is positive and significant. That is, more established firms are more likely to use captives. The relationship between captive utilization and foreign tax payments is insignificant.[12]

The authors included *NoSeg* as a control variable in specification (3) to examine the relationship between captive use and diversification.[13] The coefficient is insignificant, failing to suggest that firms with more operating segments are inclined to form captives for risk management purposes. Due to the available segments data for the firms in this sample, the sample size with *NoSeg* as a control variable decreases dramatically, only making up one-fifth of the full sample. As a result, the specification with *NoSeg* carries less weight in the rest of the analysis.

To determine whether the logistical results are robust across industries, multivariate analysis is conducted based on two subsamples of financial firms that have the two-digit NAICS codes of 52 and 53 (equivalent to the Standard Industrial Classification [SIC] codes between 6000 and 6999) and nonfinancial firms.[14] Specifications (1) and (2) in Table 7 report estimates of logistic regressions for financial firms; specifications (3) and (4) report for nonfinancial firms. According to Marsh (2017), financial institutions make greater use of captives, accounting for about one-quarter of captives under its management. As a result, the disaggregated subsamples may explain any dissimilarities between financial and nonfinancial firms when it comes to captive utilization. Consistent with the results for the full sample reported in this section, firms with larger assets, lower cash reserves and the NYSE-listed status continue to be more likely to use a captive structure.[15] Moreover, results differ for financial firms and nonfinancial firms with respect to capital expenditures, opacity, firm age and foreign taxes. Nonfinancial companies with smaller proportions of capital expenditures and intangible assets are more likely to engage in risk retention in the form of captive insurance subsidiaries. In addition, the use of captives among nonfinancial companies is significantly and positively related to firm age and foreign tax payments.

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12. The authors also estimated the model with domestic tax rates as an alternative to foreign taxes. The results continue to show no statistical effect of tax incentives on captive formations.

13. The segments data is self-reported by the companies. Many missing observations exist for the firms in the sample. Thus, this control variable is included separately for testing the diversification issues.

14. Of the firms included in the sample, 33% of nonfinancial firms have captives in comparison with 42% of financial firms.

15. These results continue holding up when the one-year lagged values of the explanatory variables have been used in the regression for the entire sample and disaggregated subsamples. The results based on lagged values are not reported. They are available upon request.

Table 7:
Logistic Regression Results for Financial and Nonfinancial Firms

Variables	Financial Firms		Nonfinancial Firms	
	(1)	(2)	(3)	(4)
Operating characteristics				
Size	1.528***	1.485**	1.581***	1.941***
	(0.000)	(0.024)	(0.000)	(0.000)
Capex	-3.880	14.40	-14.97***	-21.72**
	(0.706)	(0.334)	(0.000)	(0.016)
Opacity	0.975	-0.826	-2.233***	-5.084***
	(0.410)	(0.632)	(0.002)	(0.001)
Sales growth	0.0863	0.518	-0.287	-0.698
	(0.821)	(0.326)	(0.140)	(0.147)
Financial characteristics				
Cash	-4.140**	-6.970	-2.453**	-2.908
	(0.034)	(0.162)	(0.024)	(0.171)
Dividend	0.0995	-1.443***	0.276	0.837*
	(0.871)	(0.009)	(0.334)	(0.099)
Leverage	-0.0997	-0.182	-0.007	0.270
	(0.121)	(0.488)	(0.827)	(0.227)
ROA	3.713	3.863	0.788	2.646
	(0.435)	(0.592)	(0.532)	(0.230)
Market characteristics				
Market-to-book	0.0314	0.0140	-0.006*	-0.006
	(0.311)	(0.775)	(0.070)	(0.446)
Price-to-earnings	-0.0002	-0.001	-0.000	-0.003*
	(0.866)	(0.551)	(0.681)	(0.073)
NYSE	0.946*	1.584*	0.672*	-0.122
	(0.094)	(0.054)	(0.058)	(0.847)
Controls				
Age	0.994	0.761	0.683*	0.685
	(0.271)	(0.705)	(0.098)	(0.392)
Foreign tax	-0.141	-1.433*	0.654*	0.658
	(0.759)	(0.063)	(0.078)	(0.464)
NoSeg		0.173		0.079
		(0.208)		(0.463)
Intercept	-9.345***	-7.532	-10.87***	-7.906***
	(0.000)	(0.118)	(0.000)	(0.000)
No. of observations	1,633	345	5,880	1,185

Captive is a dummy variable that equals 1 for a firm-year in which a captive is used, and 0 otherwise. *Size* is measured as the natural log of the book value of total assets. *Capex* is computed as capital expenditure divided by total assets. *Opacity* is measured as the ratio of intangible assets to total assets. *Sales growth* is the percentage growth in annual sales from the prior year to the current year. *Cash* is computed as cash and short-term investment divided by total assets. *Dividend* dummy equals 1 if the company paid out dividends for that year, and equals 0 otherwise. *Leverage* is equal to the ratio of book value of long-term debt divided by the market value of equity. *Return on assets (ROA)* measures accounting performance and is equal to net income divided by total assets. *Market-to-book (MB)* is the ratio of market equity to book equity. *Price-to-earnings (PE)* is the ratio of stock price to earnings per share for the fiscal year. The *New York Stock Exchange (NYSE)* equals 1 if a firm is listed on the NYSE, and 0 otherwise. *Age* is the log of the number of years a firm's initial public offering. *Foreign tax* is a dummy variable that takes a value of one if a firm paid foreign income taxes in that year, and 0 otherwise. *NoSeg* is the number of operating segments for each self-reported firm. The model also controls for year and industry dummies at the two-digit North American Industry Classification System (NAICS) level. Standard errors are adjusted for firm-level clustering. P-values are in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Robustness Tests[16]

In response to the criticism in the literature for the use of binary choice models, a survival data set is constructed to test the robustness of the results (Berry-Stölzle and Xu, 2018; Pagach and Warr, 2011). Firm-year observations are removed from the data set once a captive is formed. A firm with a captive has a maximum of one observation with *Captive* equal to one. Firms with captives licensed before 2000 are also dropped from the sample. This survival data set facilitates the investigation into the determinants of the decision to add a captive over the sample period rather than simply the characteristics of the firms with captives. However, this approach results in both a decrease in sample size and statistical power. The study re-estimates the logistic model with this survival data set that contains 4,683 firm-year observations.

Table 8 reports the results of the logistic regression model with the survival data set. For specifications (1) and (2), the coefficients and signs of *Size* and *Cash* are like those estimated with the full sample. That is, the study finds a significantly positive relation between captive use and firm size. Firms with captives maintain lower levels of cash reserves. Two major findings stand out from the survival data set. First, the coefficients for *Cash* are approximately twice as large as those in the full sample. The implication is that firms with captives formed over the sample period hold less cash when compared with the estimates from the full sample. Second, the NYSE-listed status is not significant in the survival data set. One plausible explanation is that firms with captives formed before 2000 tend to be listed on the NYSE. In turn, firms that added captives in the 2000s are not listed on the NYSE. This may also explain a regulatory change indicated by Lai and McNamara (2004) that using captives for employee benefits has been permitted by the U.S. Department of Labor (DOL) since 2000.

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16. Most companies rely on third-party administrators (TPAs) for captive operations. There are only three companies with captives with the self-managed status in the sample. The authors have removed these three companies and re-estimated the model. The results are still consistent with the main results from the entire sample.

Table 8:
Logistic Regression Results for Survival Data Set

Variable	(1)	(2)	(3)
Operating characteristics			
Size	1.032***	0.986***	0.404
	(0.000)	(0.000)	(0.352)
Capex	-8.338	-8.061	-1.008
	(0.101)	(0.117)	(0.941)
Opacity	-1.980**	-2.103**	-3.213
	(0.039)	(0.027)	(0.245)
Sales growth	0.464	0.434	1.44
	(0.160)	(0.198)	(0.152)
Financial characteristics			
Cash	-4.280***	-4.475***	-4.870**
	(0.002)	(0.002)	(0.019)
Dividend	0.024	0.088	-1.937**
	(0.945)	(0.801)	(0.015)
Leverage	0.002	-0.014	0.0177
	(0.943)	(0.779)	(0.733)
ROA	5.385***	5.156***	2.873
	(0.007)	(0.01)	(0.522)
Market characteristics			
Market-to-book	-0.008*	-0.007*	-0.017
	(0.098)	(0.094)	(0.318)
Price-to-earnings	0.003	0.002	0.005
	(0.157)	(0.191)	(0.474)
NYSE	0.265	0.306	-0.684
	(0.391)	(0.338)	(0.270)
Controls			
Age		-0.589*	-0.0383
		(0.066)	(0.970)
Foreign tax		0.266	-0.639
		(0.388)	(0.352)
NoSeg			0.279***
			(0.004)
Intercept	-20.880***	-21.220***	-3.549
	(0.000)	(0.000)	(0.248)
No. of observations	4,683	4,683	519

Captive is a dummy variable that equals 1 for a firm-year in which a captive is used, and 0 otherwise. *Size* is measured as the natural log of the book value of total assets. *Capex* is computed as capital expenditure divided by total assets. *Opacity* is measured as the ratio of intangible assets to total assets. *Sales growth* is the percentage growth in annual sales from the prior year to the current year. *Cash* is computed as cash and short-term investment divided by total assets. *Dividend* dummy equals 1 if the company paid out dividends for that year, and equals 0 otherwise. *Leverage* is equal to the ratio of book value of long-term debt divided by the market value of equity. *Return on assets* (*ROA)* measures accounting performance and is equal to net income divided by total assets. *Market-to-book (MB)* is the ratio of market equity to book equity. *Price-to-earnings (PE)* is the ratio of stock price to earnings per share for the fiscal year. The *New York Stock Exchange (NYSE)* equals 1 if a firm is listed on the NYSE, and 0 otherwise. *Age* is the log of the number of years a firm's initial public offering. *Foreign tax* is a dummy variable that takes a value of one if a firm paid foreign income taxes in that year, and 0 otherwise. *NoSeg* is the number of operating segments for each self-reported firm. The model also controls for year and industry dummies at the two-digit North American Industry Classification System (NAICS) level. Standard errors are adjusted for firm-level clustering. P-values are in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

5. Conclusion

A captive insurance company is a wholly owned subsidiary created to provide insurance to its parent company (or companies) and meet the risk management needs of its owner(s). Captives are held by the vast majority of Fortune 500 companies as an alternative solution to risk transfer. A report by Marsh (2017) pointed out that the number of captives has grown every year since 1994 (with the exception of 1996). However, the existing literature has not explored the use of captives among large-cap, publicly traded companies.

This study investigates the general characteristics of firms that do or do not own a captive. It uses a data set of S&P 500 companies from 2000 to 2016. The analytical approach applies a logistical regression model to estimate the indicators of a firm's decision to use a captive structure. Explanatory variables are divided into operating characteristics (i.e., size, capital expenditures, opacity and sales growth), financial characteristics (i.e., cash, dividend, leverage and ROA), and market characteristics (i.e., MB, PE and the NYSE). The study also controls firm age, foreign tax payments and operating segments in the model.

This work adds value to the literature by providing evidence that firms with greater size and lower cash reserves are more likely to own a captive insurer for retained risks in logit model results. In addition, nonfinancial firms with smaller proportions of capital expenditures and intangible assets tend to use captives. The results of this research complement studies primarily concerned with the treatment of tax deductibility for the premiums paid to captives by their parent companies.

Although this study offers insight into the decision of firms to employ a captive insurance structure, there are some limitations on the inference of the results. There is a lack of full disclosure of a firm's risk management programs. This study identifies the decision to use a captive as a risk retention strategy. A company may use a mix of risk retention and risk transfer tools in its risk management program. For example, The Walt Disney Co. has formed two captives and purchased commercial insurance from third-party carriers for different types of risks.[17] A clear-cut dichotomy between risk retention and risk transfer for a company is not easy to find. Further research is needed to incorporate the details of risk-financing programs within the firm.

17. Special thanks to Stephanie Conner, a senior analyst in the Department of Corporate Risk Management at The Walt Disney Co., who presented her firm's risk management strategies at California State University, Northridge on Oct. 10, 2017.

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The Florida Insurance Market: An Analysis of Vulnerabilities to Future Hurricane Losses

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Abstract

Florida is the peak zone for hurricane risk. The authors evaluate the current vulnerabilities and risks associated with the residential property insurance system in Florida and its financial capability to respond to future hurricane events. The state's residential property insurance system is composed of private insurers and Florida's three public risk financing entities: Citizens Property Insurance Corp. (Citizens), the Florida Hurricane Catastrophe Fund (FHCF) and the Florida Insurance Guaranty Association (FIGA). The Florida residential insurance market has been transformed since the last Category 5 hurricane—Andrew—made landfall, and the current system has not been tested with a major hurricane loss. The authors used the characteristic event (CE) methodology to analyze the impacts of 20-, 50- and 100-year hurricanes on the Florida market from both a micro and a macro perspective. Using a set of realistic assumptions, the analysis illustrates and quantifies Florida's vulnerabilities to hurricane losses by estimating the numbers of private insurer insolvencies and resulting impacts on Florida's public risk financing entities for each of the hurricane scenarios.

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I. Introduction

Florida is the most vulnerable state to hurricane losses and is known as a "peak zone" (Aon Benfield, 2018).[1] Since 1900, 70 hurricanes have made landfall along the Florida coastline—one-third of the U.S. total. During this time period, two of the three U.S. landfalling Category 5 hurricanes struck Florida along with more than 40% of the Category 4 storms (NOAA, 2017).

On average, Florida is hit with a hurricane every other year. Florida has been lucky for the past two decades. The 10-year period from 2006 to 2015 with no landfalling hurricanes was unprecedented in the historical record. In the 1920s, Florida experienced 10 landfalling hurricanes, including two Category 4 storms that would each result in more than $75 billion of insured losses if they occurred today.

Figure 1 illustrates the insured losses that would be experienced today from historical Florida hurricanes. The top loss would be a recurrence of the 1926 Great Miami Hurricane that would result in insured losses of more than $128 billion—and this was a Category 4 storm.

Figure 1:
Estimated Insured Losses for the Five Largest Historical Hurricanes Affecting Florida Based on Current Exposures

Date	Event Name	Category	2017 Insured Loss
Sept. 18, 1926	Great Miami Hurricane	4	$128 billion
Sept. 17, 1928	Great Okeechobee Hurricane	4	$78 billion
Sept. 17, 1947	1947 Fort Lauderdale Hurricane	4	$62 billion
Aug. 24, 1992	Hurricane Andrew	5	$56 billion
Sept. 10, 1960	Hurricane Donna	4	$50 billion

Source: AIR Worldwide, 2017

* Modeled loss to onshore property, contents and business interruption, and additional living expenses for residential, mobile home, commercial and auto exposures as of Dec. 31, 2016, using the indexed takeup rates provided in the 2017 CATRADER release. Losses include demand surge and account for storm surge.

1. Florida is referred to as a "peak zone" in that it is considered to have the most insured concentration of risk representing the largest insured loss potential in the world. As such, it is difficult for reinsurers to diversify or offset Florida hurricane risk with other risk.

Recent events—including hurricanes Harvey, Irma and Maria—highlight the magnitude of destruction that is possible from flooding and hurricane force winds. Hurricane Irma was almost the "Big One," and Florida dodged a bullet with this storm. On Sept. 7, 2017, the meteorological forecasts were projecting Irma to make landfall near downtown Miami as a borderline Category 4/Category 5 hurricane. Had Irma taken this path at this intensity, the insured losses would have exceeded $180 billion.[2] Such an event would have caused most domestic insurers to become insolvent, and undoubtedly exhausted the capabilities of the FIGA to pay the claims of policyholders. At some point, Florida's luck will run out.

The purpose of this study is to evaluate the vulnerabilities and risks associated with the residential property insurance system in Florida and its financial capability to respond to hurricane events. The state's three public risk financing entities—Citizens, the FHCF and the FIGA—will collectively be referred to as Florida's public risk financing entities.

The authors illustrate a methodology that would enable Florida policymakers to more fully quantify the current vulnerabilities of the residential property insurance market in Florida in order to strengthen and enhance the resiliency of the system. The residential property insurance system in Florida is essentially subsidized by taxpayers, but the public is not generally aware of the potential magnitude of its financial involvement in assuming hurricane risk.

II. Review of the Literature

Very little research has been done to examine the viability of the current probable maximum loss (PML) methodology for evaluating insurer solvency, and no previous studies have evaluated the capabilities of the Florida residential property insurance system as a whole. The current system has not been tested with a hurricane loss greater than $12 billion, which is less than the insured loss Hurricane Andrew caused in 1992.

The Florida Commission on Hurricane Loss Projection Methodology (FCHLPM)[3] was created in 1995 to develop standards and to review hurricane computer models for ratemaking and PML purposes. There are currently five models that have been reviewed and found acceptable by the FCHPLM.[4] While these models are similar in structure with the same model components, the loss estimates vary widely between the models. For the most recent model submissions,

2. Estimated by Karen Clark and Company.

3. The FCHLPM is designated in Section 627.0628, Florida Statutes, as an expert panel consisting of 12 members that are designated in the law. Additional information regarding the FCHLPM can be found at *https://www.sbafla.com/Methodology/*.

4. These models were developed by the following modeling organizations: AIR Worldwide Corp., Applied Research Associates Inc., CoreLogic Inc., Florida Public Hurricane Model, and Risk Management Solutions.

the difference between the highest and lowest model-generated PMLs based on the same set of exposure data is nearly a factor of two.[5]

Not only is there significant variation in the loss estimates among the models found acceptable by the FCHPLM, but also different model versions from the same model vendor can result in widely fluctuating numbers from year to year. This is because the models are based on numerous expert judgements and assumptions.

Clark (2012) has commented that much of the volatility in the model loss estimates is due to "noise" and changing assumptions versus new science. Clark points out that models are not strictly objective tools since many assumptions are based on experts' opinions and biases rather than objective data. Weinkle and Pielke Jr., (2016) have noted model inconsistencies and consider them as "politically stylized views about an intractable scientific problem."

Although there have been criticisms of models due to volatility and inconsistencies associated with PMLs, the viability of the current PML approach for evaluating insurer solvency has not been researched extensively or tested systematically using alternative methodologies and actual insurer data. Some authors have suggested alternative PML approaches for insurance purposes (Cummins and Freifelder, 1978; Wilkinson, 1982; and Woo, 2002), as well as proposed new PML engineering approaches (Unanwa, 1997). Other authors have analyzed computer model output in terms of sensitivity, uncertainty, and validation results (Iman, Johnson and Watson 2005a; Iman, Johnson and Watson 2005b; and Pinelli, Gurley, Subramanian, Hamid and Pita, 2008), but none have attempted to quantify the impacts on individual Florida insurers or the Florida market as a whole using a comprehensive set of hurricane scenarios and a consistent methodology.

Evaluating and stress testing an insurer's exposure to various catastrophic hurricane losses is required by the Florida Office of Insurance Regulation (FLOIR) for selected companies each year.[6] This stress testing is limited and is based on the current PML methodology and a few historical hurricanes. Individual insurers' PMLs and their risk transfer program are not made available to the public. Additionally, no consideration has been given to stress testing the Florida insurance system as a whole.

Stress testing Florida's insurance system would involve comprehensive tests of Florida's public risk financing entities since their role is one of supporting the system. The state of Florida depends on these public entities[7] to provide a residual market; to prevent insolvencies; to stabilize the market, including Florida's

5. On the FCHLPM's website, see Form 8A for each accepted model in order to compare various return periods on both an aggregate and an occurrence basis.

6. See FLOIR's website at *https://www.floir.com/Sections/PandC/prepared.aspx*. In 2015, 112 insurers writing residential property insurance were subject to FLOIR's Annual Reinsurance Data Call. It was determined that "…all had sufficient reinsurance, capital, and surplus to pay for claims of their policyholders in a 1-in-100-year storm event or higher." A catastrophe stress test was performed on 67 of these insurers based on three loss scenarios. The results for 2016 and 2017 were not posted at the time of this paper.

7. As the term "public entities" is used, it also incorporates quasi-public entities which can be argued are a more correct characterization of both Citizens and FIGA.

economy; and to pay losses to policyholders if insurers fail. Given that Florida's public risk financing entities use assessments on policyholders as a source of funding, it is in the public interest to manage Florida's catastrophic hurricane risk in a transparent and comprehensive way.

A number of authors have conducted studies that point out that stress testing is used widely to identify vulnerabilities for financial systems. These studies include: Jones, Hilbers and Slack (2004); Sorge (2004); Čihák (2007); and Henry and Kok (2013). Various studies in the insurance literature consider financial solvency from the individual insurer standpoint. Examples of such studies are those by BarNiv and McDonald (1992); Cummins, Harrington and Klein (1995); Lee and Urrutia (1996); and Grace, Harrington and Klein (1998). Medders and Nicholson (2018) raise concerns about the public financing of hurricane risk in Florida and note vulnerabilities within the insurance system and their impact on its future. However, their article deals with public policy and does not involve stress testing the system or provide an illustration or example of how such stress testing can be done. No studies were found that stress tested insurance systems similar to the stress testing of financial systems as noted above.

III. Background on the Florida market

Hurricane Andrew made landfall near Homestead, FL, in August 1992. The storm caused $15 billion in insured losses and resulted in 11 insurer insolvencies (Bailey, 1999). This was a major shock to Florida's insurance system partly because prior to Andrew, the largest U.S. hurricane loss was $4 billion caused by Hurricane Hugo in 1989. The magnitude of Andrew's loss was not anticipated by insurers and reinsurers, most of whom were using simplistic premium-based methodologies to evaluate hurricane risk.

Hurricane Andrew was the impetus for major changes in the Florida insurance market, most notably:

- The expansion of the involuntary market.
- The largest U.S. property/casualty (P/C) insurers pulling back from the state.
- The creation of the FHCF to provide additional capacity for the marketplace.
- A moratorium on cancellations and nonrenewal.
- The rise of thinly capitalized domestic insurers heavily dependent on the global reinsurance market and the FHCF.

Introduction of Catastrophe Models

Hurricane Andrew also led to the widespread adoption of catastrophe models for estimating hurricane loss potential. Prior to Hurricane Andrew, most U.S.

insurers were using premiums to determine how much reinsurance to buy, and companies, for the most part, were not tracking their actual property exposures. The 1970s and 1980s were decades of relatively low hurricane activity, and the industry had become complacent even though coastal populations and property values were swelling—particularly in Florida.

The first catastrophe models were developed in the mid-1980s, well before Hurricane Andrew (Clark, 1985), but there was skepticism about this new modeling technique and no strong impetus for adoption. At the time, the insurance industry collectively assumed that the worst-case scenario hurricane would cause $7 billion in insured losses (All-industry Research Advisory Council, 1986) even though the first hurricane model projected that a Category 5 hurricane making a direct hit on Miami would cost insurers $60 billion. Few believed that number. Lewis (2007) provides a brief historical context describing the insurance industry's attitude regarding the early hurricane computer modeling results preceding and following Hurricane Andrew.

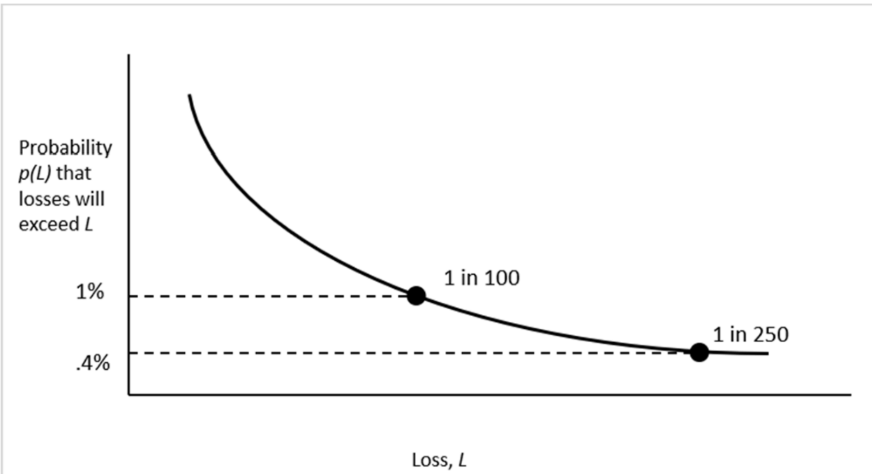
Hurricane Andrew confirmed the validity of the catastrophe models. After this event, it was easy to extrapolate that had Andrew hit 20 miles north, the loss would have been four times higher, i.e., $60 billion. Catastrophe modeling technology brought two major advancements to the industry: 1) the use of actual property values to estimate losses; and 2) the use of simulation techniques to generate many possible future events to develop a full probability distribution of losses. The primary model output is the distribution of losses, called the Exceedance Probability (EP) curve as shown in Figure 2 on page 7.

The EP curve shows the estimated probabilities (vertical axis) of exceeding losses of different sizes (horizontal axis). While a specific curve is generated by a specific model version, in reality there is significant uncertainty surrounding these numbers due to data limitations and imperfect scientific knowledge.

Uncertainty around the probabilities results from the paucity of historical data used to estimate the frequencies and severities of future events by landfall location. For example, there have been only two Category 5 hurricanes to make landfall in Florida since 1900, and both have affected South Florida. Does this mean the return period is 50 years or 100 years? What is the chance of a Category 5 hurricane making landfall near Tampa or a Category 4 hurricane near Jacksonville? These are the questions the catastrophe models attempt to answer with the development of the EP curves. Because there is so little data available, model developers must make many assumptions based on expert judgment rather than scientific facts. This is in large part why the EP curves can differ so significantly between modeling companies and between model versions from the same company.

Uncertainty around the loss stems from the fact that engineers and modelers face uncertainties about how different types of structures will respond to various wind speeds. There are other factors affecting the losses as well, such as demand surge and assignment of benefits (AOB).[8] AOB has been an ongoing problem that has resulted in increased claim costs in Florida.

Figure 2:
Illustration of EP Curve



Despite the uncertainty in the EP curves and the widely differing numbers that result, the industry has gravitated to one point on the curve—namely, the 1% loss exceedance, more commonly known as the 1 in 100-year PML. This number is used by the rating agency Demotech to assign financial strength ratings to Florida insurers and by the FLOIR for solvency tests. Essentially, insurers in Florida are expected to buy reinsurance up to their 1 in 100-year PML.

From a regulator's perspective, the primary issue in relying on the PML is that it does not provide a consistent yardstick for comparing insurers. As explained previously, the PML can differ by a factor of two for the same insurer depending on which model is used. Also, there are various levers and secondary modifiers that have a significant impact on loss estimates that can be turned on or off by individual insurers. Additionally, because most of the models used to generate the PMLs are proprietary to the model vendors and "black boxes" to the model users, the PML does not provide a transparent yardstick. And because model versions can change significantly, the PML does not provide a stable currency. Therefore, the PML lacks the three things crucial to a regulator for a robust rating methodology: 1) consistency; 2) transparency; and 3) stability.

8. Demand surge refers to the surge in prices when materials and labor are in short supply following a catastrophic event. AOB refers to a legal situation where benefits are assigned to a third party, which, if abused, may unnecessarily inflate claims costs and the ultimate losses following an insured peril.

The PML can also mask exposure concentrations and give insurers a false sense of security. The PML shows the loss amount for which an insurer has a 1% chance of *exceeding in a year.* Over a 10-year period, an insurer has almost a 10% chance of exceeding this loss amount (exposures held constant). The PML gives no insight into where or by how much the PML will be exceeded. In fact, insurers trying to "optimize" their PMLs to a particular model version may end up building unknown exposure concentrations in areas where that model has a "miss" or bias. These exposure concentrations can easily lead to insolvencies resulting from losses that far exceed the PMLs. While PMLs generated from the catastrophe models are far better than the methods used prior to Hurricane Andrew, the PMLs do not provide enough information to ensure a stable and efficient residential property insurance market, particularly in Florida—the most hurricane-exposed state.

Changes in the Florida Residential Property Insurance Market Since Hurricane Andrew

Since Hurricane Andrew, the Florida residential property insurance market has been transformed. Much of the business previously written by large national insurers has shifted to the less capitalized Florida domestic insurers, who are heavily dependent on both the FHCF and the private risk transfer market for their financial viability. At the time of Andrew, approximately 288 insurers (Florida Department of Insurance [DOI], 1993) wrote residential property insurance business in the state. However, Allstate and State Farm, two large insurer groups consisting of four companies—Allstate Indemnity Company, Allstate Insurance Company, State Farm Fire and Casualty Company, and State Farm General Insurance Company—wrote more than 50% of the Florida residential property insurance by the number of policyholders (2,347,139 out of 4,463,054 total policyholders).[9] The population in Florida was 13.93 million in 1993 and had grown to an estimated 21 million by 2017. In 1993, the Allstate and State Farm companies collectively had a policyholder surplus of $8.87 billion ($15.4 billion adjusted to 2017 dollars). Operating today as Florida-based subsidiaries of their parent companies, State Farm Florida Insurance Company, Castle Key Indemnity Company and Castle Key Insurance Company have a combined surplus of $1.47 billion and a 7.5% market share by number of policyholders.[10]

9. The authors adjusted the data because commercial property insurance was reported as one number and did not separately break out the number of policies for commercial residential property insurance policies. The authors make the assumption that the residential portion is 10% of the total reported commercial property insurance policyholders.

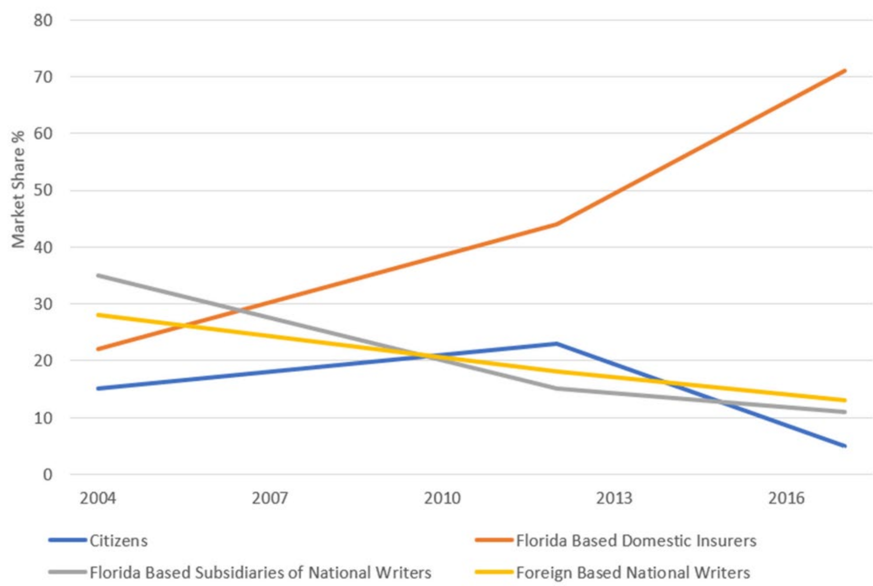
10. As reported in Florida Office of Insurance Regulation (2017), State Farm Florida Insurance Company's surplus at Dec. 31, 2016, was $1,083,656,557, and the surplus for the Allstate subsidiaries were $13,683,768 for Castle Key Indemnity Company and $370,460,752 for Castle Key Insurance Company.

According to Citizens (2017), insurers participating in the market can now be characterized as:

- Citizens with a 5% market share.
- Florida-based domestic insurers with a 71% market share.
- Florida-based subsidiaries of national writers with a 11% market share.
- Foreign-based national writers with a 13% market share.

Figure 3 illustrates the increase in market share of the Florida-based domestics since 2004.[11]

Figure 3:
Florida Residential Property Insurance Market Share Percentage Changes by Policyholder Count



Source: Citizens Market Share Report, June 30, 2012, and Sept. 30, 2017

Over time, the Florida-based domestics have taken over a larger and larger share of the market, but their surplus and financial strength is only a fraction of that compared to the national writers. As of calendar year-end 2016, the total policyholder surplus of 62 Florida-based domestics comprising more than 70% of the residential market was reported as $5.2 billion. Citizens reported a surplus of

11. The data in the figure represents three data points as of June 30, 2004; June 30, 2012; and Dec. 31, 2017.

$7.4 billion, and the Florida-based subsidiaries of national writers reported a surplus of more than $1.5 billion. The foreign-based national writers had a combined surplus of $158.2 billion, but they will only be responsible for about 13% percent of hurricane losses (FLOIR, 2017).

Florida's Public Risk Financing Entities

What is common to all of Florida's public risk financing entities is that they involve insurance premium assessment mechanisms that function to essentially tax the public to finance losses. These entities do not rely on private capital, and they do not earn profits as a result of taking insurance risk.

Citizens operates as the state's residual insurer for residential property insurance risk.[12] The FHCF operates as a type of mandatory state-administered reinsurer and is designated in Florida Statute as a state trust fund under the State Board of Administration (SBA).[13] FIGA is a nonprofit corporation with the purpose of paying claims of insolvent P/C insurance companies ordered to be liquidated by a court of competent jurisdiction.[14]

IV. Discussion of Vulnerabilities

Potential Hurricane Losses

Understanding the consequences of varying size hurricane losses on the state is crucial for Florida policymakers. According to the FHCF,[15] Florida has $2.2 trillion of residential property insurance exposure, and based on the state's expected hurricane frequency, it is only a matter of time before a large destructive hurricane strikes. The current system has not been tested against a large loss or even a repeat of Hurricane Andrew, which would cause $50 billion to $60 billion today according to the catastrophe models. While significant gains have been made since Hurricane Andrew, the hurricane loss potential grows every year as property values increase and the Florida residential insurance market remains highly vulnerable to the hurricane threat.

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12. See Citizens' website at *https://www.citizensfla.com/* and refer to Section 62.351(6), Florida Statutes for additional detail regarding Citizens operations.

13. See the FHCF's website at *https://www.sbafla.com/fhcf/* and Section 215.555, Florida Statutes for additional information regarding the operations of the FHCF.

14. See FIGA's website at *http://www.figafacts.com/home* and Section 631.50, Florida Statutes for more information regarding FIGA.

15. See the FHCF's 2018 Ratemaking Formula Report at *https://www.sbafla.com/fhcf/Portals/FHCF/Content/AdvisoryCouncil/2018/20180613_Final2018FHCF_RatemakingFormulaReport_RI.pdf?ver=2018-06-14-134647-403*.

Reinsurance/Risk Transfer Market Volatility

Hurricane Andrew resulted in a lack of reinsurance capacity following the cutback or withdrawal of many reinsurers from the Florida market. The FHCF was created in 1993 primarily to solve the problem of uncertain reinsurance capacity following large hurricane events. In 2006, a different problem arose due to the spike in reinsurance costs following 2004 and 2005 when eight hurricanes affected the state, illustrating that even if the insurance system in Florida can handle one or several multibillion-dollar hurricanes, risk transfer markets can be highly volatile following such events. In light of market disruptions associated with reinsurance underwriting cycles, the state has routinely enacted major legislative initiatives following large hurricane events.

Financial Markets Vulnerabilities

Florida's public risk financing entities face vulnerabilities with regard to the volatility of the financial markets. Their claims-paying abilities depend on their ability to timely issue debt in anticipation of the exhaustion of existing resources. A large hurricane event could result in all three entities needing to issue debt. Since they have the same or overlapping assessment bases, it is possible that they may have to access the financial markets during the same time period. This could create a situation in which all three are competing for a limited amount of capital, thus resulting in a "clash financing problem," which could result in one or more of the entities failing to meet its overall mission and its obligations to policyholders.

Another vulnerability associated with limitations in the financial markets is the inability of the FHCF to finance capacity for a subsequent season after a large loss wipes out the FHCF's initial season's claims-paying resources. Under this scenario, if the FHCF cannot finance up to its statutory limit of coverage by its issuance of revenue bonds, insurers may need to replace a substantial portion of the FHCF's capacity with private reinsurance at a substantially higher cost. The FHCF's inability to maintain capacity in the insurance market could result in volatile pricing and in the lack of insurance availability for residential property insurance policyholders. A shortage of FHCF capacity for a subsequent season has been a concern for several years (Musulin, 1999). In the last 10 years, the FHCF has estimated that it would only be able to issue revenue bonds for $7 billion to $8 billion for an initial season and then have a more limited capability to finance coverage in a subsequent season if its liquid resources were wiped out. The FHCF's October 2017 Claims-Paying Capacity Estimates Report indicates that its subsequent season capacity would have been $11.2 billion—a potential drop-off of $5.8 billion (Raymond James, 2017).

The 2007–2008 financial crisis was a reminder that financial markets are cyclical and that a market crash is not uncommon (Mitchell, 2015). In the last 100 years, there were six major financial market crises: 1) the stock market crash of 1929; 2) the 1973 Organization of the Petroleum Exporting Countries (OPEC) oil embargo; 3) the early-`80s recession from 1981–1982; 4) the Black Monday stock market crash in 1987; 5) the dot-com crash in 2001; and 6) the Great Recession in 2008. According to Mitchell, this has prompted some economic observers to speculate that a financial crisis now can be expected every seven years. While this may be an overestimate, historically, financial crises have been more frequent than a Category 5 U.S. land falling hurricane. The combination of a large hurricane occurring in the middle of a financial crisis could result in serious consequences for the state.

Insurers that are required to participate in the FHCF also face a vulnerability regarding their statutory ability to rely on the FHCF's claims-paying estimates. The SBA is required by law to estimate and publish the FHCF's claims-paying capacity twice a year—once in May and again in October of each contract year.[16] These estimates are important from an insurer's standpoint in that they help determine FHCF coverage and are necessary in structuring financial resources for paying catastrophic hurricane claims.

If the FHCF cannot fund its statutory limit of $17 billion, it is only obligated to its actual claims-paying capacity regardless of the amount of capacity that it estimates. The task of accurately estimating the FHCF's claims-paying capacity is challenging at times, and the results may not be reliable. The larger the liquid assets available for paying claims, the less post-event bonds would be immediately needed, and less financial market risk would be involved in the timely reimbursement of claims. The FHCF's cash balance, reinsurance, pre-event bonds or other financial products can be used to enhance liquidity. A liquidity position of $17 billion would, for all practical purposes, eliminate the risk since no immediate debt would need to be issued to fund the FHCF's claims-paying capacity.

Other Vulnerabilities

As Florida-based domestic insurers have grown their market share in recent years by taking policies out of Citizens, FIGA has been forced to re-evaluate its risk and determine its potential liabilities. One issue that FIGA faces is managing its risk associated with insolvent insurers that have large books of condominium units. Having data on the insured values of condominium units would be beneficial for evaluating FIGA's potential liabilities associated with a large catastrophic hurricane event. FIGA has not been tested with a Category 5 hurricane hitting a major population area or areas of the state since Hurricane Andrew. Thus, FIGA's greatest vulnerability is the lack of data for evaluating its potential obligations as a result of a catastrophic hurricane. Today, the state is relying heavily on debt issuance and the risk transfer market in lieu of policyholder surplus protection. Such high leverage has resulted in increasing vulnerabilities to Florida's residential property insurance system.

Florida's public risk financing entities each have common and unique vulnerabilities. As a market of last resort, Citizens' size and manner of operations

16. See Section 215.555(4)(c)2., Florida statutes.

have made it an attractive target for litigation. Since Citizens is considered a public financing entity ultimately backed by bonding and emergency assessments on a broad base of P/C policyholders, public policy dictates that greater safeguards be put in place to protect the public from abuses.

V. Impact of Catastrophic Hurricanes: Examples and Analysis

To quantify the current vulnerabilities of the Florida market, a two-part study was conducted. The first part focused on 62 Florida-based domestic companies and estimated for each insurer the financial impacts from a set of realistic hurricane events.[17] The second part of the study examined how Citizens, the FHCF and FIGA would respond to the same set of events. [18]

Study Methodology

The set of hurricane events was selected to provide meaningful comparisons between insurers. Landfall points were positioned at 10-mile increments along the entire Florida coastline. At each landfall point, the characteristics of three types of hurricane were defined: the 20-, 50-, and 100- year hazard probability events. Note that for this study, the authors did not select extreme scenarios, such as 250- or 500-year events. The intent of this study is to investigate vulnerabilities of the Florida residential property insurance market with respect to hurricanes having a reasonable likelihood of occurring.

Because hurricane risk changes along the Florida coast, the event characteristics must vary by landfall point in order to keep the hazard probability the same. For example, the 100-year hurricane in Southeast Florida is a Category 5 hurricane, but in parts of Northeast and Northwest Florida, it is a Category 4 storm. Likewise, the 20- and 50-year hurricane characteristics vary by region within Florida.

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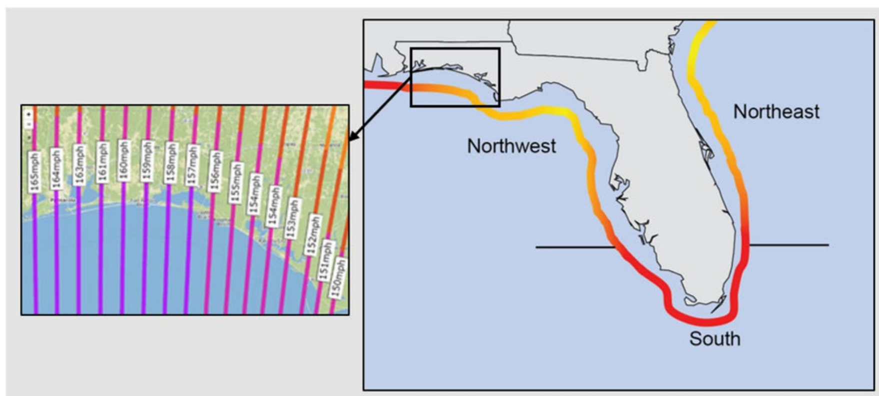
17. Though hurricanes can result in flooding, this analysis focuses on wind losses given that very little flood coverage is written by private insurers in Florida. For example, in 2017, the National Association of Insurance Commissioners (NAIC) shows only $84.5 million of net written premiums for flood coverage compared to $9.52 billion in net written premiums for residential property. This represents less than 1% of total net premiums written.

18. Florida-based domestic insurers that did not report policyholder data by county to FLOIR or ones that had incomplete data were not used in the analysis. State Farm Florida Insurance Company was the only significant insurer (having a 6% market share by total number of policies in force) that was not included in the analysis since it does not report Quarterly Supplemental Reporting (QUASR) data by policyholder count by county to FLOIR. Thus, 62 Florida-based domestic insurers out of a total of 64 were used for the first part of the study. All other insurers (excluding State Farm Florida Insurance Company) that participated in the FHCF were used for the second part of the study.

With respect to hurricane hazard, Florida can be divided into three distinct regions as shown in Figure 4: 1) Northwest; 2) South; and 3) Northeast. Within the Northwest and Northeast regions, the hazard probabilities change along the coast as indicated by the color of the coastline—red indicating a stronger (higher wind speed) event.

There are 111 10-mile spaced landfall points, and the characteristics of each event have been derived through extensive analyses of the historical data and the use of expert meteorological judgment. Following the CE methodology described more fully in Karen Clark and Company (2014), there is a smooth transition in storm track and wind speed between the landfall points. This ensures that all sections of the coastline are handled consistently.

Figure 4:
Florida Divided into Three Regions



As long as the events are credible from a meteorological perspective, the exact parameters selected for each storm are not critical for the analyses. What is important is that the *same* comprehensive set of storms is applied to each insurer. This is the only reliable way insurers can be compared with respect to hurricane vulnerability and financial solvency. A follow-up study could test the sensitivity of the results to a different set of events.

It should be noted that none of the events has a peak wind speed that has not been observed historically. The maximum peak wind for the 100-year event in South Florida is 165 mph—equivalent to Hurricane Andrew's peak winds at landfall. Therefore, all the events represent hurricanes that could easily occur in the future.

The loss estimates for this study were generated using the Karen Clark and Company (KCC) high-resolution hurricane model. The structure of this model is identical to the traditional catastrophe models, and all model components are developed using the same scientific data sources. The KCC hurricane model produces all the same output as the traditional models, including PMLs and annual average losses (AALs). In addition to the traditional EP curve metrics, the KCC model produces loss estimates for different return period events—the CEs.

Obtaining and preparing the exposure data

The data used for this study was the personal and commercial residential policy data obtained from the FLOIR. This data included for each insurer total policies and insured values by county as of December 2016.[19] In order to analyze the data, the KCC industry-wide property exposure database (KPD) was used to distribute the county-level data to five-digit ZIP code resolution that could be run through the hurricane model. Along with distributing the insured values, assumptions were made with respect to the coverage amounts, construction types and deductibles. Appendix A includes a detailed description of the assumptions used for this analysis.

In order to test the robustness of the methodology, the loss estimates obtained based on the ZIP code data were compared to the loss estimates obtained based on geo-coded street address data for several companies for which the higher resolution data were available. Appendix B shows the results of those comparisons that serve to validate the acceptability of the process for this study.

Overview of individual insurer analyses and assumptions

For each Florida insurer, the losses for the 333 hurricanes in the 20-, 50-, and 100-year CE event sets were estimated. A fully probabilistic loss analysis was also conducted for each insurer to estimate the EP curve and the 100-year PML.

To estimate the impact of each event on insurer solvency, it was assumed that each insurer buys risk transfer protection up to 75% of the KCC model-generated 100-year PML. As was discussed earlier in this paper, different insurers use different models for estimating the PMLs, and there are significant differences between the models. The KCC hurricane model PMLs tend to be above the midpoint of the range. Therefore, 75% of the KCC PMLs will be close to the average PML for the five models found acceptable by the FCHLPM. While this assumption will not be correct for every insurer, it should not bias the results. For the insurers for which their reinsurance programs are known, two purchased more reinsurance than this assumption, and three purchased less.

Private reinsurance retentions were set at the minimum of 10% of surplus or the FHCF retention amount. Rating agency guidance indicates Florida insurers should have a retention equal to 15% of surplus or less. Companies for which their retentions were publicly available had an average retention of 10% of surplus. For several insurers, their private reinsurance programs were publicly available, and a subset of these results will be illustrated on an anonymous basis. The surplus figures were taken from the 2016 year-end numbers as reported in FLOIR's 2017 annual report.

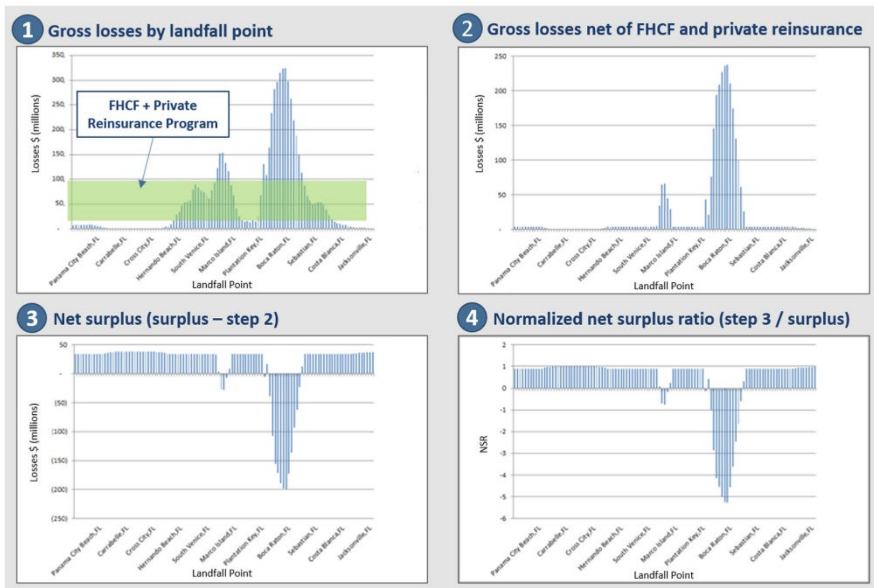
19. This analysis uses individual insurer data. We acknowledge that some Florida insurers are members of groups and that the possibility exists that insurers could receive cash infusions from group members to cover losses. It is also possible that the use of single-state insurers to conduct business in particular areas is a strategic business decision made for the purpose of protecting the group from a particular exposure or catastrophic loss. Since there is no requirement to bail out a group member and Citizens and Florida-based domestic insurers account for 76% of the market share, we do not include this option in the analysis.

For each insurer, the following was calculated:

- Gross losses for each CE.
- 100-year PML.
- Recoveries from the FHCF.
- Recoveries from private risk transfer programs.
- Surplus minus net losses.
- Normalized solvency ratio (NSR).

The NSR was calculated as described in Figure 5.

