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ABSTRACT

We study how risk management through hedging impacts firms and competition among firms in the life insurance industry - an industry with over 7 Trillion in assets and over 1,000 private and public firms. We show that firms that are likely to face costly external finance increase hedging after staggered state-level financial reform that reduces the costs of hedging. Post reform impacted firms have lower risk and fewer negative income shocks. Product market competition is also impacted. Firms that previously are more likely to face costly external finance, lower price, increase policy sales and increase their market share post reform. The results are consistent with hedging allowing firms that face potential costly financial distress to decrease risk and become more competitive.

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1 Introduction

In this paper we examine how risk management and hedging impacts firms and competition among firms in the insurance industry. The impact of hedging and risk management has had a long history in finance. Froot, Scharfstein, and Stein (1993) (FSS) present an integrated general theory of how risk management can impact the investment policies of firms and also the interaction of firms within an industry. While the rationale for hedging and the impact of hedging on different aspects of firm policies has been studied - there is no empirical evidence to date on how hedging impacts competition.[1] Following the arguments in FSS, hedging can impact competition by firms in an industry if it reduces the variability of cash flows and thus the probability of financial distress and the deadweight costs financial distress may bring. In particular, these indirect costs can include decreased product market competitiveness and underinvestment.

How might competition be impacted? Early literature, including Telser (1966) and Bolton and Scharfstein (1990), considers theoretically how the lack of access to finance or costly external finance can impact weaker and entrant firms ability to invest and survive competition and potential predation by larger incumbent firms. To the extent that the firms that are subject to financial distress become better able to survive competition by the larger well capitalized firms, the previously constrained firms will be able to offer lower prices with less risk of distress and thus gain market share as more customers will buy policies from them.[2] Customer demand will thus be directly impacted both by pricing and the insurer's financial condition. Froot (2007) theoretically considers how when insurer's financial situation declines customer demand also falls because of customer's sensitivity to risk. Froot shows that the product market sensitivity of customers to risk creates an additional hedging benefit given that insurers are especially sensitive to the costs of holding risk both from imperfect capital-markets and also from product market-market sensitivity of customers

[1]Theoretically, Smith and Stulz (1985) consider managerial motives and taxes for hedging. Empirically, the relation between hedging and firm decisions has been examined by Babenko, Bessembinder, and Tserlukevich (2020) for debt financing, Garfinkel and Hankins (2011) for M&A, Hankins (2011) and Almeida, Hankins, and Williams (2017) for operational hedging and Adams-Bonaimé, Hankins, and Harford (2014) for dividends. Chernenko and Faulkender (2011) documents that firms can use derivatives both to hedge and speculate. They show high investment firms use derivatives to hedge. In life the insurance industry, oversight by regulators reduces the ability to engage in speculation but it remains a valid concern.

[2]Phillips and Sertsios (2017) examines how private forms of financing enhance competition and firms' ability to bring new products to market.

to risk. In particular, insurers often face negatively asymmetric or skewed distributions of outcomes that increases the benefits of hedging. [3]

We examine life insurers that sell different policies and annuities whose value depends on the insurer's ability to survive to when payouts will occur. Insurers ability to offer good prices for their products also depends on their cost of finance. We examine firms in the insurance industry after staggered state-level financial reform that lowers the cost of hedging in the insurance industry - one of the largest industries in the US. The insurance industry is also considered, like the banking industry, to be systemically important.[4] We examine insurers surrounding the staggered adoption of Section 711 of the Insurer Receivership Model Act (IRMA), which was first passed by Connecticut in 1998, and has since then been adopted by 22 other states.[5]

Section 711 lowers the cost of hedging for firms as it allows the enforceability of termination clauses that give the non-defaulting derivatives counterparty the right to end the derivatives contract and claim the collateral posted for margin if the insurance company triggers a contract-specific event of default (e.g., a rating downgrade), even if the company is not formally in receivership and if the insurance company triggers an event of default (e.g., a rating downgrade) negotiated in the contract, even if the company is not formally in receivership. This means that the derivatives counterparty of a Section 711 insurer can terminate the contract and net out its positions and capture collateral posted as margin (See Berends and King (2015) for more detail on collateral and margins), thus avoiding the uncertainty typical of financial distress (to which even policyholders are subject to), and without being required to return such collateral to the insurer's estate in case the insurer is later placed in receivership. This effectively gives such counterparty a special protection against the costly consequences of the automatic stay, which subjects all creditors of an insolvent insurer, including policyholders, to a lengthy receivership proceeding.

[3] Phillips, Cummins, and Allen (1998) shows empirically that insurers demand is impacted when they face increased probability of default, either directly or indirectly through decreased recommendations by third parties.

[4] As of December 31, 2017, the list of top 20 systemically important financial institutions included eight insurance companies, Prudential, MetLife, Voya, Brighthouse, Genworth, Lincoln, AIG, and Principal (Source: NYU Stern Volatility Lab).

[5] We show that this setting and our results are robust to the concerns about staggered difference-in-difference estimates raised by Cengiz et al. (2019), Callaway and Sant'Anna (2020), and Baker, Larcker, and Wang (2021). In particular, we use never treated states as control states and show that there are no yearly pre-trends. We thus do not using early passage states as controls for late passage states (Cengiz et al. (2019) and Callaway and Sant'Anna (2020)). We also conduct a number of placebo tests.

The business model of a life insurance company consists of selling insurance policies and invest the premiums in financial assets, such as bonds, stocks, and real estate mortgages.[6] A decrease in the value of these financial assets could affect the ability of an insurer to pay claims and lead to a request for corrective actions by the National Association of Insurance Commissioners (NAIC), the regulatory body of insurance companies, the seizing of the company control by the NAIC, or insolvency, which in the worst cases could result in liquidation. Insurers can hedge to contain the risk that the value of financial assets decreases. In turn, this can help insurance companies to price their products more competitively and sell more policies. Hedging can also help insurers sell more policies because customers are more inclined to buy insurance products from companies whose financial stability has improved because of hedging, either directly or indirectly or through recommendations by external parties (Purnanandam (2008)).

We examine the financial stability, hedging and product pricing behavior, as well as subsequent product market sales and market share of insurers following the staggered state-level adoption of this reform. We expect insurers that are likely to face costly external finance will be able to hedge more following the adoption of IRMA Section 711 by their domicile state, relative to unaffected companies. To identify insurers that are likely to face costly external finance and potential future financial distress, we use both ex ante leverage as well as measures that capture a high future potential of bankruptcy. This increase in hedging is possible because derivatives counterparties are more likely to engage in derivatives transactions with highly leveraged insurers if they are more protected in case of receivership or contract-specific events of default. We also expect policy sales (life insurance and annuity premiums) and the market share of insurers with ex ante higher costly external finance and potential financial distress to increase in the post Section 711 period relative to unaffected companies.

Following the arguments of FSS and Froot, we argue that hedging allows life insurers to sell more policies by increasing their financial stability. We find that the propensity of negative income shocks or exit the sample because of receivership decreased by 7.6 percentage points (pp) and 1.7

[6] In 2017, the life insurance industry had a total of \$7.13 trillion of assets under management, consisting of \$3.37 trillion in bonds, \$2.29 trillion in stock, \$0.54 trillion in real estate mortgages, and the remaining \$0.93 trillion invested in other assets, such as loans to policyholders. Figure A1 in the Appendix contains key facts about life insurance companies in 2017.

pp, respectively, for highly leveraged insurers relative to control companies post Section 711 (see, Jarrow (2020); and DeAngelo and Stulz (2015), for insights on the role of hedging for the financial stability of insurers and banks, respectively). Relatedly, using data from the NYU Stern Volatility Lab database, we find that "systemic risk" of parent companies with highly leveraged life insurance affiliates domiciled in Section 711 went down in the post Section 711 period, further suggesting that life insurance affiliates are more stable as a consequence of more hedging.[7]

We show that insurers that are likely to face costly external finance increase hedging after staggered state-level financial reform that reduces the costs of hedging. We show that these firms that hedge have lower risk and higher market stability post hedging. These actions have an impact on the product market and competition. Firms that increase hedging lower price and increase their policy sales relative to unaffected companies. These firms are able to increase their market share after they engage in hedging.

Specifically, we find a significantly large increase in the derivatives notional amount of previously highly leveraged insurance companies and for firms with a high probability of financial distress. Derivatives increase in the years after their domicile states passed Section 711, compared to a control group. We also find that the propensity to hedge and the proportion of assets and liabilities hedged increased by 5.2 pp and 6.1 pp, respectively, for the treated group period relative to the control group in the post Section 711. We further find that life insurance and annuity policy sales increased for the treated insurers relative to the control group in post Section 711 period by about 13.3% and 20.7%, respectively. Importantly, our evidence indicates that pre-existing trends cannot explain the increase in hedging and policy sales for the treated group following the reform.

We show that competition is impacted post Section 711 passage through the increase in policy sales. Insurers that potentially have higher costs of external finance increase their market share by 21.5% and 38.8% in the life insurance and annuity segments, respectively, relative to control companies following Section 711. Relatedly, we also find that affected companies were more likely

[7] In a theoretical setting, Acharya, Philippon, and Richardson (2016) identify corporate bond holdings, structured fixed-income products, and variable annuities sold as withdrawable products as major sources of systemic risk stemming from the insurance industry. Ellul et al. (2018) develop a model showing that variable annuities and regulatory capital requirements create an incentive for insurance companies to overinvest in illiquid bonds to obtain higher returns. This introduces systemic risk because insurers will collectively sell these assets in case of negative price shocks.

to become state leaders post Section 711. In particular, we find that the probability of having life insurance and annuity policy sales in the top 25^{th} percentiles of their respective distributions increased by 4% and 6.4%, respectively, for treated companies relative to control companies following Section 711.