Figure 5:
Calculation of Normalized Solvency Ratio (NSR)



The NSR is the rate adjusted normalized net surplus ratio for all the 100-year events.[20]

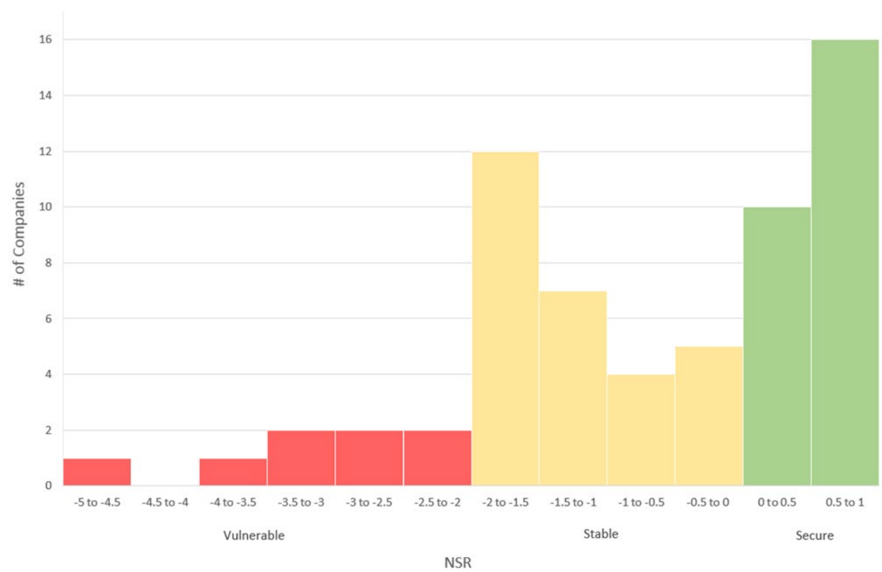
20. The authors did not include an adjustment amount to account for regulatory minimum surplus requirements given the varying amounts by company and the fact that overall such amounts would be insignificant relative to the magnitude of the catastrophic hurricane losses being modeled. Such treatment overall will not result in a bias toward greater insolvencies. See Section 624.408(1)(f)-(i), Florida statutes regarding the surplus requirements of Florida-based domestic insurers writing residential property insurance. The minimum required surplus is $15 million but is phasing in for insurers that have held a certificate of authority before July 1, 2011. The phase-in ends after July 1, 2021.

$$NSR = \sum_{i=1}^{n}\left(Normalized\ Net\ Surplus_{FL\ 100\ Event_i} * \left(\frac{Event\ Rate_{FL\ 100\ Event_i}}{\sum Event\ Rate_{FL\ 100\ Event_i}}\right)\right)$$

Results for Insurers

Figure 6 shows the distribution of NSRs for the Florida domestic insurers. An insurer with an NSR > 0 has an expected positive surplus from the 100-year events. As the NSR becomes more negative, the insurer has a higher probability of insolvency from a 100-year hurricane.

Figure 6:
Number of Florida Insurers by NSR Band



The NSR illustrates the wide disparity between Florida insurers. Twenty-six (42%) have positive NSRs and can be considered the most financially secure domestic insurers. On the other extreme, eight insurers (13%) have NSRs of -2 or less, indicating a relatively high likelihood of experiencing insolvency from a hurricane. All these insurers are rated "A" or better by Demotech. This information indicates that the Demotech rating methodology, which relies heavily on the PMLs, does not sufficiently differentiate insurers with respect to financial stability.

The study results can be presented in another way to further illustrate these points. Figure 7 on page 19 shows the losses from the 20-, 50- and 100-year hurricanes (vertical axis) by landfall point (horizontal axis), commonly referred to as the CE profile. The highest bars indicate where the insurer has exposure concentrations and is most vulnerable to hurricane landfalls. The amount of reinsurance (private plus FHCF) and surplus available for the three Florida insurers is shown by the dotted line. Note that for these insurers, the private risk transfer program is known.[21] The numbers have been disguised but scaled consistently to show the relationship between risk transfer program plus surplus to the loss potential for each insurer.

A positive NSR means that an insurer's risk transfer program plus surplus will likely protect the company from all the 20- and 50-year events and most of the 100-year hurricanes. By contrast, an NSR below -2 indicates an insurer can just barely cover the losses from the 20-year hurricanes. To reiterate, the risk transfer programs and surplus for these companies are known, and all three are rated "A" by Demotech despite the very different risk profiles.

The study results also imply that the current FLOIR stress tests based on three historical hurricanes are not comprehensive enough to identify insurers that are vulnerable to hurricane losses. This analysis indicates that there is clearly a subset of highly vulnerable Florida insurers. Thus, consumers should have more reliable information on financial stability before selecting an insurer in Florida.

More comprehensive stress tests along with an improved insurer rating agency methodology would strengthen the Florida residential property insurance market. Accurately identifying the most vulnerable insurers gives those insurers the incentive to improve their underwriting and risk management practices. This would significantly enhance the resiliency of the Florida market and lessen the probability of financial stress on FIGA and ultimately the Florida taxpayers from future hurricanes.

Results for Florida's Public Risk Financing Entities

The second part of the study examined the impacts of the 20-, 50- and 100-year hurricanes on Citizens, the FHCF and FIGA.

Citizens

Notably, Citizens is financially secure due in large part to the amount of its surplus. Citizens Coastal Account has an NSR of 0.71, and Citizens Personal Lines Account (PLA)/Commercial Lines Account (CLA) has an NSR of 0.73, among the highest of all Florida insurers. Figure 8 on page 20 shows the 20-, 50- and 100-year CE profiles for Citizens PLA/CLA and Citizens Coastal Account (CA).

21. Note that the NSR of -7.93 is the result of the computation using an actual insurer's reinsurance program. Figure 6, which is based on the authors' estimates of reinsurance programs, does not indicate any NSRs below -5.

Figure 7:
CE Profiles for Three Florida Insurers

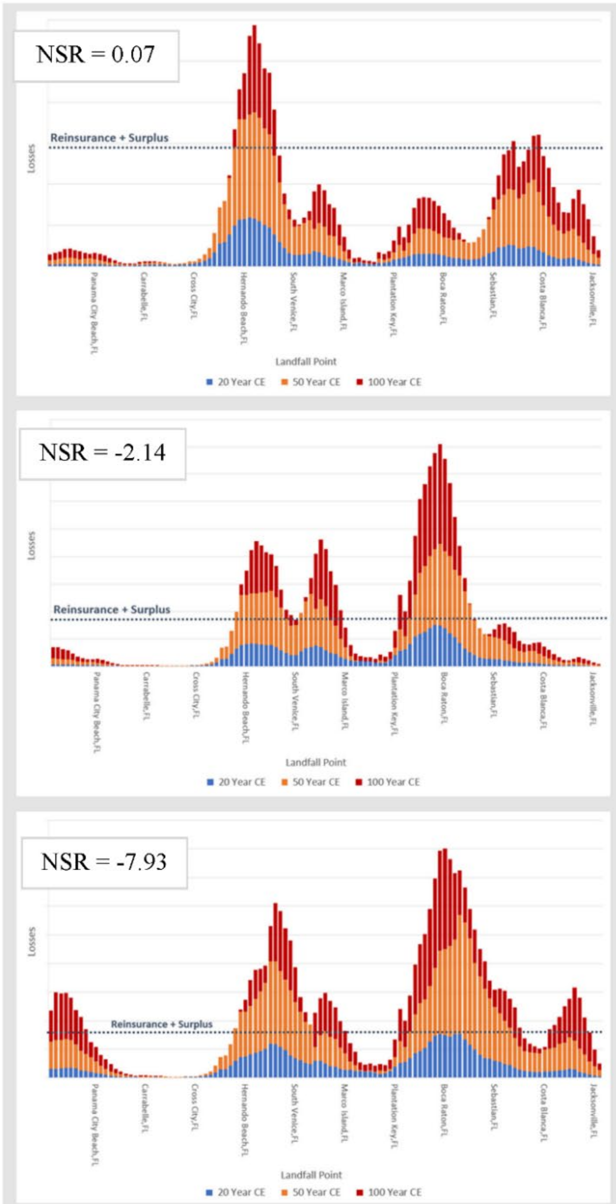


Figure 8:
Citizens CLA/PLA Profile

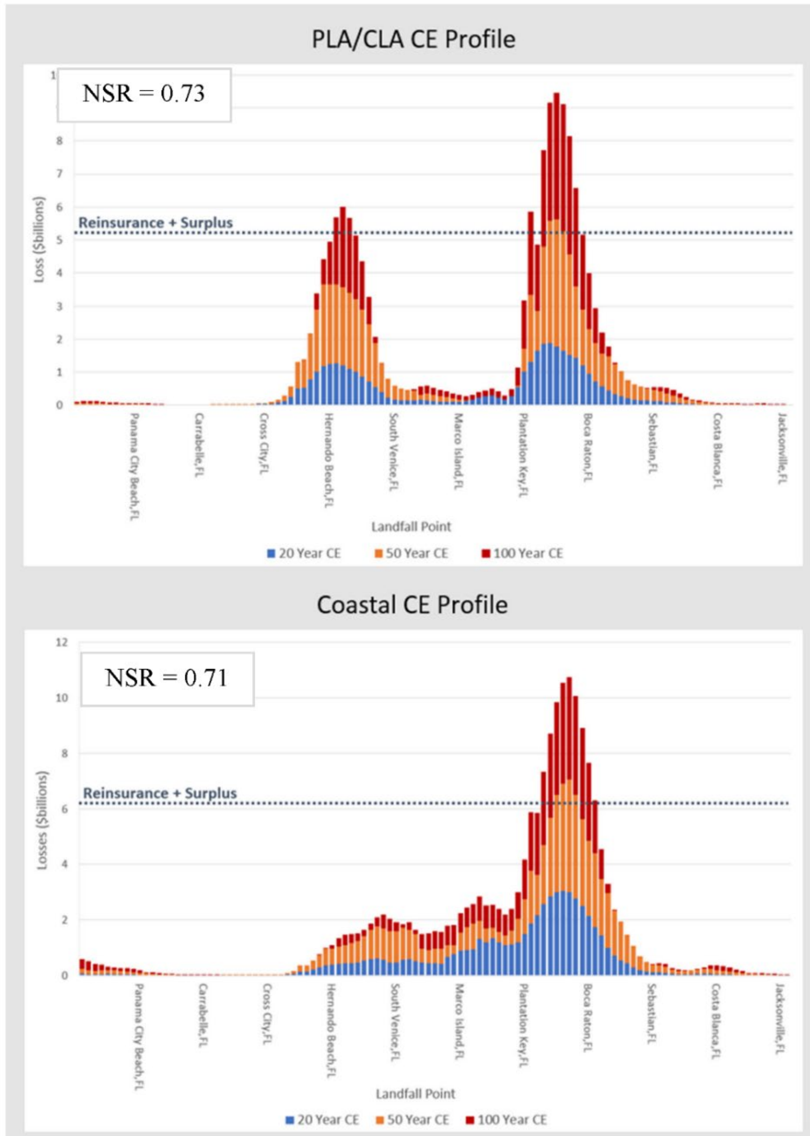


Figure 9:
Coverage and Retention Multiple

Coverage Level (%)	Retention Multiple
90	5.1028
75	6.1234
45	10.2056

FHCF

To estimate the FHCF payout for each CE, the FHCF coverage level, coverage amount and retention were first calculated for each participating insurer. More specifically, the coverage level and FHCF reimbursement premium reported by each company under the 2017–2018 FHCF annual reimbursement contract was obtained. Pursuant to the contract, each participating insurer's retention is calculated as the FHCF reimbursement premium multiplied by the retention multiple outlined in Figure 9.

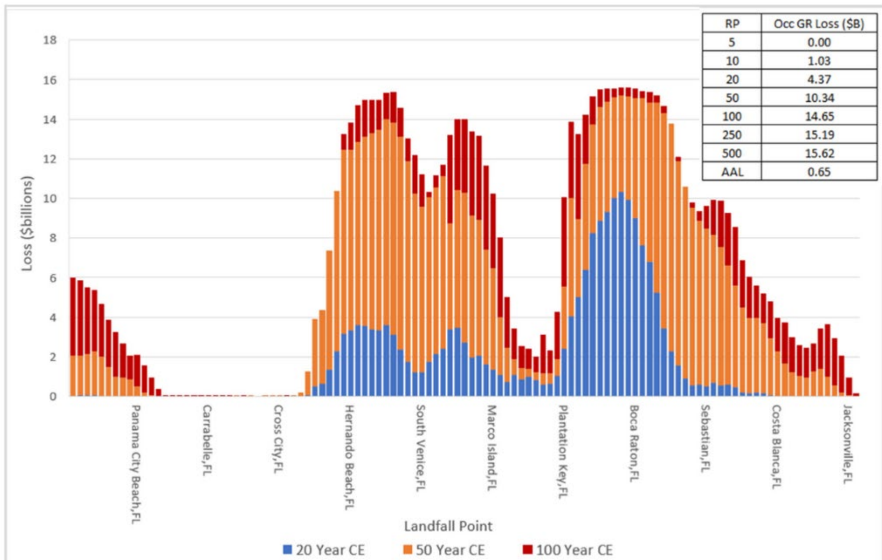
Each insurer's coverage amount is calculated as 14.9294 (the payout multiple) multiplied by the insurer's reported FHCF reimbursement premium. The FHCF recovery for each participating insurer was estimated for each event, and the cumulative FHCF payout by event was estimated as the sum of FHCF recoveries for each participating insurer. Figure 10 on page 22 shows the FHCF payout by event, by landfall point.

The FHCF's statutory maximum limit for the 2017–2018 reimbursement contract year is $17 billion. From the FHCF's CE profile, it can be noted that a one in 500-year loss is not expected to exhaust the FHCF's maximum limit, but would exhaust only $15.62 billion of the $17 billion limit.[22] For the FHCF's statutory limit

22. State Farm Florida Insurance Company was not included in this analysis, but represents a 6% market share by number of policyholders. Therefore, the authors made an exaggerated assumption to test if the results would be similar if the company had been included. The authors assumed that State Farm's losses resulted in the company's entire limit of FHCF coverage or $384 million being paid out for each and every Florida landfall event. This was overly conservative to determine how the AAL and the various return times might be affected. The results showed that the AAL would increase from 0.65 billion to 0.95 billion, and the one in 500-year PML would increase to $16.03 billion from $15.62 billion. This helps confirm that the probabilities for the higher layers of FHCF coverage being exhausted are extremely low.

to be exhausted, all participating insurers would need to exhaust their FHCF coverage limit; this would appear to be a highly unlikely occurrence. Additionally, this result implies that the cost of risk transfer products should reflect the FHCF's lower probabilities at the upper layers of coverage. The methodology used here illustrates an improvement over the crude methodology that has been used historically to price FHCF risk transfer coverage.

Figure 10:
FHCF CE Profile



FIGA

The study results can be used to quantify the numbers of insurers likely to become insolvent under different industry loss scenarios. Since most of the Florida insurers are highly dependent on reinsurance, the authors define insolvency as having a loss exceeding the insurer's risk transfer program. Figure 11 on page 23 shows the expected number of insolvencies by industry loss.

These numbers were calculated by first determining how many insurers would likely become insolvent from various size industry losses at each landfall point. Then, the average number of insolvencies for each industry loss range was calculated. The average was used because the number of insolvencies varies by landfall point.

The results indicate that at an industry loss size between $50 billion and $75 billion, 20 Florida insurers could become insolvent. This number is notable because most models agree that Hurricane Andrew would cause $50 billion to $60 billion if it occurred today. This means that more companies would become insolvent today than in 1992 from an Andrew-size loss. It is important to note that not all $60 billion events would cause 20 insolvencies. The number of insolvencies depends heavily on where the hurricane makes landfall.

Figure 11:
Companies Exceeding Risk Transfer Program

Industry Loss Range ($B)	# of Companies Exceeding Their Reinsurance Programs
< 25	0
25 to 50	11
50 to 75	20
75 to 100	37
> 100	48

Once a company is insolvent, most[23] of the unpaid losses are passed to FIGA and can be calculated for each event as:

$$\sum_{i=1}^{n}(Event\ Loss_i - FHCF\ Recovery - Private\ Reinsurance\ Limit - Surplus)$$

Where:
n = number of insurers insolvent for that event

Not surprisingly, FIGA is most exposed to hurricane landfalls near Miami, as noted from Figure 12 on page 24, where event losses can exceed risk transfer programs by several multiples. In extreme cases, the FIGA's debt obligations can exceed $40 billion. However, FIGA is limited in its statutory authority to fund insolvencies.[24] A hurricane event on the order of Hurricane Andrew could exhaust its financing capabilities (Florida Guaranty Insurance Association, 2018).[25] Results

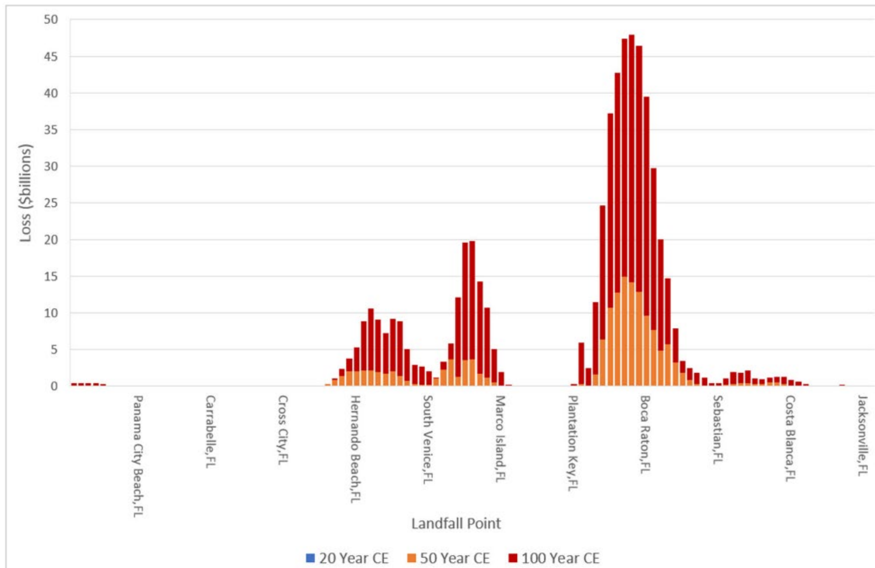
23. For example, residential homeowner policyholder recoveries are limited to $500,000 for structure and contents claims, and a $100,000 limit is applied to condominium units.

24. See Section 631(3)(a)-(f), Florida statutes.

25. FIGA has levied regular assessments 10 times and emergency assessments six times in the last 22 years for a total amount of $1.7 billion. Since 2004, 31 insurers have become insolvent, with more than 73,000 claims costing an estimated $1.8 billion, but no bonding has been required. The assessment base is $18.4 billion (made up of 17 different P/C lines of insurance), and FIGA's current emergency assessment authority would support $2 billion in bonding. The civil case for bond validation purposes (Florida Insurance Assistance Interlocal Agency v. The State of Florida,

of the analysis indicate that it does not take a one in 100-year event to stress FIGA's capabilities to the limit. FIGA is vulnerable to the potential volatility of the financial markets following an event and by its limited assessment authority.

Figure 12:
FIGA Debt Profile



The authors of this study also assume that the policies from the insolvent insurers will be renewed by Citizens post-event.

At its maximum historical policyholder count, Citizens had almost 1.5 million policies in its combined PLA/CLA and CA. At the end of 2017, the combined policy count was 440,406. Figure 13 on page 25 illustrates that there are a large number of one in 50-year hurricanes that could result in the repopulation of Citizens to its historical maximum policy count. Additionally, a number of the one in 50-year hurricane events could result in a surge of policies by inundating Citizens with an extra 1 million policies or more, far surpassing the historical record. For certain landfall locations, a one in 100-year hurricane event could result in the Citizens policy count exceeding 4 million policyholders, which represent about two-thirds of all policyholders in the state. Citizens, FIGA and the entire Florida residential property insurance market are highly vulnerable to insurer insolvencies, which could arise from moderate to large hurricane events that are not extreme, but that could easily occur in the future.

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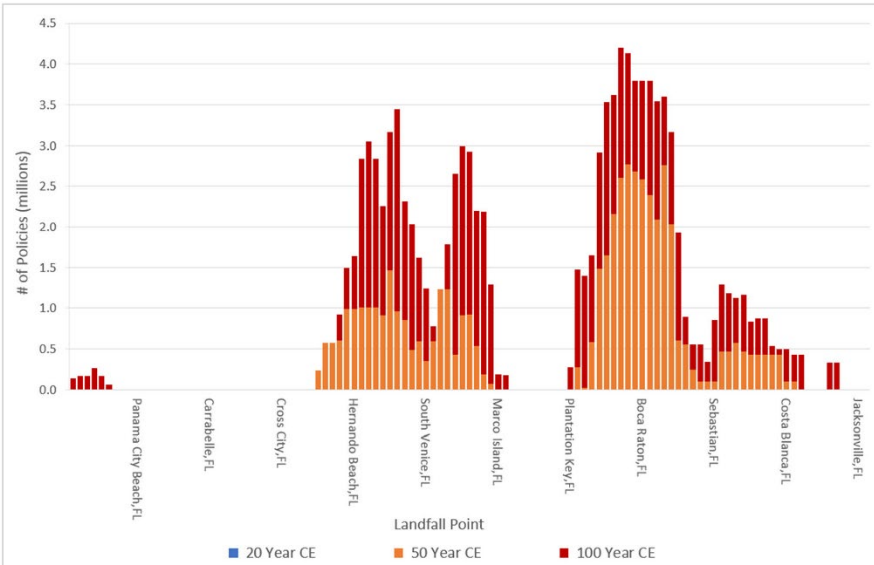
et al, 2008) served to validate the issuance of up to $750 million of revenue bonds by FIGA. FIGA can use its regular assessments of 2% or $386 million annually to pay its claims as well.

Figure 13:
Policies to Citizens from Insurer Insolvencies



VI. Summary and Conclusions

This paper has shown the state of Florida is highly vulnerable to hurricanes, not just extreme hurricanes, but from hurricanes that have characteristics of those that have occurred in the past and are likely to occur in the future. The authors conducted a two-part study—one from a micro perspective and the other from a macro perspective. The micro perspective included the analysis of 62 Florida-based domestic insurers. The macro perspective examined Florida's public risk financing entities (Citizens, the FHCF and FIGA) to assess the impact of hurricanes on the residential property insurance system as a whole. The analyses were conducted using publicly available information on private insurers in Florida, data from the FHCF and Citizens, and a high-resolution hurricane model and industry database of property values. A transparent and consistent set of hurricane scenarios was applied to each insurer using the CE methodology. For the analyses, the 20-, 50- and 100-year hurricane events were used in order to represent scenarios with a reasonable likelihood of occurring.

Each private insurer in Florida has a unique geographical distribution of property values and will be affected by the scenarios differently according to the hurricane landfall location. In order to compare insurers across all events, an NSR was calculated based on the average difference between the scenario loss and the insurer's surplus plus risk transfer protection. A positive NSR indicates the surplus and risk transfer is enough to cover all 20- and 50-year events and most of the 100-year event losses. An NSR below -2 indicates the insurer will barely cover the 20-year event losses and is much more likely to be financially impaired from a hurricane. The analysis revealed a wide range in the NSRs, indicating disparities in financial solvency that are not being captured by the rating methodology of Demotech or the FLOIR stress tests. Among the Florida insurers rated "A" by Demotech, 26 (42%) have positive NSRs, indicating that they are among the most secure, while eight (13%) have NSRs below -2. The 62 Florida-based domestics had a combined surplus of only $5.2 billion at year-end 2016 and were writing 71% of the policyholders in the state. In contrast, Citizens writes only 5% of the market with more than $7 billion in surplus. Citizens is among the most financially secure insurers when compared to the Florida-based domestic insurers. Citizens' NSR ratio for its PLA/CLA is 0.73, and for its Coastal Account, it is 0.71.

The findings from the analysis can be used to calculate the number of insurers likely to become insolvent under various loss scenarios and the potential impact on FIGA. Interestingly, a repeat of a Hurricane Andrew-sized loss today ($50 billion to $60 billion) would result in more insurer insolvencies than occurred in 1992. For an industry loss from $25 billion to $50 billion, the expected number of insolvencies is 11. For a loss between $50 billion and $75 billion, the expected number of insolvencies is 20. FIGA is limited in its ability to finance the losses for these insolvencies. The authors found that FIGA's debt profile based on hurricane losses and resulting insolvencies could result in the need to issue more than $40 billion in debt. To put this number in perspective, FIGA's net assessments since inception in the late 1960s have totaled $2.3 billion. All guarantee fund net assessments in the U.S. since inception have totaled $17 billion (FIGA, 2018).

If the insurance industry in Florida is affected by various sized hurricanes similar to those that have occurred in the past, the resulting insolvencies could lead to Citizens having to take on numerous policies in its role of a residual insurer. Citizens had a record number of policyholders (both accounts) in 2011 of 1,472,391. The number of policies that could repopulate Citizens given various size hurricane events will vary by landfall. However, the authors illustrate how a few 50-year hurricanes could inundate Citizens with an extra 1 million policyholders. Additionally, there are certain 100-year hurricanes that could result in Citizens inheriting an additional 3 million to 4 million policyholders or as much as two-thirds of all policies in the state.

This paper has identified various vulnerabilities in the current Florida residential insurance market and suggested new analytical approaches that could be used to strengthen the market. It is clear that while Florida's public risk financing entities provide some protection to Florida policyholders, the viability of the market depends heavily on financially stable private insurers. To date, most tests of Florida insurer solvency have focused on the one-number PML approach, which has numerous issues from a regulatory perspective. Stress tests should include a robust set of scenarios covering the complete Florida coastline so pockets of exposure that could lead to solvency-impairing losses are not overlooked and be extended to

Florida's public risk financing entities and their capability for responding and stabilizing the residential property insurance system over the long run.

Further research can be done examining the sensitivity of the results to the various assumptions used for this study. Publicly available information on each insurer's complete risk transfer program would enable more precise quantification of the solvency impacts of each hurricane scenario and perhaps is important information for Florida residential insurance policyholders. Stress testing under a range of financial market and reinsurance market conditions could also be insightful from a long-term risk management perspective.

Appendix A

Assumptions Used for Analyses

In support of this analysis, fourth-quarter 2016 QUASR exposure data was obtained from the FLOIR. Of particular note, the following information is provided for each company at county resolution: 1) policy type; 2) number of policies that include wind coverage; and 3) the total exposure value for policies in force that include wind coverage. Catastrophe model analyses have minimum data requirements and also provide higher quality loss estimates when data is provided at finer geographic resolution. Consequently, the following assumptions were made and applied to the QUASR data prior to importing into the catastrophe model to make the information more suitable for estimating insured losses for each company:

1) The KCC industry-wide KPD was used to distribute the QUASR county-level data to five-digit ZIP code resolution within the state of Florida. It was assumed that individual company exposure data was distributed to ZIP codes within each county in the same proportion as the industry.

2) Policy code descriptions contained in the QUASR data were used to assign appropriate occupancy codes recognized by the catastrophe model, including single-family home, multi-family home, agriculture, multi-family dwelling homeowners' association, and multi-family dwelling condominium owner occupancy codes.

3) In order to assign construction-type information to the QUASR data, an analysis of individual property data for Citizens and several Florida insurance companies was performed. The analysis indicated that residential and commercial residential properties north of the Gainesville area are predominantly wood frame, and properties to the south are predominantly masonry. Consequently, exposures in ZIP codes north of the Gainesville area are assumed to be wood frame, and properties in the remainder of the state are assumed to be masonry. Mobile home policies were assigned a mobile home construction code in all regions of Florida.

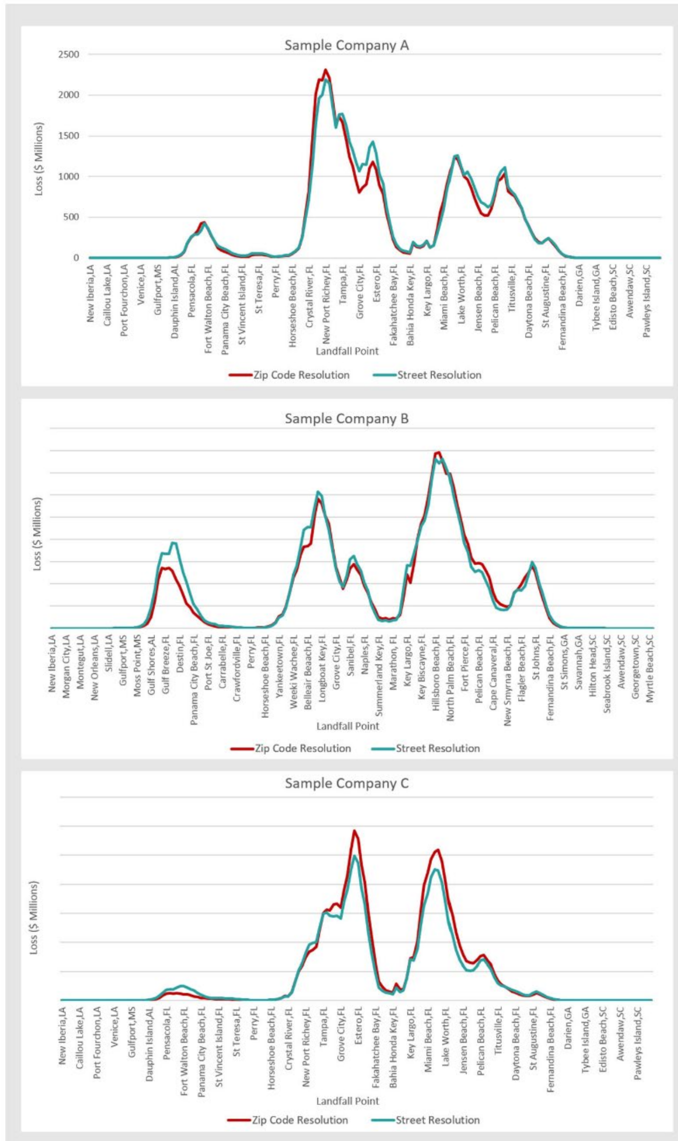
4) All properties in the analysis were assigned a year built of 1995, which is representative of the average residential and commercial residential building stock in Florida.

5) An analysis of individual property data for Citizens and several Florida insurance companies was performed to determine representative policy deductibles and coverage splits (the proportion of Building, Contents and Loss of Use coverage amounts) within the state of Florida. Average deductibles were estimated for each policy type at a ZIP code resolution,

and for single-family dwellings (the majority of the QUASR data), a 2% deductible was assigned to the majority of ZIP codes in Florida, with a range spanning a 1% deductible applied to more inland ZIP codes up to a maximum of a 4% deductible applied in a few coastal ZIP codes. Statewide coverage splits were estimated for each QUASR policy code. For the Personal Residential – Homeowners – Owner Occupied policy code (nearly 75% of the QUASR exposure), the total insurable value was assumed to split 70% building coverage, 20% contents coverage and 10% loss of use coverage.

Appendix B

100-Year CE Zip Code and Geo-Code Loss Comparison for Three Companies



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Analyzing the Impact of Time Horizon, Volatility and Profit Margins on Solvency Capital: Proposing a New Model for the Global Regulation of the Insurance Industry

Thomas Müller *

Abstract

The European Solvency II regime requires a solvency capital covering risks with a given shortfall probability of 1/200=0.5% on a one-year time horizon, which is extremely short compared to the contractual terms in traditional life insurances, as well as the settlement periods of several decades in some casualty branches. This approach undermines the importance of a high return margin and, given a risk-averse approach to management, may lead to an overall riskier business strategy in the long run. In light of this, we cannot help but ask whether such a short time horizon is capable of providing a meaningful guideline for a sustainable business and risk management that has a long-term perspective.

In response to this question, we present a new model for assessing the evolution of the equity of an insurance company and calculating the probability that the initial equity of an insurance company will be depleted during a given time period. This model demonstrates that insolvencies mostly do not occur in the first year. Therefore, if one only considers a one-year window, as is the case under Solvency II, the risk will be underestimated. Even more serious is that the business will be managed too cautiously without aiming for a suitably high profit margin, which significantly reduces the risk only in the long term.

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1. Introduction

Over the past 20 years, the debate on the appropriate solvency requirements for the insurance industry has become increasingly more global. Colliding within it are fundamentally different concepts regarding the life and non-life insurance sectors and the methods such as the rule-based or stochastic approaches, coming from the leading economies of the U.S., European Union (EU) and Asia. Critical to the definition of any solvency requirement is the length of the time horizon used for a company's financial projections. It is here that the U.S., for example, differs significantly from the EU.

Within the next few years, the International Association of Insurance Supervisors (IAIS) will be developing a global insurance capital standard (ICS) for internationally active insurance groups (IAIGs) and global systematically important insurers (G-SIIs). Currently, it appears that this global standard ICS will incorporate the key points of the Solvency II system, which requires sufficient solvency capital to cover risks with a specified probability of default of 0.5% over a one-year time horizon. In statistical terms, this would allow for an insurance company to go bankrupt once in 200 years. At least this is what the current field test for ICS version 1.0 envisages, cf. IAIS (2017). However, serious questions remain as to whether this one-year window can function as a meaningful guideline for the insurance industry.

Clearly, the length of the time horizon itself—whether it is a single year, as stipulated in the Solvency II standard formula, or longer as required by the European Own Risk and Solvency Assessment (ORSA) Guidelines, cf. European Insurance and Occupational Pension Authority (EIOPA) (2015)—sets the stage for major differences in business management. With a short time horizon, the risk itself becomes crucial for the solvency capital requirement. On the other hand, the estimated profit margin only plays a minor role. The importance of the margin greatly increases when looking at longer time horizons of several years or even decades.

As mentioned above, the Solvency II regime requires a solvency capital covering risks with a given shortfall probability of 1/200 = 0.5%[1] on a one-year time horizon. However, this one-year time horizon is very short compared to the contractual terms in traditional life insurances, as well as to the settlement periods of several decades in some casualty branches. This undermines the importance of a high return margin and, given a risk-averse business management, may lead to an overall riskier business strategy in the long run. Indeed, the question arises, if such a short time horizon can, in fact, serve as an appropriate guideline for a sustainable business and risk management strategy with a long-term perspective rather than just a potentially wrong incentive that aims at a higher, but short-term, security level.

1. Usually this is reversed by saying that Solvency II requires sufficient risk capital to ensure that at least 99.5% of companies are still solvent after one year, cf. EIOPA (2009).

In this paper, we present a new model for understanding the evolution of the equity of an insurance company and calculating the probability that the initial equity of that company will be depleted during a given time period. A key focus of our examination is the one-year window requirement, for which we consider both its implications and viability for the insurance industry. It should be pointed out that this issue mainly concerns life insurance, including variable annuities with a contract duration of decades, and has more limited implications for non-life insurance where a one-year time horizon may be adequate for risk assessment due to the typical one-year contract duration.

2. Background and Significance of Approach

In recent years, the important developments among insurance regulators around the world have been closely followed in the U.S. and are shaping the debate on the revision of the long-standing risk-based capital (RBC) standards there. However, initiatives to revise the existing rules-based system at the beginning of the millennium—Solvency Modernization Initiative (SMI)—did not lead to the repeal of the rules-based U.S. solvency standard. A brief overview of the literature on these recent developments in global solvency regulation can be found in Mao, Carson, Ostaszewski and Hao (2015). As Eling and Schmeiser (2010) and many other critical essays on this topic have shown,[2] the current global debate has been taking place primarily in academic circles, where there is little understanding of the rule-based U.S. approach. However, there have also been contributions in the academic literature demonstrating that the concept of principle-based supervision is not as straightforward and unambiguous to implement as the clear theoretical principles suggest. Table 6 in Eling (2012), for example, reveals large differences in the resulting risk capital, depending on which statistical method is applied to the empirical loss event data for non-life insurance.

Moreover, the U.S. RBC standard cannot simply be transferred to other markets outside the U.S. Their risk factors are based on U.S. claims experience and depend on the circumstances in the U.S., thinking only of health insurance, medical malpractice or environmental pollution and see also Hooker et al. (1995) on the catastrophic effects of judicial, legislative and regulatory decisions. By contrast, the stochastic model of Solvency II seems much better suited to a global framework that is independent of the local characteristics of the insurance risks assumed. Having said this, within this rule-based U.S. RBC standard, there is a modern stochastic model that we consider to be groundbreaking. This concerns a modern life insurance product, the variable annuities, whose capital requirements are calculated in a stochastic model that takes into account the entire period up to the expiry of the contracts.[3]

2. See also Eling and Holzmüller (2008) or Mao et al. (2015).

3. See Section 8 for more details.

A key point of contention in current debates is how solvency requirements can be designed in an optimal manner. In this regard, the financial literature contains a number of publications dealing directly with this issue, cf. Stoyanova and Schlütter (2015), Yow and Sherris (2008) and Myers and Read (2001). These studies usually model the risk component on two different geometric Brownian motions—one for the assets and one for the liabilities. This allows the probability of default to be calculated according to Magrabe's formula. By contrast, the model we propose does not consider separate Brownian motions for assets and liabilities, but uses only one Brownian motion—sometimes also called arithmetic Brownian motion—to differentiate it from the geometric Brownian motion, which in our model describes the motion of equity overall—i.e., the surplus of assets over liabilities or also a possible deficit.

The random path for an arithmetic Brownian motion is modeled by sums of random terms, while this is done for geometric Brownian motions by products of random factors. In contrast to the geometric Brownian motion, the arithmetic Brownian motion in our model can also move into the negative range, as can also be the case if the stochastic motion of the company's balance sheet is modeled by two separate geometric Brownian motions—one for the assets and another one for the liabilities. Geometric Brownian movements lead to lognormal distributions for the corresponding random variables, while arithmetic Brownian movements lead to the better-known normal distributions. In the Myers and Read (2001) study, the two separate lognormal distributions—one for assets and one for liabilities—were modified by only considering a normally distributed equity. As far as the stochastic model is concerned, this approach largely corresponds to what is referred to here by the shortfall probabilities in the simple model. This relationship is described in more detail in chapter 9.

The main difference between most models in the financial literature and our model is that their models almost exclusively consider the probability that there will be a negative equity at a fixed future point in time, usually after one year,[4] which will be called the "probability of shortfall" hereafter. Their considerations require mathematical methods such as the Magrabe formula, which always take into account only a certain future point in time. This naturally raises the question of when the solvency requirements should apply: in one year, five, 10 or perhaps 20 years?

In the approach employed here, this question does not arise, or at least it is much less relevant, since we look at whole periods. For example, we wonder what the probability is that an insurer can stay in business for the next 20 years, thus the probability to survive the next 20 years. This allows us to look at much longer periods of time, which is the appropriate view for long-term insurance contracts.

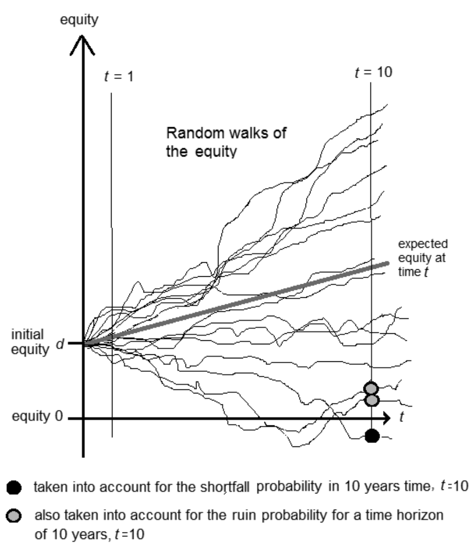
If you only want to determine the probability of shortfall in our simpler model, where the motion of the equity is modeled by an arithmetic Brownian

4. There are occasions when the fixed future point is much later, such as when the insurance contracts expire, as in the literature on the calculation of risk measures for variable annuities guarantees. This is explained in more detail in Section 9.c.

motion, no further financial techniques are required, as for instance the Magrabe formula in the studies mentioned above. In our model, equity is normally distributed at each given specific future date. However, what is significant here is that we are not really interested in the shortfall probability at a point in time, but in the probability that the equity is depleted during a whole period of time.

This is obtained by the stopping hypothesis, which states that those companies whose equity once reached the zero line and was thus exhausted can never become solvent again and are considered to be out of business. This additional assumption is natural from an economic point of view, but it catapults the mathematical problems to be solved into another dimension. In order to solve this question, usually very advanced stochastic methods are required, since all possible paths that the equity capital can take in the regarded time period must now be considered. (See Figure 1.) Therefore, we need more sophisticated stochastic models without neglecting previous insolvencies.

Figure 1



We estimate a probability of 1/15 for each of the 15 shown random walks. Then, for a one-year time horizon, the shortfall—as well as the ruin probability—is zero. Indeed, all random walks are still quite close to the initial equity.
At time horizon t=10, the walks spread over a larger area due to the diffusion of the process described by the volatility σ. In one of the 15 cases, the equity at time t=10 is negative, and the simple shortfall probability only considers this case.
In contrast, all the three walks undercutting the zero equity line before t=10 are taken into account for the probability of ruin.

time horizon= years t	1	10
Probability of shortfall, **without** stopping when the equity has been depleted before t	0%	6.6% =1/15
Ruin probability, **with** stopping when the equity has been depleted before t	0%	20% = 3/15

These models grow out of the so-called ruin theory, which posits mathematical models designed to describe an insurer's vulnerability to insolvency or ruin. Here they are explained on the basis of solutions to differential equations like the heat equation. In this approach, the stopping hypothesis will be regarded as fulfilled by the solutions of the heat equation vanishing on the equity-zero axis, which means the probability that the path taken by the development of the equity capital has ever crossed the zero line in the past is zero. This is a geometrically more tangible approach than the usual derivation found in the actuarial literature, cf. e.g. Søren and Albrecher (2010), which is little known outside the actuarial community, probably because it is very technical and not intuitive.

3. Numerical Results

a. A Sketch of the Equity Process Model

In order to emphasize the importance of the assumptions regarding the time horizon and the hypothesis of stopping, we start by presenting numerical values for the probability of ruin along with the probability of a shortfall for some examples of stochastic processes describing the equity of an insurance company. These stochastic processes are defined as Brownian motions with an initial equity ratio d, return margin m and volatility σ. If we were to consider the ruin probability, the stochastic process would stop when the equity was depleted before the time horizon. However, there is no stoppage of the Brownian motion of the equity when we calculate the shortfall probability. This means the random walks of the equity with negative values before the time horizon are not allocated to any shortfall if the equity is positive at the end (i.e., at the considered time horizon). In this model, the probability of being in shortfall can be calculated by simply evaluating a normal distribution with a standard deviation $\sigma\sqrt{t}$ at minus the expected value of the equity at time horizon t, that is, at $-d(+mt)$. Therefore, with the cumulative normal distribution denoted by Φ, the shortfall probability is

$$\Phi\left(-\frac{d+mt}{\sigma\sqrt{t}}\right).$$

For the calculation of the ruin probability, an additional probability must be taken into account that covers the cases ignored by the default probability—i.e., the cases in which the stochastic equity process was stopped at some point in the meantime but then recovered and shows positive equity up to the assumed time horizon. This additional probability can also be expressed by a cumulative normal distribution, in fact by

$$e^{-\frac{2md}{\sigma^2}}\Phi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right).$$

This term becomes increasingly important with a growing time horizon. This is reasonable because the probability of previously insufficient coverage increases, whereas the probability of a shortfall without a prior stop decreases after a certain time. While the probability of a shortfall at a point in time t without stoppage before can already be understood by fairly straightforward calculations, the derivation of the latter term, which takes into account a stoppage due to the prior undercutting of the zero-line, usually requires very advanced probability theory—hardly accessible to non-specialists.

b. An Illustrative Example of the Equity Walks in the Two Different Concepts

Figure 1 on page 5 gives an illustrative example to visualize the two different models. The random walk of the equity starts at time 0 at a given positive initial equity $d > 0$. We expect the equity to drift upwards due to a positive trend parameter, the return margin $m > 0$.

c. Numerical Values and Their Discussion

Table 1 considers the combinations of two different values for the initial equity and the return margin and the same volatility everywhere. In the probabilistic model of a Brownian motion, this indicates:

- The probability of shortfall without stopping when the process reaches the zero line.
- The probability of ruin with finite and infinite time horizon with stoppage when the equity was previously depleted.

Table 1

					Probability of shortfall "Simple model"				Probability of ruin $\psi(t)$ "Advanced model"			
Stoppage when the equity has been depleted before t:					without				with			
Param-eter set Ps	Initial equity d	Return margin m	Vola-tility σ	Formula	$\Phi\left(-\frac{d+mt}{\sigma\sqrt{t}}\right)$				$\Phi\left(-\frac{d+mt}{\sigma\sqrt{t}}\right)+e^{-\frac{2md}{\sigma^2}}\Phi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right)$			
				time horizon = years t	1(*)	5	20	100	1	5	20	∞
1	10%	1%	4%		0.30%	4.68%	4.68%	0.30%	0.65%	12.9%	25.1%	28.7%
2	20%	1%	4%		0.00%	0.26%	1.27%	0.13%	0.00%	0.6%	5.4%	8.2%
3	10%	2%	4%		0.13%	1.27%	0.26%	0.00%	0.32%	5.4%	8.1%	8.2%
4	20%	2%	4%		0.00%	0.04%	0.04%	0.00%	0.00%	0.1%	0.6%	0.7%

The standard formula for the Solvency II requirement is based on the specifications (*). They simply represent the probability of shortfall at the end of the one-year period for an equity following the stochastic process of a Brownian motion. These values show:

i. All the four examples meet the Solvency II requirement with a probability of shortfall of less than 0.5%—i.e., a level of solvency that can withstand a one in 200-years event.

ii. The values of the probability of ruin with a longer time horizon are much higher than those of Solvency II. This indicates that the seemingly very strong Solvency II requirements with a probability of shortfall of at most 0.5% are largely due to the specific assumption upon which the model is based—namely, the one-year time horizon.

iii. For a broad time horizon of 20 or 100 years, concepts based on the shortfall of a normally distributed equity at the end of these periods are meaningless. By then the riskiest time for the company could be over. All that can be checked is whether the company is solvent exactly at this point in time—e.g., after 20 years—regardless of what happened before. Let us take the example of parameter set 3 in Table 1: In the model that considers the shortfall, there is no stopping when the equity is depleted before. Then only 0.26% of the companies are insolvent after 20 years, but 8.1% – 0.26% ≈7.8% have become insolvent at least once in this period of 20 years and have then recovered to report positive equity again at the end of the 20 years. Thus, when considering longer time horizons, the simple shortfall model is no longer applicable, and the advanced model needs to be applied.

iv. The parameter set 2 assumes an initial equity, which is twice as large as the one of parameter set 3 but has only half of the return margin. These effects on the probability of ruin cancel out with infinite time horizon. However, in order to meet the Solvency II requirements, the initial equity is much more important than the return margin. This is mainly due to the small time horizon for Solvency II, which means the return margin can only contribute to equity growth for one year.

Thus, it is important to note that the too narrow time horizon of Solvency II may lead to a too risk-averse business strategy, underestimating the importance of a reasonable margin in the longer term for life insurances. Another way to explain this is as follows: The risk grows with the square root of time, and the additional return due to a good margin grows linearly over time. For example, if you compare a period of 20 years with a period of one year, the risk increases only about 4.5 times, whereas the additional yield increases 20 times. But the reality is a little more complicated: If you do not have enough equity at the beginning, you starve on the way, and it is precisely this risk that is also taken into account in our advanced model.

4. The Calculation of the Shortfall Probability Using the Standard Normal Distributions

Here we consider a stochastic process, defined as Brownian motion, beginning with an initial equity ratio d constantly growing with a positive return margin m and carrying a risk corresponding to a volatility σ. With these assumptions, the stochastic equity process will not be stopped when the equity is depleted—i.e., when the equity crosses the zero line and slides into the negative range due to an unfavorable risk development. Brownian motions are the most common stochastic processes. They can be interpreted as diffusion processes, which describe the spreading of heat as time passes. Those processes are well-known in physics, especially in thermodynamics. The probability distribution of a random variable defined by Brownian motion fulfills a partial differential equation (PDE) of a type referred to as heat diffusion equation. See equation (9) and (10) in chapter 7 below. In our case, the random variable corresponds to the equity of the considered insurance company, which starts at time 0 at the given initial equity d and then spreads more and more as time passes due to the volatility σ analogue of the diffusion rate or the thermal diffusivity in the physical context.

The function

$$p_+ = p_+(x,t) = \varphi_{\mu,std}(x) = \varphi_{d+mt,\sigma\sqrt{t}}(x) = \eta \cdot e^{-\frac{1}{2}\cdot\frac{(x-d-mt)^2}{\sigma^2 t}},$$
$$\eta = \frac{1}{\sqrt{2\pi}} \cdot \frac{1}{\sigma\sqrt{t}} \tag{1}$$

solves the heat equation of type (10) and defines the probability density of the equity at time t. Thus, the probability of a negative equity at time t corresponds to that indicated above in the simple model, which only considers a shortfall at a given time t, without stoppage due to the premature depletion of equity:

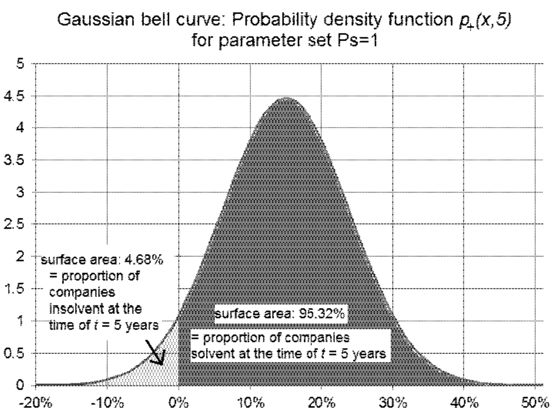
$$\int_{-\infty}^{0} p_+(x,t)\,dx =$$
$$\int_{-\infty}^{0} \varphi_{d+mt,\sigma\sqrt{t}}(x)\,dx = \int_{-\infty}^{-(d+mt)} \varphi_{0,\sigma\sqrt{t}}(x)\,dx = \int_{-\infty}^{-\frac{d+mt}{\sigma\sqrt{t}}} \varphi_{0,1}(x)\,dx$$
$$= \Phi\left(-\frac{d+mt}{\sigma\sqrt{t}}\right). \tag{2}$$

5. The Additional Probability for Previously Stopped Equity Processes

a. Some Remarks About the Gaussian Bell Curve

For a given time $t > 0$, $p_+(x,t)$ has the shape of a bell. Indeed, this is the famous Gaussian bell curve as shown in Figure 2.

Figure 2



Parameter set Ps 1:
Initial equity d = 10%
Return margin m = 1%
Volatility σ = 4%

$p_+(x,5)$ shows the probability density of the equity of a firm, whose equity moves with parameter set 1, at the time after five years, without going out of business when the equity was depleted before during this five years. In this case as listed in Table 1, the probability of underfunding is 4.68%.
This probability can be visualized by the area of the surface between the probability curve and the x-axis for the negative equity range.

b. The Additional Probability for the Stopped Equity Processes

Gaussian bell curves run from $-\infty$ to $+\infty$. Thus, the equity can attain any negative range with positive probability. This does not correspond to the usual public requirements for the available equity, where a negative equity is strictly inconceivable. An insurance company goes out of business immediately when its equity moves down to zero. We are looking for another solution of the diffusion equation that we have not considered yet. For this new solution, we impose an additional boundary condition on the equity-zero axis—i.e., on the line $(x,t) = (0,t),\ t > 0$. As is shown in the Appendix 1, the function

$$p_-(x,t) = e^{-\frac{2dm}{\sigma^2}} \varphi_{-d+mt,\sigma\sqrt{t}}(x) \tag{3}$$

also fulfills the PDE (10) in chapter 7, and it pushes moreover the Gaussian bell curves p_+ down, so that the difference $p = p_+ - p_-$,

$$p = p(x,t) = p_+(x,t) - p_-(x,t) = \varphi_{d+mt,\sigma\sqrt{t}}(x) - e^{-\frac{2dm}{\sigma^2}}\varphi_{-d+mt,\sigma\sqrt{t}}(x) \tag{4}$$

fulfills the boundary condition, the vanishing of $p(x,t)$ on the x=0-axis. This makes sense, because p only considers the firms whose equity had never become negative. The subtrahend p_- can be interpreted as the probability density for an equity $x > 0$ at time $t > 0$, whereby the equity was exhausted at least once in between, but then recovered again. In other words, the probability density that the equity process attains the equity $x > 0$ at time $t > 0$ but has crossed the "red" line of ruin $x = 0$ once before. To determine the proportion of companies that have left the business because they previously reached the "red" line and lost all their equity, one has to calculate how much the area of the Gaussian bell curve p_+ has been reduced by the subtrahend p_- . This reduction in area has to be restricted to positive equities > 0, thus to the companies still in business, which yields the following integral to determine the additional probability:

$$\int_0^\infty p_-(x,t)dx = \int_0^\infty e^{-\frac{2dm}{\sigma^2}}\varphi_{-d+mt,\sigma\sqrt{t}}(x)\,dx = e^{-\frac{2dm}{\sigma^2}}\int_0^\infty \varphi_{-d+mt,\sigma\sqrt{t}}(x)\,dx$$

$$= e^{-\frac{2dm}{\sigma^2}}\int_{\frac{d-mt}{\sigma\sqrt{t}}}^\infty \varphi_{0,1}(x)\,dx = e^{-\frac{2md}{\sigma^2}}\Phi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right) \tag{5}$$

To extend the simple model of shortfall probabilities, which ignores previous underfunding to the advanced model of ruin theory, this term has to be added. As mentioned above, especially for longer time horizons, this additional probability becomes increasingly important and must be taken into consideration.

The probability of ruin up to time t, noted by $\psi(t)$, results as the sum of the probability of the shortfall and the additional probability, thus

$$\psi(t) = \Phi\left(-\frac{d+mt}{\sigma\sqrt{t}}\right) + e^{-\frac{2md}{\sigma^2}}\Phi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right). \tag{6}$$

The first term of the right side of equation (6) corresponds to the probability of shortfall. See equation (2)—i.e., the probability of having negative equity at time t, irrespective of the development of equity in the period from 0 to t. The second term represents the additional probability, cf. equation (5)—i.e., the probability that the entire equity capital has been lost at least once in the meantime, but has then recovered to positive equity if the business could have continued. Looking at the illustrative example in Figure 1 for t =10 years, the first term corresponds to the probability of 1/15 and the second term to 2/15, which add up to the ruin probability 3/15 = 1/5.

For an infinite time horizon, the ruin probability $\psi(\infty)$ corresponds to the limit of $\psi(t)$ when t approaches infinity. Because the first term then describes the cumulative normal distribution at minus infinity and the second one at plus infinity, the first term vanishes and the second term gives the factor, which multiplies 1, the cumulative normal distribution at plus infinity. Hence, the ruin probability results to [5]

$$\psi(\infty) = e^{-\frac{2md}{\sigma^2}} \quad (7)$$

The probability of staying in business forever, also referred to as survival probability, is

$$1 - \psi(\infty) = 1 - e^{-\frac{2dm}{\sigma^2}} \quad (8)$$

and the probability of staying in business up to time t—i.e., the survival probability with finite time horizon t—is $1 - \psi(t)$.

6. Graphics

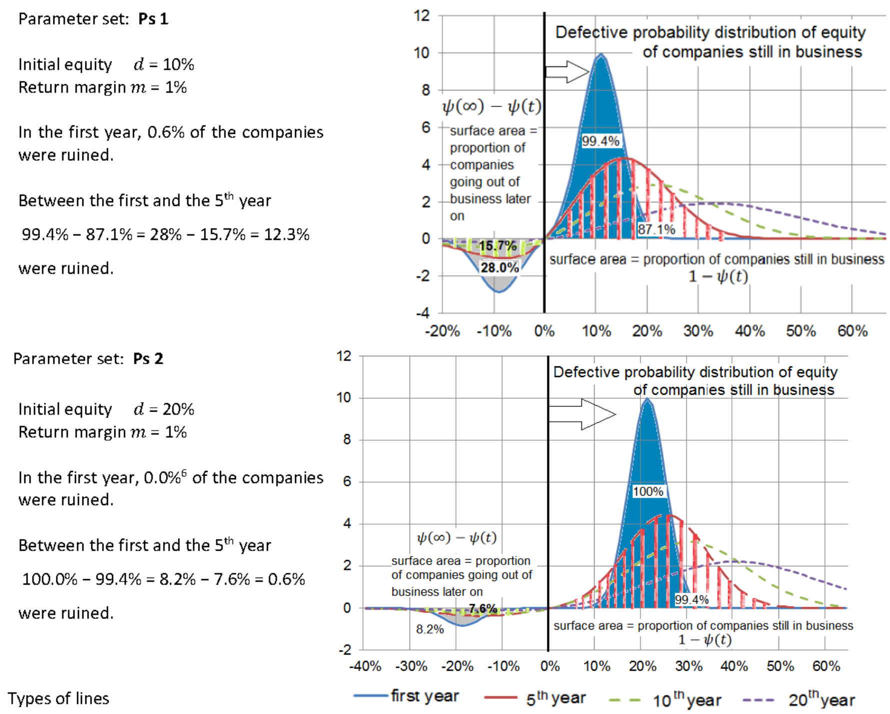
a. Geometric Interpretations of Shortfall and Ruin Probabilities by the Area of Surfaces

The most important and applied parts of mathematics often combine two very different concepts, providing a synthesis of some vague geometric idea with a strict and unambiguous formalism. Just think of differential calculus and the interpretation of the integrals as the surface area. Hence, the probabilities of shortfall in the simple model of a Brownian motion, as provided for by Solvency II, are usually explained by the area of the surface between a Gaussian bell curve and the x-axis up to the considered Value at Risk. This gives a similar picture as in Figure 2, but with a much smaller area to represent insolvent companies for the Solvency II requirements of only 0.5%.

5. Similar formulas, at least for the upper limits of the probability of ruin, also apply to more general risk processes. This allows, for example, jumps in order to model particularly high individual claims as they may typically occur for non-life coverages without appropriate reinsurance protection. In this context, the parameter $R = 2m/\sigma 2$ usually denotes the "adjustment coefficient" because of the way in which it can be calculated for these more general risk processes. In the more general context, it also depends on the return margin and on the appropriate parameters describing the supposed risks of the process. These classical considerations are mainly due to two Swedish actuaries and statisticians: Filip Lundberg introduced his theory at the beginning of the 19th century, and Harald Cramér republished part of Lundberg's work in the 1930s. Before the introduction of Solvency II and the Swiss Solvency Test (SST), the theory of ruin seemed to be more relevant for risk management. In this context of risk management, ruin theory applies to the decisions regarding how much risk one is willing to take and which part should be reinsured with a given equity ratio. As already mentioned, it is regrettable that this broader view—as opposed to the narrow view based on the very short one-year time horizon required by the standard formula in Solvency II and in the SST—seems to have lost attention when implementing the complicated and meticulous new European regulations.

We now seek such interpretations for the ruin probabilities, thus attempting to interpret the surfaces between the curve p and the x-axis as probabilities of ruin. Figure 3 illustrates the distribution of the equity $p(x,t)$ depicted as curves for fixed time horizon.

Figure 3



For a given $t > 0$, the curve $p = p(x,t)$ on the positive side, that is for positive x, describes the probability density of the equity for the companies that are still active. Strictly speaking, this function p on the positive side does not represent a probability distribution function, because the sum of the probabilities does not add up to 100%. This is because some companies prematurely left the business. In Feller's classic textbook (1971), the probability distributions that add up to less than 100% are referred to as "defective."

The curve $p = p(x,t)$ on the negative side has no immediate interpretation. Indeed, insurance companies are not allowed to have negative equity. As soon as equity reaches zero, the process will be stopped, which means that the company must cease its activity. But there is another interpretation of the negative side of the curve p: This part of the curve does not provide information about the past, but about the future development of equity, in particular on the probability of ceasing activity in the future ($\tilde{t} > t$). The surface area on the negative side between the curve p and x-axis corresponds to the probability of going out of business later on, thus for $\tilde{t} > t$, because the surface area may be calculated by an appropriate integral that gives $\psi(\infty) - \psi(t)$.

Figure 3 represents the probability distribution of the equity $p(x, t)$ for t = 1, 5, 10 and 20 years and parameter set 1 and set 2 on the positive side of the x-axis. As already mentioned, the curves on the positive side describe the probability density of equity for companies that are still active. The longer the time horizon under consideration, the more the equity spreads and the curves become flatter and flatter. The area of the surface between the probability density curve and the x-axis on their positive side decreases as the considered time interval becomes longer, since more companies have been at least once underfinanced over a longer time period and had to leave business. The difference between the two areas on the positive and negative sides of the x-axis is constant over time, as can be seen in Table 2. This difference, also referred to as survival probability, shows the proportion of companies that remain solvent for any length of time from the start at time 0—i.e., the survival probability $1 - \psi(\infty)$.

Table 2 lists further values for the area contents of the curves in graphic 3 that were not entered there.

Table 2

t years	Parameter set: **Ps 1,** d = 10%, m = 1%			Parameter set: **Ps 2,** d = 20%, m = 1%		
	Proportions of companies		Survival probability	Proportions of companies		Survival probability
	still in business after t years =$1-\psi(t)$	going out of business sometime after more than t years = $\psi(\infty)-\psi(t)$	=$1-\psi(\infty)$	still in business after t of years =$1-\psi(t)$	going out of business sometime after more than t years = $\psi(\infty)-\psi(t)$	=$1-\psi(\infty)$
	(I)	(II)	(I)–(II)	(I)	(II)	(I)–(II)
1	99.35%	28.00%	71.35%	100.0%	8.2%	91.8%
5	87.07%	15.72%	71.35%	99.4%	7.6%	91.8%
10	79.98%	8.63%	71.35%	97.4%	5.6%	91.8%
20	74.93%	3.58%	71.35%	94.6%	2.8%	91.8%

The parameters for both sketches correspond to the same return margin m = 1% p.a. and to the same volatility σ = 4% p.a., but at different initial equities. Therefore, the areas on the negative side are considerably higher for Ps 1. Because the curve p for Ps 2 intersects the x-axis at point 0 in a very shallow angle, it will take some time until a major part of the ruin cases occurs. In fact, in the case Ps 2, a time horizon of one or even five years does not give any good indication of the complete probability of ruin with infinite time horizon. In this case, the fairly high initial equity combined with a small margin leads to a high value for the expected time of ruin μ_{IG}, assuming that ruin ever occurs. See also, for example, Table 3 and Figure 4.

Figure 5 in Appendix 3 on page 28 displays the complete functions $p(x, t)$ as a two-dimensional surface in three-dimensional space and not just vertical sections of this surface for some selected time points.

b. *The Physical Interpretation of Figure 2 and Figure 3*

Looking at these Brownian movements under physical circumstances, it can be noted that the area between the curve describing the heat distribution over an interval of the x-axis corresponds to the heat stored in this sector of the x-axis for a given point in time. If you look at the entire x-axis from minus infinity to plus infinity, the heat cannot escape anywhere and thus remains constant over time. With the arithmetic Brownian movement, this area always remains equal to the total probability of 1, as shown in Figure 2.

The situation in Figure 3 is somewhat more complicated, but also has a nice physical interpretation through a heat pool on the positive x-axis and a cooling pool on the negative x-axis. Over time, the cold pool moves to the right and mixes with the warm pool. The total heat in the system always remains the same—i.e., the area difference above and below the x-axis is constant over time and corresponds to the constant survival probability $1 - \psi(\infty)$ in our solvency model according to Table 2. This physical interpretation is especially vivid in the case without any margin: Then both the areas above and below the x-axis are even equal, or in the physical picture, the heat and cold accumulators are equal. As a result, all heat is lost over time, which in our economic context means that the probability of the company remaining solvent is zero, and the probability $\psi(\infty)$ of going into ruin at some time is one.

c. *The Distribution of the Time of Ruin Given That Ruin Ever Occurs Shown in Figure 4*

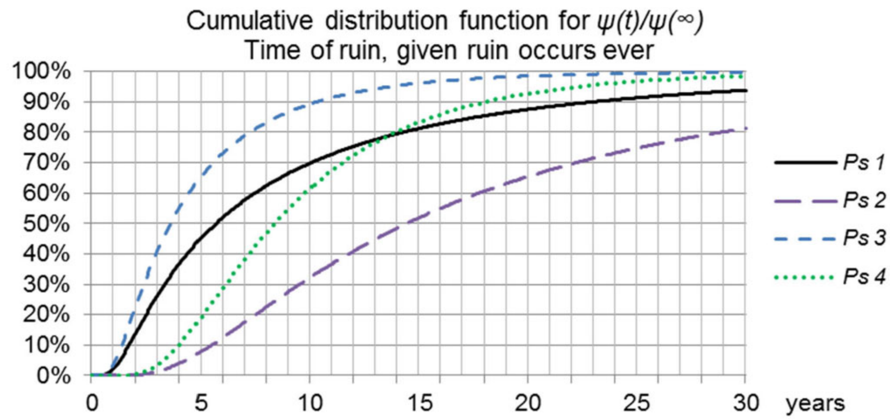
The formula for the expected time of ruin μ_{IG} can be obtained by $\psi(t)/\psi(\infty)$ as an Inverse Gaussian distribution $IG_{\mu_{IG},\lambda}$ with its two parameters μ_{IG} and λ, which leads to the simple relation $\mu_{IG}= d\ /m$. (See Appendix 2 for more details.) For the case of Ps 2, it shows that it takes more time to get out of the danger zone of a possible ruin. In the case of Ps 1 or even Ps 3, the dangerous time runs out faster, but here too it lasts more than a year. The particular values of μ_{IG} for the parameter sets considered are listed in Table 3:

Table 3

Parameter set Ps	Initial equity d	Return margin m	Expected time of ruin, assuming it occurs ever, in years, μ_{IG} = $d\,/m$
1	10%	1%	10
2	20%	1%	20
3	10%	2%	5
4	20%	2%	10

Figure 4 shows the cumulative probability distribution function $\psi(t)/\psi(\infty)$ of the time of ruin for the four parameter sets.

Figure 4



d. *The Use of the Inverse Gaussian Distribution in the Theory of Stopped Brownian Motions*

In modern textbooks, the probability of finite-time ruin for a Brownian motion with drift is usually derived by transforming the process into a new process corresponding to Wald's martingale and then applying the stop theory to this transformed process in order to obtain the moment-generating function of the probability distribution of ruin, given that it occurs ever. This moment-generating function is then transformed by the inverse Laplace transformation, and this, after all those calculations, leads to the Inverse Gaussian distribution function in the form set out at the end of Appendix 2. This requires a great deal of hard work and a deep understanding of advanced mathematics, cf. for instance Crépey (2013). Of course, this provides only a formal proof, without any intuitive and more quantitative understanding of what actually happens to the Brownian process while stopping when it crosses the given "red" line of ruin. It is, therefore, not surprising that the laws and guidelines of Switzerland and the European community and the planned global capital standard of the IAIS are not based on these concepts of the theory of ruin, but on much simpler approaches such as those of Solvency II. The latter ones, based on a value-at-risk ratio for a time horizon of one year, also seem to be comprehensible to non-specialists, a necessity for legally founded solvency regulation.

7. More About the Differential Equation Modeled on the Heat Equation

In general, the term "diffusion" describes a dynamic process whereby physical particles spread out from an area of high concentration to an area of low concentration. These particles can be atoms or molecules or, in an economic context, assets like the price of shares or the equity of a company. In the economic context, the probability of a given asset spreads out from a known current value to distributions of potential subsequent values. These distributions are very steep at the beginning of the process. Then they melt away and spread out over a wider area with time. (See Figure 5 and Figure 6 in Appendix 3 on pages 2829.) In this context, the diffusion process acts on the probability distribution of economic values, showing the uncertainty of future developments by spreading out from known fixed values to more and more different potential values. The faster the spreading takes place, the riskier the equity is considered. Usually, the economic parameter describing this risk of spreading out is denoted as "volatility," as we do in this paper.

In physics, the most notable diffusion process describes the evolution of the repartition of heat in a medium. The heat will be conducted from "hot spots" toward colder regions. The mathematical description is given by the heat conduction equation, a partial differential equation describing how the repartition of heat develops as time passes by. The more concentrated the temperature[6] u, the faster the heat will be conducted away, measured by a decline of $-\partial u/\partial t$ in the temperature. This heat-concentration is gauged by the second derivative of the repartition of temperature in the medium preceded by a negative sign, $-\partial^2 u/\partial x^2$. Therefore, $\partial u/\partial t$ and $\partial^2 u/\partial x^2$ are proportional, linked by a positive constant of proportionality. In the case of the heat equation, this constant depends on the material of the medium considered. Since we are not interested here in actual heat equations and their solutions, we move on to the economic context and understand this constant as volatility σ of the equity considered. In order to emphasize that the diffusion process refers to probability distributions, we also drop the notation of u commonly used to describe the heat equation and use the letter p instead, suggesting that we are dealing with probability distributions. In this paper, the PDE of this type of heat equation,[7]

$$\frac{\partial p}{\partial t} = \frac{\sigma^2}{2} \frac{\partial^2 p}{\partial x^2}, \qquad (9)$$

6. The commonly used letter *u* in thermodynamics denotes the *internal energy*, a more general term than the temperature. In the considered simpler setting, *u* is proportional to the temperature and may be understood as such.

7. The constant of proportionality is selected $\sigma^2/2$ to ensure that the notation fits with Brownian motions with volatility σ.

will be considered as a diffusion equation. Equation (9) describes how the uncertainty of the future development affects the value of an asset and transforms this value to an entire range of possible values to be taken into account when dealing with risk management.

Since we are particularly interested in the economic risks over a long period of time, we have to take into account an additional component reflecting a continuous increase in the value of the asset due to an investment return—i.e., a margin m in the business granted by the equity in question. This leads to the partial differential equation

$$\frac{\partial p}{\partial t} = \frac{\sigma^2}{2}\frac{\partial^2 p}{\partial x^2} + m\frac{\partial p}{\partial x} , \tag{10}$$

describing a diffusion process analogous to the development of the probability density of a Brownian motion with volatility σ, which can be understood as "risk intensity" (risk exposure per time[8]) and by a drift m caused by a return margin rate m. This rate designates the expected rate of return margin per time t. In the usual economic context, the standard measurement unit for the time t is years, and thus the two development parameters σ and m are given in change per year.

Since we are looking here at the development of equity and not, for example, the development of assets or liabilities separately, we do not consider here geometric Brownian motions that lead to lognormally distributed random variables when viewed at a fixed point in time.

8. The Two Risk Measures: Value at Risk (VaR) and Conditional Tail Expectation (CTE)

This topic is of secondary importance for the considerations in this article and can be solved simply by recalibration. However, it is explained here for a better overall understanding.

The issue is that one of the two risk measures used in connection with the solvency requirements must be selected. One of these, the so-called VaR, requires compliance with a level of trust within which the insurance company may not become insolvent. This method was adopted by Solvency II and requires the insurance company to remain solvent in a 99.5% percentile over a one-year period. The required capital at risk with this specified percentile is called VaR, and it

8. The variance σ^2 has the unit "currency squared per time," which in the probabilistic interpretation corresponds to an increase of the variance of the considered random equity per time. In financial sciences, the volatility σ is usually given based on a currency unit "1" and, as mentioned below, the time coordinate in years.

corresponds to the capital buffer required to remain solvent within the desired confidence interval.

The second method is called expected shortfall or CTE. As with the VaR method, it is necessary to remain solvent with a certain percentile, but it also requires sufficient funds to absorb the average load in the unfavorable cases outside this percentile. This risk measure is applied to variable annuities by the U.S. RBC standard and requires a risk charge for the stochastically calculated market risk C-3c based on a CTE of 90%.

In this context, it is particularly interesting that this is taken into account not only for a time horizon of one year, as is the case for almost all stochastic solvency requirements, but in accordance with the recommendations of the American Academy of Actuaries (Academy) (2005) over a period of decades until most policies have expired. Since fat tail risks are generally not reflected for market risks, the VaR and CTE risk measures are linked by appropriate recalibration. According to the Academy, the CTE 90% risk buffer required for variable annuities corresponds to approximately a VaR 95% demand. Thus, the C-3c component of the U.S. RBC requires that variable annuities have enough risk capital to ensure that the probability of insolvency is above 95%. Conversely, the probability of insolvency is below about 5% and this does not refer, nota bene, to the time horizon of one year, but until the policies expire. There is extensive literature dealing with various methods for the calculation of the risk measures for variable annuities. We will discuss this literature in more detail in Section 9.c. and compare it with our model.

9. Comparison of Our Model with Those in Financial Literature

a. Comparison with Similar Stochastic Models

Myers and Read (M&R) (2001) also reported numerical values for the case where the stochastic component was not only modelled by two separate lognormal distributions for assets and liabilities, as this is the case for a series of similar studies mentioned in the introduction, but additionally also by a normally distributed equity. This corresponds to our approach with regard to the stochastic component, if you only look at the shortfall probability time $t = 1$ with a vanishing return margin $m = 0$. Their studies, as well as the similar ones, are especially interested in the default value, also referred to as default ratio. This default value corresponds to the additional requirement in the case of a CTE metric instead of a VaR metric. However, in the case of solvency requirements, each insurance undertaking must provide this capital cushion for its own hypothetical insolvency, while this default value discussed in the financial literature is understood as general costs for the insurance industry due to such insolvencies. The additional equity requirement for the CTE metric corresponds, therefore, to the default value as referred in the financial literature divided by the probability of the considered shortfall. As a reminder, Solvency II applies a VaR metric, while the Swiss Solvency Test (SST) and the U.S. RBC for variable annuities are based on a CTE metric. To make these relationships between our model and the similar model in M&R clear, we present here some figures of Table 5 of the M&R study for a normally distributed equity using our notations.

Table 4

		M&R	Solvency II	SST
Equity requirement for VaR metric	d	50%	75%	68%
Volatility (referred to liabilities)	σ	29.18%	29.18%	29.18%
Probability of shortfall	$\Phi(-d/\sigma)$	4.331%	0.500%	1.000%
Default value	$-d \cdot \Phi(-d/\sigma)$ $+\sigma\Phi'(d/\sigma)$	0.52%	0.05%	0.10%
Additional equity requirement for CTE metric	*ad* = Default value/ probability of shortfall	12%	9%	10%
Entire equity requirement for CTE metric	*d+ad*	62%	84%	78%

All columns in Table 4 are based on the volatility listed in Table 5 of the M&R paper. The column referred to by M&R also assumes equity capital, called surplus in the M&R paper, of 50% of the liabilities, which corresponds to d =50% in our notation and leads to a default value of 0.52% as listed in the M&R study. This corresponds to the expected value of defaults, i.e., the expected value of a negative equity at the time point of one year. The capital cushion for solvency requirements with a CTE metric also includes this expected value of default in the hypothetical case of a shortfall. In the M&R column, this results in 0.52%/4.331% = 12% additionally required equity for the stricter CTE metric. However, the capital requirements in the M&R column are below those of Solvency II or the Swiss SST. With this volatility of 29.31%, as assumed by M&R, Solvency II would require the equity to be increased to 75% of the liabilities such that the capital cushion meets the demanded 0.5% confidence level for a VaR metric. Accordingly, the Swiss SST would require equity capital of 78% of the liabilities so that the requirements of a CTE metric are met with a confidence level of 1%, cf. FINMA (2006).

b. Differences Between Our Economic Parameters and Those in the Financial Literature

We assume a significantly lower volatility of equity than in the above-mentioned M&R study, as well as in the papers referred to in the introduction, cf. Stoyanova and Schlütter (2015) and Yow and Sherris (2008), where volatilities of

20% and above are assumed. We believe that these economic parameters do not or no more correspond to reality, at least not to those shown by the reports for Solvency II.

According to the balance sheet and the equity published in EIOPA (2017) for the third quarter of 2017 in regard to the entire EU market, equity amounted to around 15% of liabilities or 13% of assets and the solvency ratio to around 240%. In simplified calculations, this results in an average solvency capital requirement (SCR) of around 15%/240% = 6.25% of liabilities; the actual value corresponds to 6.5% of liabilities. The confidence level for Solvency II of 99.5% corresponds for a normal distribution to the value at risk of 2.57 times the standard deviation. Thus, the average volatility of equity for the overall market under Solvency II amounts to about 6. 5%/2.57% ≈ 2.5% of liabilities, which is even below our assumption of 4% and far from the level of more than 20% often used in financial literature.

In this context, however, it should be noted that the financial literature quoted here refers to typical non-life insurance companies, while the EIOPA Solvency II figures refer to the market as a whole, where the generally larger balance sheet volume of life insurers is decisive for the overall figures. In the non-life insurance industry, the insurance risk itself is much more decisive than the investment risk, which leads to a significantly higher overall risk for the non-life insurances when the standard deviation measuring the risk is expressed in relation to the assets volume. As already mentioned above, there are significant differences between the characteristics of the risks assumed by a life insurer and those borne by a non-life insurer, such as the completely different contract durations.

c. *Comparison with Calculation of Risk Measures for Variable Annuities in the Literature*

We pointed out in Section 2 that the U.S. RBC standard for variable annuities takes into account the entire period up to the expiry of the contracts, which we consider exemplary, and mentioned in Section 8 that there is extensive literature on the calculation of risk measures for variable annuities. In the following, the concepts, methods and results for the variable annuities discussed in the literature are compared with those of our model.

Conceptually, there is a difference between our model and that of many of the papers published in the literature: Both our model and the U.S. RBC requirements take into account the risk that policyholders will receive insured benefits from the insurance company. In contrast, the literature usually calculates the risk taken by the insurance company on specific insurance contracts, which provide nominal guarantees for investment vehicles that are close cousins of investment funds, cf. Milevsky and Salisbury (2006). This paper, like others—such as Feng (2014), Feng and Volkmer (2012), and Bauer, Kling and Russ (2008)—deal mostly with a fixed maturity and evaluate the probability distribution of the volatile investment part less the nominal guarantees. They usually only consider the outcome of the stochastic process at maturity—i.e., at the end of the contract period—and thus neglect the course of the random path during this contract period. In particular, if the process is very long, the risk almost disappears if you look only at the end point and if your guarantee is based on lower interest rates than the expected returns of the investments, what is fulfilled by a reasonably designed insurance product. The significant apparent risk reduction by considering the process only at the end of a long period is shown in Table 1 of Section 3 by the probability of a shortfall for long periods of 20 or 100 years.

From the insurer's point of view, it is right to ignore the stochastic process in the meantime, if the calculation takes correctly into account all guarantees that the policyholder holds during the term of the contract. The situation is quite different if you take a regulatory perspective. In this regard, the principle of hope, saying here that with good luck the insurance will come out of a deficit sometime later, is out of place. If the financial situation of an insurance company becomes insufficient at some time, it must leave business immediately so that new customers can always be sure to conclude contracts only with financially healthy companies. This makes the stopping hypothesis crucial, especially if longer periods are taken into account for solvency requirements, as we believe to be correct, in particular for life insurance policies, which generally have long maturities.

In the case of variable annuities with guaranteed minimum death benefits (GMDB), the two perspectives almost give the same picture. See Gerber, Shiu, Yang (2012). When death occurs, the guaranteed benefit must be paid immediately, and the insurance company cannot wait until the contract expires. With this coverage, the stochastic investment process is stopped during the contract term and not at the end of the period, regardless of any regulatory requirements. This is similar to the stopping hypothesis in our model. Therefore, it is not surprising that the prices of GMDB increase when longer periods are considered. See Table 2 and Table 3 in the paper mentioned, similar to the figures in our Table 1 for the probability of ruin.

Apart from this methodological difference due to the stopping hypothesis applied here, there are also important similarities to all the papers mentioned here; they also take into account a much longer time horizon, usually between five and 20 years to the maturity of the contracts in question, instead of just one year as with Solvency II. Of course, these longer time intervals then lead to significantly lower security levels of 80%, 90% or 95%—i.e., far below the high level of 99.5% of Solvency II. As our Table 1 shows, the time horizon is decisive for any risk assessment, and the high level of 99.5% appears unrealistic when calculating the risk for the entire term for these variable annuities guarantees. The studies show in particular that the risk decreases significantly as the margin increases. See for instance Table 3 in Milevsky and Salisbury (2006).

In terms of one technical, mathematical aspect, all these papers, including the presented one, are similar. Namely, at a particular point in time, you know exactly what the facts are, which then become more and more uncertain the further you move away from that particular point. In our model, you know exactly the equity capital at the beginning of the process at time 0. In the mentioned financial literature, this particular point is at the end of the period, thus at the maturity time T, when the warranted guarantee no longer represents a risk, but has become a fact, a loss, if the value of the investment is not sufficient to cover the guarantee or no loss otherwise. This unambiguous situation at time 0 or at time T is then viewed forward at time T in our model or backwards at time 0 in the cited literature in order to calculate the current price or risk of a guarantee warranted by a variable annuity product. As mentioned, the clear situation becomes more and more diffuse when you move away from these particular points in time. This diffusion is modelled by a diffusion process and mathematically described by a PDE similar to the heat equation here. In using today's computer technology and new and sophisticated numerical methods to solve these PDEs, one may speed up the often time-consuming calculations, cf. Feng (2014) and Privault and Wei (2018). Note that all these calculations can be done with Monte Carlo simulations, which in practice are still the most common approach. The advantages of the Monte Carlo method are that it can be adapted almost arbitrarily to the specific assumptions regarding product design and policyholder behavior, and it can be used without deep mathematical knowledge. In contrast, the disadvantage is that they are time-consuming without conveying as clear an insight into the crucial assumptions and parameters as can be gained by analytical solutions.

10. Conclusion

Our calculations and analyses show that in addition to volatility and initial capital, the business margin is becoming increasingly crucial when considering solvency over a longer time horizon. It is unclear whether the global trend in setting solvency requirements for insurance companies takes this into account or follows the path taken by the EU with Solvency II, see IAIS (2017), which will be particularly problematic for the life insurance industry.

For the management of life insurance policies, for which a time horizon of several decades is the rule, the short time horizon of the standard formula within the framework of EU Solvency II can entail an investment policy that is too risk-averse. In the broader range, it may lead to a too cautious business management at the expense of higher business margins, which gain in importance only when looking at longer time horizons. It is also questionable to encourage insurance companies to issue hybrid capital in order to reduce the risk to the detriment of the margin. Since margins mainly count in the long run, regulations requiring the use of such instruments could in fact only reduce the apparent risks measured by mandatory risk metrics without actually helping customers with a long-term perspective.

The high confidence level of 99.5%, which Solvency II exhibits, results from the way risks are measured there, and this relates, in particular, to the short time horizon of only one year. For those life insurance customers who are not aware that this high level corresponds only to a one-year perspective, this may result in a too favorable picture of the confidence level that is of interest to them—i.e., for the entire contract term of possibly several decades.

Our proposed model for regulating the life insurance industry takes into account the entire contract term and focuses not only on the end of the contract, when a sufficiently high margin can compensate for all interim losses, but also on the risk of a shortfall in the early contract years. It is a perfect synthesis to overcome the disadvantages of the too short time horizon of Solvency II and too long time horizon from a regulatory point of view, as considered in the publications on the risk for life insurers due to the guarantees embedded in their variable annuities products. Moreover, it complies with the current U.S. RBC standard for variable annuities.

Acknowledgments

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Appendix 1

$p(x,t)$ is a Solution of the Diffusion Equation, Which Vanishes on the Equity x=0-axis

Besides the function p_+ in equation (1), the Gaussian bell curve considered in the simple model, there are many other solutions of the diffusion equation (10)—for example, one for each starting point. For any initial equity c, without restriction on positive values for c, the function $\varphi_{c+mt,\sigma\sqrt{t}}(x)$ represents such a solution. With different values for c, the whole diffusion process will be translated only up or down on the x-axis. Let us now consider $c = -d$—thus, the function $\varphi_{-d+mt,\sigma\sqrt{t}}(x)$**.** With a vanishing margin m , the two functions $\varphi_{d+mt,\sigma\sqrt{t}}(x)$ and $\varphi_{-d+mt,\sigma\sqrt{t}}(x)$ are mirror images of each other with regard to the equity-zero axis, and the difference of these two functions (11) and (12) vanishes on this equity-zero axis. In the case of a nonzero margin d, one has to introduce a constant coefficient multiplying one of these functions, cf. equation (13) below. To determine this coefficient, we compare the values of the two functions in question on the equity-zero axis

$$\varphi_{d+mt,\sigma\sqrt{t}}(0) = \eta \cdot e^{-\frac{1}{2}\cdot\frac{(-d-mt)^2}{\sigma^2 t}} = \eta \cdot e^{-\frac{1}{2}\cdot\frac{d^2+2mt+(mt)^2}{\sigma^2 t}} \text{ and} \tag{11}$$

$$\varphi_{-d+mt,\sigma\sqrt{t}}(0) = \eta \cdot e^{-\frac{1}{2}\frac{(d-mt)^2}{\sigma^2 t}} = \eta \cdot e^{-\frac{1}{2}\cdot\frac{d^2-2mt+(mt)^2}{\sigma^2 t}} \tag{12}$$

The only difference between equation (11) and equation (12) consists of the mixed term

$$e^{-\frac{1}{2}\cdot\frac{4dmt}{\sigma^2 t}} = e^{-\frac{2dm}{\sigma^2}}, \tag{13}$$

Thus, the time coordinate drops out, and the quotient (13) of the functions (11) and (12) is constant along the equity-zero axis for a given parameter set defining the specific Brownian motion. Hence,

$$\varphi_{d+mt,\sigma\sqrt{t}}(0) - e^{-\frac{2dm}{\sigma^2}}\varphi_{-d+mt,\sigma\sqrt{t}}(0) = 0 \quad \text{for} \quad t > 0 \tag{14}$$

and the function

$$p = p(x,t) = p_+(x,t) - p_-(x,t) = \varphi_{d+mt,\sigma\sqrt{t}}(x) - e^{-\frac{2dm}{\sigma^2}}\varphi_{-d+mt,\sigma\sqrt{t}}(x) \tag{15}$$

vanishes on the equity-zero axis—i.e., on the line (x,t)=$(0,t)$**,** $t > 0$. Therefore, the probability of a vanishing equity is zero for $p(x,t)$. That must be the case;

remember that $p(x,t)$ represents the probability density for an equity x at time t, whereby the equity has moved on a stochastic path during the period 0 to t without ever crossing the zero line.

A linear combination of solutions to a homogeneous differential equation is still a solution, and this is the case for the function p. Therefore, p is a solution to the diffusion equation (10), which describes the evolution of the equity of the insurance company based on the estimated volatility and margin appropriate to its business model and starting with its initial equity d>0.

Appendix 2

Representing $\psi(t)/\psi(\infty)$ as Inverse Gaussian Distribution $IG_{\mu_{IG},\lambda}$

The following calculations are not required to understand the present article. They are given here, since the complex methods commonly used in actuarial literature first yield the inverse Gaussian distribution in the form given below, which must then be converted into the form used here as the sum of two cumulative normal distributions.

This representation yields to the expected time of ruin as parameter μ_{IG}. First, we look at the following question: If ruin occurs, at what time will it occur? Therefore, it is necessary to calculate the probability density that ruin occurs at a given time, assuming that it occurs. In the language of processes, this corresponds to the probability that the process path crosses the zero line of ruin until time t, if the path crosses it at all. Thus,

$$\psi(t)/\psi(\infty) \quad = \quad e^{-\frac{2md}{\sigma^2}}\Phi\left(-\frac{d+mt}{\sigma\sqrt{t}}\right)+\Phi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right)$$

Setting $g(t) = -\frac{d+mt}{\sigma\sqrt{t}}$ or $\frac{-d+mt}{\sigma\sqrt{t}}$ and applying the chain rule $\frac{d\Phi(g(t)}{dt} =$

$\varphi(g(t))\frac{dg(t)}{dt}$ with

$\frac{d\Phi}{dt} = \varphi_{0,1} = \varphi$ being the standard normal distribution $\varphi(z) = (\frac{1}{2\pi})^{1/2} \cdot e^{-z^2/2}$,

leads to

$$\begin{aligned}\frac{d(\psi(t)/\,\psi(\infty))}{dt} &= e^{-\frac{2md}{\sigma^2}}\varphi\left(-\frac{d+mt}{\sigma\sqrt{t}}\right)\left(-\frac{m}{\sigma\sqrt{t}}+\frac{1}{2}\,\frac{d+mt}{\sigma\,t^{3/2}}\right)+\varphi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right)\left(\frac{m}{\sigma\sqrt{t}}+\frac{1}{2}\,\frac{d-mt}{\sigma\,t^{3/2}}\right)\\ &= \varphi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right)\left(-\frac{m}{\sigma\sqrt{t}}+\frac{1}{2}\,\frac{d+mt}{\sigma\,t^{3/2}}+\frac{m}{\sigma\sqrt{t}}+\frac{1}{2}\,\frac{d-mt}{\sigma\,t^{3/2}}\right) = \frac{d}{\sigma t^{3/2}}\varphi\left(\frac{-d+mt}{\sigma\sqrt{t}}\right)\end{aligned}$$

$$= \left(\frac{d^2/\sigma^2}{2\pi t^3}\right)^{1/2}\cdot e^{-\frac{1}{2}\cdot\frac{(t-d/m)^2}{(\sigma/m)^2 t}} = \left(\frac{\lambda}{2\pi t^3}\right)^{1/2}\cdot e^{-\frac{1}{2}\cdot\frac{\lambda}{\mu_{IG}{}^2 t}(t-\mu_{IG})^2} = p(IG_{\mu_{IG},\lambda}),$$

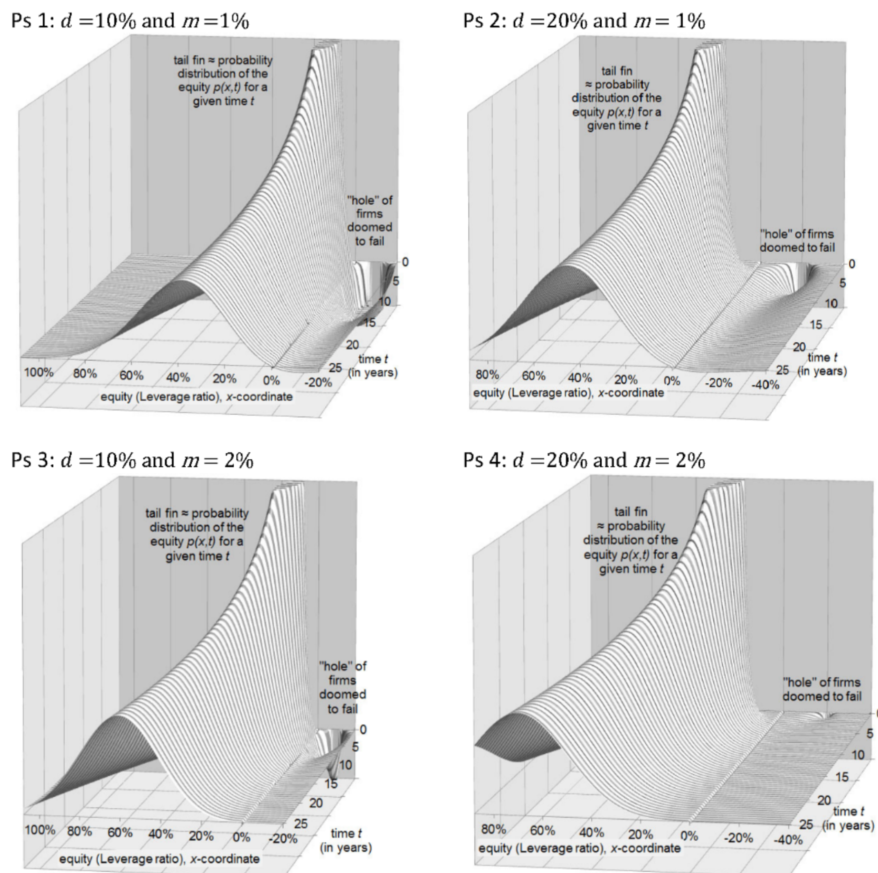
where $p(IG_{\mu_{IG},\lambda})$ denotes the probability density function of the Inverse Gaussian random variable with mean μ_{IG}=*d/m* and shape parameter $\lambda = d^2/\sigma^2$.

Appendix 3

The function $p(x,t)$ shown as surfaces

Figure 5 displays the whole graph of the function $p(x,t)$ as a two-dimensional surface in a three-dimensional space. It starts at the initial equity with a high probability density. The image resembles a tail fin, getting more and more broad as time passes by. The time coordinate is oriented from the background towards the viewer, with the known equity at the beginning of the process represented by a peak in the background.

Figure 5



Since the process moves toward the foreground, the drift caused by the return margin drags the tail fin towards the left. The “red” line, that is the line where the process stops, is the time axis at zero percent equity.

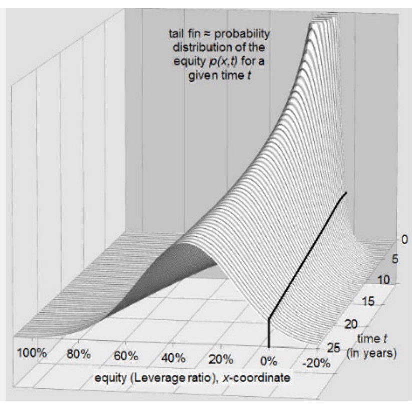
Figure 5 illustrates that this kind of tail fin $p(x,t)$ crosses the zero level at equity x = 0 and then enters the range of negative equity values. This negative $p(x,t)$ on the right side—i.e., for negative x-coordinates from 0% to –20% and –40%, respectively—can be understood as the proportion of firms still active at the time but doomed to fail later on.

At the beginning of the process—i.e., for small values of time t—the negative part has approximately the size of $\psi(\infty)$. The higher the initial equity d at time t = 0 and the faster the process moves away from the stopping line x = 0—that is, the higher return margin m—the smaller the size of the hole $\psi(\infty)$ needed to fulfill the imposed boundary condition on the stopping line. See Figure 5 Ps 4 for a small hole or Ps 1 for the converse case, where all images display the development over the next 25 years for all parameter sets, with time measured in years. In fact, the 25-year period depicted seems reasonable for a more holistic understanding of the risk situation and, therefore, provides a useful overview of the solvency situation.

For comparison, we have presented in Figure 6 the probability distributions of equity that result if the stochastic process is not stopped once the equity is depleted.

Figure 6

The graph in the simple model
The surface on the right illustrates the development of the equity for the simple model of a Brownian motion that is not stopped if it crosses the zero line and thus leads to positive probabilities for negative equities. Thus, the equity at a given time t is normally distributed and the graphs of these curves are Gaussian bell curve, widening and moving slowly to the right by increasing time. The specific graph shown here corresponds to the parameter set Ps 1, thus to d =10% and m=1%.



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Regulation and Surplus Lines Activity

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Abstract

Surplus lines insurers play a crucial role in the marketplace. These companies commonly provided coverage for high capacity, distressed or unique risks, as well as new or emerging risks for which coverage is not available in the admitted market. Though surplus lines insurers play a valuable role in the marketplace and business written by these insurers have grown over time, there has been little academic literature that focuses on this segment of the industry. In this study, we examine whether surplus lines activity differs across regulatory environments, where activity is measured by surplus lines premiums, the number of active surplus lines companies and the concentration of the surplus lines market within each state. We find a positive correlation between premiums written and several regulatory measures, such as greater capital and surplus requirements, higher premium taxes and the existence of state surplus lines associations. The positive correlation with capital and surplus requirements and surplus lines associations is also observed when examining the proportion of surplus lines insurers in states. Finally, we find strong correlations between the concentration of the surplus lines market in states and all regulatory measures considered.

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Introduction

There are several different types of insurers operating in the marketplace today. These insurers can serve different purposes, and each has unique advantages relative to other structures. While most insurance is placed in the standard or admitted market, there are risks the admitted market is unable, or unwilling, to insure. Excess and surplus lines companies commonly insure these risks. Prior literature recognizes the importance of surplus lines insurers within the overall insurance economy, suggesting that the surplus lines market functions as a safety value to the standard market, specifically because surplus lines insurers are capable of solving market availability issues (Brockett, Witt, and Arid, 1990).[1] Thus, one could argue the most salient feature of the surplus lines market is ensuring the availability of insurance coverage to all consumers who wish to purchase.

Surplus lines insurers play a crucial role in the marketplace, primarily providing coverage for high capacity, distressed or unique exposures, as well as emerging risks. Often, coverages originally developed by surplus lines insurers will be offered by admitted carriers in the future. For example, while consumers can now purchase employment practices liability, directors' and officers' liability, medical malpractice, and cyber-risk policies in the admitted market, these coverages were initially written only by surplus lines insurers (ISLM, 2017). More recently, surplus lines insurers began providing coverage for ride-sharing services and drone activities (A.M. Best, 2017).

Relatively speaking, the surplus lines market is deregulated. That is, surplus lines insurers are free from certain aspects of insurance regulation imposed on their admitted counterparts, the most widely recognized of which is the freedom from rate and form regulation. This enables surplus lines carriers to charge a premium that is appropriate for a given degree of risk. Without this ability, surplus lines insurers would be unable to offer coverage for high risk exposures or unique and emerging risks and, therefore, would be unable to fulfill their role of ensuring availability within the insurance economy. Schwartz and Mendelson (1989) evidence this phenomenon through their examination of physicians that, due to excessive losses, were forced to purchase insurance from the surplus lines market. The authors acknowledge that premiums charged by the surplus lines companies are typically several times higher than what the physicians were charged when covered in the admitted market. The policies offered by surplus lines insurers also frequently contained very large deductibles.

Like admitted insurers, surplus lines carriers are required to maintain specified levels of capital and surplus, and their premiums are also subject to taxation.[2] In

1. The authors also note that some consumers may be forced into the surplus lines market if stringent rate regulation causes admitted insurers to temporarily cease writing new business.

2. The regulation of capital and surplus requirements, as well as taxes, within a given state can differ substantially between the surplus lines and admitted markets. This analysis focuses solely on the regulatory requirements affecting surplus lines insurers.

addition to these regulations, surplus lines insurers face some impediments in terms of market access in that they must sell their insurance through a broker (GAO, 2014). These wholesale brokers, intermediaries licensed by the states, place business with surplus lines carriers. They are responsible for selecting eligible insurers, submitting premiums taxes due to states, reporting their transactions to regulators, and ensuring compliance with all requirements (GAO, 2014). Historically, states either maintained a list of eligible surplus insurers with whom brokers could do business, maintained a list of surplus lines insurers with whom brokers could not do business, or allowed brokers to exercise their own due diligence in identifying an appropriate surplus lines insurer.