We perform a series of tests to pin down the economic channels through which hedging allows life insurance companies to sell more policies. One important channel through which hedging allows life insurers to sell more policies is by increasing their financial stability, in line with our findings discussed above. As also discussed, by mitigating the risk that the value of financial assets decreases, hedging allows life insurers to price their products more competitively. Consistent with this prediction, we find that, for the average policy, prices decreased by about 9.8% for highly leveraged insurers relative to the control group after Section 711. Using hand-collected data for some of the more popular life insurance and annuity products, we further find that the prices of life annuity and term annuity policies went down for the treated group relative to the control group in the post Section 711 period by about 4.5% and 4.8%, respectively. Similarly, we find that the price of the 10-year term life insurance policy went down by about 3.7% for the affected insurers relative to control companies in the post event period, but no effect on the price of universal life insurance policies.

Finally, we examine the effect of Section 711 on life insurance companies' investments and performance. Our analysis reveals that highly leveraged life insurers invested the additional life insurance premiums and annuities collected in the post Section 711 adoption period in bonds, real estate, loans to policyholders, and other long-term assets. Overall, the increase in policy sales led to an increase in operating performance, indicating that treated insurers were able obtain better terms on the policies generated in the post Section 711 period. We also find an increase in investment income for the treated group in the post Section 711 period, which, combined with the higher operating performance, led to an increase in net income.

We run a number of tests to assess the robustness of our results. We include these in an Appendix. Our results are robust to (1) accounting for differences between treated and control companies, (2) controlling for domicile and licensing states regulatory and economic conditions,

(3) using alternative proxies for costly external finance, (4) using alternative estimation methods, such as the random effects and the fixed effects Tobit models (Honoré (1992)), (5) sample selection issues, and (6) treatment heterogeneity.

Our paper is broadly related to the literature on the relationship between risk management and corporate policies. This literature has focused on the effect of hedging on growth capacity in banking (Schrand and Unal (1998)), merger activities (Garfinkel and Hankins (2011)), operational hedging (Hankins (2011); Almeida, Hankins, and Williams (2017)), payout policies (Adams-Bonaimé, Hankins, and Harford (2014)), real effects (Cornaggia (2013); Pérez-González and Yun (2013); Gilje and Taillard (2017); Giambona and Wang (2020)) and debt financing (Babenko, Bessembinder, and Tserlukevich (2020)).[8] We contribute to this literature by identifying an important driver of risk management for life insurance companies. We show that regulation that mitigates derivatives counterparty risk leads to an increase in hedging and through hedging affects policy sales, market shares, product pricing, and financial stability of life insurers. We do so by relying on the quasi-natural experimental setting provided by the staggered adoption of IRMA Section 711 across 23 states over the period from 1998 to 2015.

Our paper also adds to the growing academic interest in the stability of insurance companies. This literature has focused on the effect of regulatory reserves and capital requirements (Koijen and Yogo (2015)), captive reinsurance regulations (Koijen and Yogo (2016)), accounting rules (Ellul et al. (2015); Koijen and Yogo (2017)), capital market (Koijen and Yogo (2018)) and regulatory limits (Sen (2019)) to risk management, insurance companies' investment choices (Becker and Ivashina (2015); Acharya, Philippon, and Richardson (2016); Ellul et al. (2018); Ge and Weisbach (2019)), and product pricing (Ge (2019)). We contribute to this literature by studying the effect of risk management on the risk and financial stability of life insurance companies.

In addition to the insurance industry studies discussed above, our paper contributes to the literature on the interaction between firm financial conditions and its product markets. This literature has considered how firm financial structure affect a firm's competitive position (Opler and Tit-

[8]These studies build on some of the earlier risk management work including, among others, Bessembinder (1991); Nance, Smith, and Smithson (1993); Tufano (1996); Géczy, Minton, and Schrand (1997); Graham and Rogers (2002); and Faulkender (2005).

man (1994); Phillips (1995); Kovenock and Phillips (1997); and product pricing (Chevalier (1995); Chevalier and Scharfstein (1996)), the effect of firm-customer relationships on capital structure (e.g., Kale and Shahrur (2007); Banerjee, Dasgupta, and Kim (2008)), or the nexus between governance and competition (Giroud and Mueller (2011)). We contribute to this literature by studying the effect of risk management on competition including the market share and product pricing of life insurers. While the theoretical literature has identified the importance of risk management for the product market (FSS, Adam, Dasgupta, and Titman (2007); Purnanandam (2008)), to our knowledge, our paper is the first to analyze this relationship empirically.