The regulation of surplus lines insurers has been affected recently with the passage of the federal Nonadmitted and Reinsurance Reform Act (NRRA), found within the federal Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act). Becoming effective in 2011, the NRRA stated that, generally, "the placement of nonadmitted insurance shall be subject to the statutory and regulatory requirements solely of the insured's home State" and that "no State other than the home State of an insured may require any premium tax payment for non-admitted insurance" (NRRA, Sec. 522 (a); Sec. 521 (a), 2010). The NRRA generally defined the home state as the state in which the insured's principle place of business was located, or in the case of individuals, the primary residence of the insured. The NRRA was designed to simplify the regulation of surplus lines insurers. The impact on specific areas of regulation relevant to the current study are discussed in later sections.

Though the surplus lines market serves a valuable function within the insurance marketplace, there is little academic research that focuses on this segment of the industry. Historically, business written by surplus lines insurers made up a small portion of total insurance premiums, which may explain the lack of interest up to this point in this group of insurers. However, the surplus lines market has shown active growth in recent years. In 1994, surplus lines insurers wrote barely 6% of all commercial lines premiums. However, by the end of 2014, this number had more than doubled, climbing to approximately 14% (A.M. Best, 2015).

The purpose of this study is to examine the existing regulation of surplus lines insurers and provide insight into how regulation has changed over time. In addition, we explore differences in surplus lines activity across different regulatory environments. First, we establish thresholds identifying individual states, over time, as either stringently or non-stringently regulated in each of the four regulatory areas examined. Next, we use a series of t-tests to compare means to determine whether there are significant differences in surplus lines activity across regulatory climates. We capture surplus lines activity using three measures: 1) the percentage of premiums written in each state that can be attributed to the surplus lines market; 2) the proportion of firms operating in the state that are classified as surplus lines insurers; and 3) the concentration of a given state's surplus lines market.

Prior literature has long since recognized the potential impact of regulation on market structure. The number of insurers operating in a state, as well as the volume of business insurers are willing to write in particular states, have been identified as specific areas that could be affected by the stringency of regulation (e.g., Harrington, 1992; Browne and Hoyt, 1995; Suponcic and Tennyson, 1995; Tennyson, 1997; Bikker and Spierdijk, 2017). The number of firms within a market serves as one measure of market competition (see, for example, Vives, 2008 and Schmidt et al., 2017). However, a recognized limitation is that a market could be characterized by many active insurers, yet a small number of those insurers might possess significant shares of the market (Cole, He and Karl, 2015).[3] For this reason, we examine both the number of surplus lines insurers operating in states, as well as the concentration of each state's surplus lines market.

We find a positive correlation between premiums written and several regulatory measures, such as higher capital and surplus requirements, higher premium taxes, and the existence of state surplus lines associations. With respect to the proportion of surplus lines firms operating within a state, we find similar results with one exception: We do not observe any differences in the tax comparison. Finally, we find more concentrated surplus lines markets in states with greater capital and surplus requirements and in states that do not use eligibility lists to identify surplus lines insurers that have been preapproved to sell coverage in the state. States without surplus lines associations and lower tax rates are also more concentrated.

The paper is organized as follows. The following section describes the resources used to obtain information on the regulation of surplus lines insurers, as well as surplus lines activity by state. Then we examine changes in surplus lines activity over time. A discussion of existing regulation follows. Next, we provide some evidence as to the impact of regulation on surplus lines activity. Finally, we provide concluding remarks.

Data Source

Information on surplus lines laws is obtained from *Excess and Surplus Lines Laws in the United States – Including Direct Procurement Tax Laws and Industry Insured Exemptions*. We use editions published annually from 2005 to 2015 and report three points in time in the regulation section.[4] Data on surplus lines activity is obtained from the National Association of Insurance Commissioners (NAIC) property/casualty (P/C) database during the same period. Surplus lines insurers are identified using A.M. Best guidelines, which require surplus lines business comprise at least 50% of the company's total business. To identify whether the

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3. In cases such as these, though the number of firms is high, the market is quite concentrated, and the marketplace itself does not foster competition.

4. Detailed information on when changes to laws were made is available from the authors upon request.

coverage written in a state is surplus lines, we examine the status held by each insurer in each state over time. If the insurer has positive premiums in a state and is classified as either “Surplus Lines,” “Not Licensed” or “Eligible Surplus Lines,” we consider premiums written in that state as surplus lines activity. We then retain only surplus lines insurers in our sample. Companies with nonpositive values for direct premiums written, total assets and surplus are excluded. We also limit our sample to stock and mutual companies before aggregating our data to the state level.

Surplus Lines Activity

As mentioned previously, there has been a change in the proportion of premiums written by surplus lines insurers, with commercial premiums climbing from approximately 6% to more than 14% over the 20-year period spanning from 1994 to 2014 (A.M. Best, 2015). However, we do not find a corresponding increase in the number of individual surplus lines companies operating in the U.S. over our sample period.[5] Between the years of 2005 and 2015, the highest number of surplus lines insurers was 160 in 2011, and the lowest number was 147 in 2013. As an overall percentage of all insurers in the sample, surplus lines companies made up 7.29% in 2005 and 7.13% in 2015. As such, it follows that the increase in the proportion of premiums written by surplus lines insurers is explained not by an increase in the number of surplus lines companies, but rather a similar number of individual insurers writing a greater volume of business. A table tracking the number of surplus lines insurers over our sample period may be found in Table 1 on page 6.

Interestingly, the proportion of insurer groups that are affiliated with surplus lines insurers has changed over time. In 2005, approximately 17% of all insurer groups were affiliated with at least one surplus lines insurer. By 2015, the end of our sample period, this number had increased to 22%. This shift in the composition of insurer groups suggests that there are some advantages to being affiliated with one or more surplus lines companies, for at least a subset of insurer groups. Figure 1 on page 6 presents a graphical representation of this shift in the composition of insurer groups over the sample period.

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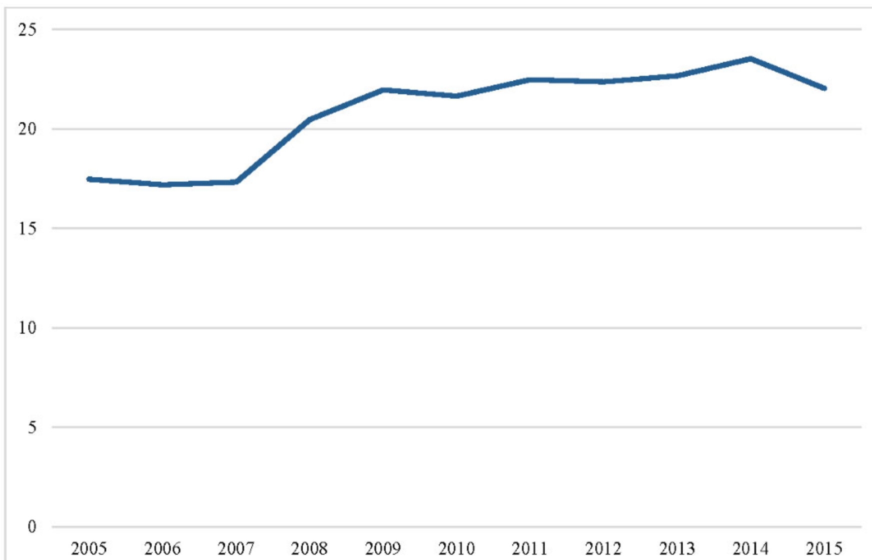
5. It should be noted that surplus lines companies domiciled within the U.S. and licensed in at least one state are referred to as foreign insurers in states other than their domiciliary state, while those domiciled outside the U.S. are referred to as alien insurers (GAO, 2014). This analysis focuses on foreign surplus lines insurers only, as all insurers within our sample are domiciled within the U.S.

Table 1:
Number of Firms

Year	*Surplus Lines*	*Admitted*	*Total*	*% Surplus Lines*
2005	154	1,958	2,112	7.29
2006	148	1,970	2,118	6.99
2007	153	1,999	2,152	7.11
2008	159	2,013	2,172	7.32
2009	157	2,023	2,180	7.20
2010	155	2,006	2,161	7.17
2011	160	1,980	2,140	7.48
2012	148	1,957	2,105	7.03
2013	147	1,950	2,097	7.01
2014	150	1,935	2,085	7.19
2015	148	1,928	2,076	7.13

Figure 1:
Percentage of Insurer Groups With Surplus Lines Affiliates



The extent of surplus lines activity in individual states is likely affected by the demand for insurance. Demand can be affected by the size of a state/insurance marketplace and other factors. For example, Baggett and Cole (2017) examine insurer groups and find that groups with surplus lines insurers have higher levels of catastrophe exposure than groups without surplus lines insurers.[6] When examining the subset of groups with surplus lines affiliates, the authors also found that the inclusion of surplus lines insurers in the group increased catastrophe exposure by more than 17%. Given the exposure to natural disasters, such as hurricanes, tornados, flooding and wildfires, it follows that some geographic regions will have greater needs for participation from the surplus lines market. As such, we examine the premiums written in each state by surplus lines insurers over the period 2005 through 2015. Over this 10-year period, the five states with the highest dollar value of direct premiums written (in thousands) were: California ($13,508,407); Florida ($9,183,049); Texas ($8,812,087); New York ($7,018,385); and Illinois ($2,906,711). The five states with the lowest dollar value of premiums written were: South Dakota ($102,688); Wyoming ($107,140); North Dakota ($136,805); Maine ($162,682); and Vermont ($165,322).

Regulation of the Surplus Lines Industry

While surplus lines insurers are not subject to rate and form regulation, they are subject to some of the same types of regulations as admitted insurers, including maintaining certain capital and surplus requirements, as well as paying state premium taxes.[7] In addition to these requirements, surplus lines carriers also face some restrictions on market access. To accommodate surplus lines producers, surplus lines associations provide information on local issues and serve to inform members of important regulatory changes (WSIA, 2017). This section of the paper explores each of these four areas and reviews how these regulations have changed over time.

Capital and Surplus Requirements

Similar to admitted insurers, states require surplus lines insurers to meet minimum capital and surplus requirements. Table 2 on pages 8 and 9 presents a summary of capital and surplus requirements imposed by individual states on surplus lines insurers for the years 2005, 2010 and 2015. The capital and surplus requirements for surplus lines insurers are relatively consistent toward the end of

6. The authors measure catastrophe exposure as the ratio of premiums in Southeastern coastal states to total premiums written.

7. It should be noted that in almost all states, the tax rate for surplus lines insurers exceeds that of admitted insurers.

the sample, at $15 million, though there are some significant difference between states in earlier years.

Table 2:
Capital and Surplus Requirements

State	*2005*	*2010*	*2015*
Alabama	$5,000,000	$5,000,000	$15,000,000*
Alaska	$15,000,000*	$15,000,000*	$15,000,000
Arizona	$5,000,000	$5,000,000	$15,000,000
Arkansas	$3,000,000	$3,000,000	$15,000,000*
California	$15,000,000	$15,000,000	$45,000,000
Colorado	$15,000,000	$15,000,000	$15,000,000
Connecticut	$15,000,000	$15,000,000	$15,000,000
Delaware	NA	NA	$15,000,000*
District of Columbia	$300,000 $300,000	$300,000 $300,000	$15,000,000*
Florida	$15,000,000	$15,000,000	$15,000,000
Georgia	$3,000,000	$3,000,000	$15,000,000*
Hawaii	Domicile	Domicile	$15,000,000*
Idaho	NA	NA	$15,000,000*
Illinois	$15,000,000	$15,000,000	$15,000,000
Indiana	NA	NA	NA
Iowa	$5,000,000	$5,000,000**	$15,000,000**
Kansas	$1,500,000	$1,500,000	$4,500,000
Kentucky	NA	NA	$15,000,000*
Louisiana	$15,000,000	$15,000,000	$15,000,000
Maine	$500,000 $500,000	$500,000 $500,000	$15,000,000*
Maryland	$6,500,000	$6,500,000	$15,000,000*
Massachusetts	$20,000,000	$20,000,000	$15,000,000*
Michigan	$7,500,000	$7,500,000	$15,000,000*
Minnesota	$3,000,000	$3,000,000	$15,000,000*
Mississippi	$600,000 $900,000	$600,000 $900,000	$15,000,000*
Missouri	$1,200,000 $1,200,000	$1,200,000 $1,200,000	$15,000,000
Montana	$15,000,000	$15,000,000	$15,000,000*
Nebraska	$1,000,000 $1,000,000	$1,000,000 $1,000,000	$15,000,000*
Nevada	$15,000,000	$15,000,000	$15,000,000*
New Hampshire	$20,000,000	$20,000,000	NA
New Jersey	$15,000,000	$15,000,000	NA
New Mexico	NA	NA	$15,000,000*
New York	$15,000,000	$15,000,000	$45,000,000
North Carolina	$15,000,000	$15,000,000	$15,000,000*
North Dakota	$1,000,000	$1,000,000	$15,000,000
Ohio	NA	NA	$15,000,000*
Oklahoma	$15,000,000	$15,000,000	$15,000,000*

Table 2:
Continued

Oregon	$5,000,000	$5,000,000	$15,000,000
Pennsylvania	$7,050,000	$7,050,000	$15,000,000*
Rhode Island	$15,000,000	$15,000,000	$15,000,000*
South Carolina	NA	NA	$15,000,000
South Dakota	NA	NA	$15,000,000*
Tennessee	$1,000,000 $1,000,000	$1,000,000 $1,000,000	$15,000,000
Texas	$15,000,000	$15,000,000	$15,000,000
Utah	$15,000,000	$15,000,000	$15,000,000*
Vermont	$10,000,000	$10,000,000	$15,000,000
Virginia	$15,000,000	$15,000,000	$15,000,000
Washington	$15,000,000	$15,000,000	$15,000,000*
West Virginia	NA	$15,000,000	$15,000,000
Wisconsin	NA	NA	$15,000,000*
Wyoming	$3,500,000	$3,500,000	$15,000,000*

When capital and surplus requirements are reported separately for single-line and multiple-lines, the multiple-lines figures are used. Note that (*) denotes states that require the greater of a specified dollar amount of capital and surplus or domiciliary requirement, (**) denotes states that require the greater of a specific dollar amount of capital and surplus or risk-based capital (RBC) requirement, “domicile” denotes states that require the insurer to have capital and surplus equivalent to the requirements of that state for that type of insurer, while "NA" reflects states that do not specifically provide information related to capital and surplus eligibility requirements. While few states do not provide capital and surplus requirements in 2015, the NRRA requires the greater of $15 million or the minimum capital requirements of the insured’s home state, and as such, $15 million is assumed for the purposes of the analysis.

Over the sample period examined, there are relatively few changes across time for a given state. However, there are wide fluctuations across states for a given year. For example, in 2005, the District of Columbia required $300,000 of surplus lines insurers in capital and surplus levels, and Maine and North Dakota each required $1 million. Alternatively, in the same year, Massachusetts and New Hampshire required $20 million in capital and surplus for surplus lines insurers. As demonstrated in Table 2, many states increased their capital and surplus requirements to $15 million between 2010 and 2015. This shift is explained by the enactment of the NRRA.

The NRRA became effective July 21, 2011, and served to simplify the regulation and taxation of surplus lines insurers. A key component of the NRRA was the introduction of a “home-state” system, whereby only the home state is permitted to regulate or tax surplus lines transactions (GAO, 2014). The NRRA establishes uniform eligibility requirements across individual states, thereby making it less cumbersome for a surplus lines insurer to write multistate risks. Before the passage of the NRRA, and as demonstrated in Table 2, it was possible for a surplus lines insurer to be eligible to conduct business in one state but not another. Under the NRRA, insurers are required to maintain the greater of $15 million or the minimum capital and surplus requirements imposed by the insured's home state (GAO, 2014).[8]

As noted above, though the capital and surplus requirements are now fairly consistent across states, this was not the case in earlier years. In examining the surplus and capital of insurers during the sample period, we find that nearly all insurers substantially exceed the minimum requirements. Specifically, we find that slightly more than 99% had capital and surplus that exceeded the minimum requirements set by the state and more than 96% exceeded the minimum requirements by at least 50%. This suggests that capital and surplus requirements are not binding. As such, we do not expect to observe differences in the volume of premiums written by surplus lines insurers in states, the number of surplus insurers operating in states or the level of market concentration in states with more stringent requirements in comparison to those with less stringent requirements.

Accessing the Surplus Lines Market

The regulation of surplus lines companies also involves the supervision of agents and brokers. As discussed previously, wholesale brokers must be licensed by the states where they conduct business and serve an important role in placing coverage with surplus lines insurers. The surplus lines market does not compete directly with the admitted market, as evidenced by due diligence requirements. These requirements may differ by state, but typically require wholesale brokers to verify no less than three insurers in the admitted marketplace declined to provide coverage for a risk before sending the account to a surplus lines carrier (GAO, 2014). States with export lists identify lines of business that are generally unavailable in the admitted market, and because of this known availability issue, allow the wholesale broker to send the risk to a surplus lines carrier without first completing a diligent search in the admitted market (Dearie, 2015).

Brokers are also responsible for ensuring customers are placed with financially stable surplus lines insurers. Historically, these intermediaries generally used one of three methods, dictated by the individual states, to determine whether they could place a risk with a particular surplus lines company (Dearie, 2005). More recently, it appears states either use eligibility lists or rely on brokers to independently evaluate the appropriateness of surplus lines insurers. States that maintain eligibility lists provide brokers with a list of eligible surplus lines insurers that have been preapproved by the state. Brokers can place business with any surplus lines insurer that appears on the list. Alternatively, states employing broker responsibility rules require the broker practice due diligence when selecting a surplus lines insurer.[9]

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8. However, in some cases, a lesser amount may be permitted if the insurance commissioner deems an insurer acceptable, but capital and surplus should not be lower than $4.5 million (Dearie, 2015).

9. Though references to blacklists can still be found in some discussions of surplus lines insurers, it appears they are no longer commonly used. In addition, states that use eligibility lists

In 2005, more than 75% (39 states) of states maintained a list of eligible surplus lines insurers. This has declined slightly over time. As shown in Table 3 on pages 12 and 13, 37 states maintained such lists in 2015. The states that moved away from maintaining eligibility lists over the sample period examined were Georgia, Nevada and Vermont. This information is summarized in Table 3.

Eligibility lists can serve to expedite the decision-making process regarding the placement of business by identifying the surplus lines companies with which a broker can place business in a particular state. This can lead to more efficient operations by brokers. As a result, these states represent a lower regulatory burden than states in which the broker must evaluate the eligibility of surplus lines insurers. Therefore, we hypothesize that if any observable differences exist among states relative to eligibility lists, the percentage of surplus lines premiums written and the percentage of active surplus lines insurers operating in those states with eligibility lists will be higher and the level of concentration of the market will be lower relative to those states that do not maintain these lists.

Surplus Lines Associations

Not to be confused with stamping offices, surplus lines associations provide information on local issues. Some of the associations are full-time offices, while others use volunteer representatives (WSIA, 2017). One key difference between surplus lines associations and stamping offices is that participation is voluntary in an association (Dearie, 2015). WSIA (2017) notes that surplus lines insurers themselves started stamping offices to self-regulate and estimates that stamping offices currently process 80% of all surplus lines transactions. Additionally, these offices assist in preventing ineligible insurers from conducting business within a given state and may assist in evaluating the financial stability of eligible insurers. Table 4 on pages 14 and 15 tracks states with and without surplus lines associations over the years 2005, 2010 and 2015.

Over the sample period examined, there has not been a substantial shift in the number of states with surplus lines associations. In both 2005 and 2010, 33 states had associations, while in 2015, this number dropped slightly to 30.[10] Five states shifted from having surplus lines associations to dissolving them—Iowa, Michigan, North Dakota, South Carolina and Wisconsin—while two states acquired associations that did not have them at the beginning of the sample period—Minnesota and Ohio.

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do not necessarily use these lists in the strictest sense. While insurers on the list have been preapproved by the Department of Insurance (DOI) in the state, participation can be voluntary, and brokers can place business with other surplus lines insurers not on the list if the insurers meet the requirements of the states. For an example of this discussion, see California's DOI website at *https://www.insurance.ca.gov/01-consumers/120-company/07-lasli/index.cfm*.

10. It should be noted that state associations are not directly correlated to market size. For example, Washington, DC, and Hawaii rank in the top five in terms of premiums written by surplus lines insurers relative to total premiums in 2015. However, neither has a surplus lines insurance association.

Table 3:
State Maintains List of Eligible Surplus Lines Insurers

State	*2005*	*2010*	*2015*
Alabama	N	N	N
Alaska	Y	Y	Y
Arizona	Y	Y	Y
Arkansas	Y	Y	Y
California	Y	Y	Y
Colorado	Y	Y	Y
Connecticut	Y	N	Y
Delaware	Y	Y	Y
District of Columbia	N	N	N
Florida	Y	Y	Y
Georgia	Y	Y	N
Hawaii	N	N	N
Idaho	Y	Y	Y
Illinois	N	N	N
Indiana	Y	Y	Y
Iowa	Y	Y	Y
Kansas	Y	Y	Y
Kentucky	N	N	N
Louisiana	Y	Y	Y
Maine	Y	Y	Y
Maryland	Y	Y	Y
Massachusetts	Y	Y	Y
Michigan	Y	Y	Y
Minnesota	Y	Y	Y
Mississippi	Y	Y	Y
Missouri	Y	Y	Y
Montana	Y	Y	Y
Nebraska	N	N	N
Nevada	Y	Y	N
New Hampshire	Y	Y	Y
New Jersey	Y	Y	Y
New Mexico	Y	Y	Y
New York	Y	Y	Y
North Carolina	Y	Y	Y
North Dakota	Y	Y	Y
Ohio	N	Y	Y
Oklahoma	Y	Y	Y

Table 3: Continued

Oregon	N	N	N
Pennsylvania	Y	Y	Y
Rhode Island	Y	Y	Y
South Carolina	Y	Y	Y
South Dakota	N	N	N
Tennessee	Y	Y	Y
Texas	Y	Y	Y
Utah	Y	Y	Y
Vermont	Y	Y	N
Virginia	Y	Y	Y
Washington	N	N	N
West Virginia	Y	Y	Y
Wisconsin	N	N	N
Wyoming	N	N	N
Totals	*39*	*39*	*37*

While not every state that has a surplus lines association has a stamping office, every state that has a stamping office currently has a surplus lines association, and it appears that these offices do work closely together.[11] As noted in a recent industry publication discussing California's surplus lines association (SLA), "The SLA operates as a self-governed private organization that serves as the statutory surplus line advisory organization to the CDI and facilitates the state's capacity to monitor and direct surplus line brokers' placements of insurance with eligible non-admitted insurers." (Insurance Journal, 2017). As such, we contend these associations offer a valuable service to surplus lines insurers. If any differences exist, we would expect states with SLAs to have more surplus lines activity, as measured by both percentage of surplus lines premiums and percentage of active surplus lines insurers, than states without. We would also expect these states to have lower levels of market concentration.

11. Based on the information currently provided on the WSIA (2017) website, 15 states currently have stamping offices. These are: Arizona, California, Florida, Idaho, Illinois, Mississippi, Minnesota, Nevada, New York, North Carolina, Oregon, Pennsylvania, Texas, Utah and Washington.

Table 4:
Surplus Lines Association

State	*2005*	*2010*	*2015*
Alabama	Y	Y	Y
Alaska	N	N	N
Arizona	Y	Y	Y
Arkansas	Y	Y	Y
California	Y	Y	Y
Colorado	Y	Y	Y
Connecticut	N	N	N
Delaware	N	N	N
District of Columbia	N	N	N
Florida	Y	Y	Y
Georgia	N	N	N
Hawaii	N	N	N
Idaho	Y	Y	Y
Illinois	Y	Y	Y
Indiana	N	N	N
Iowa	Y	Y	N
Kansas	N	N	N
Kentucky	Y	Y	Y
Louisiana	Y	Y	Y
Maine	N	N	N
Maryland	Y	Y	Y
Massachusetts	Y	Y	Y
Michigan	Y	Y	N
Minnesota	N	Y	Y
Mississippi	Y	Y	Y
Missouri	Y	Y	Y
Montana	Y	Y	Y
Nebraska	N	N	N
Nevada	Y	Y	Y
New Hampshire	Y	Y	Y
New Jersey	Y	Y	Y
New Mexico	Y	Y	Y
New York	Y	Y	Y
North Carolina	Y	Y	Y
North Dakota	Y	N	N
Ohio	N	Y	Y
Oklahoma	N	N	N

Table 4: Continued

Oregon	Y	Y	Y
Pennsylvania	Y	Y	Y
Rhode Island	N	N	N
South Carolina	Y	Y	N
South Dakota	N	N	N
Tennessee	N	N	N
Texas	Y	Y	Y
Utah	Y	Y	Y
Vermont	N	N	N
Virginia	Y	Y	Y
Washington	Y	Y	Y
West Virginia	Y	Y	Y
Wisconsin	Y	N	N
Wyoming	N	N	N
Totals	*33*	*33*	*30*

Taxes

Like insurance sold by admitted insurers, surplus lines premium taxes must be paid to the state for surplus lines transactions, and this responsibility falls on the wholesale broker.[12] Table 5 on pages 16 and 17 shows the tax rates applicable to surplus lines premiums across states for select years. The rates reported are for most P/C insurance products. Some states do have varying premium taxes for specific lines of business (e.g., wet marine and transportation), and others have additional charges, such as stamping or filing fees, service fees, and fire marshal taxes, that must be paid in addition to the premium tax.[13]

12. Though taxes are passed on to the consumer, they affect the cost of coverage. Additionally, there are a number of existing studies that find state taxes affect insurer decision-making and the size of the insurance industry in states (e.g., Petroni and Shackelford, 1995; Grace, Sjoquist and Wheeler, 2014). As such, taxes are relevant to consider as a measure of regulatory stringency.

13. Where possible, any applicable fees and taxes are added to the base rate to arrive at the final tax rate shown in Table 5. We should also note that surplus lines premium taxes are higher than the taxes paid by admitted insurers in almost every state. These higher taxes are likely due, in part, to the additional costs mentioned above.

Table 5:
Premium Taxes

State	*2005*	*2010*	*2015*
Alabama	6.0%	6.0%	6.0%
Alaska	3.7%*	3.7%*	3.7%*
Arizona	3.25%*	3.2%*	3.2%*
Arkansas	4.0%	4.0%	4.0%
California	3.225%*	3.25%*	3.2%*
Colorado	3.10%	3%	3%
Connecticut	4%	4%	4%
Delaware	2%**	2%**	3%
District of Columbia	2%	2%	2%
Florida	5.55%*	5.1%*	5.175%*
Georgia	4%	4%	4%
Hawaii	4.68%	4.68%	4.68%
Idaho	3.25%	1.75%	1.75%
Illinois	3.8%**	3.6%**	3.7%**
Indiana	2.5%	2.5%	2.5%
Iowa	1.5%	1%	1%
Kansas	6%	6%	6%
Kentucky	3%	3%	4.8%*
Louisiana	5%	5%	4.85%
Maine	3%	3%	3%
Maryland	3%*	3%*	3%*
Massachusetts	4%	4%	4%
Michigan	2.5%*	2.5%*	2.5%*
Minnesota	3%	3.025%*	3.06%*
Mississippi	4.25%	4.25%	4.25%
Missouri	5%	5%	5%
Montana	3.75%**	3.75%**	2.75%**
Nebraska	3%**	3%**	3%
Nevada	3.5%	3.9%	3.9%
New Hampshire	2%	2%	3%
New Jersey	3%	5%	5%
New Mexico	3%	3.003%	3.003%
New York	3.9%*	3.8%*	3.8%*
North Carolina	5%	5%	5%
North Dakota	1.75%**	1.75%**	1.75%
Ohio	5%	5%	5%
Oklahoma	6%	6%	6%

Table 5: Continued

Oregon	3%*	2%**	2.3%*
Pennsylvania	3%	3%	3%
Rhode Island	3%	3%	4%
South Carolina	4%	4%	6%
South Dakota	2.5%**	2.5%**	2.5%**
Tennessee	2.5%**	2.5%**	5%
Texas	4.95%*	4.91%*	4.91%*
Utah	4.5%*	4.4%*	4.4%*
Vermont	3%	3%	3%
Virginia	2.25%	2.25%	2.25%
Washington	2%	2.25%*	2.1%*
West Virginia	5%*	4.5%*	4.55%
Wisconsin	3%**	3%**	3%
Wyoming	3%	3%	3%

Note that (*) denotes states in which filing/stamping fee, special tax or service/fire marshal fee was added to the base premium tax, and (**) denotes states in which different tax rates apply to specific lines of business (e.g., wet marine and transportation, fire, and ocean marine).

In 2005, the District of Columbia (2%), Delaware (2%), Iowa (1.5%), New Hampshire (2%), North Dakota (1.75%) and Washington (2%) imposed state premium taxes of 2% or lower on surplus lines transactions. Alternatively, states charging more than 5.5% were: Alabama (6%), Florida (5.5%), Kansas (6%) and Oklahoma (6%). At the end of the sample period, in 2015, the high and low-tax thresholds were similar to the rates found in 2005, but the group of states in each category changed slightly. States charging 2% or less on surplus lines transactions in 2015 were the District of Columbia (2%), Idaho (1.75%), Iowa (1%) and North Dakota (1.75%), while states charging more than 5.5% were Alabama (6%), Kansas (6%), Oklahoma (6%) and South Carolina (6%). In examining the tax rates on a collective basis over the sample period, it appears that there has been little change, with average tax rates across states increasing from 3.55% in 2005 to 3.68% in 2015.

The home-state system created by the NRRA may also apply to taxation and has largely alleviated the complexities involved in paying premium taxes to various states, which frequently impose different tax rates on surplus lines transactions (GAO, 2014).[14] For accounts that involved exposures in multiple

14. The GAO (2014) notes that the home state is defined by the NRRA as, "the state in which the insured maintains its principal place of business, or in the case of an individual, the individual's principal residence. If all the insured risk is outside this state, NRRA defines the home state as the state to which the greatest percentage of taxable premium taxed for that insurance contract is allocated."

states, apportioning premium taxes between the states involved was a burdensome and complex process for surplus lines brokers, as each state could potentially charge a different tax rate for their portion of the risk.[15] Despite the majority of states currently calculating surplus lines premium taxes on a home state basis, the tax rates charged by individual states are not consist.[16] As such, we expect less activity in states with higher tax rates. We would also expect states with higher taxes rates to be more concentrated.

Analysis of the Impact of Regulation on Surplus Lines Activity

In the comparative analysis, we consider three measures of surplus lines activity: 1) the volume of premiums written by surplus lines insurers in the state; 2) the number of surplus lines insurers operating in the state; and 3) the extent of concentration within the surplus lines market in the state. To control for variations in market size, both the premium volume and the number of insurer variables are scaled. Total direct premiums written by surplus lines insurers is divided by total direct premiums written in the state. Likewise, total surplus lines insurers operating in the state, defined by positive direct premiums written in the state in that year, is scaled by total insurers operating in the state. Finally, market concentration is measured using a Herfindahl Index (HHI).[17]

After reviewing the laws regarding surplus lines insurers over the three years of interest, each state is identified as more stringent or less stringent. All comparisons are made between these two groups over the sample period, and t-tests are conducted to determine if differences observed are statistically significant. Table 6 provides summary information for both stringent and less stringent states. In Table 7, we present the results of a series of t-tests capturing each of the four regulatory areas examined. In Panel A, results are presented for differences in premiums, while in Panel B, results are presented for differences in the number of active surplus lines insurers. Panel C presents results for differences in degrees of market concentration. Details regarding the identification of states as

15. Tax-sharing agreements between states are permitted, though not required, by the NRRA. The Non-Admitted Insurance Multi-State Association (NIMA) and the Surplus Lines Insurance Multistate Compliance Compact (SLIMPACT) are two such agreements that followed the NRRA's passage. However, SLIMPACT was abandoned and NIMA was dissolved effective Oct. 1, 2016, with the run-off period ending Oct. 1, 2017 (WSIA, 2017).

16. Moynihan (2018) reports that only four remaining states fail to calculate surplus lines taxes on a home state authority: Florida, Hawaii, New Hampshire and Vermont.

17. The HHI is a common measure of concentration. To determine the HHI, we first calculated the market share of each surplus lines insurer and then added the square of each. This is done for each state in each year. The higher the HHI, the more concentrated (or less competitive) the market.

more stringent or less stringent across each of the regulatory areas, respectively, are provided below.

Table 6

Panel A. Surplus Lines Premiums

	Mean			
	Stringent	*N*	*Non-stringent*	*N*
Capital and Surplus	1,027,044.0	43	328,012.2	86
Eligibility List	287,566.6	38	610,255.7	115
Association	205,032.3	57	723,126.0	96
Taxes	817,579.5	38	435,121.0	115

Panel B. Surplus Lines Firms

	Mean			
	Stringent	*N*	*Non-stringent*	*N*
Capital and Surplus	152.7674	43	149.1512	86
Eligibility List	150.2105	38	150.687	115
Association	150.193	57	150.7917	96
Taxes	150.6316	38	150.5478	115

Capital and Surplus Requirements

In surveying whether capital and surplus requirements result in differing degrees of surplus lines activity, we consider stringently regulated states to be those where the capital and surplus requirements are in the 75^{th} percentile for the years 2005 and 2010. In both years, this was $15 million or greater. Due to the passage of the NRRA and the consistency across states in the year 2015, we consider stringently regulated states to be those where the capital and surplus requirements exceed $15 million.

As shown in Table 6, on average, more premiums are written in states with higher capital and surplus requirements. Premiums written in states with stringent capital and surplus requirements average more than $1 billion relative to premiums written in states without stringent capital and surplus requirements, which average less than $330 million. Additionally, states with stringent capital and surplus requirements average approximately 153 active surplus lines firms, while non-stringent states average 149 active firms.

Contrary to expectations, we find correlations between capital and surplus regulations and all three measures of surplus lines activity. Panel A of Table 7 reports the results of the comparison of the percentage of premiums written by surplus lines insurers. We find a higher percentage of surplus lines premiums written in states with more stringent capital and surplus requirements, approximately 6% compared to 4.4%. We also find that, on average, there is a greater proportion of surplus lines insurers operating in states with more stringent capital and surplus requirements. However, the difference is negligible, 7.25% compared to 7.19%. Finally, in Panel C, we find greater concentration (i.e., less competition) in states with stringent capital and surplus requirements.

Table 7

Panel A. Percentage of Surplus Lines Premiums

	Means				Significance
	Stringent	*N*	*Non-stringent*	*N*	
Capital and Surplus	0.0602	43	0.0438	86	***
Eligibility List	0.0489	38	0.0478	115	
Association	0.0447	57	0.0500	96	*
Taxes	0.0575	38	0.0449	115	***

Panel B. Percentage of Surplus Lines Firms

	Means				Significance
	Stringent	*N*	*Non-stringent*	*N*	
Capital and Surplus	0.0725	43	0.0719	86	***
Eligibility List	0.0720	38	0.0722	115	
Association	0.0720	57	0.0722	96	**
Taxes	0.0723	38	0.0721	115	

Panel C. Concentration in Surplus Lines Market

	Means				Significance
	Stringent	*N*	*Non-stringent*	*N*	
Capital and Surplus	0.0863	43	0.0787	86	*
Eligibility List	0.0919	38	0.0809	115	**
Association	0.0931	57	0.0781	96	***
Taxes	0.0738	38	0.0869	115	**

Note that capital and surplus information is not available for all states in all three years of observation. Specifically, West Virginia does not report for 2005. Information is missing for both 2005 and 2015 for the following states: Delaware, Hawaii, Idaho, Indiana, Kentucky, New Mexico, Ohio, South Carolina, South Dakota and Wisconsin. Information is missing for 2015 for New Hampshire, New Jersey and Texas. These 24 missing observations account for the difference between the total observations for the three other regulatory areas of interest (N = 153) and the total for the capital and surplus variable (N = 129).

In exploring why more premiums are written in states with stringent capital and surplus requirements, we consider the demand for surplus lines insurance in the states. States with greater catastrophe exposure may also be the states with more stringent regulation, thereby affecting the results obtained. As such, we drop from the sample the 10 states identified as having the greatest catastrophe exposure and re-run the comparison.[18] The results are qualitatively similar to those presented here. The differences observed may be due to the demand for surplus lines insurance. However, this appears to be unrelated to catastrophe exposure.

Access to the Surplus Lines Market

Also of interest is whether there are differences in surplus lines activity based on variations in market accessibility. As noted earlier, states that place the decision-making responsibility on the broker can be viewed as having a greater regulatory burden in comparison to states that provide a list of eligible insurers. As such, states using eligibility lists are considered less stringent. As shown in Table 6, greater premium volume is written by surplus lines insurers in states using eligibility lists, though the numbers of surplus lines insurers operating in states with and without eligibility lists are relatively equal. The results of the t-tests of the scaled variables presented in Table 7 indicate there are no differences in the degree of surplus lines activity based on stringent and non-stringent market accessibility, with the exception of market concentration. As shown in Panel C, as expected, states with eligibility lists, or greater market accessibility, are less concentrated (i.e., more competitive) than those that do not maintain these lists.

Surplus Lines Associations

We also explore whether there are significant differences between levels of surplus lines activity between states with and without SLAs. As discussed previously, SLAs broadly serve their local areas, whether on a full-time or volunteer basis, to ensure compliance with surplus lines regulations. Since these associations are beneficial to the surplus lines market and offer a valuable service, we consider states with these associations to be more "surplus lines friendly" and, therefore, acknowledge they may encourage more surplus lines activity in the state.

Based on the summary information in Table 6, there does not appear to be differences in activity based on the number of surplus lines insurers operating in the states, but we do observe higher premiums written in states that have SLAs. The results of the t-tests suggest there are substantial differences across all three measures of surplus lines activity when considering the existence of SLAs. Presented in Panel A of Table 7, we find a greater proportion of premiums are written, on average, in states with SLAs relative to states without associations. In

18. The 10 states identified by the CoreLogic Hazard Risk Score as having the greatest catastrophe exposure are: California, Connecticut, Delaware, Florida, Kansas, Louisiana, Massachusetts, Oklahoma, Rhode Island and South Carolina. We explored conducting a similar analysis using only these 10 high catastrophe risk states. However, due to the small sample size, there was not sufficient variation in the four stringency measures examined to produce meaningful results.

states with SLAs, surplus lines premiums account for 5% of total premiums, relative to less than 4.5% in states without associations. In addition, as shown in Panel B of Table 7, we find that surplus lines insurers make up 7.22% of the overall number of insurers in states with associations relative to 7.20% of overall insurers in states without associations. Panel C also indicates that there is evidence of lower levels of market concentration (i.e., greater competition) in states with associations when compared to states without. These results are all consistent with expectations.

Taxes

With respect to taxation, we identify stringently regulated states as those with tax rates in the 75th percentile for each of the three years of analysis. This threshold was 4.25% or greater in 2005, 4.4% or greater in 2010, and 4.8% or greater in 2015. The summary information presented in Table 6 is contrary to expectations for premium volume and reveal no discernable differences for the number of surplus lines insurers. The t-tests of the scaled variables yield similar results. We find, as demonstrated in Panel A of Table 7, a greater percentage of overall premiums are written, on average, in states with stringent taxation. After scaling by the total premiums written in a given state, surplus lines insurers account for 5.75% of premiums in stringently taxed states and less than 4.5% in non-stringently taxed states. This difference is statistically significant. In Panel B of Table 7, we report the proportion of surplus lines firms operating in stringently and non-stringently taxed states, but we find no statistical difference. Finally, contrary to expectations, we find that markets are more concentrated (i.e., less competitive) in non-stringent states relative to states with more stringent taxation.

One explanation for these findings is that more premiums are written in states that charge higher taxes simply due to particular exposures in these states being well-suited for placement in the surplus lines market. Surplus lines companies, assuming they want to remain competitive, must write policies in states where surplus lines exposures are most plentiful. As such, regulators in these states may encourage higher taxes to capitalize on premium revenues. Nine states have stringent tax requirements in all three years of analysis: Alabama, Florida, Kansas, Louisiana, Missouri, North Carolina, Ohio, Oklahoma and Texas. More than one of these states were mentioned previously as being in the top five states for overall surplus lines premiums. However, none of these were found to be in the lowest five states for overall surplus lines premiums.

Conclusion

As a vital component of the overall insurance economy, surplus lines insurers provide coverage for risks deemed uninsurable in the admitted market. This segment of the industry, while deregulated to a great extent, must meet minimum capital and surplus requirements and pay state premium taxes, like their admitted counterparts. Some states make writing business on a surplus lines basis easier by maintaining SLAs or maintaining a list of eligible surplus lines carriers with which they conduct business. The objective of this study was to review regulation that applies to surplus lines insurers, while examining the differences between states with respect to four regulatory areas.

The surplus lines industry has experienced significant changes with respect to regulation in recent years. The NRRA sought to make regulation more efficient among surplus lines brokers and insurers by implementing a "home state" system. This provided consistency with respect to both taxation and capital and surplus eligibility requirements for multistate exposures. While the sharing of premium taxes between states is permitted under the NRRA, both agreements thus far attempting to do so—the Non-Admitted Insurance Multi-State Association (NIMA) and the Surplus Lines Insurance Multistate Compliance Compact (SLIMPACT)—have either failed or have been dissolved.

We consider four regulatory areas over the years 2005, 2010 and 2015, and examine whether surplus lines activity differs across regulatory environments, where surplus lines activity is measured by the proportion of premiums written by surplus lines insurers, the proportion of surplus lines insurers conducting business in the state, and the level of market concentration in the state. We find a positive correlation between premiums written and several regulatory measures, such as greater capital and surplus requirements, higher taxes and the existence of SLAs. Additionally, we find that surplus lines carriers make up a greater proportion of total insurers in states requiring higher levels of capital and surplus requirements, as well as those that maintain SLAs. There is also evidence that markets are less concentrated in states with lower capital and surplus requirements, in states that maintain eligibility lists, in states with SLAs and in states charging higher taxes.

Earlier in this analysis, we acknowledge that capital and surplus requirements on surplus lines insurers are not binding, and therefore the seemingly counterintuitive finding of greater activity in states with higher capital and surplus requirements is not suspicious. However, our results also indicate that surplus lines insurers have greater activity and less concentrated markets in stringently taxed states, which is contrary to standard expectations. It is important, however, to recall that surplus lines insurers do not compete directly with the standard market. For that reason, these insurance companies have a more limited pool of potential exposures available to insure and must capitalize on available business, even if such business is in a stringently taxed state. Consistent with this supposition, states in our sample with consistently stringent tax environments have relatively high surplus lines activity. We contend that regulators in these states may use higher taxes to benefit from the high volume of surplus lines activity in the state.

Most existing literature focuses on admitted insurers. However, surplus lines insurers play a distinct and important role within the insurance industry. The results of the current study indicate correlations between several regulatory provisions and surplus lines activity. This suggests that changes to these provisions by policymakers could affect the surplus lines insurance market. To the extent that future legislation resulting in changes to the regulation of surplus lines insurers reduces the willingness of surplus lines insurers to operate in particular states, the supply of coverage to consumers could be affected.

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The Impact of Medicaid Expansion, Diversity and the ACA Primary Care Fee Bump on the Performance of Medicaid Managed Care

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Abstract

In response to the policy changes to Medicaid, this research examines the impact of Medicaid expansion, diversity, and the Medicaid fee bump on Medicaid managed care. It aims to provide insights to health insurers, consumers, regulators and policymakers regarding profitability, better services, reducing expenses and improving efficiency. The results indicate that Medicaid expansion increases the profit efficiency of Medicaid managed care, but it has no significant impact on medical service efficiency or composite efficiency. The diversity of business lines, product types or payment methods does not create economies of scope for Medicaid profitability, medical service efficiency or composite efficiency. However, the diversity of product types is associated with more ambulatory encounters, while the diversity of payment methods reduces medical and administrative expenses. The Medicaid fee bump does not increase medical expenses or the utilization of medical services, and it has no significant impact on profitability or composite efficiency. "Medicaid lower reimbursement" should not be a big concern for Medicaid managed care in terms of profitability, medical services, expenses or overall efficiency. Another finding was that offering more preferred provider organization (PPO) plans improves the performance in profits, services and expenses; and managed care organizations (MCOs) also serving

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Medicare beneficiaries perform better in Medicaid managed care. In addition, capitation and contractual fee payments both enhance composite efficiency. The value-based payments do not have a significant impact on expenses or efficiency, but they are associated with more ambulatory encounters.

Introduction

Medicaid programs, designed to provide health coverage for low-income people, are available in all states, Washington, DC, and the U.S. territories. Medicaid is the largest source of health coverage in the U.S. According to the June 2018 report of the federal Centers for Medicare & Medicaid Services (CMS) (2018a), 66.9 million individuals were enrolled in Medicaid. States have increasingly used managed care to deliver services to Medicaid beneficiaries (Garfield et al., 2018). Medicaid managed care has become the nation's dominant delivery system for Medicaid enrollees, and it covers around 68% of all Medicaid beneficiaries (CMS, 2018b).[1] This research examines the factors affecting the performance of Medicaid managed care, including Medicaid expansion; the diversity of business lines, product types and payment methods; and the Medicaid fee bump This research aims to provide insights to health insurers, consumers, regulators and policymakers through the analysis of various performance evaluations of profit, expense, service and efficiency measures. The performance analyses should reveal potential moves and strategies to: 1) increase profits and profit efficiency from the perspective of insurers; 2) reduce medical costs and expenses; 3) provide better medical services; and 4) enhance medical service efficiency from the perspective of consumers, regulators and policymakers. The empirical evidence of this research should provide important implications to policymakers and regulators on achieving the three overarching aims of health care: better care, better health and lower costs (CMS, 2016a).

States establish and administer their own Medicaid programs, and they determine the type, amount, duration and scope of services within broad federal guidelines. To help achieve the major objective of universal health coverage, the federal Affordable Care Act (ACA) provides states the authority to expand Medicaid eligibility to all individuals under age 65 in families with incomes below 138% of the Federal Poverty Level (FPL). As of 2018, there are 33 states, including Washington DC, that have expanded Medicaid (KFF, 2018). Furthermore, Section 1115 Medicaid waivers provide states an avenue to test new approaches in Medicaid. States can obtain comprehensive Section 1115 waivers to make broad changes in Medicaid eligibility, benefits and cost-sharing, and provider payments. States can also obtain narrower waivers to focus on specific services or populations (Musumeci et al., 2018). By November 2018, 46 Medicaid waivers across 38 states had been approved (Medicaid waiver tracker: *www.kff.org*). In the recent literature regarding the take-up behavior of the new Medicaid eligibles due to Medicaid expansion, Courtemanche et al. (2017), Frean et al. (2017), and Kaestner et al. (2017) all examine the coverage effects of Medicaid expansion of the ACA, and they found that Medicaid expansion

1. Hurley and Somers (2003) review the evolution of Medicaid managed care and the challenges that it has had to overcome. They indicate that most states believe "the conversion of Medicaid to managed care has been a right step in the right direction to gain more control and accountability from the health care marketplace."

significantly increased Medicaid coverage. As for the utilization of medical services, Simon et al. (2017) find evidence consistent with the increased use of certain forms of preventive care, while Jones et al. (2015) document an increase in Medicaid encounters from 2013 to 2014. These studies investigate the impact of Medicaid expansion from the perspective of individual beneficiaries. However, the take-up of these new Medicaid beneficiaries (probably with dissimilar utilization patterns of medical services) might also affect the performance of the insurer, such as profitability and efficiency.[2] This motivates the current research to examine the impact of Medicaid expansion on the performance of Medicaid managed care. An earlier study by McCue et al. (1999) analyzes the operating characteristics and financial performance of commercial health maintenance organizations (HMOs) in the Medicaid market from 1992 to 1996. Inversely, this current research contributes to the literature by focusing on the impact of the recent Medicaid policy changes—i.e., Medicaid expansion and Medicaid fee bump—on Medicaid managed care, using a comprehensive set of performance measures.

Nearly every state uses some form of managed care for its Medicaid program, such as comprehensive managed care, primary care case management, and limited-benefit plans (Palmer et al., 2018). The dominant model of Medicaid managed care is comprehensive managed care, which is available in 39 states, including Washington DC. States contract with MCOs to provide comprehensive managed care to Medicaid beneficiaries and pay the MCO a fixed monthly premium or "capitation rate" for each enrollee (Garfield et al., 2018). In 2016, the CMS issued a final rule on Medicaid managed care, the first overhaul of Medicaid managed care regulations in more than a decade. The CMS final rule advanced the Administration's efforts to modernize the health care system to deliver better care, smarter spending and healthier people (CMS, 2016b). It strengthened states' efforts in terms of delivery system reform such as adopting value-based purchasing approaches and using incentive and withhold arrangements. In the literature, Yang (2014) compares the medical service efficiency of different payment methods, product types and business lines from the societal perspective. Nonetheless, the diversity impact of business lines, payment methods and product types has not been examined, nor the impact of a specific payment method, business line or product type on the performance of Medicaid managed care. In contrast to economies of scale that arise from more volume, economies of scope are efficiencies formed by variety, the diversity of products or services, or even various payment methods. This current research investigates and provides

2. As stated, Medicaid managed care has become the nation's dominant delivery system for Medicaid enrollees, and it covers around 68% of all Medicaid beneficiaries (CMS, 2018b). In addition to the differential risk characteristics, utilization of medical services, and medical costs/expenses of the new Medicaid eligibles, the research design of this current article also takes into consideration the impact of the enrollment and take-up behaviors of Medicaid beneficiaries and insurers. Specifically, this research analyzes the sample of insurers who voluntarily enroll the Medicaid expansion beneficiaries, thus obtaining different market shares. For example, no matter if the new risks are profitable or not, there would not be much of an impact on the insurer's profitability if the take-up or enrollment rate is low.

empirical evidence on how MCOs and other health insurers may improve their performance by selecting the optimal mix or portfolio of business lines, product types and payment methods to achieve economies of scope.