The rest of the paper is organized as follows. Section 2 discuss the use of derivatives by life insurance companies. Section 3 discusses the insolvency of insurance companies and the treatment of derivatives counterparties after the Section 711 reform. Section 4 describes data and presents our empirical strategy. Section 5 presents our main results, robustness tests to assess reliability of our main results, and tests showing additional effect of Section 711 on insurers with ex ante high measures of costly external finance. Section 6 concludes.

2 The Use of Derivatives by Life Insurance Companies

We focus on life insurance companies because the bulk of derivatives by insurance companies is concentrated in this segment. For example, in 2015, among all insurance segments, life insurers accounted for 94.7% of the reported derivatives notional amount, followed by Property & Casualty (P&C) companies, which accounted for 5.2%. Derivatives exposure in the health and fraternal segments was minimal, and title insurers reported no exposure. 96.6% of life insurance companies used derivatives for hedging (NAIC (2015)).

Figure 1 graphically presents the notional amount of life insurers' derivatives transactions.

[Figure 1]

Figure 1 shows that the notional amount of life insurers' derivatives transactions grew significantly during our sample period, from \$ 0.56 trillion in 2000 to \$ 2.14 trillion in 2017. Notably, the pace of the growth accelerates when states pass safe harbor provisions. For example, the notional derivatives amount was \$0.52 trillion in 2004, oscillated between \$0.56 or \$0.57 in the years from 2000 to 2003, but spiked to \$0.64 trillion in 2005, after Michigan adopted Section 711, and again to \$0.89 trillion in 2006, following Section 711 adoptions in Iowa, Maryland, and Texas. In 2015, life insurers with derivatives exposure were domiciled in 43 states, but about 79% of the derivatives exposure was concentrated in life insurance companies domiciled in Connecticut, Delaware, Iowa, Massachusetts, Michigan, Minnesota and New York, which have all adopted the reform to IRMA Section 711 (NAIC (2015)) that we discuss in the next section.

The types of risks managed by life insurers with derivatives include hedging against a possible decline in stock prices if they have a large portfolio of guaranteed minimum death benefit annuities, using interest rate forwards or futures to manage the effect of changing interest rates on the value of their fixed income investments, or relying on credit default swaps to reduce their exposure to the default risk of certain companies they are invested in.

Notably, 96.4% of all derivatives used by life insurance companies in 2015 involved over-the-counter (OTC) swaps, forwards, and options (NAIC (2015)). In 2010, 98.2% of all life insurers' derivatives were OTC (NAIC (2010)), of which 57.2% were swaps, 39.7% were options, 3.1% were forward contracts. This is important for our analysis because OTC derivatives, unlike exchange traded derivatives (which are cleared through a central clearing house), carry significant counterparty risk and therefore could benefit from the special protection under the reform that we discuss in the next section that was granted by Section 711 of IRMA in case of default or insolvency.

About 23.7% out of all the 2010 derivatives had a maturity of one year, 38.1% had a maturity between 2 to 5 years, 20% had a maturity between 6 to 10 years, and the remaining 18.2% had a maturity longer than 10 years. Our own analysis using insurer-level data reveals that swaps have a relatively longer maturity than options. We find that 11.4% of the swaps had a maturity of one year, 36% had a maturity of 2 to 5 years, 20.4% had a maturity of 6 to 10 years, and the remaining 32.2% had a maturity of longer than 10 years. By comparison, 34% of the swaps had a maturity of one year, 41.4% had a maturity of 2 to 5 years, 18.9% had a maturity of 6 to 10 years, and the remaining 5.8% had a maturity of longer than 10 year.

3 Life Insurance Company Insolvency and The Reform of the Treatment of Derivatives

We first discuss the treatment life insurance company insolvency and then discuss the significant reform of how derivative contracts are treated under insolvency. In a nutshell, the reform reduced the likelihood of default by making derivative contracts less risky for the counterparty and thus reducing the cost of their use by life insurance companies.

3.1 Insolvency in the Life Insurance Industry

In this section, we discuss the treatment of insolvency by companies in the life insurance industry. We then present two facts that show the importance of potential financial distress in this industry. The insolvency of an insurance company is regulated by the company's state of domicile.[9] In practice, however, states generally share similar insolvency regulations because they have adopted (at least some parts) of IRMA (or the earlier Insurers Rehabilitation and Liquidation Model Act (IRLMA)) as drafted by the NAIC, the main regulatory support organization created and governed by the chief insurance regulators from the 50 states, the District of Columbia, and U.S. territories.[10] The main objective of IRMA is that policyholder claims are paid, while limiting liabilities for the states.

State insurance departments routinely monitor insurance companies by collecting, analyzing, and auditing financial reports, licensing requests, and risk-based capital reports. When necessary to establish whether an insurer is in financial troubles, the insurance department of the company's domicile state may require additional information from the company or other state insurance departments. If a troubled company is identified, state regulators take corrective actions to stabilize the financial situation. These corrective actions include, among others, monitoring the sale and pur-

[9] This principle was affirmed by the McCarran-Ferguson Act of 1945, and further reiterated by Gramm-Leach-Bliley Act of 1999, which allowed affiliations between banks, insurance companies, and security firms. Section 109 of the U.S. Bankruptcy Code expressly provides that domestic insurance companies and foreign insurance companies engaged in U.S. business may not become debtors under the Bankruptcy Code either for the purpose of Chapter 7 liquidation or Chapter 11 reorganization. The main argument for a state-level regulation of the insurance industry is that insurance is a regional matter because insurance consumers in each state are concerned with difference insurance issues.

[10] IRLMA was first enacted in 1978 and amended twice in 1986 and 2000. IRMA replaced IRLMA at the end of 2005 after NAIC completed a revision of its insurance insolvency model legislation.

chase of assets, changing the troubled insurer's management, changing the company's operations, and merging with a financially sound insurer.

To convey the importance of hedging, we present two facts that show that potential financial distress is significant in this industry.

Fact 1: Insolvency and receivership of life insurance companies is not rare. If the insurance commissioner of the company's domicile state determines that the company situation cannot be corrected, the troubled company is formally placed in receivership and the receiver initiates a conservation process, regulated by the laws of the state, to assess whether it would be best for the interest of policyholders and creditors to return the company to private management, to start a rehabilitation process, or to liquidate the company. Our analysis using data from the National Organization of Life and Health Insurance Guaranty Associations (NOLHGA) shows that 4.6% of life insurers were placed in receivership (conservations, rehabilitations, and liquidations) during 2000−2017. About 10% of the insurers placed in receivership had exposures to derivatives at the time of the insolvency. For the case of larger insurers (companies licensed in multiple states requiring NOLHGA's involvement), the percentage of receivership cases was lower, but still sizable at 2.8%.

Fact 2: Our analysis also shows that receivership can be a very lengthy process. About 60% of cases started as either conservation or rehabilitation before being converted into liquidation. It took on average about 18 months before this conversion occurred, while the liquidation process on itself took on average more than 7 years to be completed. In 14% of cases, the company was successfully rehabilitated and returned to private management. The rehabilitation process took on average 34 months.

3.2 The Reform of the Treatment of Derivatives in Company Insolvency

Until the reform of the treatment of derivatives was passed by each state, derivatives counterparties were typically also subject to the automatic stay and the uncertainty typical of any receivership procedure. Things changed in 1998 when Connecticut, followed by 22 other states (over the period 2004-2015), passed Section 711 of IRMA, granting derivatives counterparties of an insurance company in receivership a safe harbor protection.[11] The latest state to join the safe harbor group is Wisconsin in 2015.

Figure 2 shows the complete list of states with safe harbor provisions and years of adoption. The list is compiled from NAIC reports, websites of state insurance departments, and from reports by news agencies.

[Figure 2]

These safe harbor provisions allow the derivatives counterparty of an insurance company domiciled in a Section 711 state to terminate the derivatives contract and net out all derivative contracts take the collateral posted as margin if the insurance company is placed in receivership, giving, effectively, such counterparty a special protection against the costly consequences of the automatic stay.[12] More generally, Section 711 allows for the enforceability of pre-receivership termination clauses, which give the non-defaulting derivatives counterparty the right to terminate the derivatives contract and claim the collateral posted as margin (both initial margin, to cover potential losses if default and variation margin to cover marked-to-market changes)[13] and if the insurance company triggers an event of default (e.g., a rating downgrade) negotiated in the contract, even if the company is not formally in receivership. This effectively means that derivatives counterparties of a Section 711 insurer can terminate the contract before the insurance company is formally declared insolvent, thus avoiding the uncertainty typical of financial distress (to which even policyholders are subject to), and without being subject to the avoidance powers, which requires that any property transferred within a certain time frame prior to insolvency must be returned to the insurer's estate, when such transfer constitutes a preference.

We expect therefore that hedging should increase for insurers with high measures of costly external finance (those insurers more likely to default), relative to unaffected companies, following

[11] Although we refer exclusively to Section 711 of IRMA, the safe harbor provisions of Connecticut and Michigan are based on Section 46 IRLMA. Section 711 and Sections 46 are very similar in terms of the protection provided to derivatives counterparties in case of insolvency.

[12] Collateral posted by life insurers to over-the-counter (OTC) derivatives counterparties is available in Schedule DB - Part D - Section 2 starting in 2013. On average, life insurers pledged $13.6 billions or 47% of their cash balances to OTC counterparties over the period 2013-2017.