The Medicaid program is administered by states according to federal requirements, and it is jointly funded by the federal government and the states. President Donald Trump and Republican Party leaders have been considering fundamental changes to Medicaid's financing structure in order to achieve substantial federal budgetary savings. For example, the American Health Care Act of 2017 (AHCA) proposed to convert federal Medicaid matching funds to a per capita cap or a block grant. The Congressional Budget Office (CBO) estimates that the AHCA's Medicaid financing changes would reduce federal Medicaid spending by $756 billion from 2017 to 2026 (Rudowitz et al., 2017). With such Medicaid financing proposals, states would have to focus more on Medicaid program savings. Wiener et al. (2017) discuss some strategies to reduce Medicaid spending such as premiums, cost sharing, and alternative payment models. They also argue that the use of accountable care organizations (ACOs), episode-based payments, and global budgets is still new in Medicaid; and rigorous evaluations are too limited to support the expectation that these models can reduce total Medicaid spending. Therefore, it is imperative to examine the factors affecting expenses and cost efficiency in order to uncover potential moves for cost reductions and efficiency improvement for Medicaid managed care and health insurers in general.

Medicaid cost reductions may be achieved through delivery and payment reforms or adopting the best practices of efficient peers. However, Medicaid has historically paid physicians lower fees than either private insurance or Medicare for the same services. To encourage provider participation and help ensure access to care in Medicaid, the ACA required states to pay certain physicians Medicaid fees at least equal to Medicare's for many primary care services in 2013 and 2014 (Medicaid fee bump). The federal government funded the full cost of the fee increase. The ACA required that qualified physicians in Medicaid managed care also receive the full benefit of the fee increase. Polsky et al. (2015) examine appointment availability after increases in Medicaid primary care; Callison and Nguyen (2018) evaluate the effect of Medicaid fee changes on health care access, utilization and spending; and Alexander and Schnell (2018) discuss the impact of the Medicaid primary care rate increase on access and health, all for individual Medicaid beneficiaries. However, Decker (2018) investigates the association between the Medicaid fee bump and physician participation in Medicaid, but she finds no such relation. Supposedly, the Medicaid fee bump should affect medical costs/expenses; the utilization of medical services; and, in turn, the efficiency of insurers. This current research examines the impact of the fee bump on the performance of Medicaid managed care (not individuals or providers) to inform the decision of increasing or reducing expenses for MCOs and regulators.

Specifically, this current research conducts a series of regression analyses on a comprehensive set of performance measures of Medicaid managed care: profit measures, service measures and expense measures. These performance measures consist of single-variable measures such as underwriting gains/losses, two-variable ratio measures such as medical loss ratio, as well as efficiency measures. The traditional single-variable and ratio measures are commonly used to evaluate insurers. The efficiency measure combines more than two variables and provides a more complete evaluation of the insurer. Yang and Lin (2017) indicate that financial ratios are not effective indicators of the efficiency of health insurers. They suggest a combination of efficiency measures and financial ratios be adopted to satisfy all stakeholders. The efficiency measures are generated using the data envelopment analysis (DEA) models[3] from the insurer's and the societal perspective. A composite efficiency measure is also included, which combines the two perspectives to accommodate the interests of different stakeholders and avoid the potentially biased regulatory decisions from focusing on medical services alone (without profits) (Yang and Lin, 2017). The difference-in-differences (DiD) component of the regression models is utilized to analyze the impact of Medicaid expansion by comparing the pre-expansion and post-expansion periods. This research examines the diversity impact and test economies, or diseconomies, of scope for Medicaid managed care. The Gini-Simpson index is adopted to measure the diversity in business lines, product types and payment methods. The impact of the specific payment method, product type or business line is also discussed. Furthermore, this article examines the impact of the Medicaid fee bump by comparing the two fee-bump years with the year before in terms of utilization, profitability, expenses and efficiency of Medicaid managed care. Additionally, this current research also presents some descriptive and univariate analyses of the performance of Medicaid managed care.

This article proceeds as follows. Data and research design are presented in the next section. The article then presents descriptive and univariate analyses of performance measures and insurer characteristic variables. After that, the article discusses underwriting profit, profit ratio and profit efficiency of Medicaid managed care; examines the utilization of medical services and medical service efficiency of Medicaid managed care; analyzes the composite efficiency of Medicaid managed care; and presents the analysis of expenses, medical loss ratio and expense ratio, and the impact of the Medicaid fee bump. The final section concludes the article with a summary of the findings.

3. DEA is a mathematical programming frontier approach to estimating the relative efficiency of a homogeneous set of peer entities called decision making units (DMUs). Different from financial ratios, DEA is a multi-input, multi-output efficiency measurement technique that generalizes the classical single input, single output approach. The relative efficiency is measured by the DEA efficiency score, which is the optimal ratio of the weighted sum of outputs over the weighted sum of inputs, which is obtained by solving the DEA optimization programs. The interested reader is referred to Cooper et al. (2007) for details and references.

Data and Research Design

As stated, this research examines the factors affecting the performance of Medicaid managed care, including Medicaid expansion, diversity, the Medicaid fee bump, business lines, product types, and payment methods. The data used in this research come from the health insurers' financial statements filed with the NAIC. Most states expanded Medicaid in 2014, and the Medicaid fee bump applied in 2013 and 2014. Therefore, we use four years of annual data from 2012 to 2015, two years before (2012 and 2013) and two years after (2014 and 2015) the Medicaid expansion.[4]

We estimate regression models with the DiD component. The DiD component compares changes in the performance of the insurers in the treatment states to that of the insurers in the control states. The pre-expansion period is 2012–2013, and the post-expansion period is 2014–2015. For each of the performance measures, we estimate the following regression:

$$Y_{ist} = \alpha + \beta_1 (MedicaidExpansion_s * Post_t) + \beta_2 BusinessLines_{ist} + \beta_3 ProductTypes_{ist} + \beta_4 PaymentMethods_{ist} + \beta_5 Diversity_{ist} + \gamma X_{ist} + \eta State_s + \delta Year_t + \varepsilon$$

where Y_{ist} represents a performance measure for insurer (*i*) in state (*s*) during year (*t*). *Year* is a vector of year dummy variables, and *State* is a vector of state dummy variables. X_{ist} is the vector of the control variables of some insurer characteristics: insurer organization type, group affiliation, number of states the insurer serves, and insurer size. Organization type is a dummy variable: 1 for stock insurers, and 0 for others. Group affiliation is also a dummy variable: 1 if the insurer is affiliated with a group, and 0 for unaffiliated insurers. A dummy variable is included for the number of states the insurer serves: 1 if the insurer operates in only one state. The size of the insurer is measured by the logarithm of the insurer's enrollment (total member months).

MedicaidExpansion is a binary variable equal to 1 if the insurer offers Medicaid managed care plans in an expansion state, and 0 if the insurer's Medicaid managed care business is in a non-expansion state.[5] *Post* is a binary variable equal to 1 if the time period is after the expansion, and 0 if the time period

4. A longer term most likely invites more confounding factors for the DiD analysis. Most of the Medicaid expansion studies use the data up to 2014, with just one treatment year. This current research uses two treatment years (2014 and 2015), and it includes the states that expanded Medicaid in 2015. Two more states adopted Medicaid expansion in 2016. For a robustness check, all the regression analyses are also conducted using the data for 2012–2016. The results are not significantly different from those using the data for 2012–2015. Therefore, they are not presented in the article, but they are available upon request.

5. Almost all insurers only offer Medicaid managed care plans in the state of domicile. Very few insurers serve out-of-state Medicaid beneficiaries. For each of the several insurers who serve multiple states, the state with most of its Medicaid business is selected as its state.

is prior to the expansion of the state.[6] As indicated by Simon et al. (2017) and Jones et al. (2015), Medicaid expansion results in more utilization of medical services. Therefore, it is expected that Medicaid expansion should have a positive impact on medical costs and medical expenses. However, a sicker or healthier population does not necessarily lead to higher or lower profitability or efficiency of the insurer. For example, Medicaid expansion may incur more premiums, expenses and medical services, which actually leaves the impact on underwriting profits (the difference between premiums and expenses) and medical service efficiency (the ratio of weighted medical services over weighted expenses) undetermined. Accordingly, the sign/significance of the impact of Medicaid expansion on profitability and efficiency is uncertain.

The year dummy variables are included to evaluate the impact of the Medicaid fee bump on the performance of Medicaid managed care. As stated, the Medicaid fee bump was applied to increase Medicaid reimbursements to providers aiming for better care and better health for Medicaid beneficiaries. Alexander and Schnell (2018) find that increasing Medicaid payments to primary care doctors is associated with improvements in access and self-reported health. Callison and Nguyen (2018) indicate that increased primary care reimbursement leads to higher utilization of medical services for Medicaid enrollees. Therefore, it is expected that the Medicaid fee bump should have a positive impact on the utilization of medical services, and correspondingly, incur more medical expenses. Similar to Medicaid expansion, the sign/significance of the impact of the Medicaid fee bump on profitability and efficiency is undetermined.

Diversity is the vector of the diversity indexes of business lines, product types and payment methods. This research adopts the Gini-Simpson index to measure diversity. A higher value of the Gini-Simpson index indicates a higher diversity. The Gini-Simpson index is a transformation of the Simpson index, which is also known as the Herfindahl index or the Herfindahl-Hirschman index (HHI). Specifically, the Gini-Simpson index equals:

$$1-\lambda = 1-\sum_{i=1}^{R} p_i^2$$

where λ is the Simpson index. R is richness (the total number of types in the dataset). p_i is the proportional abundance of each type. Proportional abundances are by definition constrained to values between zero and unity, hence $\lambda \geq 1/R$, which is reached when all types are equally abundant. The diversity variables are

6. Either the *MedicaidExpansion* and *Post* or the state and year dummy variables can be included in the expansion research. In most other Medicaid expansion studies, the state/area dummy variables and the year dummy variables are adopted, instead of the *MedicaidExpansion* and *Post* variables (Simon et al., 2017; Kaestner et al., 2017; and Courtemanche et al., 2017). In this current research, the state dummy variables are included to control for the differential Medicaid designs of each state. To compare the impact of the Medicaid fee bump among the two fee bump years and other years, year dummy variables have to be included in our research.

used to evaluate economies of scope, in contrast to economies of scale. Economies of scope are formed by variety, not volume. The insurer might generate efficiencies by diversifying product types, payment methods and business lines. Cummins et al. (2010) analyze whether it is advantageous to diversify by offering both life-health and property-liability insurance while showing that life-health insurers realize both cost and revenue scope diseconomies. Yang (2014) finds that some specific business line, product type or payment method is superior to others as far as efficiency is concerned. Therefore, it is expected that diversity should not have a positive impact on profitability or efficiency. However, a diversified portfolio caters to the differential needs of customers and providers, such as indemnity plans and fee-for-service payments, which is expected to have a positive impact on the utilization and supply of medical services, and correspondingly, medical expenses.

BusinessLines, ProductTypes and *PaymentMethods* represent the vectors of variables of business lines, product types and payment methods. By the NAIC, payment methods include capitation payments, contractual fee payments, fee-for-service payments, bonus/withhold – fee-for-service, bonus/withhold – contractual fee payments, non-contingent salaries, and aggregate cost arrangements. For a payment method, the measure is its percentage of the total payments. The NAIC classifies health insurance into comprehensive (hospital and medical) – individual, comprehensive (hospital and medical) – group, Medicare supplement, Federal Employees Health Benefits (FEHB) plan, Medicare, and Medicaid. The product types include HMOs, provider service organizations (PSOs), PPOs, point of service (POS) and indemnity only. They are all measured by their percentage of the total enrollment.

The description of the independent variables is presented in Table 1 on page 10. Most insurers do not use all the payment methods or operate in all the business lines, and they do not offer all the different types of plans. There is also some multicollinearity among the variables of payment methods, product types and business lines. Therefore, only some of them are included in the regression models.

There are four groups of performance measures: profit measures, service measures, expense measures and composite measures. These measures consist of single variables, ratios and efficiency measures. This research adopts a comprehensive set of performance measures to accommodate the preferences of different stakeholders. For example, the insurers may focus more on profit measures, of which some might prefer the single variable measure (underwriting profit) while others might favor the ratio measure (combined ratio) or the efficiency measure (profit efficiency). All the performance measures are presented in Table 2 on page 11. Underwriting profit is the net underwriting gain/loss in the insurer's financial statements. The single variable measures (underwriting profit, ambulatory encounters, hospital patient days, hospital and medical expenses, and claim adjustment and administrative expenses) are all calculated on the per member per year basis.

To be consistent with the other two profit measures (underwriting profit and profit efficiency) of which a higher value indicates more profitability, combined ratio is transformed to profit ratio: profit ratio = 1 – combined ratio. The profit ratio is the underwriting profit divided by the earned premium. In contrast to profit ratio, medical loss ratio and expense ratio are two "indirect" profitability measures. They are actually relative expense measures of hospital and medical expenses, as well as claim adjustment and administrative expenses, with regard to the earned premium. Therefore, they are included in "expense measures."

Table 1:
Description of Independent Variables

Variables		Description
Size of the insurer		Logarithm of member months
Group affiliation		Dummy, 1 for group insurers and 0 for others
Organization type		Dummy, 1 for stock insurers and 0 for others
Number of states the insurer serves		Dummy, 1 for single-state insurers and 0 for others
MedicaidExpansion*Post		Equal to 1 if the insurer is in the expansion state and in the post-expansion year, 0 otherwise
Diversity index of business lines		Gini-Simpson index of business lines
Diversity index of product types		Gini-Simpson index of product types
Diversity index of payment methods		Gini-Simpson index of payment methods
Payment methods	Capitation payments	Capitation payments (% of total payments)
Payment methods	Contractual fee payments	Contractual fee payments (% of total payments)
Payment methods	Fee-for-service	Fee-for-service payments (% of total payments)
Payment methods	Bonus/withhold – fee-for-service	Bonus/withhold – fee-for-service-payments (% of total payments)
Payment methods	Bonus/withhold – contractual fee payments	Bonus/withhold – contractual fee payments (% of total payments)
Payment methods	Non-contingent salaries	Non-contingent salaries (% of total payments)
Payment methods	Aggregate cost arrangements	Aggregate cost arrangements (% of total payments)
Product types	Health maintenance organizations (HMOs)	HMO enrollment (% of total enrollment)
Product types	Provider service organizations (PSOs)	PSO enrollment (% of total enrollment)
Product types	Preferred provider organizations (PPOs)	PPO enrollment (% of total enrollment)
Product types	Point of service (POS)	POS enrollment as % of total enrollment
Product types	Indemnity only	Indemnity enrollment (% of total enrollment)
Business lines	Comprehensive – individual	Comprehensive (individual) enrollment (% of total enrollment)
Business lines	Comprehensive – group	Comprehensive (group) enrollment (% of total enrollment)
Business lines	Medicare supplement	Medicare supplement enrollment (% of total enrollment)
Business lines	Federal Employees Health Benefits (FEHB) plan	FEHB plan enrollment (% of total enrollment)
Business lines	Medicare Advantage	Medicare Advantage enrollment (% of total enrollment)
Business lines	Medicaid managed care	Medicaid managed care enrollment (% of total enrollment)
Year (Y2013, Y2014, Y2015)		Year dummy variables, year 2012 is the reference year
State		State dummy variables, Texas is the reference state

Table 2:
Performance Measures for Medicaid Managed Care

Profit measures	Underwriting profit
	Profit ratio
	Profit efficiency
Service measures	Ambulatory encounters
	Hospital patient days
	Medical service efficiency
Expense measures	Hospital and medical expenses
	Claim adjustment and administrative expenses
	Medical loss ratio
	Expense ratio
Composite measure	Composite efficiency

The definitions of the efficiency measures (profit efficiency, medical service efficiency, and composite efficiency) are similar to those of Yang and Lin (2017). The efficiency scores are generated by the input-oriented variable returns-to-scale (VRS) DEA models[7] that are translation invariant to outputs. Different from Yang and Lin (2017), capital and surplus, investment expenses, and investment incomes are not included in the DEA inputs or outputs because they are not available by the line of business of the insurer (Brockett et al., 2018). The profit efficiency measures the insurer's efficiency in generating profits and the medical service efficiency evaluates the insurer's efficiency in providing medical services. The composite efficiency combines both profit and medical service efficiency. The inputs and outputs of the DEA efficiency models are presented in Table 3 on page 12.

7. Two alternative model orientations are available in DEA to determine the relative efficiency of DMUs: input-oriented in which the inputs are minimized conditional on the level of outputs and output-oriented in which the outputs are maximized conditional on input usage. Two scale assumptions are generally employed: constant returns-to-scale (CRS) and VRS. CRS reflects the fact that output will change by the same proportion as inputs are changed; VRS reflects the fact that production technology may exhibit increasing, constant and decreasing returns-to-scale (Cooper et al., 2007).

Table 3:
Inputs and Outputs of Data Envelopment Analysis (DEA) Efficiency Models

DEA efficiency models	Inputs	Outputs
Profit efficiency	Total hospital and medical expenses	Underwriting profit
	Claim adjustment expenses	
	General administrative expenses	
Medical service efficiency	Total hospital and medical expenses	Total member months
	Claim adjustment expenses	Ambulatory encounters
	General administrative expenses	Hospital patient days
Composite efficiency	Total hospital and medical expenses	Underwriting profit
	Claim adjustment expenses	Total member months
	General administrative expenses	Ambulatory encounters
		Hospital patient days

Descriptive and Univariate Analyses

Medicaid expansion is voluntary with states. As of 2018, 33 states, including Washington DC, have expanded Medicaid (KFF, 2018). Most of them (27) adopted the Medicaid expansion in 2014. Three states expanded Medicaid in 2015. Five states that expanded Medicaid by 2015 also have prior full expansions for parents and childless adults (Kaestner et al., 2017), so they are excluded from the treatment group. Therefore, to examine the impact of Medicaid expansion, there are initially 25 states in the treatment group and 26 states in the control group. As stated, not all states offer Medicaid managed care. Three states in the treatment group and 10 states in the control group have no insurers (with Medicaid managed care) in the whole time period (2012–2015). They are also excluded from analyses.

The final sample includes 22 states in the treatment group, 16 states in the control group, and 682 insurer-years (insurers) with Medicaid managed care. 395 insurers are in the expansion states and 287 insurers are in the non-expansion states. 164 of the 682 insurers are in the treatment group. That is, there are 164 insurers that are in the expansion states and also in the post-expansion year(s). 75% of the 682 insurers are stock insurers, 88% are single-state insurers, and 80% are affiliated with a group. There are 165 insurers in 2012, 165 in 2013, 176 in 2014 and 176 in 2015.[8]

8. It is worth noting that some insurers enter or exit from the Medicaid managed care market overtime. (See Long and Yemane (2005) for an examination of factors that affect an insurer's decision to exit from the Medicaid managed care market.) In the sample of this current research, 126 insurers were participating in all four years of 2012–2015, which accounted for 76% of all the MCOs in 2012, 76% in 2013, 72% in 2014 and 72% in 2015. In order to capture the possible impact of Medicaid expansion and the fee bump, this current research analyzes all the involved insurers in the sample years. It does not just consider the insurers who were participating each year.

**Table 4:
Summary Statistics of Business Lines, Product Types,
Payment Methods and Diversity Indexes**

Variable	Min	Max	Median	Mean	StDev
Comprehensive – individual	0.0%	79.7%	0.1%	5.2%	9.5%
Comprehensive – group	0.0%	89.6%	0.0%	12.5%	22.2%
Medicare supplement	0.0%	14.8%	0.0%	0.2%	1.2%
Federal employees health benefits (FEHB) plan	0.0%	24.4%	0.0%	0.6%	2.3%
Medicare	0.0%	94.9%	0.2%	6.3%	12.9%
Medicaid	0.3%	100.0%	88.4%	75.2%	29.8%
Business line diversity index	0.00	0.77	0.20	0.25	0.23
Health maintenance organization (HMO)	0.0%	100.0%	100.0%	90.3%	26.0%
Provider service organization (PSO)	0.0%	0.0%	0.0%	0.0%	0.0%
Preferred provider organization (PPO)	0.0%	100.0%	0.0%	3.3%	14.9%
Point of service (POS)	0.0%	100.0%	0.0%	1.7%	8.0%
Indemnity only	0.0%	54.8%	0.0%	0.5%	4.4%
Product type diversity index	0.00	0.69	0.00	0.05	0.14
Capitation payments	0.0%	100.0%	4.5%	13.2%	20.2%
Fee-for-service payments	0.0%	100.0%	4.0%	11.4%	19.7%
Contractual fee payments	0.0%	100.0%	82.1%	71.4%	28.8%
Bonus/withhold – fee-for-service	0.0%	5.6%	0.0%	0.0%	0.4%
Bonus/withhold – contractual fee payments	0.0%	72.1%	0.0%	2.0%	7.9%
Non-contingent salaries	0.0%	59.3%	0.0%	0.7%	4.2%
Aggregate cost arrangements	0.0%	47.0%	0.0%	0.4%	3.5%
Payment method diversity index	0.00	0.74	0.26	0.28	0.19

The descriptive statistics of business lines, product types, payment methods and diversity indexes are presented in Table 4. With regard to business lines, on average, Medicaid managed care accounts for 75.2% of the total enrollment. The second biggest line is comprehensive – group, which only represents 12.5%. The average diversity of business lines is 0.25 (out of the possible highest value of 0.83) and some insurers have a diversity index as high as 0.77. For product types, the diversity is very low, and the average diversity is only 0.05. More than 90% of the enrollees have an HMO plan. PPO plans only account for 3.3% and very few insurers offer POS plans. Regarding payment methods, the average diversity is at a similar level to business lines, with a value of 0.28 (out of the possible highest value of 0.88). Contractual fee payments account for 71.4%. The value-based payment method (bonus/withhold – contractual fee payments) only represents 2%. As stated, the variables with very few values are not included in the regression models: PSO, bonus/withhold – fee-for-service, non-contingent salaries, and aggregate cost arrangements. There is also some multicollinearity among the variables. The variables with a high variance inflation factor (bigger than 5) are excluded due to multicollinearity: comprehensive – group, Medicaid, and fee-for-service payments (Menard, 1995).

Table 5 presents the summary statistics of earned premiums, expenses, underwriting profit, medical loss ratio, expense ratio, and profit ratio of Medicaid managed care. The claim adjustment expenses and general administrative expenses account for 3.4% and 8.5% of the earned premium. It is worth noting that the financial performance of Medicaid managed care is highly variable among the insurers. For example, the underwriting profit per member per year ranges from -$2,728.6 to $18,213.9. The average underwriting profit per member per year is $67.80; however, the standard deviation is $796.60. Furthermore, the average profit ratio is 0.8%, but the standard deviation is as high as 7.9%.

Table 5:
Summary Statistics of Some Performance Measures of Medicaid Managed Care (Per Member Per Year, the Dollar Amount is in 2015 Texas Dollars)

Variable	Min	Max	Median	Mean	StDev
Earned premium ($)	489.3	51253.1	4092.9	4667.6	3313.2
Hospital and medical expenses ($)	424.6	30255.8	3601.0	4044.4	2646.0
Claim adjustment expenses ($)	1.6	1582.6	125.0	156.7	141.1
General administrative expenses ($)	4.3	3530.4	325.5	398.7	317.7
Underwriting profit ($)	-2728.6	18213.9	66.7	67.8	796.6
Medical loss ratio	55.9%	129.1%	87.0%	87.2%	8.1%
Expense ratio	0.2%	37.7%	11.8%	12.1%	4.3%
Profit ratio	-42.8%	35.5%	1.6%	0.8%	7.9%

To illustrate the profit variation within a state, the profit ratio of Medicaid managed care by state is presented in Table 6 on page 15. The state average profit ratio ranges from -5.5% to 8.6%. However, within a state, the range can be as high as more than 70%. For example, the profit ratio ranges from -36.5% to 35.5% in Wisconsin in the years 2012–2015.

The average profit ratio of the insurers in the expansion states is 1%, higher than that of the non-expansion states (0.5%), even though the difference is not very significant; the p-value of the two-sample two-tailed t test is 0.392. The average medical loss ratio in the expansion states is almost the same as that of the non-expansion states (87.1% vs. 87.2%); the p-value is 0.960. However, the average amount of hospital and medical expenses per member per year in the expansion states is $4,321, significantly more than that of the non-expansion states ($3,664); the p-value is 0.001.

Table 6:
Summary Statistics of Profit Ratio of Medicaid Managed Care

State		# of insurers	Min	Max	Median	Mean	StDev
Expansion states	AZ	3	1.3%	4.0%	2.0%	2.4%	1.4%
	CA	1	4.5%	4.5%	4.5%	4.5%	N/A*
	CO	6	-4.5%	2.2%	-1.3%	-1.3%	2.7%
	DC	10	-4.5%	17.9%	4.0%	3.8%	6.3%
	HI	10	-35.1%	6.2%	0.3%	-5.5%	14.2%
	IA	4	-8.3%	3.6%	-3.8%	-3.1%	5.1%
	IL	24	-31.5%	9.9%	-0.6%	-3.3%	10.0%
	IN	9	-1.4%	3.8%	1.4%	1.2%	1.6%
	KY	19	-34.1%	19.9%	2.7%	2.6%	13.3%
	LA	14	-10.4%	6.3%	-0.6%	-1.6%	4.8%
	MA	22	-9.3%	19.9%	-0.8%	0.2%	6.7%
	MD	12	-11.1%	7.8%	2.2%	0.1%	6.8%
	MI	53	-21.4%	22.5%	1.0%	1.5%	5.6%
	MN	19	-9.3%	10.9%	3.8%	3.0%	4.4%
	ND	2	-0.2%	0.4%	0.1%	0.1%	0.4%
	NH	5	-12.7%	6.8%	-6.5%	-4.7%	7.2%
	NJ	18	-11.7%	13.1%	1.2%	1.3%	5.7%
	NM	17	-9.0%	8.7%	1.7%	1.3%	4.1%
	NV	8	3.5%	15.7%	6.1%	8.6%	4.7%
	NY	27	-25.2%	10.3%	-2.0%	-1.5%	7.5%
	OH	24	1.2%	14.9%	4.8%	5.3%	3.6%
	OR	7	-4.0%	8.4%	2.0%	2.7%	4.0%
	PA	40	-7.7%	14.9%	0.4%	0.7%	4.1%
	RI	7	-1.1%	5.6%	2.2%	1.7%	2.6%
	WA	21	-10.6%	14.8%	0.5%	0.8%	6.3%
	WV	13	-5.5%	15.6%	9.1%	7.7%	5.9%
	Total	395	-35.1%	22.5%	1.5%	1.0%	7.1%
Non-expansion states	FL	54	-16.4%	22.9%	-0.4%	-0.1%	8.6%
	GA	12	-3.2%	6.4%	1.5%	1.8%	3.0%
	KS	12	-15.2%	11.1%	-5.1%	-2.1%	8.3%
	MO	14	-25.9%	27.8%	3.1%	0.5%	11.5%
	MS	5	-4.4%	5.8%	-1.2%	0.3%	4.2%
	NE	12	-14.8%	7.7%	3.7%	1.6%	6.1%
	SC	18	-9.5%	11.1%	4.2%	2.8%	6.1%
	TN	12	2.4%	20.2%	3.9%	6.2%	5.4%
	TX	71	-42.8%	12.9%	1.0%	0.0%	7.9%
	UT	7	1.4%	12.7%	3.1%	4.5%	3.9%
	VA	19	-10.0%	8.7%	2.3%	1.8%	4.9%
	WI	51	-36.5%	35.5%	0.9%	-1.3%	12.6%
	Total	287	-42.8%	35.5%	1.9%	0.5%	8.9%
Total		682	-42.8%	35.5%	1.6%	0.8%	7.9%

*In the sample, there is only one insurer in California.

The summary statistics of the utilization of medical services (ambulatory encounters and hospital patient days) by year are presented in Table 7 on page 16. The average number of ambulatory encounters per member per year is 12.19 in 2013, 11.66 in 2014 and 11.25 in 2015, insignificantly different from that of 2012 (11.56); the p-values are 0.545 in 2013, 0.906 in 2014 and 0.723 in 2015. This indicates that the ACA Medicaid fee bump in 2013 and 2014 might not have a significant positive effect on the utilization of medical services of Medicaid managed care. Additionally, the average number of hospital patient days is 0.94, 0.94 and 0.98 in 2013, 2014 and 2015, respectively—also insignificantly different from that of 2012 (1.01). The p-values are 0.760 in 2013, 0.689 in 2014 and 0.886 in 2015.

To compare the expansion and non-expansion states, it shows that the average number of ambulatory encounters per member per year in expansion states is significantly bigger than that of the non-expansion states (12.05 vs. 11.12); the p-value is 0.07. However, the average number of hospital patient days in the expansion states is not significantly different from that of the non-expansion states (0.96 vs. 0.98); the p-value is 0.894.

Table 7:
Summary Statistics of the Medical Service Utilization of Medicaid Managed Care

Year	Ambulatory encounters			Hospital patient days		
	Median	Mean	StDev	Median	Mean	StDev
2012	9.83	11.56	9.65	0.59	1.01	1.78
2013	9.91	12.19	9.03	0.55	0.94	2.20
2014	9.84	11.66	6.79	0.60	0.94	1.02
2015	9.87	11.25	5.96	0.61	0.98	1.17

The correlation among the performance measures is presented in Table 8 on page 17. We can see that medical service efficiency and profit efficiency are not closely related, similar to the results of Yang and Lin (2017). This indicates that it should be advisable to include composite efficiency in evaluating the overall efficiency of Medicaid managed care. As discussed, the composite efficiency takes into consideration both medical service efficiency and profit efficiency. It is highly related to medical service efficiency and moderately related to profit efficiency (the correlation coefficients are 0.88 and 0.62).

It also shows that profit ratio and medical loss ratio are highly related; the correlation coefficient is -0.86. Hospital and medical expenses are also highly related to claim adjustment and administrative expenses; the correlation coefficient is 0.78. However, none of the other pairs of performance measures are closely related. Therefore, most of the performance measures are not redundant.

The descriptive and univariate analyses of the efficiency measures are presented in the following sections.

Table 8:
Correlation Among Performance Measures of Medicaid Managed Care

	Composite efficiency	Medical service efficiency	Profit efficiency	Medical loss ratio	Expense ratio	Profit ratio	Hospital and medical expenses	Claim adjustment and administrative expenses	Underwriting profit	Ambulatory encounters
Medical service efficiency	0.88									
Profit efficiency	0.62	0.35								
Medical loss ratio	-0.26	0.03	-0.38							
Expense ratio	-0.09	-0.07	0.03	-0.32						
Profit ratio	0.32	0.01	0.38	-0.86	-0.21					
Hospital and medical expenses	-0.27	-0.33	-0.03	0.07	-0.11	-0.01				
Claim adjustment and administrative expenses	-0.26	-0.32	-0.01	-0.22	0.44	-0.01	0.78			
Underwriting profit	0.23	-0.02	0.35	-0.49	-0.13	0.57	0.33	0.20		
Ambulatory encounters	0.05	0.04	-0.05	0.01	-0.10	0.04	0.55	0.46	0.27	
Hospital patient days	0.09	0.08	0.03	-0.03	0.06	0.00	0.09	0.12	-0.01	-0.16

Profit Efficiency, Profit Ratio and Underwriting Profit

Profitability is the primary goal of all business ventures, including health insurers. This section analyzes the factors affecting profit measures of Medicaid managed care: profit efficiency, profit ratio and underwriting profit. Underwriting profit is the underwriting gain/loss per member per year, and profit ratio is the ratio of the underwriting profit over the earned premium. Profit efficiency is generated by using the most efficient mix of expenses/costs given a certain underwriting profit level. Some summary statistics of the profit efficiency are presented in Table 9 on page 18.

The average profit efficiency is 0.13 for all the MCOs. By the two-sample two-tailed t test, the average profit efficiency of expansion states (0.12) is significantly lower than that of the non-expansion states (0.15); the p-value is 0.039. Furthermore, there is some significant difference among the states. The average state profit efficiency ranges from 0.03 to 0.34.

Table 9:
Summary Statistics of Profit Efficiency of Medicaid Managed Care

State		Min	Max	Median	Mean	StDev
Expansion states	AZ	0.03	0.14	0.06	0.08	0.06
	CA	0.21	0.21	0.21	0.21	N/A*
	CO	0.03	0.22	0.09	0.10	0.07
	DC	0.02	0.45	0.11	0.15	0.13
	HI	0.02	0.13	0.06	0.06	0.04
	IA	0.05	0.91	0.08	0.28	0.42
	IL	0.00	0.79	0.04	0.10	0.16
	IN	0.01	0.10	0.03	0.04	0.03
	KY	0.01	1.00	0.10	0.26	0.30
	LA	0.00	0.19	0.02	0.03	0.05
	MA	0.00	0.55	0.06	0.10	0.13
	MD	0.01	0.37	0.07	0.12	0.11
	MI	0.01	1.00	0.10	0.15	0.21
	MN	0.01	0.49	0.10	0.12	0.11
	ND	0.04	0.10	0.07	0.07	0.04
	NH	0.02	1.00	0.14	0.34	0.42
	NJ	0.00	0.39	0.05	0.09	0.10
	NM	0.00	0.25	0.04	0.06	0.07
	NV	0.07	0.49	0.16	0.24	0.16
	NY	0.01	0.30	0.04	0.08	0.08
	OH	0.03	0.40	0.13	0.15	0.10
	OR	0.03	0.26	0.10	0.13	0.09
	PA	0.00	0.44	0.02	0.07	0.10
	RI	0.01	0.13	0.04	0.05	0.05
	WA	0.01	1.00	0.06	0.16	0.29
	WV	0.04	0.47	0.24	0.23	0.14
	Total	0.00	1.00	0.06	0.12	0.17
Non-expansion states	FL	0.00	0.89	0.07	0.16	0.22
	GA	0.00	0.17	0.03	0.06	0.06
	KS	0.01	0.32	0.02	0.09	0.13
	MO	0.01	1.00	0.06	0.18	0.29
	MS	0.01	0.12	0.01	0.05	0.06
	NE	0.06	0.19	0.09	0.10	0.04
	SC	0.01	0.25	0.12	0.11	0.08
	TN	0.06	0.60	0.09	0.17	0.17
	TX	0.00	0.56	0.08	0.12	0.14
	UT	0.07	0.29	0.09	0.12	0.08
	VA	0.03	0.30	0.11	0.11	0.07
	WI	0.00	1.00	0.16	0.22	0.21
	Total	0.00	1.00	0.09	0.15	0.18
Total		0.00	1.00	0.08	0.13	0.17

*In the sample, there is only one insurer in California.

The regression estimates of the impact on underwriting profit, profit ratio and profit efficiency are presented in Table 10. The results show that Medicaid expansion has an insignificant positive impact on underwriting profit and profit ratio. In other words, MCOs are not making significantly more profits from covering the newly eligible Medicaid beneficiaries. In contrast, Medicaid expansion has a significant positive impact on the profit efficiency of Medicaid managed care. The results imply that enrolling the newly eligible Medicaid beneficiaries should be beneficial to the insurer as far as profit efficiency is concerned. The insurers are also not suffering losses judging from the other two profit measures of underwriting profit and profit ratio.

Table 10:
Regression Estimates of the Impact on Underwriting Profit, Profit Ratio and Profit Efficiency of Medicaid Managed Care

Independent variables	Underwriting profit	Profit ratio	Profit efficiency
	Coefficient	Coefficient	Coefficient
Medicaid expansion*post	134.537	0.001	0.034*
Stock insurer	-33.166	0.031***	0.022
Single-state insurer	153.731	0.007	0.033
Group affiliation	-142.416	-0.015	-0.020
Log of Medicaid member months	-86.446	0.007	-0.179***
Comprehensive – individual	46.599	0.009	0.134*
Medicare supplement	5172.557	0.731**	-0.231
Federal employees	-4358.284***	-0.625***	-0.523*
Medicare	1586.456***	0.130***	0.171***
Diversity index of business lines	89.852	-0.009	-0.044
Health maintenance organization (HMO)	-36.821	0.005	-0.057
Preferred provider organization (PPO)	183.049	0.026	0.120**
Point of service (POS)	-184.570	0.021	-0.123
Indemnity only	-628.157	-0.214**	-0.368**
Diversity index of product types	-293.254	0.046	0.067
Capitation payments	-241.785	0.036	0.039
Contractual fee payments	457.794***	0.072***	0.083***
Bonus/withhold – contractual fee payments	211.009	0.050	-0.137
Diversity index of payment methods	126.840	-0.017	0.058
Y2013	-134.064	-0.004	-0.020
Y2014	-156.366	-0.001	0.001
Y2015	-76.273	0.013	0.007
R^2	0.114	0.232	0.413
Adjusted R^2	0.030	0.159	0.357

Other variables included: state fixed effects.
Variables excluded due to very few values and multicollinearity: PSO, bonus/withhold—fee-for-service, non-contingent salaries, aggregate cost arrangements, comprehensive—group, Medicaid, and fee-for-services payments.
***$p<0.01$, **$p<0.05$, *$p<0.10$.

The diversity of business lines, product types, or payment methods does not have a significant impact on any of the three profit measures. This implies that diversity does not create economies of scope for Medicaid profitability. This provides some insights into the operation of Medicaid managed care. As for specific business lines, Medicare Advantage has a significant positive impact on underwriting profit, profit ratio and profit efficiency, while FEHB plans have a significant negative impact on these three profit measures. Therefore, higher profitability of Medicaid managed care is associated with more shares in Medicare but less in FEHB plans.

Regarding specific product types, PPO plans have a significant positive impact on profit efficiency and an insignificant positive impact on both underwriting profit and profit ratio. However, indemnity plans are the opposite with an insignificant negative impact on underwriting profit and a significant negative impact on both profit ratio and profit efficiency. Therefore, in terms of profit, it should be beneficial to the MCOs to offer more PPO plans while reducing the share of indemnity plans.

As for specific payment methods, contractual fee payments have a significant positive impact on underwriting profit, profit ratio and profit efficiency. This indicates that more contractual fee payments should be used for higher profitability of Medicaid managed care no matter which profit measure is adopted. Surprisingly, the widely promoted value-based payments (bonus/withhold payments) of the health care (and Medicaid) delivery and payment reforms actually do not have a significant positive impact on any of the three profit measures. The bonus/withhold payments have a negative impact, though insignificant, on profit efficiency.

Medical Service Efficiency and Medical Service Utilization

Medicaid is a societally-oriented governmental program designed to provide medical services with reasonable medical costs to society members. Accordingly, this section analyzes the utilization of medical services and the medical service efficiency from a societal perspective. The two utilization measures are ambulatory encounters and hospital patient days (per member per year). The medical service efficiency is obtained using the two services and enrollment as the outputs, and then hospital and medical expenses, claim adjustment expenses, and administrative expenses as the inputs. The summary statistics of the medical service efficiency are presented in Table 11 on page 21.

The average medical service efficiency is 0.31 for all the MCOs. By the two-sample two-tailed t test, the average composite efficiency of expansion states (0.31) is not significantly different from that of the non-expansion states (0.31); the p-value is 0.978. However, there is some significant difference among the states. The average state composite efficiency ranges from 0.14 to 0.87.

Table 11:
Summary Statistics of Medical Service Efficiency of Medicaid Managed Care

State		Min	Max	Median	Mean	StDev
Expansion states	AZ	0.53	1.00	0.77	0.77	0.23
	CA	0.31	0.31	0.31	0.31	N/A*
	CO	0.20	1.00	1.00	0.87	0.33
	DC	0.23	0.37	0.27	0.28	0.05
	HI	0.07	0.26	0.21	0.16	0.08
	IA	0.36	0.97	0.40	0.53	0.29
	IL	0.08	1.00	0.31	0.38	0.27
	IN	0.17	1.00	0.32	0.44	0.28
	KY	0.13	1.00	0.22	0.32	0.27
	LA	0.08	0.25	0.19	0.19	0.04
	MA	0.20	0.33	0.25	0.26	0.04
	MD	0.15	0.55	0.20	0.23	0.11
	MI	0.14	1.00	0.24	0.33	0.25
	MN	0.10	0.26	0.14	0.17	0.05
	ND	0.18	0.31	0.25	0.25	0.10
	NH	0.15	1.00	0.51	0.47	0.35
	NJ	0.17	0.68	0.25	0.30	0.14
	NM	0.09	0.24	0.14	0.14	0.04
	NV	0.19	0.48	0.24	0.27	0.10
	NY	0.16	0.44	0.26	0.27	0.08
	OH	0.13	1.00	0.20	0.30	0.23
	OR	0.15	0.41	0.25	0.28	0.09
	PA	0.12	1.00	0.17	0.38	0.34
	RI	0.14	0.70	0.18	0.27	0.21
	WA	0.19	1.00	0.25	0.34	0.23
	WV	0.18	0.46	0.25	0.27	0.09
	Total	0.07	1.00	0.23	0.31	0.23
Non-expansion states	FL	0.06	0.69	0.23	0.27	0.14
	GA	0.23	0.36	0.24	0.26	0.04
	KS	0.10	1.00	0.13	0.25	0.29
	MO	0.16	1.00	0.22	0.28	0.19
	MS	0.12	0.57	0.14	0.22	0.19
	NE	0.17	0.27	0.21	0.22	0.03
	SC	0.13	1.00	0.18	0.29	0.25
	TN	0.16	0.45	0.17	0.21	0.09
	TX	0.13	1.00	0.32	0.35	0.18
	UT	0.18	0.38	0.23	0.28	0.09
	VA	0.19	0.72	0.27	0.33	0.16
	WI	0.13	0.87	0.38	0.40	0.18
	Total	0.06	1.00	0.26	0.31	0.18
Total		0.06	1.00	0.24	0.31	0.21

*In the sample, there is only one insurer in California.

The regression estimates of the impact on medical service efficiency, ambulatory encounters, and hospital patient days are presented in Table 12 on page 23. The results show that Medicaid expansion has an insignificant positive impact on ambulatory encounters and a significant positive impact on hospital patient days; i.e., Medicaid expansion increases ambulatory encounters (insignificantly) and hospital patient days (significantly). The possible explanation is that the newly eligible Medicaid beneficiaries might have started to get medical services that they had postponed because of no coverage before. Different from the two service measures, which evaluate service utilization alone without considering costs, the medical service efficiency incorporates both services and costs/expenses. The results indicate that Medicaid expansion has an insignificant negative impact on the medical service efficiency of Medicaid managed care. This implies that Medicaid expansion beneficiaries might incur relatively more costs/expenses. (This is analyzed in more detail in the expenses section of this article.)

The diversity of business lines, product types or payment methods does not have a significant effect on medical service efficiency. This suggests that diversity does not create economies of scope for the medical service efficiency of Medicaid managed care. However, the diversity of product types has a significant positive impact on ambulatory encounters and a significant negative impact on hospital patient days; i.e., a more diversified portfolio of product types is associated with more ambulatory encounters but fewer hospital patient days. The diversity of payment methods has a significant negative impact on ambulatory encounters and an insignificant positive impact on hospital patient days. This implies that payment methods should not be diversified so much as far as the service measures are concerned.

Among business lines, Medicare has a significant positive impact on both service utilization measures, but it has an insignificant impact on medical service efficiency; i.e., Medicaid beneficiaries receive more medical services when the insurer also serves Medicare customers. This is consistent with the profit analysis. Medicare supplement plans have a significant negative impact on medical service efficiency. However, FEHB plans have a significant positive impact on medical service efficiency, as is inconsistent with the impact on Medicaid profitability. The results indicate that MCOs score a higher medical service efficiency with more FEHB plans and fewer Medicare supplement plans.

Regarding product types, indemnity plans have a significant negative impact on medical service efficiency but an insignificant impact on ambulatory encounters and hospital patient days. Thus, the share of indemnity plans should be reduced for a higher medical service efficiency without significantly affecting the utilization of medical services. PPO plans have a significant positive impact on ambulatory encounters and medical service efficiency, and an insignificant impact on hospital patient days. Accordingly, MCOs should offer more PPO plans from the perspective of medical services. HMO plans have an inconsistent impact on the service measures: a significant positive impact on ambulatory encounters, a significant negative impact on medical service efficiency, and an insignificant impact on hospital patient days. For higher medical service efficiency, the share of HMO plans should be reduced.

Table 12:
Regression Estimates of the Impact on Utilization (Ambulatory Encounters and Hospital Patient Days) and Medical Service Efficiency of Medicaid Managed Care

Independent variables	Ambulatory encounters per member per year	Hospital patient days per member per year	Medical service efficiency
	Coefficient	Coefficient	Coefficient
Medicaid expansion*post	0.207	0.441*	-0.015
Stock insurer	0.779	-0.212	0.001
Single-state insurer	-0.851	-0.032	-0.040
Group affiliation	-2.557***	0.281	-0.092***
Log of Medicaid member months	-0.042	-0.165	-0.031*
Comprehensive – individual	2.103	-0.438	-0.107
Medicare supplement	-41.944	8.954	-2.642***
Federal employees	13.028	-4.391	0.765*
Medicare	7.219**	1.698***	-0.004
Diversity index of business lines	-3.210	0.314	-0.037
Health maintenance organization (HMO)	4.392**	-0.581	-0.105**
Preferred provider organization (PPO)	9.977***	-0.716	0.466***
Point of service (POS)	0.870	-0.391	-0.081
Indemnity only	-10.478	0.897	-0.396*
Diversity index of product types	5.618*	-1.146*	-0.051
Capitation payments	-1.670	-0.715	0.157***
Contractual fee payments	1.822	-0.110	0.056
Bonus/withhold – contractual fee payments	9.423*	-0.594	-0.036
Diversity index of payment methods	-8.145***	0.526	-0.042
Y2013	0.638	-0.074	-0.001
Y2014	0.255	-0.261	-0.009
Y2015	-0.014	-0.179	-0.007
R^2	0.256	0.139	0.351
Adjusted R^2	0.185	0.057	0.289

Other variables included: state fixed effects.
Variables excluded due to very few values and multicollinearity: PSO, bonus/withhold—fee-for-service, non-contingent salaries, aggregate cost arrangements, comprehensive—group, Medicaid, and fee-for-services payments.
***p<0.01, **p<0.05, *p<0.10.

As for payment methods, their impacts on service measures are inconsistent with their impacts on Medicaid profitability. Capitation payments have a significant positive impact on medical service efficiency and an insignificant impact on ambulatory encounters and hospital patient days; contractual fee payments have no significant impact on all three service measures while contractual fee payments are significantly favorable for Medicaid profitability. Therefore, more capitation payments are associated with higher medical service efficiency.

Interestingly, the value-based payments (bonus/withhold) have a significant positive impact on ambulatory encounters and an insignificant impact on hospital patient days and medical service efficiency. Considering that bonus/withhold payments have no significant impact on the profitability of Medicaid managed care, they should continue to be promoted for more ambulatory encounters without significantly affecting the other two service measures.

Analyses of Composite Efficiency of Medicaid Managed Care

Profit efficiency and medical service efficiency are evaluated from perspectives of different stakeholders, and they are not highly correlated. Neither profit efficiency or medical service efficiency is a good measure of the overall efficiency of health insurers (Yang and Lin, 2017). The composite efficiency combines both profit efficiency and medical service efficiency. It incorporates profit, medical services and expenses, and it should be an appropriate measure of the overall performance of health insurers. Some summary statistics of the composite efficiency of Medicaid managed care are presented in Table 13 on page 25. The average composite efficiency is 0.38 for all the MCOs. By the two-sample two-tailed t test, the average composite efficiency of expansion states (0.38) is not significantly different from that of the non-expansion states (0.38); the p-value is 0.897. However, there is some significant difference among the states. The average state composite efficiency ranges from 0.19 to 0.87.

The regression results of the factors affecting the composite efficiency are presented in Table 14 on page 26. Medicaid expansion has no significant impact on the overall efficiency of Medicaid managed care. It shows that the diversity of business lines has an insignificant negative impact on the composite efficiency of Medicaid managed care. This indicates that MCOs should not be engaged in a diverse portfolio of business lines as far as composite efficiency is concerned. It is not saying that the MCO should only serve Medicaid beneficiaries. The results show that the composite efficiency of Medicaid managed care will be improved by increasing the share of Medicare, which has a significant positive impact. On the contrary, the share of Medicare supplements should be reduced because it has a significant negative impact.