[13] See Berends and King (2015) for more detail on collateral and margins.

the adoption of IRMA Section 711 by their domicile state. We also expect policy sales (life insurance and annuity premiums) for the affected insurers to increase in the post-adoption period, relative to unaffected insurers. This sales increases are predicted because hedging contains the risk that the value of financial assets decreases allowing affected insurers to price their policies more competitively.

Further, hedging can help insurers selling more policies because customers are more inclined to buy policies from companies whose financial stability has improved because of hedging. Thus, we also expect that competition between insurers will be impacted. To the extent the this reform allows previously financially constrained firms or firms that face financial distress to access derivatives to reduce risk and thus be more attractive to consumers in the product market, we expect that these firms will sell more products and gain in market share post reform.

It is important to note that IRMA Section 711 is the result of lobbying from the derivatives industry claiming that derivatives superpriority was important to contain systemic risk stemming from the derivatives market. This lobbying intensified after the demise in 1998 of Long-Term Capital Management (LTCM), who had derivatives positions with a notional value of about $1.25 trillion. The policymakers' response to this event was the passage of derivatives superpriority regulations to safeguard derivatives counterparties engaged in transactions with a large spectrum of end-users, including insurance companies with Section 711 of IRMA and non-financial firms with the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005.[14] These reforms therefore are plausibly exogenous to pressures from end-users and originated because of regulatory changes wanted by the derivatives industry and supported by policymakers, which is important for our identification strategy.

The extent to which unpaid policyholder claims in case of insolvency are paid by the guaranty fund varies by state and depends on the per-person limit set by the policyholder's residence state.[15] This variation suggests that the consequences of an insurance company financial distress

[14] See, among others, Stulz (2004); Edwards and Morrison (2005); Lubben (2009); and Duffie and Skeel (2012), for a general discussion of derivatives safe harbor and systemic risk.

[15] The maximum coverage provided by the guaranty association in most states is based on NAIC's Life and Health Insurance Guaranty Association Model Act and is typically capped at $300,000, for any one policyholder with one or multiple policies. Virginia has a maximum coverage of $350,000 and there are eight states with a maximum coverage of $500,000.

for policyholders depend on their state of residence. We thus perform our empirical analysis at the insurer-state level, whenever data is available at such level of disaggregation. Further, insurer-state level data allow us also to directly control for state-level changes in regulations and economics conditions that could also affect policy sales.

4 Data and Empirical Design

4.1 Data

To test our predictions, we obtain data from several sources. Insurer-state level premiums, licensing data, and insurer level data come from the S&P Global SNL Insurance Statutory Financials database. The derivatives data is from the National Association of Insurance Commissioners (NAIC) Schedule DB annual files. Life insurance policy prices are from Compulife, while annuity policy prices are manually collected from reports published by the WebAnnuities Insurance Agency. Section 711 adoption year information is hand collected from NAIC reports, the websites of state insurance departments, and news agencies. Domicile data is from the NAIC historical demographic annual files. Receivership data is from the National Organization of Life and Health Insurance Guaranty Associations (NOLHGA). Insurer's parent company systemic risk data is from the NYU Stern Volatility Lab (*https://vlab.stern.nyu.edu/docs/srisk*). Other company-level data for insurers' parent companies is from the S&P Global Companies database. Age-adjusted mortality rate data is from the United States Mortality Database website (*https://usa.mortality.org*). Rating data is from the A.M. Best's Insurance Reports database. Our sample contains 18 years of insurer-state level (for the life insurance and annuity premium variables) and insurer level (for all the other variables) observations over the 2000 – 2017 period.[16] Detailed definitions for all the variables used in the paper are in Table 1 in the Appendix.

Geographical heat maps in Figure 3 shows the distribution of life insurance companies by domicile and licensing state during our sample period.[17]

[16] Derivatives data in Schedule DB is not available prior to 2000, which is why our sample starts in 2000.

[17] Table A1, in the Appendix, shows the actual number of life insurers (% out of the total number of companies)

[Figure 3]

Panels A and B of Figure 3 display the number of life insurers by domicile state and by domicile state population, respectively. Panels C and D show similar maps by licensing state and licensing state population, respectively.

During our sample period, about 14.8% and 8.5% of life insurers were domiciled in Texas and New York, the second and fourth largest state by population, respectively. On the other hand, there were only about 2% of life insurers domiciled in California and Florida (the first and third largest state by population, respectively), and barely 2.5% domiciled in Connecticut, whose capital, Hartford, is considered the "insurance capital of the world". The distribution of insurers by domicile state becomes more homogeneous after scaling the number of life insurers by their domicile's state population. This is visible by comparing Figure 3, Panel B with Figure 3, Panel A. Overall, Figure 3, Panels A and B suggest that life insurers do not have a "preferred" domicile. This also applies when we consider life insurers by licensing state, Figure 3, Panels C and D.

Unlike domicile, which can only be established in one state, a life insurer can be licensed to sell policies in multiple states. Figure 4 displays the number of life insurers licensed in one, two, or multiple states. About 29% of life insurers are licensed in only one state, while only about 5% of companies operates in just two states. There are about 9% of life insurers operating in 3-10 states and 11-40 states, and about 13% of companies licensed in 41-50 states. Notably, 34% of life insurers operates in all 50 states, plus D.C.[18].

[Figure 4]

Figure 4 suggests that our sample is heterogeneous in terms of number of states in which a life insurer is allowed to operate.

Using NAIC historical demographic annual files, we also check the propensity of life insurers to change domicile state in relation to IRMA Section 711. The bars in Figure 5 show the total number of redomiciliations by life insurance companies in each year from 2000 to 2017, with the

domiciled and licensed in each U.S. state. An insurance company is said to be "domiciled" in the state that issued its first license. Once an insurance company has established its domicile, it may seek to be licensed in other states.

[18]Table A2, in the Appendix, reports the number of life insurance companies (% out of the total number of companies) licensed in only one state or multiple states for the period 2000 – 2017

orange portion of the bars indicating those redomiciliations into a state that has passed Section 711.

[Figure 5]

Figure 5 shows that redomiciliations of life insurance companies are rare. Moreover, we do not observe any pattern in redomiciliation associated to Section 711 adoption. This is perhaps unsurprising given that redomiciliations require the insurance companies to conform to state-specific regulations, which can be a costly process.

Table 1 gives the definitions for the key variables used in our paper along with the variable numbers from the SNL insurance database. Table 2 reports summary statistics for the main variables used in the paper for the sample period 2000 – 2017. Panels A and B report descriptive statistics at the insurer-state level and insure level, respectively. In Panels C and D, we report descriptive statistics for pre-event high leverage insurers, companies with leverage above the sample median in the year before the insurer's domicile state adopted IRMA Section 711, and pre-event low leverage insurers, companies with leverage below the sample median in the year before the insurer's domicile state adopted IRMA Section 711, or companies domiciled in a state that has not adopted IRMA Section 711 (which are also part of the control group).

We drop negative premium observations because these involve companies that are going into runoff/liquidation during a given year, companies spinning off/selling/ceasing their operations in a specific state during the year, or are the result of cancellation of policies which leads to refunds of premiums, causing returned premiums to exceed written premiums during the year. We further drop premium observations for insurers that report $0 premiums in states in which they are not licensed to operate. None of these filters have any effect on our findings.

[Table 2]

Table 2, Panel A shows that on average life insurers collected $5.4 million and $18.5 million in life insurance and annuity premiums in each state during 2000 – 2017. At the company level, Panel B shows that the average life insurance and annuity premiums were $168.9 million and $489.8

million, respectively. Notably, annuity policy sales were nearly three times as big as life insurance policy sales. These patterns persist when we compare pre-event high leverage and low leverage life insurers, Panels C and D, respectively. High leverage companies are also clearly larger policy sellers, collecting on average \$32.7 million and \$9.2 million in annuity and life insurance premiums, respectively, in each licensing state, compared to \$7.1 million and \$2.4 million for low leverage insurers.

Derivatives Notional (\$ billions), the notional amount of all derivatives contracts, and *Assets & Liabilities Hedged*, the ratio of derivatives notional to the sum of total assets, net liabilities, and derivatives notional, for the average life insurer, are \$1.4 billion and 14.3%, respectively (Panel B). *Derivatives (Yes = 1)*, a dummy for insurers reporting a derivatives notional value, indicates that on average around 17% uses derivatives. This figure is in line with evidence for banks in Rampini, Viswanathan, and Vuillemey (2020). Evidence in Panels C and D reveals that 32.8% of high leverage life insurers use derivatives compared to 9% of low leverage insurers, respectively. Assets are \$14.8 billion for high leverage insurers (Panel C), compared to \$2 billion for low leverage insurers (Panel D), confirming the evidence based on premiums discussed above that high leverage companies are larger. Figure A2 in the Appendix contains the list of the top 10 and bottom 10 life insurance companies by 2017 assets.