Table 13:
Summary Statistics of Composite Efficiency of Medicaid Managed Care

State		Min	Max	Median	Mean	StDev
Expansion states	AZ	0.54	1.00	0.77	0.77	0.23
	CA	0.55	0.55	0.55	0.55	N/A*
	CO	0.20	1.00	1.00	0.87	0.33
	DC	0.23	0.74	0.33	0.37	0.15
	HI	0.09	0.29	0.21	0.19	0.06
	IA	0.36	0.97	0.40	0.53	0.29
	IL	0.11	1.00	0.36	0.41	0.27
	IN	0.27	1.00	0.36	0.48	0.26
	KY	0.15	1.00	0.50	0.53	0.30
	LA	0.08	0.39	0.21	0.21	0.07
	MA	0.20	0.75	0.27	0.31	0.12
	MD	0.15	0.55	0.24	0.29	0.12
	MI	0.14	1.00	0.30	0.38	0.25
	MN	0.10	0.50	0.24	0.25	0.09
	ND	0.18	0.31	0.25	0.25	0.10
	NH	0.15	1.00	0.51	0.47	0.35
	NJ	0.17	0.84	0.34	0.38	0.16
	NM	0.11	0.34	0.17	0.19	0.07
	NV	0.27	0.84	0.38	0.48	0.21
	NY	0.16	0.49	0.33	0.32	0.10
	OH	0.19	1.00	0.36	0.44	0.23
	OR	0.18	0.49	0.37	0.34	0.11
	PA	0.12	1.00	0.18	0.40	0.34
	RI	0.15	0.76	0.25	0.32	0.21
	WA	0.19	1.00	0.31	0.37	0.22
	WV	0.19	0.59	0.49	0.44	0.14
	Total	0.08	1.00	0.30	0.38	0.24
Non-expansion states	FL	0.06	1.00	0.25	0.34	0.23
	GA	0.24	0.45	0.32	0.32	0.06
	KS	0.10	1.00	0.15	0.30	0.29
	MO	0.17	1.00	0.31	0.40	0.27
	MS	0.12	0.66	0.15	0.26	0.23
	NE	0.19	0.42	0.25	0.27	0.06
	SC	0.13	1.00	0.31	0.37	0.26
	TN	0.25	0.76	0.26	0.35	0.16
	TX	0.13	1.00	0.36	0.40	0.19
	UT	0.27	0.52	0.38	0.36	0.09
	VA	0.22	0.75	0.32	0.37	0.16
	WI	0.16	1.00	0.42	0.46	0.19
	Total	0.06	1.00	0.32	0.38	0.21
Total		0.06	1.00	0.31	0.38	0.23

*In the sample, there is only one insurer in California.

Table 14:
Regression Estimates of the Impact on Composite Efficiency of Medicaid Managed Care

Independent variables	Coefficient
Medicaid expansion*post	0.022
Stock insurer	0.028
Single-state insurer	-0.001
Group affiliation	-0.107***
Log of Medicaid member months	-0.044**
Comprehensive – individual	-0.008
Medicare supplement	-2.413***
Federal employees	0.303
Medicare	0.141*
Diversity index of business lines	-0.029
Health maintenance organization (HMO)	-0.141***
Preferred provider organization (PPO)	0.469***
Point of service (POS)	-0.157
Indemnity only	-0.621***
Diversity index of product types	-0.011
Capitation payments	0.148***
Contractual fee payments	0.097**
Bonus/withhold – contractual fee payments	-0.103
Diversity index of payment methods	-0.030
Y2013	-0.015
Y2014	-0.015
Y2015	-0.001
R^2	0.339
Adjusted R^2	0.276

Other variables included: state fixed effects.
Variables excluded due to very few values and multicollinearity: PSO, bonus/withhold—fee-for-service, non-contingent salaries, aggregate cost arrangements, comprehensive —group, Medicaid, and fee-for-services payments.
***p<0.01, **p<0.05, *p<0.10.

The diversity of product types has an insignificant impact on the composite efficiency of Medicaid managed care. To enhance the composite efficiency of Medicaid managed care, MCOs should offer more PPO plans but reduce the share of HMOs and indemnity plans. This is because PPOs have a significant positive impact while HMOs and indemnity plans have a significant negative impact.

The diversity of payment methods has an insignificant negative impact. Capitation payments and contractual fee payments both have a significant positive impact on the composite efficiency of Medicaid managed care. Therefore, MCOs should increase the share in capitation and contractual fee payments to further increase the overall efficiency of Medicaid managed care. Surprisingly, the value-based payments (bonus/withhold) have a negative impact, though insignificant, on the overall efficiency of Medicaid managed care.

Hospital and Medical Expenses, Claim Adjustment and Administrative Expenses, and the ACA Primary Care Fee Bump

The National Quality Strategy (NQS) pursues three broad aims: better care, better health and lower costs (*www.ahrq.gov*). The CMS is working to build a health care delivery system that is better, smarter and healthier—a system that delivers improved care, spends health care dollars more wisely, and makes our communities healthier (CMS, 2016a). Furthermore, with the potential conversion of Medicaid financing to per capita cap or a block grant, states would have to focus more on cost savings and cost efficiency. In response, this section analyzes the factors affecting Medicaid expenses and expense ratios to uncover some potential moves for cost reductions of Medicaid managed care.

The regression results of the impact on expenses, medical loss ratio, and expense ratio are presented in Table 15 on page 28. The results show that Medicaid expansion does not have a significant impact on expenses, medical loss ratio, and expense ratio. Medicaid expansion increases both hospital and medical expenses, as well as claim adjustment and administrative expenses, though insignificantly. The expense increase might be relatively more than the service increase because Medicaid expansion, which has expenses as the input and services as the output, decreases medical service efficiency, though insignificantly.

The diversity of business lines significantly reduces claim adjustment and administrative expenses (and expense ratio) probably due to economies of scope. However, considering its potential positive impact on hospital and medical expenses and the fact that claim adjustment and administrative expenses only account for a small portion of total expenses, the reduction in claim adjustment and administrative expenses from the diversity of business lines may not be highlighted. In other words, generally, a diverse portfolio of business lines may not be encouraged for the performance of Medicaid managed care.

Table 15:
Regression Estimates of the Impact on Hospital and Medical Expenses, Claim Adjustment and Administrative Expenses, Medical Loss Ratio, and Expense Ratio of Medicaid Managed Care

Independent variables	Hospital and medical expenses	Claim adjustment and administrative expenses	Medical loss ratio	Expense ratio
	Coefficient	Coefficient	Coefficient	Coefficient
Medicaid expansion* post	187.941	49.489	0.003	-0.004
Stock insurer	-382.737	4.515	-0.039***	0.008*
Single-state insurer	444.780	22.622	0.001	-0.009*
Group affiliation	620.591**	32.871	0.020**	-0.006
Log of Medicaid member months	-952.709***	-209.519***	0.012*	-0.018***
Comprehensive – individual	-80.430	191.942	-0.056	0.048***
Medicare supplement	11057.559	5015.434***	-1.245***	0.514***
Federal employees	-12253.351***	-2211.106***	0.584***	0.041
Medicare	1374.769	449.916***	-0.156***	0.025*
Diversity index of business lines	307.624	-193.129*	0.054**	-0.044***
Health maintenance organization (HMO)	1180.731**	259.974***	-0.023	0.018*
Preferred provider organization (PPO)	-1466.168*	-339.068***	0.018	-0.044***
Point of service (POS)	751.518	78.475	-0.003	-0.018
Indemnity only	2187.968	-335.061	0.301***	-0.087**
Diversity index of product types	74.602	245.570*	-0.082***	0.036**
Capitation payments	-1720.180***	-356.481***	0.000	-0.035***
Contractual fee payments	261.479	55.836	-0.060***	-0.012
Bonus/withhold – contractual fee payments	402.650	-103.521	0.023	-0.072***
Diversity index of payment methods	-1200.155*	-169.109*	0.008	0.009
Y2013	153.533	15.771	0.005	-0.002
Y2014	178.373	60.633	-0.008	0.009**
Y2015	235.570	79.144*	-0.021**	0.008*
R^2	0.375	0.413	0.308	0.395
Adjusted R^2	0.315	0.357	0.243	0.338

Other variables included: state fixed effects.
Variables excluded due to very few values and multicollinearity: PSO, bonus/withhold—fee-for-service, non-contingent salaries, aggregate cost arrangements, comprehensive—group, Medicaid, and fee-for-services payments.
***p<0.01, **p<0.05, *p<0.10.

The diversity of product types significantly increases claim adjustment and administrative expenses and insignificantly increases hospital and medical expenses. It also significantly reduces medical loss ratio but increases expense ratio. However, the magnitude of the impact on the ratios is very small. Therefore, a diverse portfolio of health plans is not beneficial to Medicaid managed care. The diversity of payment methods significantly reduces both hospital and medical expenses, as well as claim adjustment and administrative expenses. This suggests that a more diverse payment portfolio is favorable in reducing expenses.

Generally, significant or not, the magnitude of the impact of business lines, product types and payment methods on medical loss ratio and expense ratio is very small and negligible. As far as the expenses of Medicaid managed care are concerned, MCOs should reduce the share of Medicare and Medicare supplements and increase the share of FEHB plans, offer more PPO plans and fewer HMO plans, and use more capitation payments. As for the value-based payments, bonus/withhold payments do not have a significant impact on reducing expenses.

As stated, to encourage provider participation and help ensure access to care in Medicaid, the ACA required states to pay certain physicians Medicaid fees at least equal to Medicare's for many primary care services in 2013 and 2014 (Medicaid fee bump). This is contrary to the efforts for cost reductions. This research is designed to analyze the impact of the Medicaid fee bump on expenses and all other performance measures of Medicaid managed care. Specifically, the year dummy variables are included to compare the two fee-bump years (2013 and 2014) with the year before the fee bump (2012), controlling other factors. The results of the impact of the Medicaid fee bump are included in Table 10 on page 19 (profitability), Table 12 on page 23 (medical services), Table 14 on page 26 (composite efficiency) and Table 15 on page 28 (expenses).

The results show that the fee bump does not significantly increase hospital and medical expenses or claim adjustment and administrative expenses. (See Table 15 on page 28.) The fee bump does not have a significant impact on medical loss ratio. It does affect the expense ratio significantly in 2014, but the magnitude of the impact is very small (only 0.009 percentage points higher than 2012).

The major objective of the Medicaid fee bump is to increase access to care for Medicaid beneficiaries. However, the results show that the Medicaid fee bump does not have a significant impact on any of the three service measures: ambulatory encounter, hospital patient days and medical service efficiency. (See Table 12 on page 23.)

With regard to the profitability of MCOs, the Medicaid fee bump does not have a significant impact on any of the three profit measures: underwriting profit, profit ratio and profit efficiency. (See Table 10 on page 19.) Finally, the Medicaid fee bump has no significant impact on the composite efficiency of Medicaid managed care either. (See Table 14 on page 26.)

The probable explanation is that Medicaid managed care might have been paying higher fees than the traditional fee-for-service Medicaid. Therefore, the claimed "Medicaid lower reimbursement" may not exist in Medicaid managed care. At least the results indicate that it should not be a big concern for Medicaid managed care for profitability, medical services, expenses or overall efficiency.

Conclusions

Medicaid is the largest source of health coverage in the U.S., and Medicaid managed care has become the nation's dominant delivery system for Medicaid enrollees. The ACA provides states the authority to expand Medicaid eligibility, and it required states to increase the Medicaid primary care payments in 2013 and 2014. The CMS final rule of 2016 advances the efforts to modernize the health care system to deliver better care, smarter spending and healthier people. In response to the policy changes to Medicaid, this research examines the factors affecting the performance of Medicaid managed care, including Medicaid expansion; the diversity of business lines, product types and payment methods; and the Medicaid fee bump. This research aims to provide insights to health insurers, consumers, regulators and policymakers regarding profitability, better services, reducing expenses and improving efficiency.

The results show that Medicaid expansion has a significant positive impact on the profit efficiency of Medicaid managed care. This implies that enrolling the newly eligible Medicaid beneficiaries should be beneficial to the insurer as far as profit efficiency is concerned. The diversity of business lines, product types or payment methods does not create economies of scope for Medicaid profitability. As for medical services, Medicaid expansion increases ambulatory encounters insignificantly and hospital patient days significantly. The results indicate that Medicaid expansion has an insignificant negative impact on the medical service efficiency of Medicaid managed care. The diversity of business lines, product types or payment methods does not create economies of scope for medical service efficiency. However, a more diversified portfolio of product types is associated with more ambulatory encounters, yet fewer hospital patient days. The results suggest that payment methods should not be diversified so much as far as medical services are concerned.

The composite efficiency incorporates profit, medical services and expenses; and it serves as a measure of the overall efficiency of health insurers. It shows that Medicaid expansion has no significant impact on the overall efficiency of Medicaid managed care. The diversity of business lines, product types or payment methods does not have a significant impact on composite efficiency either. Regarding expenses, Medicaid expansion has no significant effect on hospital and medical expenses or claim adjustment and administrative expenses. The diversity of business lines significantly reduces claim adjustment and administrative expenses. However, considering its potential positive impact on hospital and medical expenses, and that claim adjustment and administrative expenses only account for a small portion of the total expenses, a diverse portfolio of business lines may not be encouraged. A diverse portfolio of health plans also does not help to reduce expenses. The diversity of payment methods significantly reduces both hospital and medical expenses, as well as claim adjustment and administrative expenses.

The results indicate that the Medicaid fee bump actually does not significantly increase hospital and medical expenses or claim adjustment and administrative expenses of Medicaid managed care. The major objective of the Medicaid fee bump is to increase access to care for Medicaid beneficiaries. However, the results show that the Medicaid fee bump does not have a significant impact on any of the three service measures: ambulatory encounter, hospital patient days and medical service efficiency. Additionally, the Medicaid fee bump has no significant impact on profit measures or the composite efficiency of Medicaid managed care either. The probable explanation is that Medicaid managed care might have been paying higher fees than the traditional fee-for-service Medicaid. The results indicate that “Medicaid lower reimbursement” should not be a big concern for Medicaid managed care for profitability, medical services, expenses or overall efficiency.

Surprisingly, the value-based payments (bonus/withhold payments) do not have a significant impact on profitability, medical service efficiency, composite efficiency, or expenses. However, they do have a significant positive impact on ambulatory encounters. Therefore, bonus/withhold payments should continue to be promoted for more ambulatory encounters without significantly affecting other performance measures.

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Individual Market Underwriting Profitability in Health Insurance

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Abstract

We analyze the underwriting performance of insurers operating in the individual health insurance market from 2010–2017. Our sample consists of both life and health insurance companies. First, we offer descriptive sample statistics of key financial performance measures in this market. Then, we study the difference in performance pre- and post-2014, which represents the year that state online marketplace exchanges were implemented as part of significant health care reform, namely the federal Affordable Care Act (ACA). Our analysis allows us to test whether health care reform affected insurers operating in this market and in what ways. Our results suggest that underwriting profitability was worse in the post-ACA period: Generally, loss ratios and losses per enrollee were significantly higher in the post-reform time period. On the other hand, insurer administrative expenses were significantly lower post-2014. Furthermore, we show that these effects are not uniform across all insurers in the market.

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1. Introduction

Despite its relatively small size, the individual market—i.e., non-group—for health insurance has long been regarded as the most unstable and controversial of health insurance markets in the U.S. Challenges to insurers operating in this market include greater susceptibility to adverse selection, severe rating restrictions, and higher administrative costs (Pauly and Nichols, 2002). While the enactment of the ACA affected nearly the entirety of the health care financing sector, the individual market was of particular focus. Provisions included: 1) the establishment of state-level online exchanges on which consumers in this market could more easily purchase affordable health insurance; 2) an individual mandate to purchase health insurance coverage; 3) the standardization of plans with guaranteed access and renewal; 4) cost-sharing subsidies for lower-income individuals; and 5) minimum requirements for insurers' expenditures on claims. Combined, these provisions transformed the landscape of the individual market.

In this paper, we evaluate the underwriting performance of insurers operating in the U.S. individual market for health insurance from 2010 to 2017. We analyze financial data from all insurers writing individual market health business, including life insurers. We evaluate loss ratios, losses per enrollee, and expense ratios for all insurers in the sample and a sub-sample (SS) consisting only of insurers that operated throughout the sample period. We analyze the difference in performance pre- and post-2014, which represents the year that the online marketplace exchanges were implemented. Our results suggest that the reform, namely the ACA, had little or no impact on average insurer loss ratios for the full sample (FS), but loss ratios significantly increased for the SS of insurers. We found that losses per enrollee increased significantly in both samples while insurer administrative expenses decreased. Furthermore, we show that these effects are not uniform across all insurers in the market.

The paper proceeds as follows. The second section offers background information. The third section presents our data and methodology. In the fourth section, we present our results. A final section offers a conclusion.

2. Background

While health insurance coverage in the U.S. has been available on an individual—i.e., direct-purchase, non-group—basis since the early twentieth century, the growth of the employer-sponsored market and the advent of Medicare and Medicaid quickly diminished the size of this market.[1] By 2010, when the ACA

1. Prior to the pre-paid hospital and physician services (e.g., Blue Cross and Blue Shield Association—BCBSA) plans of the 1920s and 1930s, "industrial sickness funds" were developed in the late 1800s by railroad companies to serve sick and injured employees; i.e., workers' compensation plans (Murray, 2007). Additionally, private life insurers, during the time of pre-paid

was passed into law, the individual market represented only 7% of the total non-elderly market for health insurance.[2] Approximately 16% of the non-elderly population in the U.S. was uninsured at that time.[3] The large percentage of the population without health insurance was one of the broad issues that the ACA was designed to address (Harrington, 2010). Key populations of non-elderly uninsureds included non-disabled adults without employer-sponsored coverage who were not eligible for Medicaid. Hence, significant provisions were included in the ACA to expand affordable and accessible health insurance coverage to this particular segment of the population.

Table 1 (see on page 4) lists the ACA provisions designed to specifically address issues in the individual market. In Panel A, we list provisions that are most likely to affect underwriting performance. In Panel B, we list provisions that are most likely to affect expenses. Other provisions that may indirectly affect underwriting performance and expenses are listed in Panel C. We recognize that each provision in the table may have consequences for multiple measures of performance. We discuss the theoretical effects of these provisions below.

The individual market is prone to two fundamental problems: higher administrative costs and increased potential for adverse selection. Operations in this market are more administratively costly when compared to group health insurance. Prior to the ACA, the largest share of non-group operation costs for health insurers was the cost of selling the policies (Pauly and Nichols, 2002). Therefore, the implementation of online exchanges and the standardization of plans sold on those exchanges had the potential to lower the administrative costs associated with this market. In general, the exchanges may have afforded an opportunity for insurers to increase participation in the individual market.[4]

The minimum medical loss ratio (MLR) requirements are likely to have affected health insurer performance, as well. Health insurers writing business in the individual market must maintain a minimum MLR of 80%; i.e., at least 80% of premiums earned in this market must be spent on claims and other allowable expenses. The NAIC was charged with the responsibility of establishing definitions and methodologies for calculating the MLR and the associated rebate amounts, including providing a definition of allowable quality improvement activities. While

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plans, began selling group health insurance policies to employers, but the major growth of those plans was seen following wage controls of the 1940s and changes to the Internal Revenue Code (IRC) in the 1950s (Morrisey, 2014).

2. Source: U.S. Census Bureau, Current Population Survey, 2011 Annual Social and Economic Supplement.

3. Source: Cohen, Martinez and Zammitti (2015) Health Insurance Coverage Trends 1959–2017. In the years following the enactment of the ACA provisions, the rate of uninsured has declined from 16% in 2010 to roughly 9% in 2016 (U.S. Census, 2017). While this decline can be partially attributed to the expansion of the individual market, other provisions such as the extension of coverage to young adult dependents and the Medicaid expansion also contributed to this decrease.

4. Rating areas were established by each state. Plans offered on the exchanges were subject to specific regulation. Insurers were not required to operate on the exchanges. See Morrisey, et al (2017) for a more complete discussion on the exchanges and evidence of competition.

the administrative costs are not included in the calculation of the minimum requirements, the costs associated with improving health care quality are allowable in the calculation of the MLR.[5]

Table 1:
Provisions in the ACA

Panel A: Provisions that may affect underwriting performance	
Individual mandate (Section 1501)	Requires health insurance coverage with few exceptions; enforced from 2014 to 2018; income tax penalty for noncompliance
Adjusted (modified) community rating (Section 2701)	Required for all non-grandfathered plans in the individual and small group markets; rating adjustments are made for age (with limitations), geographic location, family size and tobacco usage
Guaranteed coverage and renewal (Sections 2702/2703)	Plans sold in the individual and small group markets are sold on a guaranteed issue and renewal basis
Pre-existing conditions prohibited (Section 1101)	Eliminates medical underwriting in the individual and small group markets
Risk corridor program (Section 1342)	Temporary (2014–2016); limits health insurer gains or losses beyond allowable range
Risk adjustment program (Sec. 1343)	Permanent; redistributes funds between plans with low- and high-cost enrollees through payments made from plans with lower actuarial risk to plans with higher risk for non-grandfathered individual and small group plans both on and off the exchanges
Reinsurance program (Section 1341)	Temporary (2014–2016); provides payment to plans that enroll high-cost enrollees
Minimum medical loss ratio (MLR) requirements (Section 2718)	Enacted in 2011; health insurers operating in the individual and small group markets must maintain minimum MLRs of 80%; noncompliance requires rebates paid to plan enrollees
Panel B: Provisions that may affect expenses	
Online marketplace exchanges (Section 1311)	Enacted Jan. 1, 2014; transparent, competitive, easily navigated websites specifically for the sale of plans in the individual and small group markets
Standardized exchange plans (Section 1302)	Exchanges offer four tiers of coverage: bronze, silver, gold and platinum (plus a catastrophic plan)
Essential health benefits (Section 1302)	10 essential health benefits (e.g., emergency, hospitalization, etc.) required for all plans sold on exchanges
Panel C: Provisions that may affect the individual market	
Premium tax credits (Section 1401)	Reduces plan costs through tax credits for premiums paid up to 400% of the federal poverty level
Cost-sharing reductions (Section 1402)	Reduces out-of-pocket exposure and includes payments for deductibles, coinsurance, and/or out-of-pocket maximum paid on the plan to eligible enrollees up to 400% of the federal poverty level

Along with increased expenses associated with operating in the individual market, health insurers operating in this market are more susceptible to adverse selection. Comprehensive underwriting is often the solution to mitigating adverse selection in insurance markets. Restrictive rating, through the mandated use of adjusted community rating, may have increased the potential for adverse selection in the individual market following the enactment of the ACA. However, the

5. Initially, in 2011, health insurers paid out more than $1billion in rebates following the enactment of minimum MLR requirements (Hall and McCue, 2013). That number was reduced to $332 million in 2013 (Kirchhoff and Mulvey, 2014).

individual mandate was designed to manage the issue of adverse selection by forcing large numbers of potentially low-risk enrollees into the pool.[6] Additionally, the risk adjustment and reinsurance programs were designed to mitigate problems associated with adverse selection through the spreading of financial risk across markets.[7,8]

Ultimately, there were several provisions within the ACA that had the potential to affect the underwriting performance of health insurers operating in the individual market. Some, such as the standardization of benefits and the individual mandate, may have a positive effect on performance while others, including the limitations on rating, may be more problematic. While theory offers *a priori* expectations as to the effects of each provision independently, the joint impact of the various provisions on insurer performance must be derived empirically.

3. Data and Methodology

Data

For this analysis we use data from the NAIC. We collect information from the Supplemental Health Care Exhibit—Part 1 as reported annually by state from 2010 to 2017 by health insurers and life insurers writing health insurance business.[9] While we are primarily interested in the individual health insurance market, we use data on all health insurers to confirm that reported administrative expenses are greater in the individual market than in the group market. We found that health insurers spent, on average over the sample period, significantly more on general administrative expenses per member per month in the individual market compared to the same expenses in the large group market.[10]

For our primary analysis, we use data on premiums, claims, expenses and member months, and then we supplement this basic information with insurer characteristics. To ensure a reasonable insurer-state-year sample of health insurers,

6. See Born and Sirmans (2018) for arguments associated with the potential for adverse selection in this market following the enforcement of adjusted community rating and evidence of adverse selection in the individual market for health insurance.

7. See NAIC (2011) for a discussion of adverse selection in the health insurance exchanges and key ACA provisions designed to address the problem of adverse selection.

8. See Cox, Semanskee, Claxton and Levitt (2016) for a more complete review of the risk adjustment, risk corridors and reinsurance programs.

9. See Cole and Karl (2015); Born, McCullough and Karl (2016); Born, Karl and Viscusi (2017); and Karaca-Mandic, Abraham and Simon (2015) for other studies that utilize the NAIC health insurer statutory filings.

10. Health insurers spent, on average, $216.33 in the individual market versus $121.72 in the large group market on general administrative expenses. The median that health insurers spent on general administrative expenses in the individual market was $33.21 compared to $26.49 spent on the same expenses in the large group market.

we include insurers writing business in any state with the exception of California.[11] Insurers must be operating in the individual market with greater than $10,000 in state-year net-adjusted premiums earned after reinsurance, positive net incurred claims after reinsurance, greater than 1,000 member months in the individual line of business, and positive expenses.[12] Our final sample includes 5,042 insurer-state-year observations.

We evaluate changes over time in three measures of insurance performance: *Loss Ratio*, *LossesPerEnrollee* and *ExpenseRatio*. The enactment of the exchanges on Jan. 1, 2014, marks a time period of transformation for the individual market. Thus, our key independent variable of interest, *Post2014,* is a binary variable equal to one for years 2014–2017. Variable definitions are presented in Table 2.

Table 2:
Variable Definitions

Variable[1]	
LossRatio	Net incurred claims after reinsurance/net adjusted premiums earned after reinsurance
LossesPerEnrollee	Net incurred claims after reinsurance/enrollee
ExpenseRatio	Sum of total claims adjustment expenses and total general and administrative expenses/net adjusted premiums earned after reinsurance
MemMosIndiv	Member months individual market
Size	Natural logarithm of total member months
UWLoss	1 if insurer reported total net loss (line 15), 0 otherwise
RecRiskAdj	1 if insurer received premium adjustments through the permanent ACA risk adjustment program, 0 otherwise
ClaimsAdjExp	Line 8.3, total quality expenses/member month, individual market
AdminExp	Line10.5, total administrative expenses/member month, individual market
PctNonRiskBearing	Member months uninsured plans/total member months
PctPremGov	Line 1.8, total adjusted premiums, government lines/total adjusted premiums
PctPremIndiv	Line 1.8, total adjusted premiums, individual market/total adjusted premiums
PctPremGroup	Sum of total adjusted premiums in small group and large group/total adjusted premiums
LifeIns	1 if insurer reports as life insurer, 0 otherwise
NumIns	Number of insurers with positive premiums in the individual market, by state

1. Line numbers reference the Supplemental Health Care Exhibit—Part 1 as reported in 2017.

Table 3 presents sample summary statistics for the two time periods of interest. We note that while mean loss ratios are below one in both time periods, the combination of mean loss ratios and mean expense ratios suggest overall performance losses. T-tests of the means and Wilcoxon rank-sum tests of the medians show significant differences in each of the variables listed in Table 3 for

11. Health insurer reporting differs for health insurers operating and/or domiciled in California. Thus, we follow prior literature and exclude business reported in California and/or insurers domiciled in California. See Cole, He, and Karl, (2015).

12. We note that in the years 2014–2017, there are 798 insurer-state-year observations where health insurers report negative adjusted premiums. We do not include these insurers in the sample.

the pre- and post-2014 periods. All differences are statistically significant at the 1% level.

Table 3:
Summary Statistics

	2010–2013			2014–2017		
	N=2929			N=2113		
Variable	Mean	Median	Std. Dev.	Mean	Median	Std. Dev
LossRatio	0.8566	0.7998	0.5139	0.9640	0.8903	0.7194
ExpenseRatio	0.2373	0.1853	1.0385	0.1688	0.1344	0.2009
LossesPerEnrollee	253.87	169.17	795.90	338.77	293.07	334.54
MemMosIndiv	144,793.2	15,496	433,260.3	305,944.2	68,026	756,462.4
Size	12.4459	12.4303	2.5070	13.3721	13.5605	2.3126
UWLoss	0.3103	0	0.4627	0.4136	0	0.4926
RecRiskAdj	0	0	0	0.7350	1	0.4415
ClaimsAdjExp	1,213,071	119,244	4,825,577	3,087,032	496,108	1,000,000
AdminExp	4,197,224	526,039	13,000,000	10,300,000	2,170,277	26,000,000
PctNonRiskBearing	0.0612	0	0.4627	0.0900	0	0.2000
PctPremGov	0.1016	0	0.2234	0.1187	0	0.2562
PctPremIndiv	0.2559	0.0663	0.3470	0.3471	0.1859	0.3538
PctPremGroup	0.2299	0.0007	0.3270	0.3440	0.3080	0.3285
LifeIns	0.6842	1	0.4649	0.3923	0	0.4884
NumIns	19.5971	19	8.0752	15.0776	14	7.0956

The ACA provisions have a variety of potential consequences, noted above, for the financial performance of insurers operating in this market. It is important to note that these provisions may have had even more far-reaching effects on market structure; i.e., to the extent that the provisions were viewed favorably [unfavorably], insurers may have elected to enter [exit] the individual market. We show in Table 4 that the number of insurers in the sample decreased over the eight-year period covered by our sample.

Table 4:
Number of Insurers, by Year

Year	Number of State-Insurers
2010	753
2011	814
2012	663
2013	699
2014	628
2015	582
2016	505
2017	398

Methodology

To test the differences in health insurer individual market performance pre- and post-2014, we estimate the following equations for insurer (i) in state (s) at year (t) using Ordinary Least Squares (OLSs):

$$LossRatio_{ist} = f(X'_{ist}\beta + \mu_i + \delta_s + \gamma_t) + \epsilon_{ist} \quad (1)$$

$$LossesPerEnrollee_{ist} = f(X'_{ist}\beta + \mu_i + \delta_s + \gamma_t) + \epsilon_{ist} \quad (2)$$

$$ExpenseRatio_{ist} = f(X'_{ist}\beta + \mu_i + \delta_s + \gamma_t) + \epsilon_{ist} \quad (3)$$

where X is a vector of controls including *Post2014, Size, PctNonRiskBearing, LifeIns, PctPremGroup, PctPremGov, RecRiskAdj, UWLoss* and *NumIns* for insurer (i) in state (s) at year (t). The terms μ_i, δ_s and γ_t account for time-invariant insurer, state, and year indicators, respectively, that control for unobserved heterogeneity. The equations are estimated for the FS of insurers as well as a SS consisting only of insurer-state observations that remain in the sample for all eight years.

The results obtained from estimating equations (1), (2) and (3) using OLSs provide a sense of how the performance of an average insurer in the individual market has changed, pre- and post-ACA, all else equal. We recognize, however, that the insurers in this market may be differentially affected, depending on whether they are already high- or low-performers, based on our performance measures. For example, insurers that were profitable in the period before the ACA may get marginally less of a benefit from a provision, such as the individual mandate, than an insurer that was less profitable. To evaluate the potential differential effects across insurers, we re-estimate the three equations using a quantile regression methodology and evaluate the effects at five quantile levels (10^{th}, 25^{th}, median, 75^{th} and 90^{th}).

4. Results

Table 5 (see on page 10) presents the results of our estimation of equations (1), (2) and (3) using OLS methodology. The estimated coefficient on *Post2014*, shown in Column (1), indicates that there is no statistically significant difference in the *LossRatio* between pre- and post-2014 for our FS. This is perhaps not surprising given that the provisions of the ACA that affected underwriting operations had, at least theoretically, the potential to increase or decrease underwriting performance. While underwriting performance might worsen *Post2014* due to a larger number of individuals in the market and restrictive rating, the individual mandate for coverage, which may have forced previously low-risk applicants into the pool, may have mitigated any adverse consequences to loss ratios across this time period. However, for the SS shown in Column (4), the coefficient on *Post2014* is positive and statistically significant at the 5% level. This result suggests that, for insurers operating throughout this time period, loss ratios are approximately 0.07 higher in the years following 2014, which represents an 8% increase in loss ratios at the mean. In Columns (2) and (5), we show the results where our dependent variable is *LossesPerEnrollee*. In these equations, we can see the impact on the underwriting performance without the effects of the premium fluctuations that may have occurred over this time period. In both samples, we note that *LossesPerEnrollee* are significantly higher in the *Post2014* time period (approximately $189 per enrollee for the FS and $167 per enrollee for the SS, or increases of 75% and 61%, respectively, at the mean) when compared to the pre-2014 period.[13] In Columns (3) and (6), we show that the *ExpenseRatio* is significantly lower in the *Post2014* time period when compared to the pre-2014 period for both samples. The *ExpenseRatio* decreases by nearly 6% in both the FS and the SS, representing reductions of 29% and 40%, respectively, at the mean. These results suggest that provisions of the ACA had an overall benefit in reducing costs, despite the potential to add costs in some areas (e.g., reporting requirements). The introduction of the exchanges and standardization of plans may have both reduced barriers to entry in this market and created economies of scale in which insurers could more efficiently sell and administer plans to those in the individual market.

Table 6 (see on page 10) shows the results from estimating equations (1), (2) and (3) using a quantile regression methodology for both the FS and the SS. We present only the estimated coefficients for our *Post2014* variable, to focus on the potential for differential effects across the distribution of insurers. First, we note that the estimated effects of *Post2014* vary in a significant way across the distribution of both performance measures, confirming our suspicion that insurers may have been affected differentially based on their prior performance. Loss ratios appear to have increased for most insurers in the individual market. Insurers at the 90th percentile (FS) in loss ratios—i.e., the most unprofitable in an underwriting sense—appear not to be affected, while the rest of the distribution shifts upward, suggesting worse performance for health insurers in the lower part of the distribution. In the SS, loss ratios increased significantly for insurers in the lower three quantiles. The estimated effect of *Post2014* on *LossesPerEnrollee* is positive and statistically significant at the 1% level across the distribution for both samples, suggesting that most, if not all, insurers have experienced an increase in losses paid per enrollee during the *Post2014* time period. The estimated effect of *Post2014* on expenses tells a different story: Insurers with the highest expense ratios appear to have benefited more than those insurers in the lower part of the distribution, based on a comparison of the magnitude of the coefficients on *Post2014* across the quantiles.

13. We also evaluated our models with indicators for each year, 2010–2017, omitting 2014, and analyzed the coefficients on each year indicator. These results (not shown) show that significant coefficients in years prior to 2014 are negative for the loss ratio and losses per enrollee, and they are positive for the expense ratio. The coefficients in years post-2014 are primarily positive and significant for the loss ratio and losses per enrollee, but they are insignificant for the expense ratio.

Table 5:
OLS Regression Results

	Full Sample (FS)			Sub-Sample (SS)		
	(1) *LossRatio*	(2) *LossesPerEnrollee*	(3) *ExpenseRatio*	(4) *LossRatio*	(5) *LossesPerEnrollee*	(6) *ExpenseRatio*
Post2014	-0.0454	188.9872***	-0.0584***	0.0768**	167.1894***	-0.0561***
	[0.057]	[48.835]	[0.018]	[0.034]	[23.085]	[0.010]
Size	-0.0705***	-10.2811	0.0012	0.0170	-10.3532	-0.0073*
	[0.015]	[12.637]	[0.005]	[0.014]	[9.702]	[0.004]
PctNonRiskBearing	0.1355	-73.1746	0.0014	-0.0233	47.9557	-0.0815***
	[0.124]	[106.843]	[0.039]	[0.065]	[44.167]	[0.019]
LifeIns	0.0379	-28.5241	0.0841***	0.0030	-33.6667	0.0808***
	[0.073]	[63.020]	[0.023]	[0.049]	[33.050]	[0.014]
PctPremGroup	0.2078***	44.9200	0.0458***	-0.0029	33.1356	0.0401***
	[0.056]	[47.867]	[0.017]	[0.038]	[25.758]	[0.011]
PctPremGov	0.0904	28.1808	0.0145	-0.0222	22.6375	0.0003
	[0.064]	[55.164]	[0.020]	[0.042]	[28.683]	[0.012]
RecRiskAdj	-0.0543	71.2624**	0.0030	0.0322*	43.9565***	-0.0125**
	[0.036]	[30.552]	[0.011]	[0.018]	[12.561]	[0.005]
UWLoss	0.1549***	29.0102*	0.0207***	0.0608***	27.3049***	0.0103***
	[0.020]	[17.509]	[0.006]	[0.013]	[9.071]	[0.004]
NumIns	-0.0098**	0.2681	-0.0008	0.0003	0.5297	0.0017***
	[0.004]	[3.354]	[0.001]	[0.002]	[1.419]	[0.001]
_cons	2.0359***	267.8942	0.2642***	0.5400***	230.7240	0.2651***
	[0.314]	[270.095]	[0.098]	[0.207]	[140.537]	[0.061]
R-Sq.	0.495	0.665	0.971	0.342	0.552	0.514
N	5042	5042	5042	1624	1624	1624

Standard errors in brackets
Note: Standard errors are in parentheses. Year, state and insurer indicators are used but not displayed.
* p<0.10, ** p<0.05, *** p<0.01

Table 6:
Estimated Effect of *Post2014* from Quantile Regressions for Full Sample (FS) and Sub-Sample (SS)

	10%	25%	Median	75%	90%
LossRatio (FS)	0.0854***	0.1207***	0.1140***	0.0730***	-0.0026
	[0.028]	[0.05]	[0.013]	[0.020]	[0.054]
LossRatio (SS)	0.0531***	0.0900***	0.0909***	0.0266	-0.0172
	[0.025]	[0.015]	[0.015]	[0.023]	[0.044]
LossesPerEnrollee (FS)	132.702***	157.419***	208.940***	250.706***	258.587***
	[9.975]	[7.837]	[8.924]	[16.956]	[37.345]
LossesPerEnrollee (SS)	141.700***	153.354***	177.900***	170.641***	165.000***
	[10.425]	[8.555]	[11.418]	[24.176]	[46.482]
ExpenseRatio (FS)	-0.0247***	-0.0510***	-0.1005	-0.1371***	-0.1118***
	[0.006]	[0.06]	[0.007]	[0.009]	[0.021]
ExpenseRatio (SS)	0.0002	-0.0078	-0.0400***	-0.0827***	-0.1051***
	[0.009]	[0.006]	[0.007]	[0.009]	[0.020]

Standard errors in brackets
Sample size: N=5042 (FS) and N=1624 (SS)
Note: Standard errors are in parentheses. Year, state and insurer indicators used but not displayed.
* p<0.10, ** p<0.05, *** p<0.01

5. Conclusion

In this paper, we analyzed the underwriting performance of insurers operating in the individual health insurance market from 2010 to 2017, a period of major reform in the U.S. health care market, using a panel of firm-state-year observations consisting of both life and health insurance companies. We found that insurer underwriting performance, captured by the loss ratio on insurer-state individual health insurance business, on average, was not affected in the post-ACA time period for insurers in our FS. However, for a SS consisting only of insurers operating over the whole sample period, the loss ratio increased significantly in the post-ACA time period. In addition to evaluating the loss ratio, we analyzed performance based on losses paid per enrollee and found that losses paid per enrollee increased significantly in the time period following the enactment of key ACA provisions. We found that the expense ratio had declined significantly for all insurers, and that this is especially true for insurers with *a priori* higher expense ratios.

Overall, our results suggest that provisions in the ACA have had a differential effect on aspects of insurer operations; i.e., their ability to effectively price coverage and manage expenses. Although we are not able to disentangle the specific effects of each provision, we can conclude that the combined influence of the ACA provisions has far-reaching implications for this market. A large number of insurers have exited the market, and for those that continue to participate, it may be difficult to reduce expenditures any further. Regulatory attempts to ensure that the market does not completely unravel must recognize that the remaining insurers need opportunities to recover on the underwriting side, especially if one key provision—the individual mandate—will be eliminated at the end of this year.

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The Excess-of-Loss Reinsurance Benefits for Small Insurers

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Abstract

This paper analyzes profitability and risk effects of the excess-of-loss (EoL) reinsurance coverage for a small insurer. Under the risk-based capital (RBC) standards, the small insurer with EoL reinsurance is more profitable and has smaller standard deviation. Therefore, the limited supply of EoL reinsurance can adversely affect the profitability and competitiveness of small insurers, especially after major catastrophes. Insurance regulators can mitigate this problem by establishing a residual reinsurance market where small insurers can obtain reinsurance.

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1. Introduction and Context

Currently, there are limited number of publications analyzing the adverse effects of the law of large numbers (LLN) and RBC standards and the lack of reinsurance supply for small insurers. This study: 1) shows that the LLN and RBC standards constrain small insurers more than large insurers; 2) demonstrates that a small firm is more profitable with a reinsurance contract (EoL); and 3) proposes a framework for establishing a residual insurance market administered by the NAIC in cooperation with the U.S. states.

This paper is motivated by the following findings:

- ***Small insurers are not well-diversified geographically and in product lines:*** Small insurers are regional, operate in a niche market and provide a limited number of insurance products (Swiss Re, 2012; U.S. Department of the Treasury, 2014).
- ***Small insurers require proportionally more reinsurance***: Small insurers are at a disadvantage relative to larger insurers because direct insurance rates are regulated, but reinsurance rates are not. Therefore, the shortage of reinsurance after major catastrophes affects small insurers more than large insurers (Holzheu, 1999).
- ***Small insurers are more vulnerable to insolvency****:* Large insurers are likely to have greater financial stability than small insurers, and insurance regulators are less likely to liquidate large insurers than small insurers (Shim, 2015; Cummins, Harrington and Klein, 1995).
- ***RBC constraints affect small insurers more than the larger insurers****:* The LLN implies that small insurers have larger standard deviations of the expected losses and hold larger amounts of required capital under the RBC standards (Munch and Smallwood, 1980; Santos et al., 2018).

This paper is organized as follows: Section II provides a background for small insurers and catastrophes. Section III shows how a small workers' compensation insurer's risk and profitability depends on the availability of the EoL contracts. Section III presents fair premium calculations, introduces a multivariate distribution, and shows how to calculate the standard deviation of expected losses and the required capital levels for both small and large insurers. Section IV incorporates the results obtained from the previous section and demonstrates the profitability of a small insurer with EoL by using financial statements. Section V incorporates other studies and considerations, including alternative capital. Section VI suggests a framework for establishing a residual reinsurance market. Finally, Section VII provides conclusions of this paper.

It is recommended that a novice of insurance read all introductory sections that present current literature showing how small insurers are disadvantaged, and how having EoL reinsurance contracts reduces risk and increases small insurer profitability. However, seasoned insurance readers can safely skip Section I through

Section V and start reading Section VI, where an argument about the establishment of residual reinsurance market for small insurers is made.

2. Background: Small Insurers and Catastrophes

The increasing frequency and severity of natural and man-made catastrophes is a challenge to primary insurers, reinsurers and legislators. A primary insurer can protect itself against extreme losses by signing a reinsurance contract or arranging an insurance-linked security (ILS). Historically, after any major natural or man-made disasters, there have been discussions in the insurance industry about the adequacy of reinsurance or ILS to primary insurers.

Natural Catastrophes

Hurricanes, earthquakes, floods, wildfires, tornados, tsunamis and volcanic eruptions are some of the natural catastrophes that cause significant property/casualty (P/C) losses around the world. Often, it is stated that reinsurance supply goes down after major natural disasters. For example, Holzheu (1999) reports a shortage in reinsurance capacity after Hurricane Andrew in 1992 because of bankruptcies and withdrawals among the reinsurers. In addition, Froot and O'Connell (1997, 1999) present historical trends showing reduction in reinsurance supply because of the supply shift in the aftermath of a catastrophic loss. Also, Cummins (2007) reports that U.S. insurers are dependent on the global reinsurance market to provide coverage in light of increasing mega-catastrophes and states, "Insurance price regulation for catastrophe-prone lines of business is a major source of inefficiency in insurance and reinsurance markets."

Further, Berger et al. (1992) find that during the mid-1980s crisis, reinsurers reduced underwriting of some risks or put strict coverage limits, especially on the upper tail of the probability of loss distribution through EoL contracts. Because catastrophic events cause insurers and reinsurers to have significant losses, some theorize that hard insurance markets may result from the catastrophes (Harrington and Niehaus, 2004).

Man-Made Catastrophes

The magnitude of human and P/C losses arising from man-made catastrophes became more concerning to legislators and insurers around the world after the 9/11 terrorist attacks. Michel-Kerjan and Kunreuther (2017) summarize that the Terrorism Risk Insurance Act (TRIA), passed in 2002, established a partnership between the U.S. federal government, private insurers and other commercial enterprises. Towers Watson (2013) assesses reinsurance availability aftermath of the terrorist attack on the World Trade Center and the Pentagon and predicts that there will be inadequate reinsurance protection for some primary companies, inadequate retrocessional protection for some reinsurers, and failed insurers among less well-capitalized companies in the industry. Further, the report asserts, "After a megacatastrophe, primary insurers reevaluate their reinsurance needs and often seek greater protection. Ironically, at the same time, reinsurers implement tighter risk controls, which tend to reduce the capacity they are willing to offer. We are already seeing the signs of a looming reinsurance capacity shortage."

Small Insurers

Most of the small insurers in the U.S. are regional carriers, work in a niche market and cede a greater percent of their business to reinsurers, therefore requiring proportionally more reinsurance. Another characteristic of a small insurer is being less diversified geographically and in insurance product lines. Swiss Re (2012) reports that small, local and regional insurers have only limited scope to diversify their book of business.

The U.S. Department of the Treasury (Treasury Department) (2017) studies the availability and cost of private reinsurance for small insurers and finds:

- Small insurers generally do not purchase reinsurance from "dollar one" (pro rata) of their exposure. Rather, the reinsurance is generally purchased to apply at some higher loss amount (EoL contracts), below which the small insurer remains exposed to the losses.
- A large percentage of small insurers face significant exposure between their Terrorism Risk Insurance Program (TRIP) deductibles and the program trigger, which has not been addressed by private reinsurance**.**
- The TRIA resulted in the TRIP. Measured against all TRIP-eligible lines combined, small insurers charge a lower premium than non-small insurers.
- Small insurers tend to transfer, or cede, a greater proportion of their direct premiums to reinsurers than larger insurers.

The findings of the Treasury Department (2017) indicate that small primary insurers work regionally, mostly in a niche market, and they are not as well-diversified in product lines or geographical operations as their large competitors are. Therefore, small insurers require proportionally more reinsurance against the volatility of their net income. In addition, the TRIA Federal Advisory Committee (2017) warns, "While direct insurance rates are regulated, reinsurance rates are not, such that small insurers might not be able to pass along such costs to policyholders, which puts small insurers at a competitive disadvantage relative to larger insurers that may not require as much reinsurance."

Furthermore, some researchers report that small insurers have higher insolvency problems in the marketplace. For example, Shim (2015) investigates an insurer's financial stability in the U.S. property-liability insurance industry for the period of 1992–2010 by using a two-stage least squares technique and finds that on average, large insurers are likely to have greater financial stability than small insurers. Also, Cummins, Harrington and Klein (1995) assert that small insurers are more likely to be vulnerable to insolvency because insurance regulators are less likely to liquidate large insurers than small insurers. Munch and Smallwood (1980) find that capital and surplus requirements are the most effective means for reducing the number of insurer insolvencies, but they note that these high capital and surplus requirements also may restrict potentially valuable services offered by small niche insurers.

Further, Holzheu (1999) analyzes the trends in the U.S. direct insurers' cession behavior for the period of 1993–1997 and finds that the larger providers tend to have lower cession rates than smaller companies, and the smallest companies cede over one-fourth of the direct business they write. In addition, *Insurance Journal* (2002) reports the findings of the Conning research and shows that small insurers' direct expense ratios are at a disadvantage because small insurers cede more premiums to reinsurers. Hemenway (2012) reports those catastrophe-laden and tornado-filled years, 2011 and 2012, could have a debilitating impact on smaller carriers because they often have a lot smaller of a financial cushion with less business from which to draw and pay claims. Also, in an interview published in *Insurance Journal* (2018), Aspen Insurance Holding's CEO explains why Aspen was successful in reinsurance underwriting profits and grew more than 20%. Aspen provided reinsurance to the large and well-capitalized (a national writer or commercial industrial writer) insurers because "the unit of exposure with the undercapitalized companies gives more loss than a unit of exposure to a big properly run insurance company in the catastrophe-prone Florida region." Furthermore, a survey by Reese (2012) reports unique challenges in securing life reinsurance and finds that just over half of the small insurer respondents say they experienced reinsurance challenges. According to the report, the number one challenge for smaller insurance companies was that the price of reinsurance was too high. Also, consistent with other findings, the challenged small insurers ceded 36% of their new face amount compared to the second group of small insurers that, reporting no challenge, ceded 16% of their new face amount.

The Treasury Department (2014) states that risk transfer through reinsurance is particularly important for smaller insurers, which have more limited opportunities to diversify risk through underwriting practices than do larger insurers with risk profiles that include multiple lines of business written in multiple jurisdictions or across broader and more diverse geographic regions. Weiss and Chung (2004) assert that a nonproportional (EoL) reinsurance contract is designed to cover the right tail of the loss distribution and that it is relatively riskier than a proportional (pro-rata) reinsurance. As a result, if reinsurers prefer pro-rata contracts, then small insurers may face difficulty in finding EoL reinsurance, especially in the hard insurance markets. Naturally, both pro-rata and EoL reinsurance contracts reduce the standard deviations of the expected losses, but small firms prefer EoL contracts because the risk of insolvency depends on the right tail of the loss distribution. However, the reinsurers' preference for pro-rata reinsurance contracts may severely limit the supply of EoL contracts for small insurers.

3. An Analysis of a Small Insurer Providing Workers' Compensation

Workers' compensation insurance is a catastrophe-prone line of P/C insurance. According to Munich Re (2012), workers' compensation insurance firms face unique challenges arising from demographics and natural catastrophes; therefore, the costs are expected to rise in the near future. Further, a study by the California Workers' Compensation Insurance Rating Bureau (WCIRB) explores the workers' compensation severities when a major earthquake catastrophe happens. According to the California WCIRB, "The nature of workers' compensation coverage is such that there is no predefined or specified limit of insurance coverage. The amount for which an insurer is ultimately liable depends on many components, including the severity of injuries, the extent of physical impairment and the duration over which benefits will be paid." Also, the Treasury Department (2017) reports that "a large-scale act of terrorism could create significant aggregation risks for workers' compensation carriers, particularly in the event of broad-based losses arising from a nuclear, biological, chemical or radiological weapons (NBCR) event."

Further, the Insurance Information Institute (2002) reports a breakdown of insurance claims after the 9/11 terrorist attacks and finds that out of 31,232 total claims, 4,748 of them were workers' compensation insurance reported to the Disaster Insurance Information Office (DIIO). Fuge (2001) finds that the resulting workers' compensation payments are estimated to be more than $4 billion for the 9/11 terrorist attacks.

According to the *Report of the President's Working Group on Financial Markets* (2006), commercial property insurance coverage is written through what is called an "all risk" insurance policy, with the exclusion of losses from acts of war. However, this is not the case for the workers' compensation insurance, which covers work-related injury or death even after an act of war or terrorism. Also, a study by Miller et al. (2003) states, "The lack of a strong reinsurance market today has continued to have a negative material impact on the cost of workers' compensation insurance and the ability of the California workers' compensation industry to respond to catastrophic losses." The report further states, "The additional uncertainty of major catastrophic events, such as the impact from terrorism or earthquake on workers' compensation exposures, and the price increases for reinsurance and increasing retention levels should not be surprising. Of the major reinsurance carriers interviewed for this project, none have expressed a commitment to returning or expanding in this market."

Table 1 provides the assumptions of a small hypothetical firm SF (with or without EoL) reinsurance and compares it to a large hypothetical firm (LF) without EoL reinsurance.

Table 1:
Assumptions Made for Small (With and Without EoL) and Large Firms

1. Small and large insurers provide workers' compensation insurance policies, and the benefits of these policies for the insureds are identical.
2. SF (with and without EoL) has 5,000 policyholders, and LF has 100,000 policyholders.
3. The risk characteristics of the policyholders in both pools for SF (with and without EoL) and LF are identical.*
4. SF (with and without EoL) and LF have identical expected loss estimations, identical proportion of the expected loss as administrative costs, loss adjustment costs, commissions to insurance agents and brokers, underwriting costs, and profit loading. Therefore, both SF (with and without EoL) and LF charge the same amount of annual premiums, $1,485.77, to their policyholders.
5. We assume that the risk-based capital (RBC) standard is 99.5% of value at risk (VaR) capital requirement in the U.S., where both SF (with and without EoL) and LF operate.**
6. Workers' compensation policies are issued once at the beginning of each year, and the premiums are collected from policyholders at the beginning of the year.
7. Both SF (with and without EoL) and LF pay the expected insurance losses, loss adjustment expenses (LAE), and commissions to agents and brokers at the end of the year, while the underwriting expense and profit loadings are applied when they occur immediately. All expenses are calculated as a percentage of expected losses.
8. SF (with and without EoL) and LF borrow $6.5 million and $130 million, respectively, through the issue of bonds at 5% interest rate to finance the shortfall in their reserves (both firms borrow $1,300 per policy) for the first year of the operations.
9. At 5% interest cost, SF (with EoL) has additional borrowing of $502,918.56 to cover the shortfall and have $0 surplus at the beginning of the year before starting its operations. Similarly, at 5% interest cost, SF (without EoL) has additional borrowing of $1,727,536 to cover its shortfall and have $0 surplus at the beginning of the year before starting its operations.
10. Market interest rate return on premium investments is also 5% annually.
11. SF (with EoL) uses an EoL reinsurance contract that would pay for the losses that exceeds $500,000 per policy.

* While Conning Holdings Ltd (2016) classifies small insurers in the P/C lines as having less than $500 million capital and surplus, Fitch Ratings (2017) criteria defines them as having less than $750 million. On the other hand, a small life insurer is defined as having less than $1 billion of capital and surplus. For the study above, using $500 million, $750 million, or $750 million for the large firm capital and surplus does not change the results and findings of the paper.
**Assumption 5 is based on an NAIC (2009) report that states the Solvency II PCR (called the Solvency Capital Requirement—SCR) at 99.5% for the VaR over a one-year time horizon.

In addition, Table 2 (see page 8) shows the cost components as a percent of the expected losses, E(L): LAE (15%); commissions to agents and brokers (6%); profit loading (10%); and underwriting (25%).

Furthermore, Table 3 (see page 8) presents the most common financial ratios used in the P/C industry to assess the financial condition of the insurance firms.

Table 2:
Cost Structure for Small (With and Without EoL) and Large Firms*,**

EXPECTED LOSSES AND TYPES OF EXPENSES	PRESENT VALUE of E(L) AND EXPENSES	E(L) AND EXPENSES ($)	% SHARE IN E(L)	TIMING OF PAYMENTS
Expected losses: E(L)	$944.44	$980.00	100%	
Loss adjustment expenses (LAE)	$141.67	$147.00	15%	End of the year
Commissions paid to agents	$56.67	$58.80	6%	End of the year
Profit loading	$98.00	$98.00	10%	Beginning of the year
Underwriting expenses	$245.00	$245.00	30%	Beginning of the year
TOTAL (fair premium)	**$1,485.77**			

* Table 2 has the present values for E(L), LAE, and commissions to agents and brokers because these payments occur at the end of a year.
** Fair premium = PV of E(L) + PV of LAE + PV of commissions paid to agents and brokers + profit loading + underwriting expenses. Thus, the fair premium is equal to $\$1{,}485.77 = \frac{\$980}{1.05} + \frac{\$147}{1.05} + \frac{\$58.80}{1.05} + \$98 + \ \$245.$

Table 3:
Loss, Expense and Combined Ratios for Small (With and Without EoL) and Large Firms*

Firms**	Loss Ratio	Expense Ratio	Combined Ratio
SF	75.85%	26.75%	102.6%
SF (with EoL)	59.03%	40.27%	99.3%
LF	75.85%	26.75%	102.6%

*Using information from Table 8, loss ratio = (net losses incurred + loss adjustment expenses)/premium earned where the premiums earned and premiums written items are assumed to be the same. Expense ratio = (underwriting expenses + commissions + premium taxes (3%))/ premium earned, and combined ratio = loss ratio + expense ratio. For SF (with EoL), the expense ratio additionally includes "reinsurance premium."
** SF and LF are without EoL reinsurance.

SF and LF have identical loss, expense and combined (loss + expense) ratios because each item in the loss and expense loadings are the same proportion of the fair premium. On the other hand, SF (with EoL) has an additional item as "reinsurance premium." SF and LF (both without EoL reinsurance) have the combined ratios of 102.6%, implying that both firms pay $1.026 for the losses and expenses for every $1 received as premiums. Thus, both firms need investment income to pay for their additional $0.026 losses and expenses. On the other hand, the combined ratio of SF (with EoL) is 99.3%. This implies that SF (with EoL) is more profitable than SF; while SF spends $1.026 for the loading (loss and expenses) for every $1 it receives as premium, SF (with EoL) spends only $0.993 for the loading (loss and expenses) for every $1 it receives as premium.

Table 4 summarizes actuarial E(L), estimations for SF (with and without EoL) and LF based on the expected losses from the workers' compensation policies. A multinomial distribution treats the workers' compensation insurance policies as 5,000 for SF (with and without EoL) and 100,000 trials for LF. According to the multinomial distribution, there is a 95% chance (probability) of having no workplace accidents. There is a 5% chance that a damage may occur; a 3% chance that the loss will be $2,000; a 1% chance the loss is $10,000; a 0.95% chance that the loss is $60,000; and, finally, a 0.05% chance that there is a loss equivalent to $500,000. SF (with EoL) protects itself against the most adverse outcome, the loss of $500,000, by paying $250 [=0.005 x $500,000] to a reinsurer.

Table 4:
Multinomial Distribution of Expected Losses, E(L), and Standard Deviation, SD(L), Estimations for Small (With and Without EoL) and Large Firms*

FIRMS	**SF**	**SF (with EoL)**	**LF**
PROBABILITY OF LOSS: P(L)	LOSS: L	LOSS: L	LOSS: L
95%	$0	$0	$0
3%	$2,000	$2,000	$2,000
1%	$10,000	$10,000	$10,000
0.95%	$60,000	$60,000	$60,000
0.05%	$500,000	$0	$500,000
NO POOLING	**1 policy**	**1 policy**	**1 policy**
Expected loss: E(L)	$980	$730	$980
Standard deviation: SD(L)	$12,623.77	$5,898.06	$12,623.77
POOLING	**5,000 Policies**		**100,000 Policies**
Expected loss: E(L)	$980	$730	$980
Standard deviation: SD(L)	$178.53	$83.41	$39.92

*Standard deviation of the expected losses with no pooling is high and equal to $12,623.77, $5,898.06 and $12,623.77 for SF, SF (with EoL) and LF.

**In general, workers' compensation (WC) premium = Payroll per $100 x Classification Rate x Experience Modifier. The WC rates are specified per $100 of payroll, classification rate reflects the riskiness of the job, and experience modifier adjusts the rate based on past accident experience of the employer. The expected loss of $980 from Table 4 above can cover small firms with five employees in Alaska to 30 employees in Michigan and Texas. This estimation uses the WC rate of $0.50 in Alaska and $0.10 in Michigan and Texas, respectively, from the Council of Petroleum Accountants Societies Inc. (2018) with a class code of 8810 (clerical office employees) and the mean annual wage of $33,910 for the office clerks in the U.S. from the U.S. Bureau of Labor Statistics (2017).

The frequency and severity of the losses for the workers' compensation are the same for both SF and LF without reinsurance. The expected loss for one policy is the same for SF and LF at $980. However, SF (with EoL) has a lower expected loss, $730, because SF (with EoL) eliminates the probability of losing $500,000 (transfers the risk to the reinsurer). On the other hand, the standard deviations of the expected losses per policy for SF is $178.53 [= $12,623.77/SQRT(5,000)], $83.41 [=$5,898.06/SQRT(5,000)] for SF (with EoL) and $39.92 [=

$12,623.77/SQRT(100,000)] for LF. Thus, we can conclude that SF (with EoL) reduces its risk by having a reinsurance contract.

In addition, Table 5 shows the required capital estimations for SF (with and without EoL) and LF. The RBC standards based on the VaR method is set at 0.5% level corresponding to a z-table value of 2.575 (one-sided) from the standard normal distribution. The required capital for each firm can be estimated by multiplying 2.575 with the standard deviations of SF (with and without EoL) and LF. For example, the required capital per policy for SF and LF is $459.71 [= $178.53 x 2.575] and $102.79 [= $39.92 x 2.575], respectively. Similarly, the required return per policy for SF (with EoL) is $214.78 [= $83.41 x 2.575]. Thus, SF has a 0.5% chance that the expected losses for its workers' compensation contract could be $1,439.71 [=$980 + $459.71] or greater, and LF has a 0.5% chance that its expected losses for its workers' compensation contract in the pool could be $1,082.79 [= $980 + $102.79] or greater.

Table 5:
Capital Requirement Estimations for Small (With and Without EoL) and Large Firms

	SF	SF with EoL	LF	Explanation
Number of policies (N)	5,000	5,000	100,000	
Premium received per policy (P)	$1,485.77	$1,485.77*	$1,485.77	P = Fair premium
Total premium	$7,428,849	$7,428,849	$148,576,978	= P*N
E(L) with pooling	$980	$730	$980	
SD(L) with pooling	$178.53	$83.41	$39.92	= SD(L) without pooling/SQRT(N)
z-value	2.575	2.575	2.575	= z-value at 0.5% level
Capital requirement per policy	$459.71	$214.78	$102.79	= z*SD(L)
1-year total capital requirement	$2,298,536.22	$1,073,918.56	$10,279,366.46	= N*z*SD(L)
Capital requirement to premium	30.94%	14.46%	6.92%	= z*SD(L)/Premium

*The reinsurer receives $250 from SF (with EoL) for each workers' compensation insurance policy.

Column 2 and Column 3 in Table 5 compare SF's capital requirement with and without reinsurance. The capital requirement for SF (with EoL) is $214.78 per policy, which is less than the capital requirement for SF, $459.71. Thus, having a reinsurance contract benefits the small firm because the required capital is lower.

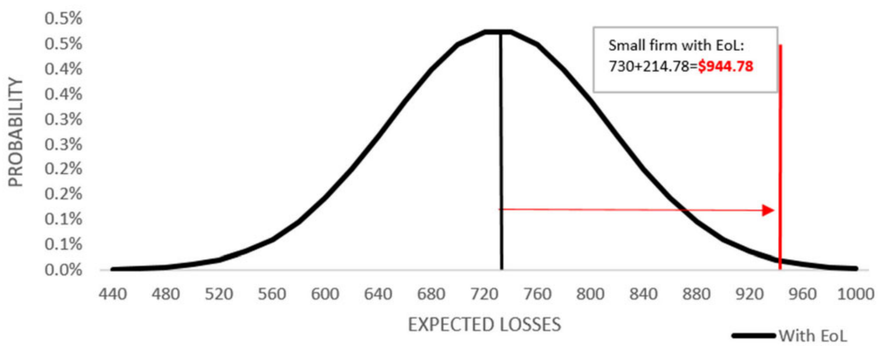
Additionally, Figure 1 shows how the uncertainty (standard deviations) affect both small and large firms. At given the VaR of 99.5%, while the small firm secures financial resources up to $1,439.71 [=$980.00+ $459.71] of losses per policy, the large firm needs only $1,082.79 [= $980.00 + $102.79] of losses per policy at 0.5% significance.

Further, Figure 2 shows that SF (with EoL) has a 0.5% chance that the total damage is $944.78 [= $730.00 + $214.78] or greater. This result is an improvement for the small firm, SF (with EoL) because the case without a reinsurance contract needs $1,439.71 [=$980.00 + $459.71] of losses or greater. In addition, the expected losses per policy for the small firm, SF (with EoL), $730, is lower than that of SF, $980.

Figure 1:
Total Financial Resources Needed for Each Policy to Support Expected Losses at 0.5% for Small and Large Firms*

* Summary statistics: The means for (SF and LF) are $980, and the standard deviations for SF and LF are $178.53 and $39.92, respectively. When the RBC standards use the VaR of 99.5%, the required capital for small and large firms is $1,439.70 and $1,082.79, respectively.

Figure 2:
Total Financial Resources Needed for Each Policy to Support Expected Losses at 0.5% for a Small Firm with a Reinsurance (EoL) Contract*



*Summary statistics: The mean is $730, the standard deviation for SF (with EoL) is $83.41, and the required capital for SF (with EoL) is $214.78 per policy (without EoL, it is $459.71) when the RBC standards are specified at the VaR of 99.5%.

Also, the total capital requirement for SF (with EoL), $1,073,918.56, is lower than that of SF, $2,298,536.22. Further, the capital requirement to premium ratios for SF (without and with EoL) and LF are 30.94% [=$459.71 / $1,485.77], 14.46% [= $214.78 / $1,485.77] and 6.92% [= $102.79 / $1,485.77], respectively. This implies that the capital requirement for SF is 4.47 times proportionally greater than that of LF, and the capital requirement for SF (with EoL) is 2.09 times proportionally greater than that of LF. In general, SF is required to have proportionally higher amounts of the required capital under the RBC standards, but the capital requirement goes down by obtaining an EoL reinsurance contract.

4. Sample Financial Statements for Small (With and Without Reinsurance Contract) and Large Firms

Table 6 through Table 8 provide the balance sheets and income statements for SF (without and with EoL) and LF. Table 6 shows the assets and liabilities of SF (without and with EoL). The firms are assumed to start their operations on Jan. 1, 2017.

Table 6:
Balance Sheet of Small (Without or With EoL) and Large Firms at the Beginning of the Year Before Starting to its Operations on Jan. 1, 2017*

ASSETS	SF	SF with EoL	LF**
Cash and investments	$15,656,385	$13,181,767	$278,576,978
TOTAL ASSETS	$15,656,385	$13,181,767	$278,576,978
LIABILITIES AND SURPLUS			
Unearned premiums	$7,428,849	$7,428,849	$148,576,978
Loss reserves	$4,900,000	$3,650,000	$98,000,000
Loss adjustment expenses (LAE)	$735,000	$735,000	$14,700,000
Commissions to agents and brokers	$294,000	$294,000	$5,880,000
Required capital	**$2,298,536**	**$1,073,919**	**$10,279,366**
Surplus	**$0**	**$0**	**$1,140,634**
TOTAL LIABILITIES AND SURPLUS	$15,656,385	$13,181,767	$278,576,978

* SF (with or without EoL) and LF have 5,000 and 100,000 policies, respectively, and both firms are charging $1,485.77 for a one-year workers' compensation insurance policy.
** LF has positive surplus of $1,140,634 and does not need any additional borrowing.

Cash and investments (or total assets) of SF (without EoL) is equal to $15,656,385 [= $7,428,849 + 6,500,000 + $1,727,536]. The amount of $7,428,849 is the value of 5,000 policies each with $1,485.77 annual premiums; 6,500,000 is from $1,300 of borrowing for each policy contract; and $1,727,536 is the additional borrowing that makes the surplus item equal to $0. Further, since the firm has not started its operations, unearned premiums is $7,428,849 (none of this amount is earned by the SF yet); loss reserves is $4,900,000 [$980 x 5,000]; LAE is $735,000 [=$147 x 5,000]; commissions to agents and brokers is $294,000 [=$58.80 x 5,000]; required capital is $2,298,536 [=$459.71 x 5,000]; and surplus is equal to $0 [=$15,656,385 – $7,428,849 – $4,900,000 – $735,000 – $294,000 – $2,298,536]. This indicates that SF without EoL needs to borrow $1,727,536 as additional funds. Therefore, total liabilities and equity is equal to $15,656,385.

Similarly, cash and investments [= unearned premiums + initial borrowing + additional borrowing – payment to reinsurer] for the SF (without EoL) is equal to $13,181,767 [= $7,428,849 + 6,500,000 + $502,919 – $1,250,000]. The amount of $7,428,849 is the value of 5,000 policies, each with $1,485.77 annual premiums; 6,500,000 is from initial borrowing of $1,300 for each policy contract; $502,919 is the additional borrowing that makes the surplus item equal to $0; and $1,250,000 [=$250 x 5,000] is the amount of fee paid to the reinsurer for EoL contract to cover losses that are equal to or exceed $500,000 per contract. Similarly, on the liability side, SF (with EoL) has unearned premiums as $7,428,849; loss reserves as $3,650,000; LAE as $735,000; commissions to agents and brokers as $294,000; required capital as $1,073,919; and surplus equal to $0. This indicates that SF (with EoL) needs to borrow $502,919 as additional funds. The balance sheet items for LF are similar to that of SF.

Further, Table 7 presents balance sheet items for SF (without and with EoL) and LF after a one-year period of operations and paying out the losses and expenses on Dec. 31, 2017. For example, after a year, unearned premiums are now earned, and therefore it is equal to $0. Additionally, the assets are lower for all cases because expenses are paid out: loss reserves, LAE, and commissions to agents and brokers are all equal to $0. At the end of the year, the required capital levels are the same, and surplus levels are higher because some of the capital tied to unearned premiums is released.

Table 7:
Balance Sheets for Small (Without and With EoL) and Large Firms After a One-Year Period of Operations and Paying Out the Losses and Expenses on Dec. 31, 2017*

ASSETS	SF	SF with EoL	LF
Cash and investments	$9,727,385	$7,252,767	$159,996,978
TOTAL ASSETS	$9,727,385	$7,252,767	$159,996,978
LIABILITIES AND SURPLUS			
Unearned premiums	$0	$0	$0.00
Loss reserves	$0	$0	$0.00
Loss adjustment expenses (LAE)	$0	$0	$0.00
Commissions to agents and brokers	$0	$0	$0.00
Required capital	**$2,298,536**	**$1,073,919**	**$10,279,366**
Surplus	**$7,428,849**	**$6,178,849**	**$149,717,612**
TOTAL LIABILITIES AND SURPLUS	$9,727,385	$7,252,767	$159,996,978

* SF (with or without EoL) and LF have 5,000 and 100,000 policies respectively, and both firms are charging $1,485.77 for a one-year workers' compensation insurance policy.

Finally, Table 8 (see page 14) shows the income statements of SF (without and with EoL) and LF. Revenues of insurance firms are equal to premium earned plus investment income. It is assumed that the items of premium written and premium earned are equal. Total expenses and losses are equal to the summation of net losses incurred, underwriting expenses, LAE, commissions and premium taxes. Premium taxes are the state taxes and assumed to be 3% charged on premiums earned. In addition, there is 5% interest charged to SF (without and with EoL) and LF because of $1,300 borrowing per policy and for the additional borrowing of $1,727,536 and $502,919 for SF and SF (with EoL). Table 8 shows that profits (net income) of SF (with EoL), $252,648, is higher than the profits of SF, $185,362, even though SF (with EoL) has paid a fee, $1,250,000, to the reinsurer.

Table 8:
Income Statements for Small (Without and With EoL) and Large Firms on Dec. 31, 2017

REVENUES	**SF**	**SF (with EoL)**	**LF**
Premium earned	$7,428,849	$7,428,849	$148,576,978
Investment income	$721,588	$659,088	$13,928,849
Total income	$8,298,045	$8,087,937	$162,505,827
EXPENSES			
Net losses incurred	$4,900,000	$3,650,000	$98,000,000
Loss adjustment expenses (LAE)	$735,000	$735,000	$14,700,000
Underwriting expenses	$1,470,000	$1,225,000	$29,400,000
Commissions	$294,000	$294,000	$5,880,000
Reinsurance premiums paid	$0	**$1,250,000**	$0
Premium taxes (3%)	$222,865	$222,865	$4,457,309
Total expenses and losses	$7,621,865	$7,376,865	$152,437,309
Earnings before interest and taxes	$676,179	$711,072	$10,068,518
Interest payments	411,377	350,146	6,500,000
Earnings before taxes (EBT)	$264,803	$360,926	$3,568,518
Federal taxes (30%)	$79,441	$108,278	$1,070,555
Net Income	$185,362	**$252,648**	$2,497,962

*SF (with or without EoL) and LF have 5,000 and 100,000 policies, respectively, and both firms are charging $1,485.77 for a one-year workers' compensation insurance policy. SF with EoL has an excess-of-loss reinsurance agreement and pays $250 to the reinsurer per insurance policy.

5. Other Studies and Considerations

Park and Xie (2014) address the interconnectedness between reinsurers and U.S. P/C insurers and illustrate the potential systemic risk caused by the interconnectedness of the insurance sector through reinsurance. On the demand side, Cole and McCullough (2006) examine the effect of the state of the international reinsurance market capacity and profitability on the demand for reinsurance by U.S. insurers using data from 1993–2000 and find that the state of the U.S. reinsurance market significantly affects the overall demand for reinsurance. In addition, Doherty and Tinic (1981) show that reinsurance is compatible with the share price maximization objective of the insurance companies and that there is sufficient motivation on the part of insurance companies to spread risks through reinsurance, even in the absence of regulations designed to protect policyholders' interests. However, Bernard and Tian (2009) claim that insurance companies have adverse incentives and do not protect themselves against extreme losses from the right tail of the loss distribution when compulsory VaR risk management requirements are imposed.

Recently, alternative capital (ILS) has been touted to solve the reinsurance shortage problem. According to a report from the Insurance Information Institute (2015), the alternative capital constituted 12% of the global reinsurance market at the end of 2014. The report states that alternative capital is concentrated in the insurance products for the natural catastrophes such as hurricanes, earthquakes or other disasters. The alternative capital capacity has been growing steadily over time because of the participation of hedge funds, sovereign wealth funds, pensions and mutual funds by using products such as catastrophe bonds, collateralized reinsurance and reinsurance sidecars. For example, Aon Benfield (2017) reports that the global reinsurer capital stands at $605 billion, with $516 billion being traditional capital and $89 billion as alternative capital made up with sidecars, industry loss warranties and collateralized reinsurance. A study by Braun and Weber (2017) predicts that ILS will reach almost a quarter of the global P/C reinsurance limit or approximately $101 billion by the end of 2018.

6. Past Legislation and the Case for a Residual Reinsurance Market

Efforts to legislate catastrophe-prone insurance lines in the U.S. go back to the 1970s after observing insurance shortages in the market after major natural disasters. According to Cleary and Boutchee (2002), the NAIC worked on a proposal in the mid-1990s to implement a voluntary, tax-deferred, pre-event catastrophe reserves for insurers and allow them to set aside a portion of premiums as reserves against future catastrophic events. Also, the NAIC (2008) states, "The United States Congress has considered many proposals to address catastrophic loss. In fact, since the early 1970s, only three Congresses (the 98th through the 100th—1983 to 1988) have failed to consider significant natural disaster legislation. Nevertheless, the only federal program currently in operation is the National Flood Insurance Program (NFIP), which is under Federal Emergency Management Agency (FEMA) jurisdiction."

Additionally, for reinsurance legislation, the NAIC (2012) proposes a federal legislation framework encompassed in a model law, the *Credit for Reinsurance Model Law* (#785), and regulation, the *Credit for Reinsurance Model Regulation* (#786), to modernize reinsurance regulation in the U.S. The goal is to improve state-based regulation of reinsurance by providing a uniform implementation throughout all the U.S. states. In 2010, Congress passed the federal Nonadmitted and Reinsurance Reform Act (NRRA) but did not implement the NAIC's proposal. However, the NRRA provided an avenue for the states to implement reinsurance collateral reforms on an individual basis without restricting them from working with the NAIC and acting together. Thus, the NAIC's efforts preserved the delicate balance between the state and federal jurisdictions and suggested a uniform framework for all insurers and reinsurers operating in the U.S. through the NAIC's leadership.

When reinsurance supply is significantly down, there are calls for reinsurance regulation at the state and federal levels to fill the reinsurance gap left from the private reinsurance sector. For example, England and Yousey (1998) examine two major proposals (H.R. 219 and H.R. 230) introduced during the 105th Congress to deal with the lack of reinsurance after natural disasters. H.R. 219 suggested direct auctioning of reinsurance coverage to private insurers, reinsurers and state disaster programs. Also, H.R. 230 offered a federally run auction of reinsurance contracts that could be purchased by both state programs and private insurers. Later, these proposals were culminated in the *Assumption Reinsurance Model Act* (#803) (NAIC, 1999). As England and Yousey (1998) indicate, while the H.R. 219 proposal puts the burden on the states by reinsuring state disaster programs, H.R. 230 passes the cost of reinsurance to all taxpayers nationwide.

Also, Lewis and Murdock (1996) investigate the market for disaster insurance in the U.S. and find that insurance markets are limited in their ability to diversify catastrophic risk; therefore, they propose a federal reinsurance program to auction the catastrophe EoL contracts for insurers.

There is a case to be made for a residual reinsurance market based on a three-tier model for all catastrophic insurance as suggested by Litan (2005) and Penner (2006). According to them, "In the first tier, individuals would be required to cover small losses through deductibles and limited copayments; private and state insurance and reinsurance would cover moderate losses in a second tier; and in the third, the federal government would cover extremely large losses that would otherwise drive private insurers from the marketplace." The second tier can be strengthened by a residual reinsurance market that serves all insurers who cannot find the reinsurance needs in the private market. Thus, especially, smaller insurers that are capital-constrained by the RBC standards will have a chance to protect themselves, especially during major natural or man-made catastrophes. According to Balcombe (2016) and Gambardella (2018), there are about 150 reinsurers operating in the U.S., and the reinsurance industry is somewhat concentrated. Their report, based on the data from the Reinsurance Association of America (RAA), indicates that "foreign reinsurers account for 65.5% of U.S. reinsurance activity, leaving U.S. reinsurers with 34.5% of domestic demand," with Berkshire Hathaway Reinsurance Group, General Re and Reinsurance Group of America Inc. (RGA) holding about 37% and 9.9% of the market share.

The fact is that there is a limited number of reinsurers operating in each U. S. state and, therefore, a solution to reinsurance supply should include all reinsurers operating nationwide (including international reinsurance providers). The suggested residual reinsurance market below has several advantages: 1) starting residual reinsurance markets for the traditional primary markets, such as personal automobile liability and workers' compensation, can provide assurance for its success since these markets have uniform products with well-established insurance agency-broker framework; 2) the burden of reinsurance supply stays in the private sector, and the losses are shared among all reinsurers nationwide (including international player participating on the U.S. soil); and 3) there is room for the states and federal government to observe and learn from these experiments and carry them into other markets such as reinsurance for property insurance losses from natural or man-made disasters.

The following are suggested frameworks for the residual reinsurance market:

1. Initial residual reinsurance markets should correspond to the existing compulsory primary insurance markets. For example, the residual insurance market for personal automobile liability and workers' compensation can be two major experimental areas to start. Property insurance should be left out from the initial residual reinsurance markets because of its immense size and the interactions with other existing programs—i.e., Fair Access to Insurance Requirements (FAIR) Plans, as well as Beach and Windstorm Plans. In addition, there is room for ILS to grow as a substitute for the traditional reinsurance products and protect insurers against property insurance losses.
2. The residual insurance market should be at the national level to include all domestic and international reinsurers operating on the U.S. soil.
3. The NAIC should have leadership to organize and govern the residual reinsurance markets. Because the NAIC has access to the opinions of the insurance commissionaires from all states, it is possible to achieve a high level of coordination among states to establish a viable residual market. Due to sensitivities involved in federal or state legislation proposals, the NAIC should lead states to act together and establish a reinsurance residual market nationwide with the same uniform rules.
4. The residual reinsurance market should provide EoL contracts to cover the VaR of the RBC standards. For example, a 99.5% of VaR for the RBC implies that EoL reinsurance contracts cover the tail probability of loss at 0.5%. In other words, the reinsurer fee for a tail probability of 0.5% should correspond to: (0.005) x (expected losses at 0.5% likelihood) plus other processing fees.
5. The reinsurance residual market can use one of the following residual market types that are currently used in the primary residual markets (Harrington and Niehaus, 2004): 1) assigned risk plan; 2) joint underwriting association; and 3) reinsurance facility.

With the assigned reinsurance residual market, primary market insurers can request reinsurance contracts (proportional or nonproportional) from reinsurers. If the reinsurers reject their applications several times, then the rejected primary market insurers can apply to the assigned risk plan. A reinsurance agent can assign the rejected primary insurer to one of the reinsurance providers. At the end of the year, the losses from the assigned residual reinsurance market can be pooled and distributed to registered reinsurers based on each reinsurer's national market share.

Under the joint underwriting association, primary insurers who were rejected by the reinsurers several times can reapply for reinsurance coverage through the help of a reinsurance agent. The rejected primary insurer can be assigned to one of the several selected reinsurers who take responsibility to process reinsurance contracts for all reinsurers nationwide. At the end of the year, these reinsurers calculate the losses and assess each reinsurer based on the national market share.

On the downside, the reinsurance residual market has potential costs for U.S. taxpayers. Additionally, some in the business community may push back against the establishment of a reinsurance residual market because of the prior reinsurance market experiences in primary insurance lines such as in North Carolina’s auto market. Baker and Logue (2017) and Lehrer (2008) report a complex and subsidized auto insurance reinsurance facility with growing problems. Therefore, the NAIC can lead a discussion about the pros and cons of a proposed residual reinsurance market before implementing any steps.

7. Conclusions

Small insurers are at a disadvantage against large players because they have small insurance pools, resulting in large standard deviations of the expected losses and RBC capital requirements.

A small insurer is more profitable and has lower risk with an EoL contract. Therefore, small firms may be adversely affected if they cannot secure the reinsurance contract during hard insurance markets.

However, insurance regulators can create a residual reinsurance market where small insurers can secure reinsurance. As a result, small firms with EoL reinsurance have lower risk and higher profitability, and they can compete better in the insurance marketplace. Browne and Hoyt (1995) see the number of companies as the proxy for the degree of competition in the insurance market, and Heck (2017) claims that “small and mid-sized insurance carriers inject competition into the markets and provide coverage that may otherwise be unavailable in certain regions and serving specific niche markets.” Therefore, the creation of a residual reinsurance market can achieve higher levels of small firm participation, as well as achieve larger number of market participants to promote market efficiency in traditional and niche markets.

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New Evidence on an Old Unanswered Question: The Decision to Purchase Credit Insurance and Other Debt Protection Products

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Abstract

Credit-related insurance and other debt protection are products sold in conjunction with credit that extinguish a consumer's debt or suspends its periodic payments if events like death, disability or involuntary unemployment occur. High sales penetration rates observed in the 1950s and 1960s raised concerns about coercion in the sale of credit insurance. This study presents evidence on credit insurance purchase and debt protection decisions from a new survey. The findings provide little evidence of widespread or systematic coercion in purchases. Instead, findings suggest that risk aversion and health or financial concerns motivate consumers to purchase credit insurance and debt protection, just as these concerns also motivate purchases of other types of insurance.

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In an environment where unfortunate consequences are possible but timing is unpredictable, both consumers facing risks and entrepreneurs looking for productive opportunities have searched for and engineered ways of spreading and mitigating those risks. Life insurance is well-known for mitigating financial risks to a family concerned about the unpredictable timing of death of a breadwinner and is often available through employers as an employee benefit. Likewise, casualty insurance like fire insurance and automobile/truck operating coverages are also well-known and even mandatory in many circumstances and jurisdictions. Many states require automobile casualty insurance with auto and truck registrations, for instance. But these are not the only areas where insurance and other risk-spreading techniques have arisen for individuals; consumer borrowing and lending is another. On consumer loans, taking on a stream of monthly installment payments can be risky for individuals, even though overall expected performance of an insurance policy portfolio usually is predictable for insurers. This property makes consumer borrowing another candidate for insurance products.

Since invention of the product in 1919, many installment lenders have made available to their borrowers insurance and insurance-like products that extinguish a consumer's debt or suspend periodic payments on it if unfortunate events like death or temporary disability occur. In effect, for borrowers these products spread the financial risks of unfortunate occurrences like death, disability, involuntary employment loss and loss to security property across all purchasers using actuarial principles and methodologies. While these products have never been of interest to all borrowers, evidence of demand for them among borrowers concerned about these financial risks has long been available. Such events could easily lead to considerable unpleasantness for families of deceased debtors or to the debtors themselves unable to work and make their periodic payments on schedule. Beyond just an impact on credit scores of consumers facing these events, in some cases they could lead to negative estates for heirs and even to repossession of critical assets like the family car for debtors or their families at the worst possible moment. Such situations can be unpleasant for creditors, as well as for borrowers.

Over the years, several academic studies have investigated debt protection at the consumer level, long known as "credit insurance" but also including "debt cancellation or suspension products" that are not legally insurance products. The number of such analyses has been small, however, at least in comparison to studies of other kinds of insurance. Most studies have focused on the public policy question whether debtors have been "coerced" to purchase credit insurance by self-interested lenders. These studies began after some observers contended in the 1950s and 1960s that monopoly position of lenders enabled them to take advantage of borrowers by coercing them to take and pay for unneeded life and casualty insurance to cover the debts.[1] Attention to such concerns led to regulations on sales practices until there is

1. For example, see Subcommittee on Antitrust and Monopoly of the Senate Committee on the Judiciary, 83rd Congress, 2nd Session, *Report on the Tie-In Sale of Credit Insurance in Connection with Small Loans and Other Transactions (Committee Print* 1955).

now an extensive legal structure discouraging coercive sales activity in the area of debt protection. There are special provisions covering debt protection sales in the federal Truth in Lending Act (TILA) of 1968 and also federal and state prohibitions on unfair, deceptive or abusive acts and practices (UDAAP). Further, there are federal and state chartering and licensing requirements for lenders with various levels of examination procedures and enforcement possibilities beyond those for other sorts of businesses. States also regulate actions of insurance companies, including contract inclusions, policy forms and pricing. An ongoing question over the period of these regulatory changes has been how they might have changed marketplace conditions.

Related consumer surveys of debt protection began with a 1973 Ohio University study (referred to below) and have continued with a list of further studies on the same general topic in the decades since. They include four Federal Reserve System reports between 1977 and 2012. Despite relevant findings from these studies, previous studies have not conducted an extended multivariate analysis of factors influencing consumers' decision to purchase these insurance and insurance-like products.

The purpose of this study is twofold: 1) to update the periodic Federal Reserve studies of these products focusing on these long-standing policy issues; and 2) to use new consumer survey data to look at aspects of demand for these products among current users.[2] Data are from a new nationally representative survey of consumers undertaken during March and April 2017 by the Survey Research Center (SRC) of the University of Michigan. The SRC is the same survey organization that provided the data examined previously in the four Federal Reserve analyses. To ensure continuity and comparability, the new study used the same questions and methodology as previously, with some new questions this time concerning product demand elements and a new simple question that helps address the coercion supposition noted earlier. The first part of this report provides updated discussion and tables based upon those in the 2012 and earlier Federal Reserve efforts, and the second part employs univariate and multivariate statistical evidence to look at aspects of demand for credit insurance and related products.

New Survey

Authors have extensively described credit insurance and other debt protection products before, including product features, costs and controversies, and it seems

2. Despite past studies spurred by regulatory activity that have developed relevant research evidence, these products have remained controversial among some advocates. See, for example, Carolyn Carter, et al., "Installment Loans: Will States Protect Borrowers from a New Wave of Predatory Lending?" (Boston: National Consumer Law Center, July 2015) and Pew Charitable Trusts, "State Laws Put Installment Loan Borrowers at Risk" (Pew Charitable Trusts, October 2018).

redundant to do so at any length again.[3] Basically, credit insurance products consist foremost of credit life insurance, which repays the debt in the event of the debtor's death, and credit casualty insurance, which continues the payments in the event of the debtor's incapacity due to covered conditions (typically, accidents and health-related incapacities, involuntary loss of employment, or loss to property securing a loan). These products have been around since 1919, and millions of borrowers have purchased them over the decades.

Related products called "debt cancellation contracts" and "debt suspension agreements," both developed decades ago, do the same things from the consumer's viewpoint. They are two-party loan agreements between the borrower and the lender for the lender to cancel the debt, in a lump sum or through a series of loan payments (debt cancellation agreements), or suspend loan payments for covered events (debt suspension agreements). As two-party loan agreements, these products are not insurance products and are regulated under federal and state banking laws. Since they are similar looking to insurance from the debtor's standpoint, they are considered here together with traditional credit insurance.

In March and April 2017, the SRC conducted 1,205 nationally-representative interviews with consumers. The SRC asked those consumers who had closed-end consumer installment loans or credit cards about their experiences with credit insurance and other debt protection products.[4] One part of the survey was based explicitly upon the 2012 survey project in order to provide evidence of similarities and trends. Indeed, some of the questions were unchanged from the 1977 Federal Reserve survey and used unchanged in 2017 for the fifth time overall. A second part asked consumers using closed-end installment credit (29% of all respondents) some new questions on other insurance coverage, health, financial concerns and risk aversion, which may help explain borrowers' credit protection decisions. The SRC's research approach produced a nationwide probability sample of respondents that is representative of the contiguous 48 states within statistical confidence limits. The SRC coded the interview results and provided a machine-readable data set in SAS format. The authors wrote the SAS computer program to produce the tables reported here.

3. See Thomas A. Durkin and Gregory Elliehausen, "Consumers and Debt Protection Products: Results of a New Survey of Borrowers," *Federal Reserve Bulletin*, December 2012. For extended discussion of features, costs and controversies associated with credit insurance and other debt protections, see Thomas A. Durkin, Gregory Elliehausen, Michael E. Staten, and Todd J. Zywicki, *Consumer Credit and the American Economy* (New York: Oxford University Press, 2014, Chapter 12).

4. The interviews were representative of the contiguous 48 states and did not include Alaska and Hawaii. The authors thank the SRC and the Consumer Credit Industries Association (CCIA) for making the data available. The analysis and views expressed here are those of the authors and not those of either of these organizations.

Survey Findings

For purchase coercion to exist, there must be some sort of coercive activity by the seller and actual purchase by a buyer. If a potential purchaser does not buy a product, this is per se evidence that a coercive sale did not take place, even if the seller attempted some sort of coercive action. And so, one goal of the survey was to observe again the long-term trends in the purchase of these insurance and insurance-like products following years of implementation of regulations.

A population survey design over time is the only way to determine such trends. Examining evidence from insurance companies would not be revelatory because it would contain information only on those who purchase the products from them and not on those who purchase from others or do not purchase. Likewise, insurance companies would not have information about debt cancellation agreements and debt suspension agreements because these are issued by the potentially thousands of lenders and creditors that might provide such products in the marketplace.

Survey evidence from SRC on prevalence of debt protection has previously been available for 1977, 1985, 2001, 2012 and now also for 2017.[5] The results show that frequency of purchase of debt protection products on consumer installment credit was much higher in 1977 and 1985 than in later years. In the earlier years when the "coercion" issue became a public-policy concern in some quarters, purchase prevalence on consumer installment credit (frequently called the "penetration rate") exceeded 60 percent. (See Table 1 on page 6.) The penetration rate has dropped by almost two-thirds since then, to measurements in the 22% to 26% range. The decline in the penetration rate after 1985 seems to have brought it well under the early range that triggered concerns of systematic purchase "coercion" in earlier times.[6]

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5. The earlier survey results are in Thomas A. Durkin and Gregory E. Elliehausen, *The 1977 Consumer Credit Survey* (Washington: Board of Governors of the Federal Reserve System, 1978); Anthony W. Cyrnak and Glenn B. Canner, "Consumer Experiences with Credit Insurance: Some New Evidence," Federal Reserve Bank of San Francisco *Economic Review*, Summer 1986; Thomas A. Durkin, "Consumers and Credit Disclosures: Credit Cards and Credit Insurance," *Federal Reserve Bulletin*, April, 2002; and Durkin and Elliehausen, "Consumers and Debt Protection Products: Results of a New Survey of Borrowers" (2012), referenced in footnote 2. Also discussing these survey results are Robert A. Eisenbeis and Paul R. Schweitzer, *Tie-Ins Between the Granting of Credit and Sales of Insurance By Bank Holding Companies and Other Lenders* (Washington: Board of Governors of the Federal Reserve System, Staff Study 101, 1979); and Durkin, Elliehausen, Staten, and Zywicki, *Consumer Credit and the American Economy* (2014), referenced in footnote 2, Chapter 12.

Other survey findings and discussion of credit insurance are in Charles L. Hubbard, ed., *Consumer Credit Life and Disability Insurance* (Athens, Ohio: College of Business Administration, Ohio University, 1973); Joel Huber, *Consumer Perceptions of Credit Insurance on Retail Purchases* (West Lafayette, Indiana: Purdue University Credit Research Center, 1976); and John M. Barron and Michael E. Staten, *Consumer Attitudes Toward Credit Insurance* (Norwell, Massachusetts: Kluwer Academic Publishers, 1996).

6. The three latter measurements for the penetration rate reported here are within normal statistical sampling range for being three measurements from the sampling frame. So, statistically,

Table 1:
Debt Protection Penetration Rates, 1977–2017
(Percentage Distributions Within Groups of Credit Users)

	1977 Install Credit	1985 Install Credit	2001 Install Credit	2012 Install Credit	2017 Install Credit	2001 Credit Card	2012 Credit Card	2017 Credit Card
Have	63.9	64.7	22.7	22.0	26.0	20.1	14.0	19.2
Do not have	30.1	33.1	74.4	75.6	70.6	73.9	82.0	75.4
Do not know/ refuse	6.0	2.2	2.9	2.4	3.4	6.0	4.0	5.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Memo: Number of observations using type of credit	1165	NA	171	222	349	724	775	976

Notes:
NA: Not available.
Columns may not sum to totals because of rounding.

To examine the coercion issue more fully, all the SRC surveys also have included specific questions about sales practices. As in earlier years of this series of survey projects, the first approach in 2017 was to question respondents directly about their experiences at the point of sale.[7] Consumers with common closed-end consumer installment credit outstanding were asked whether they had purchased any debt protection products and about the debt protection offering experience at the point of sale. It appears that experience here has also changed sharply over the decades since 1977.

In 1977, the majority (72%) of closed-end consumer installment credit users who had purchased debt protection reported that the lender had either recommended the purchase of the protection or recommended it strongly. (See Table 2.) This proportion fell to under 20% in 2017.

That the penetration rate was also much lower in the more recent years is worth noting again. This decrease in the penetration rate means that among closed-end installment credit users, the proportion who both purchased and who noted receiving a recommendation to that effect fell sharply after 1977 due to both lower penetration rates and fewer experiences of a recommendation.

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they may be considered close to identical, and no strong conclusions should be drawn from the small differences among the three more recent surveys.

Table 1 also reports penetration rates for debt protection products for consumers with credit card accounts. As discussed more fully by Durkin and Elliehausen in 2012, these rates measure proportion of respondents having any card account with debt protection. Since consumers may individually have many credit cards, penetration rates for any one kind of account or brand would be lower. (See Durkin and Elliehausen, "Consumers and Debt Protection Products: Results of a New Survey of Borrowers" (2012), referenced in footnote 2.)

7. The next few paragraphs draw upon the outline of similar discussion in Durkin and Elliehausen, "Consumers and Debt Protection Products: Results of a New Survey of Borrowers" (2012), referenced in footnote 2.

Table 2:
Recommendations Concerning Debt Protection Purchase at Point of Sale on Installment Credit, 1977–2017
(Percentage Distributions Within Groups of Users and Non-Users of Installment Credit, With and Without Debt Protection)

	1977 Protection		1985 Protection		2001 Protection		2012 Protection		2017 Protection	
	Have	Not Have	Have	Not Have	Have	Not Have	Have	Not Have	Have	Not Have
Recommendation:										
Never mentioned	10.6	52.2	14.8	45.2	15.4	53.3	18.7	62.7	30.0	67.4
Offered	15.0	22.6	44.7	35.5	53.2	33.9	43.5	29.5	42.9	21.3
Recommended	33.1	17.0	16.4	12.9	12.2	4.1	17.6	0.5	9.6	1.6
Strongly recommended/ required	39.3	2.3	20.1	2.6	16.6	3.4	20.1	0.9	10.1	0.3
Do not know/refuse	2.1	5.9	3.9	3.9	2.6	5.3	*	6.5	7.4	9.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Memo: Number of observations purchasing/not purchasing credit insurance	744	421	NA	NA	41	130	56	166	88	261

Notes:
* Less than one-half of 1%.
NA: Not available.
Columns may not sum to totals because of rounding.

Specifically, in 1977 about 46% of closed-end installment credit users reported that they purchased and received a purchase recommendation from the creditor of varying intensity (that is, the 72.4% who said that debt protection was "recommended" or strongly "recommended/required" (Table 2) of the 63.9% who purchased (Table 1)). These percentages compare to only about 5% percent in 2017 (19.7% of the purchasers who said that debt protection was "recommended" or "strongly recommended/required" (Table 2) of the 26% percent who purchased (Table 1)). This decline is substantial and suggests that even if some providers are attempting widespread aggressive sales, they are not very successful.[8]

To look at experience at the point of sale more directly, respondents who either did or did not purchase debt protection but indicated that protection was offered or recommended to them were then asked directly about their understanding of whether the offered or recommended product was voluntary. Significantly, not one respondent in either the purchasers or non-purchasers groupings reported belief the purchase decision was not voluntary. Among purchasers who indicated recollection of the circumstance (96%), almost all (again 96%) also reported the lender had explained the terms. The proportion was almost as high among non-purchasers

8. In each survey year, some purchasers indicated the lender did not mention the product at point of sale, which must mean either they purchased it after some kind of follow-up after the fact by telephone or mail, or they brought it up themselves at the point of sale before mention by the lender. If somehow it were to indicate that the lender just placed it in the contract, then it seems there would also be evidence that the attitude of these buyers toward the product would not be very good. In fact, a look at attitudes of the individuals in this relatively small group whether the insurance/protection product is good or bad, discussed next in more detail for the larger sample size of respondents as a whole, does not suggest this possibility.

(89%), even if a lot of explanation to them would seem unimportant as soon as they indicated they were not purchasing.

It is worth repeating that many respondents were not even offered these products. In each of the survey years except 1985, more than half of those who did not purchase a protection product on closed-end consumer credit reported that the lender did not mention protection products. Even in the exception year 1985, the proportion not hearing any mention was about 45%. It is difficult for people to be pushed into buying an add-on or ancillary product to a credit transaction if it is not even mentioned to them at the point of sale. The proportion of non-purchasers who said the products were not mentioned reached two-thirds (67%) in 2017.[9]

Along with the likelihood that if coercion is widespread, then evidence of it should show up in direct questioning of product purchasers, consumers who felt pressured to buy an add-on or ancillary product they did not want would probably not be very favorably inclined toward the add-on or ancillary product. To examine this possibility, consumers over the years with and without debt protection were also asked about their feelings toward buying the protection, specifically whether such purchase is "a good idea or a bad idea."

Experience in 2017 confirms prior findings that most purchasers of debt protection on closed-end consumer credit consider its purchase to be a good idea. The proportion answering good or good with some degree of qualification exceeded 85% percent in each of the interview years. (See Table 3.) In contrast, the proportion responding "bad" was less than 10% in all but the 2012 survey, in which it reached 11%. Although the proportion in 2012 is not statistically significantly different from 2017, the slightly higher incidence of this response in 2012 may be an artifact of the lengthy prior recession that had recently ended. It seems possible in any year, but maybe more so in worse economic times, that if consumers find themselves in a situation where they realize after the fact that an expenditure on insurance or an insurance-like substitute did not result in a payoff, they may to some degree regret the expenditure at a time when budgets are tight. Of course, they did not suffer the loss they insured against either, and the peace of mind entailed with the protection purchase may still resonate with many of them.

Table 3 also demonstrates that attitudes are much different between purchasers and non-purchasers of the protection products. For the non-purchasers, attitudes toward the protection products are decidedly less favorable than among purchasers, but most non-purchasers still expressed a favorable view anyway in every survey year except 2001. Nonetheless, a somewhat higher portion of non-purchasers with an unfavorable attitude toward the protection products is consistent with their choices not to purchase.

9. A consumer survey cannot address why sellers offer or chose not to offer products, but profitability undoubtedly has something to do with it. For example, anecdotal evidence from industry observers suggests that auto dealers prefer to concentrate their sales efforts on auto product features, extended warranty products, and ease and convenience of reaching their repair facilities rather than on debt protection products.

Table 3:
Attitude Toward Debt Protection Among Users of Installment Credit, 1977–2017
(Percentage Distributions Within Groups of Users and Non-Users of Installment Credit, With and Without Debt Protection)

	1977 Protection		1985 Protection		2001 Protection		2012 Protection		2017 Protection	
	Have	Not Have	Have	Not Have	Have	Not Have	Have	Not Have	Have	Not Have
Attitude:										
Good	86.7	59.8	89.9	56.4	88.5	32.3	85.5	53.8	84.4	53.6
Good with qualifications	8.6	18.9	2.9	8.3	3.8	6.1	*	3.2	2.6	*
Neither good nor bad	2.1	9.1	1.9	6.4	3.2	13.9	3.1	1.8	4.1	5.8
Bad with qualifications	*	2.7	*	2.6	*	1.6	*	6.5	*	*
Bad	2.2	9.5	5.2	26.3	4.5	46.0	11.4	40.5	8.8	40.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Memo: Number of observations purchasing/not purchasing credit insurance	744	421	NA	NA	41	130	56	166	88	261

Notes:
* Less than one-half of 1%.
NA: Not available.
Columns may not sum to totals because of rounding.

Attitudes were also measured in a related but somewhat different manner. Specifically, purchasers of debt protection were asked directly about their satisfaction with the protection product purchased. Obviously, this view could not be asked of non-purchasers. Again, using this measurement, purchasers of debt protection expressed favorable views. Approximately four-fifths of purchasers suggested satisfaction in each of the years when measurements were undertaken—2001, 2012 and 2017. (See Table 4 on page 10.) Although in each survey year that included this question some respondents appeared indifferent, relatively few expressed dissatisfaction. For this reason, it appears important to remember the views of users as well as non-users in any discussion of regulatory changes affecting availability of debt protection products.

Purchasers also expressed a high degree of willingness to purchase debt protection on future credit use. More than 70% of purchasers indicated willingness to purchase again on installment credit in each survey year. (See Table 5 on page 11.) While a favorable attitude now does not necessarily translate directly into a purchase later, it is also possible that actual purchases later could be higher than the attitude expressed now. When entering into the next credit contract, financial anxieties may surface again, and purchasing debt protection may again produce the peace of mind that it apparently did in many cases in the past. In any case, the favorable proportion on this measurement appears to have settled in the 70% to three-quarters range, down a bit from the extremely high measurement in 2001. (The measured difference between 2012 and 2017 is not statistically significantly different.) Thus, neither direct nor indirect findings about possible coercion in purchase of debt protection suggest the kind of unhappiness with a product that might arise if purchasers felt that they were being pushed into the purchase or that the product itself was not very useful.[10]

Table 4:
Satisfaction With Purchase of Debt Protection on Installment Credit, 2001–2007
(Percentage Distributions Within Groups of Installment Credit Users)

Satisfied with Purchase?	2001 Installment Credit	2012 Installment Credit	2017 Installment Credit
Very	27.8	38.2	29.6
Somewhat	65.6	40.9	43.3
Subtotal: Satisfied	93.4	79.1	72.9
Neither satisfied nor dissatisfied	3.9	20.9	17.5
Somewhat dissatisfied	2.7	*	4.7
Very dissatisfied	*	*	5.0
Total	100.0	100.0	100.0
Memo: Number of observations using type of credit	171	222	349

Notes:
* Less than one half of 1%.
NA: Not available.
Columns may not sum exactly to totals because of rounding.

Evidence on Potential Factors Associated with Willingness to Purchase Debt Protection

If coercion is not the explanation for the decision to purchase debt protection by users of installment credit, then what other factors are possibly explanatory? As it turns out, an examination of demand for credit insurance beyond cautions among some observers about possible coercion is almost unprecedented. The primary exception is the 2012 paper by Colquitt, *et al*.[11] They presented a demand model for

10. Design of the surveys does not permit further, detailed exploration of respondents' underlying reasoning for their responses to these attitude questions. The most interesting aspect of these satisfaction measurements still seems to be their relatively high levels. This is true, even after the extensive criticism of all sorts of financial institutions and products in recent years subsequent to the "Great Recession" and continuing complaints by advocates. (See references in footnote 2.) What appears to be a downward trend in satisfaction after 2001 may simply reflect comparison to an extremely high measurement level in an earlier era of respect for financial institutions generally and not likely ever to be repeated. It is interesting to note that measurement of the proportion indicating "very satisfied" actually rose after 2001. (See Table 4.)

11. L. Lee Colquitt, Stephen G. Fier, Robert E. Hoyt, and Andre P. Liebenberg, "Adverse Selection in the Credit Life Insurance Market," *Journal of Insurance Regulation*, Winter 2012.

credit life insurance and some empirical tests using mostly using statewide aggregate variables. In the absence of micro data, they necessarily had to use proxy variables from statewide data.

Table 5:
Willingness to Purchase Debt Protection Again Among Users of Installment Credit
(Percentage Distribution Within Groups of Credit Users)

Purchase again?	2001 Installment Credit	2012 Installment Credit	2017 Installment Credit
Yes	94.2	74.6	70.2
No	5.8	24.4	29.7
Total	100.0	100.0	100.0
Memo: Number of observations using type of credit	171	222	349

Notes:
* Less than one half of 1%.
NA: Not available.
Columns may not sum exactly to totals because of rounding.

Their model suggests that demand for credit life insurance (proxied by the natural logarithm of the dollar amount, a variable also used in studies of demand for common life insurance) is a function of adverse selection (proxied by the state-specific death rate) and other homogeneity variables. They suggested that adverse selection could arise from absence of underwriting on credit life (ultimately due to small size of the policies and state requirements that do not permit underwriting) and the presence of higher risk individuals in the state who died during the policy period.

Other variables in their estimating equation included frequency of other life insurance in the state, state price and a group of state demographic variables. We employ an approach that is basically similar but expanded to include some other considerations known to affect buyer behavior in general ways. We also use micro variables from individuals' personal buying situations and do not need proxy variables.

Although there do not appear to be any other studies specifically of credit insurance demand elements, there have been quite a few other studies of life insurance demand that have focused on economic considerations. Zeitz has provided a lengthy review of much of this literature and established relevant categories of variables employed, which she presents in eight tables.[12] They include: Personal and Demographic Determinants (her Table 2); Financial and Economic Determinants (Table 3); Risk Aversion (Table 5); and other considerations that might be less relevant for credit insurance demand than for other life insurance (Deductible Levels

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Their study necessarily had to rely upon state-wide averages for most of its demand-related variables because of unavailability of micro data.

12. Emily Norman Zeitz, "An Examination of the Demand for Life Insurance," *Risk Management and Insurance Review* (Volume 6, Number 2, 2003).

and Loading, Table 6; Inflation, Table 7 [see page 15]; and Wealth and Bequest Motives, Table 8 [see page 16]).

We model the demand for credit insurance as a function of: 1) standard economic variables such as substitutes (other life insurance), price (prima facie rates in individual states) and income; 2) risk aversion; and 3) situation. The latter consideration arises from a rendition of the buyer behavior approach of marketing literature where product buying is more than a function of economics alone. Psychological considerations have become more important in economics recently with the growth of "behavioral economics," but including psychological aspects as an element of buying is not a new idea.[13]

Based on these ideas, it is easy enough to hypothesize quite a few factors that might affect the purchase of credit insurance and to ask survey questions about them. The 2017 survey did this, and they are summarized in Table 6. The table contains five groupings of possible underlying reasons that might be associated with purchase of debt protection:

- Current perceptions of "underinsurance" in other areas by some purchasers who, therefore, might believe that debt protection is a means of managing this concern in at least one area of their lives.
- Specific aspects of risk aversion, including current health issues, that might make some individuals more concerned over their financial future than other individuals.
- Financial risk concerns that might make scheduled repayments potentially more problematic for some individuals than for others. These concerns could include the desire to build or protect a credit reputation as evidenced in a credit score.
- Differences in basic risk aversion among segments of the population. Some individuals may simply be more risk-averse than others, apart from specific health or financial concerns. The survey also examined this possibility.
- Difference in demographic/economic status, including income, assets, age, life cycle stage and others that indicate differences in the underlying current situation.

13. For extensive discussion of the buyer behavior approach, see Roger D. Blackwell, Paul W. Miniard, and James F. Engel, *Consumer Behavior*, 10th edition (Stamford, CT: Thompson South Western, 2006). For discussion of the beginnings of study of the psychological approach to consumer buying, see George Katona and Eva Mueller, "A Study of Purchase Decisions," L. H. Clark, ed., *Consumer Behavior: The Dynamics of Consumer Reaction* (New York: New York University Press, 1954) and George Katona, *Psychological Economics* (New York: Elsevier Scientific Publishing, 1975).

Table 6:
Factors That May Be Associated With Installment Credit Users' Willingness to Purchase Debt Protection

Factor	Proportion among *non*-purchasers of debt protection (Percent)	Proportion among purchasers of debt protection (Percent)	Hypothesized to be greater for non-purchasers?	Actual percentage points by which non-purchasers exceed purchasers[1]
Other insurance				
1. Other life insurance	76.8	78.0	yes	-1.2
2. Other life insurance of $50,000 or more	65.3	59.5	yes	5.8
3. Health insurance	95.0	94.5	yes	0.5
4. Disability insurance from employer	49.7	47.8	yes	1.9
5. Long-term care insurance	20.5	38.2	uncertain	-17.7 ***
Health concerns				
6. Respondent has bad health	13.2	22.7	no	-9.5
7. Spouse has bad health	10.4	16.9	no	-6.5
8. Respondent or spouse has bad health	15.4	29.4	no	-14.0 **
9. Respondent smokes	15.2	13.9	no	1.3
10. Spouse smokes	11.5	20.7	no	-9.2
11. Respondent or spouse smokes	18.0	22.4	no	-4.4
Financial concerns				
12. Respondent or spouse has very good credit	61.4	42.5	yes	21.9 ***
13. Has reserve funds of $400 or more	83.7	76.4	yes	7.3 **
14. Could cover living expenses for 90 days	81.3	62.9	yes	18.4 ***
15. Respondent and spouse not worried about job security	71.8	63.8	yes	8.0 *
Basic risk aversion				
16. Unwilling to take above-average risks	67.6	88.2	no	-20.6 ***
Demographic characteristics				
17. Age				
Less than 35	22.0	27.2		-5.2
34-44	19.0	18.8		-0.2
55 and older	40.0	35.2		4.8
18. Married	73.9	63.8		10.1 **
19. Children	33.6	34.1		-0.5
20. Education				
High school diploma or less	15.2	18.5		-3.3
Some college	17.1	25.9		-8.8
College degree	67.7	55.6		12.1 ***
21. Income quintile				
Lowest	16.4	25.3		-8.9 ***
Second	25.0	26.9		-1.9
Third	20.9	25.3		-4.4
Highest	37.8	22.6		15.2 **
22. Home owner	73.1	65.0		8.1 *

Significance levels: *** 1%, ** 5%, * 10%.
Note:
[1] Actual percentage point difference measured by the survey by which frequency of purchase of debt protection (Column 2) exceeds non-purchase (Column 1) for those meeting the line criterion.

Univariate display of relevant variables in Table 6 looks at each of these areas individually before passing to multivariate review. The table consists of five columns for each of 22 separate measurements, plus some sub measurements listed in column 1. Multivariate review involves looking at the same factors but accounting for (holding constant) the simultaneous effects of the others in a statistical equation.

The table is read as follows: The first column notes possible characteristics of surveyed individuals with installment credit outstanding that might be related to demand for debt protection. The second column is the percent of surveyed debtors *who did not purchase debt protection* who had this characteristic. The third is the percent of debtors who *did purchase* protection who had this characteristic.

For instance, looking at the first row, other life insurance, the second column shows that 76.8% of surveyed individuals with installment credit and who *had not* purchased debt protection had other life insurance. Still looking at this row, the third column shows that 78% of those with installment credit and *had* purchased debt protection had other life insurance.

The other rows of the table work the same way. For example, the second row shows that among borrowers with installment credit and other life insurance, 65% of non-purchasers of debt protection had other life insurance of $50,000 or more while only 59% of debt protection purchasers had this much other life insurance.

The fourth column of the table then indicates the prior hypothesis whether the row criterion is more likely for non-purchasers of debt protection. “Yes” indicates the hypothesis that likelihood is greater for non-purchasers of protection than for purchasers. For instance, the first row indicates the expectation that non-purchasers of protection would be *more likely* to have other life insurance than purchasers (“Yes” hypothesis). (As it turns out, column 5 shows that the evidence does not support this first hypothesis, although the univariate evidence is consistent with most of the other hypotheses.)

Column 5 then shows, row by row, the relationship of actual survey results to the relevant expectations. The findings are presented with the positive or negative sign of the actual relationship of column 1 (non-purchasers of protection) to column 2 (purchasers) for each characteristic.

As indicated, survey results are consistent with expectations of differences in hypothesized demand-related criteria in almost every case where there is an expectation. The first grouping of variables involves evidence of other insurance holdings. The general contention here is that if some debtors have less other insurance, they may feel underinsured when taking on more installment debt, and so they purchase debt protection as at least a partial remedy for this concern. Life, health and disability insurance can provide benefits similar in some ways to common forms of debt protection. Thus, not having these types of insurance likely stimulates demand for debt protection.

In general, Table 6 shows consistency with the hypothesized relations, although holdings of other insurance seem less important as a univariate explanation of debt protection demand than other classes of borrower criteria. For example, life insurance holding is quite widespread among both non-purchasers and purchasers of debt protection but slightly more common among debt protection buyers. (See line 1 of the table.) And so, life insurance demand already seems strong in the experience of debt protection users.

Table 7:
Logistic Regression of Factors Associated With Installment Credit Users' Willingness to Purchase Debt Protection (Model 1)

	Model 1		
Variable	Coefficient estimate	Standard error	Odds ratio
Other insurance			
Other life insurance of $50,000 or more	-0.376	0.404	0.686
Health insurance	0.415	0.735	1.515
Long-term care insurance	0.800 ***	0.295	2.226
Health concerns			
Respondent or spouse has bad health	0.664 **	0.344	1.942
Respondent or spouse smokes	0.216	0.341	1.241
Financial concerns			
Respondent or spouse has very good credit	-0.430	0.333	0.651
Has reserve funds of $400 or more	-0.045	0.428	0.956
Could cover living expenses for 90 days	-0.166	0.423	0.847
Respondent and spouse not worried about job security	-0.062	0.310	0.939
Basic risk aversion			
Unwilling to take Above-average risks	0.542	0.381	1.720
Demographic characteristics			
Less than 35	0.232	0.374	1.262
55 and older	-0.458	0.337	0.632
Married	-0.398	0.349	0.671
Children	0.011	0.319	0.989
Some college	-0.036	0.420	0.965
College degree	-0.416	0.373	0.660
Lowest income quartile	0.075	0.521	1.078
Second income quartile	0.019	0.408	1.019
Third income quartile	0.634 *	0.354	1.885
Home owner	0.303	0.339	1.354
Price			
State prima facie credit life rate	-0.187	1.231	0.829
Intercept	-1.164	1.137	
Likelihood ratio	42.348 ***		
McFadden's R-squared	14.3		
Number of observations	336		

Significance levels: *** 1%, ** 5%, * 10%.

Table 8:
Logistic Regression of Factors Associated With Installment Credit Users' Willingness to Purchase Debt Protection (Model 2)

	Model 2 Coefficient Estimates			
Variable	Variation 1	Variation 2	Variation 3	Variation 4
Other insurance				
Long-term care insurance	0.833 ***	0.851 ***	0.843 ***	0.892 ***
Health concerns				
Respondent or spouse has bad health	0.601 *	0.592 *	0.550 *	0.614 *
Financial concerns				
Respondent or spouse has very good credit	-0.683 **			
Has reserve funds of $400 or more		-0.546 *		
Could cover living expenses for 90 days			-0.621 **	
Respondent and spouse not worried about job security				-0.209
Basic risk aversion				
Unwilling to take Above-average risks	0.657 *	0.644 *	0.059	0.650 *
Demographic characteristics				
Third income quartile	0.541 *	0.577 *	0.579 *	0.524 *
College degree	-0.428	-0.485 *	-0.510 *	-0.553 *
Home owner	0.016	-0.108	-0.057	0.171
Intercept	-1.521 ***	-1.310 ***	-1.268 ***	-1.53 ***
Likelihood ratio	35.234	32.433	33.570	29.755
McFadden's R-squared	9.66	8.89	9.20	8.16
Number of observations	336	336	336	336

Significance levels: *** 1%, ** 5%, * 10%.

Debt protection purchasers are more likely to have smaller *amounts* of life insurance (line 2), however, and those with small amounts of life may feel underinsured. Survey results summarized in column 5 show that those with small amounts of life insurance are more likely to purchase debt protection than consumers with life insurance of $50,000 or more. Holding of health insurance and disability insurance also have the expected relationships between non-purchasers and purchasers of debt protection, although the differences are neither large nor statistically significant.

The most sizable difference in the insurance area concerns the question about holding of long-term care insurance (LTCI). LTCI covers a distant large expense, whereas credit insurance involves a relatively small amount limited to the amount of debt over a relatively short period of time. As such, these products would not seem to be substitutes, but the difference between purchasers and non-purchasers of debt protection is large and statistically significant, with purchaser of debt protection more likely also to have long-term care (LTC) coverage. (Frequency of this sort of insurance is lower both with purchasers and non-purchasers of debt protection compared to other kinds of insurance.) There may be an explanation, however. One possibility is that in purchasing LTCI, installment credit users, who are mostly young or middle aged, exhibit foresight for future large risks. In this case, the purchase of LTCI seems more a reflection of these consumers' risk aversion than concern that one is underinsured for an immediate shorter-term risk.

A different explanation involves non-financial considerations. In discussion with the authors, one knowledgeable insurance specialist suggested that purchase of LTCI for many purchasers does not solely involve financial concerns like other insurance. In his words, LTC is also "dignity insurance" and so involves elements of a different nature. In this view, it potentially saves the dignity of elderly individuals and so it may be relatively more important to those with fewer other resources, possibly including debt protection purchasers, for protecting dignity in old age. Whatever the specifics of this relationship that ultimately might involve psychological elements as well as financial, more extensive buying of LTC coverage by purchasers of debt protection does not seem like this purchase solely involves a financial decision. Both potential explanations seem plausible and are not mutually exclusive.

In the second grouping in Table 6, health concerns, survey measurements of a group of possible health concerns among non-purchasers and purchasers of debt protection are consistent with hypotheses (lines 6 through 11 in the table). In general, the finding is that those with health concerns are more likely to purchase debt protection, consistent with reasonable expectations in this area. In particular, the survey provides evidence of adverse selection arising because of only limited underwriting allowable for debt protection but where there is asymmetric information (i.e., consumers have better private information on their health than the insurers). This makes debt protection more attractive to higher-risk consumers. The idea is that consumers having bad health will disproportionately choose debt protection. This, of course, results in a worsening of the risk pool. The worsening of the risk pool can then lead to higher prices, causing lower-risk consumers to leave the market and produce an upward spiral of risk and price.

The findings in the health area provide evidence supporting the adverse selection hypothesis, and the differences are mostly larger than for the mainstream insurance-holding measures. The exception is whether the respondent is a smoker, but this difference disappears when whether the spouse or partner (or either individual in the relationship) is a smoker is also considered. Immediate health issues over the near term seem to be relevant to the decision to purchase debt protection for installment credit.

The third grouping of factors that might be relevant is financial concerns. Again, the survey measures in Table 6 are consistent with hypotheses, and the differences are statistically significant and mostly large (lines 12–15). Especially large is the difference in whether the respondent rates credit history for self (and spouse, if any) as "very good," with debt protection users considerably less likely to indicate "very good" credit history (line 12). This result suggests a strong possibility that protecting credit history is associated with purchasing debt protection. Since a very good credit history can lower the cost of credit arrangements by considerably more than the cost of debt protection lowers it, this is not especially surprising.[14]

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14. For further discussion of this point, see Durkin, Elliehausen, Staten, and Zywicki, *Consumer Credit and the American Economy*, referenced in footnote 2, Chapter 12.

Other measured relevant financial concerns include two measures of ability to meet financial emergencies, with limitations on financial reserves directly associated with the likelihood of purchasing debt protection (lines 13–14). Finally, in this litany of financial matters, current job security also apparently enters into the demand for debt protection. Those not worried over job security are less likely to be purchasers of debt protection than non-purchasers (line 15).

These factors taken one at a time on a univariate basis may well come together in a question on overall risk aversion (line 16). In this case, those who do not have debt protection are considerably more likely to express they are willing to take financial risks than those who have debt protection. A lot of the background for this willingness to take financial risks may well rise from their greater financial ability to take on such risks. Those with a bit less insurance, but sometimes with greater health or financial concerns, may well be looking for ways to reduce risks rather than take on more.

Finally, a series of demographic variables also collected with the rest of the survey information offers some more description of debtors who purchase debt protection relative to those who do not. For instance, purchasers of debt protection are less likely to be married (line18) than non-purchasers. This suggests they are more likely to be facing risks alone, probably with lower family income. This income description is borne out with direct family income measurement where installment debtors with debt protection are considerably less likely in the highest income quintile (line 21). They also are less likely to be home owners (a measure of asset holding, line 22) and holders of credit cards (not in the table).

A multivariate logistic regression analysis of the debt protection choice supports the findings suggested by the univariate analysis. The dependent variable is whether the consumer purchased debt protection for an installment loan. Explanatory variables include the sets of variables reflecting other insurance coverage, health concerns, financial concerns, basic risk aversion and demographic characteristics discussed in Table 6. Some categories have been combined in slightly different ways. (See Table 7.) Explanatory variables also include a price, the state prima facie rate for credit life insurance, stated as dollars per \$100 per year.[15] Credit insurers generally charge this rate in each state.[16]

Table 7 presents estimation results for Model 1, which includes the extended set of explanatory variables considered in Table 6. Several additional models are reported in Table 8. These models consider a smaller set of variables because correlations among explanatory variables may hamper the ability to detect factors influencing choice.

The estimated regression for Model 1 is statistically significant at the 1% level. Some of the variables identified as statistically related to the purchase of debt

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15. Source: *Fact Book of Credit-Related Insurance* (Atlanta: Consumer Credit Industry Association, 2016). The *Fact Book* also reports state prima facie rates for credit disability insurance, but the reference version of this product is not offered in several states. For the states that offer the reference version, prima facie rates for credit disability and credit life are strongly positively correlated.

16. See Gary Fagg, *Credit-Related Insurance* (Hurst, Texas: CreditRe, 2004).

protection when examined individually remain important when multiple variables are considered simultaneously. For instance, having LTCI is statistically significant and positive. The odds ratio, which measures the size of an explanatory variable's effect on the dependent variable, indicates that the odds of purchasing debt protection for consumers having LTCI are 2.226 times that for consumers not having LTCI.[17]

Having bad health is also statistically significant and positively related to purchasing debt protection. The odds ratio shows that consumers who have bad health are about twice as likely as healthy consumers to purchase debt protection. This finding suggests the possibility of adverse selection in debt protection markets. That is, an unfavorable risk pool that contains more with poor health can lead to higher prices, which then can cause healthy consumers to avoid debt protection products. Among the demographic characteristics, consumers in the third income quartile were significantly more likely than consumers in other income groupings to purchase debt protection.

But correlations among explanatory variables may hamper the ability to detect factors influencing choice, and this may be especially likely for the financial concern variables. For example, consumers who have very good credit histories may also be able to borrow needed funds in an emergency. Also, the ability to borrow may enable a consumer to cover expenses if income is lost. In such cases, having at least $400 in liquid assets also may help cover expenses. Statistical analysis shows high correlations between variables in this category, providing evidence supporting this possibility.

Variations of Model 2 in Table 8 include variables found to be significantly related to the purchase of debt protection in Table 6, with each variation of the model using a single variable to reflect the financial concerns category. As in Model 1, having LTCI is positively associated with debt protection purchases and is statistically significant. Bad health is also significant and positive, supporting the adverse selection hypothesis for debt protection products.

Model 2 provides evidence that financial concerns and risk aversion both are generally associated with purchase decisions for debt protection in multivariate equations, consistent with the univariate findings. Each of the financial concerns variables except job security is statistically significant. Unwillingness to take on financial risks is also statistically significant in three of the four variations and associated with greater likelihood of purchasing debt protection. The odds ratio estimate indicates that risk-averse consumers are about two times more likely to purchase debt protection than consumers who are willing to take financial risks (not shown in the table).

17. Odds are the ratio of the probability of x (purchasing debt protection, for example) to the probability of not x (i.e., not purchasing debt protection) for a given indicator variable (e.g., for those purchasing long-term care insurance). The odds ratio can be calculated by exponentiating the coefficient for having long-term care insurance from the logistic regression (here exp(0.800)=2.226).

Thus, the multivariate examination also finds a profile for debt protection purchasers of individuals with health and financial concerns, and who are not in the highest income or education groupings. A general measure also often finds them individually risk-averse. Ultimately, this describes a likely prospect to purchase insurance for perceived risks. That they sometimes do so when entering into consumer credit arrangements is not surprising.

Conclusion

And so, survey research suggests other reasons for purchasing debt protection than the old argument that purchase reflects lack of understanding or even widespread coercion at the point of sale. Direct questioning again shows a long-term decline in purchase penetration rate and in the frequency and strength of offers to the point where only about 5% of installment credit users reported both that the creditor had recommended the product and that they had bought it. Furthermore, not one respondent reported feeling that debt protection was other than a voluntary option. In contrast, a substantial majority of purchasers believed that purchase was voluntary and that they would do it again.

Rather, survey evidence shows that debt protection amounts to an add-on in credit arrangements preferred by some but not by others. Over the longer term, its prevalence as part of installment credit arrangements has declined, probably reflecting long-term growth in employment, income and assets that have permitted more consumers to self-insure themselves in the marketplace. Evidence suggests it is useful to many consumers, however, and is much more than a niche product. Installment debtors who purchase debt protection are somewhat otherwise less insured than product purchasers and more frequently have either health, financial or possibly both kinds of concerns. They generally are not among the financially elite, and they tend to be quite risk-averse. Their wealthier brethren who are similarly risk-averse may often be candidates for purchase of other specialized insurance products like trip-cancellation insurance.

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Abstracts of Significant Cases Bearing on the Regulation of Insurance 2018

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United States Courts of Appeal

Moda Health Plan, Inc. v. United States, 892 F.3d 1311 (Fed. Cir. 2018)

This case involves the federal Patient Protection and Affordable Care Act's (ACA) three-year risk corridors program, under which insurers that expanded their risk pool would receive payments from the federal government if their costs of providing coverage exceeded the premiums received. The payments were to act as an incentive to insurers unable to estimate the cost of providing care to those seeking coverage under the new exchanges. Conversely, insurers were to pay the federal government a share of their profits when the premiums received exceeded their costs. Citing a lack of payments received from insurers making profit, the federal government had paid only 12.6% of the losses incurred by Moda Health Plan, Inc. (Moda) and other participating insurers under the risk corridors program.

Moda filed suit against the federal government, seeking the remaining payments owed under both statutory and contractual liability theories. The federal government argued that the risk corridors program was intended to be budget neutral; therefore, it owed only the amounts it received as profit from the insurers. The federal government brought this appeal after the U.S. Court of Federal Claims entered judgment for Moda. On appeal, this court reversed the lower court's

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judgment, finding that the federal government did not owe money to Moda or other insurers under either theory of liability.

The court reasoned that, while the plain language of the ACA created an obligation of the federal government to pay participants in the health benefit exchanges the full amount indicated by the statutory formula, the U.S. Congress intended to suspend payments on the risk corridors program beyond the amounts insurers paid in, via riders to the appropriations bills for fiscal years 2015 and 2016. Furthermore, the court found that Moda failed to establish the existence of an implied-in-fact contract based on the ACA, its regulations and the conduct of the U.S. Department of Health and Human Services (HHS). The court applied the presumption that a law is not intended to create a private contractual right and found that the law, regulations and conduct of HHS were all simply part of the incentive program. The NAIC filed an amicus brief in support of Moda's position in this case. Following the adverse ruling, Moda filed a petition for writ of certiorari to the U.S. Supreme Court, and the NAIC filed an amicus brief in support of Moda's petition.

Pharm. Care Mgmt. Ass'n v. Rutledge, 891 F.3d 1109 (8th Cir. 2018)

The Pharmaceutical Care Management Association (PCMA), a trade association representing pharmacy benefit managers (PBMs), filed an action against Arkansas' attorney general seeking a declaration that an Arkansas statute was preempted by the federal Employee Retirement Income Security Act (ERISA). The statute, Act 900, mandates that pharmacies be reimbursed for generic drugs at a price equal to or higher than the pharmacies' cost for the drug based on the invoice from the wholesaler. Act 900 also regulates how PBMs set their reimbursement rates through maximum allowable cost (MAC) lists by requiring them to update the lists within at least seven days from the time there has been a certain increase in acquisition costs. The law also contains administrative appeal procedures and allows the pharmacies to reverse and re-invoice each claim affected by the pharmacies' inability to procure the drug at a cost that is equal to or less than the cost on the relevant MAC list where the drug is not available "below the pharmacy acquisition cost from the pharmaceutical wholesaler from whom the pharmacy or pharmacist purchases the majority of prescription drugs for resale." Finally, the law allows pharmacies to "decline-to-dispense" when they will lose money on a transaction.

The district court agreed with the PCMA that the pertinent provisions of the law were preempted by ERISA based on controlling case law in the U.S. Circuit Court of Appeals for the Eighth Circuit. However, the district court found that Medicare Part D did not preempt Act 900, nor was the law unconstitutional on any of the several bases advanced by the PCMA. The PCMA appealed the Medicare Part D ruling, and the state cross-appealed the ERISA ruling.

The Eighth Circuit found that the Arkansas law was preempted by ERISA. While the law did not explicitly reference ERISA, it made an impermissible implicit reference by regulating PBMs that administered benefits for covered entities necessarily subject to ERISA. The court held that the presumption against preemption did not apply because the law both related to, and had a connection with, employee benefit plans. Lastly, the court found that the state law was preempted by Medicare Part D, as it acted "with respect to" the Negotiated Prices Standard by regulating the price of retail drugs, and it acted with respect to the Pharmacy Access Standard, as it would interfere with convenient access to prescription drug availability.

Ausmus v. Perdue, 908 F.3d 1248 (10th Cir. 2018)

Winter wheat farmers in Colorado filed a challenge to the Federal Crop Insurance Corporation's (FCIC) implementation of the Farm Crop Insurance Act (FCIA) upon being denied the actual production history (APH) yield exclusion when they purchased crop insurance for the 2015 crop year. The farmers lost their challenge through the administrative appeals process and appealed to the district court, which reversed and remanded the matter. The U.S. Court of Appeals for the Tenth Circuit treated the remand order as final and granted review.

The farmers purchased insurance that provided protection from low crop yields due to "unavoidable, naturally occurring events." The coverage available to a farmer is calculated by multiplying the projected price, the coverage level percentage (selected by the farmer) and the APH yield. The APH is based on an average of the last four to 10 years of the farmer's own history, and it is calculated by adding the yearly yields and dividing that sum by the number of yields. The farmer can purchase more insurance with a higher APH. Congress amended the FCIA in 2000 to allow the FCIC to adjust a farmer's APH when a farmer experienced an especially poor harvest "for any of the 2001 and subsequent crop years." This provision was amended in 2014 to allow farmers to elect to exclude a yield from the APH calculation when a crop yield was 50% below the average yield of that crop in the county during the previous 10 consecutive crop years. Shortly after the 2014 amendment was made, the FCIC published an interim rule that phased in farmers' eligibility for the APH yield exclusion as the FCIC updated its actuarial documents to add newly eligible crops.

In this case, the farmers elected the APH yield exclusion, but the U.S. Department of Agriculture (USDA) notified insurance providers that the exclusion would not be available for winter wheat for the 2015 crop year. The farmers challenged this ruling, arguing that the FCIA, as amended, was written to apply to "2001 and subsequent crop years," which would include the 2015 crop year, because the 2014 amendment at issue did not contain new implementation deadlines. The Tenth Circuit found that the FCIA, including the 2014 amendment, unambiguously applied to "2001 and subsequent crop years." Because the statute was unambiguous, the court afforded no deference to the FCIC's interpretation and did not need to resort to legislative history.

United States District Courts

Amica Life Ins. Co. v. Wertz, 350 F. Supp. 3d 978 (D. Colo. 2018)

Amica Life Insurance Company (Amica) filed a declaratory judgment action against the beneficiary of a life insurance policy, Michael Wertz, arguing that it had properly denied payment of benefits. The policy at issue contained a two-year suicide exclusion that had been implemented by the Interstate Insurance Product Regulation Commission (Compact). Colorado, as a member of the Compact, implemented the two-year suicide exclusion for the policy at issue even though another Colorado statute limited suicide exclusions to one year for policies not filed with the Compact.

The question before the court was whether the Colorado Legislature, in enacting the Compact, could delegate to a Colorado administrative agency, the discretion to promulgate regulations that substantively modify state statutes. In answering this question in the affirmative, the court held that by enacting the Compact, the Colorado gave express authority to the Compact to adopt uniform standards that control over conflicting state laws as to the content of the Compact-approved policies. The NAIC filed an amicus brief in support of Amica's position in the district court. Mr. Wertz has appealed to the U.S. Court of Appeals for the Tenth Circuit, and the NAIC filed a joint amicus brief with the Compact in further support of Amica.

Progressive Northwestern Insurance Company v. Gant, No. 15-9267-JAR-KGG, 2018 WL 4600716 (D. Kan. Sept. 24, 2018)

This case involved the question of whether the court should apply the unpublished nonbinding rule from the *Restatement of the Law, Liability Insurance* (Restatement) that an insurer can be held directly liable for the conduct of defense counsel retained for the policyholder. Progressive Northwestern Insurance Company (Progressive) filed a declaratory judgment action seeking a declaration that it fulfilled its contractual obligations in good faith and without negligence under an insurance policy issued to Edward and Linda Birk, whose son, Justin Birk, was involved in a vehicular homicide that killed Kathryn Gant. Defendant Gabriel Gant, as assignee of the Birks' rights against Progressive, counterclaimed for breach of contract and bad faith.

Among the Defendant's claims was that Progressive violated its obligation to defend the Birk defendants by breaching the duty to hire competent counsel. Specifically, Mr. Gant argued that defense counsel hired by the insurer was incompetent because Progressive had prior knowledge of the attorney's alleged reputation for "thwarting" settlement. Applying Kansas law, the court predicted that the Kansas Supreme Court would have agreed that it was immaterial to the case at hand as to whether Progressive had prior knowledge that counsel in prior cases had found retained counsel aggressive or difficult to work with. Citing the Restatement Mr. Gant asserted that "where an insurer hires an attorney despite a known problem, and then that same problem surfaces in the case for which the attorney was hired, the insurance company that hired the attorney is liable for the loss to the insured by the hiring of that attorney."

The court held that Mr. Gant's reliance on the Restatement was premature because, as of the date of the court's order, the official text of the Restatement had not been published. The court also stated that Kansas courts have neither directly addressed the issue of when an insurer may be directly liable for the conduct of defense counsel retained for the insured, nor relied upon or adopted the new Restatement's rule. Therefore, the court was not inclined to use a nonbinding Restatement as a means to overturn or expand Kansas law.

Additionally, even if the court were persuaded to follow the Restatement, Progressive would only be liable for acts or omissions of retained counsel "within the scope of the risk that made his selection unreasonable." Mr. Gant argued that retained counsel failed to properly provide notice to another insurer due to the fatal collision, but the Court stated that any such failure was due to the misinterpretation of the policy, not that retained counsel obstructed the settlement or committed legal malpractice. As such, any alleged deficiency in retained counsel's performance with respect to his settlement skill set, or lack thereof, was beyond the scope of risk that made the selections of counsel unreasonable.

PHI Air Med., LLC v. New Mexico Office of Superintendent of Ins., No. 18 CV 382 JAP/SCY, 2018 WL 6478626 (D.N.M. Dec. 10, 2018)

PHI Air Medical (PHI) filed an action against the New Mexico Office of Superintendent of Insurance (OSI) and Superintendent John G. Franchini seeking a declaratory judgment that the New Mexico insurance laws prohibiting the balance billing of air ambulance patients are preempted by the federal Airline Deregulation Act (ADA). PHI also sought an injunction against the OSI defendants from enforcing New Mexico insurance laws against PHI and other air ambulance providers. The OSI defendants claim that the state laws were enacted for the purpose of regulating the "business of insurance" and are valid under the federal McCarran-Ferguson Act.

PHI is an air carrier licensed by the New Mexico Department of Health to provide air ambulance services to New Mexico residents. In June 2016, PHI provided medically necessary emergency transport for a stroke patient. The patient was covered by a policy issued by New Mexico Health Connections (NMHC). PHI, which was an out-of-network provider, submitted an invoice to NMHC but did not receive full reimbursement. The plan promised to cover emergency services from an out-of-network provider at the in-network benefit level up to the "usual, customary, and reasonable amount" as determined by NMHC. The patient was required to pay a $100 copay, which he did. PHI used NMHC's internal review process to appeal the reimbursement decision, seeking the unpaid balance of $30,961.14. Upon denial of its appeal, PHI sent an invoice for the remaining amount to the patient.

The patient filed an external review request with the OSI pursuant to the state law prohibiting balance billing. The OSI issued an opinion and order finding that the patient was not responsible for the invoice because he had paid the copay and the state law required managed health care plans to ensure "emergency care is immediately available without prior authorization requirements, and appropriate out-of-network care is not subject to additional costs." Additionally, the OSI noted that it "does not have jurisdiction over contractual matters between carriers and providers"; therefore, it could make "no determination about whether NMHC was responsible for the balance due."

PHI then filed this claim in district court. The court dismissed all claims without prejudice, finding that it did not have subject-matter jurisdiction and that PHI lacked standing to sue the OSI defendants. The Court held that PHI could seek redress only from NMHC, not the OSI, as the state law at issue provided the OSI with authority over insurers but not providers.

NRA of Am. v. Cuomo, 350 F. Supp. 3d 94 (N.D.N.Y. 2018)

The National Rifle Association of America (NRA) filed an action against defendants Andrew Cuomo, New York Governor; Maria T. Vullo, Superintendent of the New York State Department of Financial Services; and the New York State Department of Financial Services (DFS). In October 2017, the DFS initiated an investigation of the NRA's Carry Guard insurance program, focusing on two insurance companies: Chubb Ltd., which acted as underwriter of the policies; and Lockton Affinity, LLC, which acted as administrator of the program. The Carry Guard program provided, among other policy coverages: 1) liability insurance to gun owners for acts of intentional wrongdoing; and 2) legal services insurance for any costs and expenses incurred in connection with a criminal proceeding resulting from acts of self-defense with a legally possessed firearm, in violation of New York insurance law. Shortly after the DFS initiated the investigation, Lockton Affinity suspended the Carry Guard program and no longer provided Carry Guard policies to New York residents. The DFS' investigation revealed that Lockton Affinity and Chubb violated numerous provisions of the New York insurance law in connection with the Carry Guard program and additional NRA programs.

The suit, which asserted claims under the U.S. and New York constitutions for alleged violations of free speech, due process and equal protection, among other claims, came after Gov. Cuomo directed the DFS to issue guidance letters to the banks and insurers regulated by the state, urging them to consider their reputational risks by doing business with the NRA and similar groups. The NRA cited the DFS guidance letters, as well as public comments from Superintendent Vullo and Governor Cuomo, and the regulatory actions, to argue that the state agency exceeded its regulatory authority and pursued the NRA for political reasons.

The DFS filed a motion to dismiss the NRA's claims. The court dismissed most of the NRA's causes of action, including its First Amendment freedom-of-association claims; equal protection claims for selective enforcement against the NRA; due process claims; claims of a conspiracy between Gov. Cuomo and Superintendent Vullo to threaten banks and insurance companies with regulatory scrutiny if they did business with the NRA; and claims that Gov. Cuomo and Superintendent Vullo tortiously interfered with its business interests.

The court also dismissed the NRA's equal protection claims for selective enforcement to the extent that the NRA sought an order enjoining defendants from selectively enforcing the New York insurance laws against Chubb and Lockton Affinity; however, it allowed the associated claim for monetary damages to go forward. The court also allowed the NRA's First Amendment freedom-of-speech claims that Gov. Cuomo, Superintendent Vullo and the DFS interfered with the NRA's right to advance its agenda by making public statements threatening to use the power of their offices against businesses that work with the NRA.

Texas v. United States, 340 F. Supp.3d 579 (N.D. Tex. 2018)

Various states and individuals brought an action against the U.S., the HHS, the secretary of the HHS, the Internal Revenue Service (IRS) and the Acting Commissioner of the IRS, seeking a declaration that the ACA individual mandate, which imposed minimum essential coverage requirements under which certain individuals were obligated to purchase and maintain health insurance coverage, as amended by the federal Tax Cuts and Jobs Act of 2017 (TCJA), was unconstitutional and that the remainder of the ACA was not severable.

The ACA had previously been upheld by the U.S. Supreme Court in 2012, as a legitimate exercise of the congressional taxing power, but the plaintiffs argued that because the TCJA eliminated the penalty and no longer raised revenue for the federal government, the individual mandate no longer operated as a tax and was, therefore, unconstitutional. The plaintiffs further argued that the entirety of the ACA relies on the continued existence of the individual mandate, making the individual mandate inseverable from the rest of the ACA. Thus, the plaintiffs alleged, because the individual mandate was unconstitutional, that the ACA as a whole was unconstitutional, as well.

In a December 2018 opinion, the U.S. District Court of the Northern District of Texas found that the ACA was unconstitutional. In doing so, the court held that because the TCJA reduced the ACA's shared responsibility payment to zero, the mandate to purchase insurance could no longer be saved as a constitutional fundraising tax. Because the court found that the remainder of the ACA could not stand without the "essential" mandate, the entire law was set aside.

State Courts

Illinois

Thrivent Inv. Mgmt. Inc. v. Ill. Sec. Dep't, No. 1-17-1913, 2018 WL 4198879 (Ill. App. Aug. 28, 2018)

In October 2015, the Securities Department of the Office of the Illinois Secretary of State sent a Statement of Evidence to Thrivent Investment Management, Inc. (Thrivent), alleging Thrivent committed acts that could subject Thrivent to suspension of its registrations as an investment adviser and securities dealer. Thrivent filed a complaint in which it asked the court to enjoin the Securities Department's investigation, alleging that the investigation centered on Thrivent's sales of variable annuities and that the Illinois Department of Insurance had exclusive jurisdiction over such sales. Thrivent later amended its complaint, claiming that the document requests the Securities Department sent to Thrivent in the course of its investigation violated Thrivent's right to due process and its right to be free from unreasonable searches, seizures and invasions of privacy.

While the case was pending, the Securities Department sent Thrivent a notice of hearing informing Thrivent that an officer of the Secretary of State would hear evidence concerning Thrivent's alleged misconduct. Thrivent responded by arguing that only the Attorney General had authority to initiate proceedings against Thrivent and that the attorney who sent the notice worked for the Securities Department, not the Attorney General. In response, the Attorney General appointed two attorneys from the Securities Department to act as special assistant attorneys general for pursuing the charges against Thrivent. The circuit court found that the Securities Department had authority to investigate the alleged misconduct and dismissed Thrivent's complaint. Thrivent moved to vacate the dismissal and sought leave to amend its complaint again, but both requests were denied. Thrivent then appealed.

The appellate court found that by appointing the special assistant attorneys general, the Attorney General authorized the proceedings on the fraud charges, and, as a result, the circuit court did not abuse its discretion by denying Thrivent leave to amend its complaint as a claim regarding the authorization of special assistant attorneys general would have been a frivolous claim. The appellate court also found that Thrivent had not alleged facts showing that judicial proceedings on the Securities Department's requests would fail to protect Thrivent's constitutional rights. Finally, the appellate court held that while state law bars the Securities Department from regulating the issuance and sale of variable annuities, it did not bar the Securities Department from investigating allegations of fraud.

Washington

Keodalah vs. Allstate, 413 P.3d 1059 (Wash. Ct. App. 2018), review granted, 424 P.3d 1214 (2018)

Moun Keodalah was involved in an automobile accident in which the motorcyclist he collided with was killed. The motorcyclist was uninsured, and Mr. Keodalah sought underinsured motorist coverage from Allstate under his policy. Investigations were done by both the Seattle Police Department and an accident reconstruction firm hired by Allstate. Both investigations determined that the motorcyclist was speeding and that Mr. Keodalah was stopped at the stop sign. The police report further showed that Mr. Keodalah was not using his cell phone at the time of the accident. Despite these reports, Allstate claimed that Mr. Keodalah was 70% at fault and offered only a fraction of the $25,000 policy limits. Mr. Keodalah filed a lawsuit against Allstate, asserting an underinsured motorist (UIM) claim. Allstate designated insurance adjuster Tracey Smith as its representative to testify on behalf of the company. Following a jury trial, Mr. Keodalah was awarded more than $100,000. Mr. Keodalah then filed a second suit against Allstate and Ms. Smith, alleging claims of insurance bad faith and violations of the Insurance Fair Conduct Act (IFCA) and the Consumer Protection Act (CPA). The trial court granted, in part, Allstate and Ms. Smith's motions to dismiss, dismissing all of Mr. Keodalah's claims against Ms. Smith and certifying the case for discretionary review.

The Washington Court of Appeals granted discretionary review of the three issues: 1) whether the IFCA creates a private cause of action for violation of a regulation; 2) whether an individual insurance adjuster may be liable for bad faith; and 3) whether an individual insurance adjuster may be liable for violation of the CPA. An intervening Washington Supreme Court decision held that the IFCA did not allow a private right of action, so the court limited its review to the remaining two issues. The court reversed the trial court's determination and held that the claims could move forward. It found that the duty of good faith applies equally to individuals and corporations acting as insurance adjusters, as the insurance code of Washington applies to "all insurance transactions…and all persons having to do therewith…" It further held that individual adjusters can be liable for a CPA violation even without the existence of a contractual relationship with the consumer.

Journal of Insurance Regulation

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References to published literature should be inserted into the text using the "author, date" format. Examples are: (1) "Manders et al. (1994) have shown. . ." and (2) "Interstate compacts have been researched extensively (Manders et al., 1994)." Cited literature should be shown in a "References" section, containing an alphabetical list of authors as shown below.

Cummins, J. David and Richard A. Derrig, eds., 1989. *Financial Models of Insurance Solvency*, Norwell, Mass.: Kluwer Academic Publishers.

Manders, John M., Therese M. Vaughan and Robert H. Myers, Jr., 1994. "Insurance Regulation in the Public Interest: Where Do We Go from Here?" *Journal of Insurance Regulation*, 12: 285.

National Association of Insurance Commissioners, 1992. *An Update of the NAIC Solvency Agenda*, Jan. 7, Kansas City, Mo.: NAIC.

"Spreading Disaster Risk," 1994. *Business Insurance,* Feb. 28, p. 1.

Footnotes should be used to supply useful background or technical information that might distract or disinterest the general readership of insurance professionals. Footnotes should not simply cite published literature — use instead the "author, date" format above.

Tables and charts should be used only if needed to *directly support* the thesis of the paper. They should have descriptive titles and helpful explanatory notes included at the foot of the exhibit.

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