Leverage, the ratio of total liabilities minus ceded reserves plus assumed reserves to total assets, is 64.3% for the average life insurer (Panel B), with an average of 86.9% for high leverage companies (Panel C) and 53.6% for low leverage insurers (Panel D), respectively. The relatively high leverage is unsurprising for life insurers, reflecting liabilities associated to future policy claims. *Z-score plus* is the (Altman et al. 2017) updated Z-score for private companies.[19] The average of Z-score plus is 4.16 for life insurers (Panel B), with a mean value of 0.60 for high leverage insurers (Panel C) and 6.19 for low leverage insurers (Panel D), respectively. Table 2 also shows that *Net Income*, the ratio of net income to total assets, is 0.8% and 1.7% for high leverage (Panel C) and low leverage

[19] X-score plus is calculated as as $0.717 \cdot \text{X1} + 0.847 \cdot \text{X2} + 3.107 \cdot \text{X3} + 0.420 \cdot \text{X4} + 0\ .998 \cdot \text{X5}$, where X1 is the ratio of cash and cash equivalents (SNL key field 114210) to total assets (SNL key field 122915), X2 is the ratio of retained earnings (SNL key field 114097) to total assets; X3 is the ratio of pre-tax operating income (SNL key field 123445) to total assets; X4 is book equity (SNL key fields' 122915 - 122921) to total liabilities (SNL key field 122921); and X5 is total sales (SNL key fields' 121229 + 121230 + 121231 + 121232) to total assets.

(Panel D) life insurers, respectively.

To account for differences between high leverage and low leverage insurers, in all our regression we include insurer fixed effects (company level regressions), insurer-state fixed effects (company-state level regressions) and the natural logarithm of assets. In robustness tests, we further match high leverage and low leverage insurers based on relevant characteristics.

4.2 Empirical Strategy

We rely on the staggered adoption of Section 711 to identify the effect of derivatives superpriority on derivatives usage, financial stability, and policy sales (life insurance and annuity premiums) of pre-event high leverage insurers (treated group) relative to pre-event insurers (control group) in the post adoption period. Twenty two states have adopted IRMA Section 711 in the period 2000 – 2017 (our sample period), starting with Michigan in 2004, and ending with Wisconsin in 2015. The first state to adopt Section 711 was Connecticut in 1998, but derivatives information in NAIC Schedule DB is available only from 2000, which is why our sample period starts in 2000. This setting and our results are robust to the timing concerns about staggered difference-in-difference estimates raised by Cengiz et al. (2019), Callaway and Sant'Anna (2020), and Baker, Larcker, and Wang (2021). In particular, we use never treated states as control states and show that there are no yearly pre-trends (Cengiz et al. (2019) and Callaway and Sant'Anna (2020)). Lastly, we also conduct a number of placebo tests.

To test whether hedging increased for insurers facing costly external finance measures relative to the *never-treated* control group following the adoption of Section 711 in their domicile state, we estimate the following staggered difference-in-difference model:

$$\begin{aligned} Hedging_{i,t} &= \beta_1 \cdot (\textit{Pre-event Costly External Finance} \times PostSection711)_{i,Sec711} \\ &\quad + \beta_2 \cdot PostSection711_{i,Sec711} + \gamma \cdot Log\ of\ Assets_{i,t-1} + y_i + z_t + d_i \times z_t + \epsilon_{i,t} \end{aligned} \tag{1}$$

where $Hedging_{i,t}$ is hedging by insurer i in year t. We measure hedging with *Log of Derivatives*, the natural logarithm of the notional amount of all derivatives contracts, *Derivatives (Yes = 1)*, a dummy for insurers reporting a derivatives notional value, and *Assets & Liabilities Hedged*, the ratio of derivatives notional to the sum of total assets, net liabilities, and derivatives notional. We indicate *Pre-event Costly External Finance* using several different measures. We use both insurers with different leverage measures above the sample median in the year before the insurer's domicile state adopted Section 711 and also use ex ante Altman Z-Score plus below 1.23.[20] $PostSection711$ is an indicator equal to one in the year of the passage of Section 711 by the insurer's domicile state and the following years, and zero otherwise. $PostSection711$ is always zero for insurers domiciled in states that did not pass Section 711 during our sample period. In all regressions, we control for lagged *Log of Assets*. We also include insurer fixed effects (y_i), year fixed effects (z_t), and insurer's domicile times year fixed effects ($d_i \times z_t$). Standard errors are double-clustered at the domicile-state and year levels. We use very similar insurer-level specifications in our negative shock regressions and other company-level regressions.

To assess the effect of Section 711 on policy sales (life insurance and annuity premiums), we estimate the following staggered difference-in-difference model at the insurer-state level:

$$\begin{aligned} Premiums_{i,s,t} = {} & \beta_1 \cdot (Pre\text{-}event\ Costly\ External\ Finance \times PostSection711)_{i,Sec711} \\ & + \beta_2 \cdot PostSection711_{i,Sec711} + \gamma \cdot Log\ of\ Assets_{i,t-1} + l_{i,s} + z_t + \epsilon_{i,s,t} \end{aligned} \tag{2}$$

Where $Premiums_{i,s,t}$ is either the natural logarithm of life insurance premiums or the natural logarithm of annuity premiums collected by insurer i, in state s, in year t. In all regressions, we control for insurer-level lagged *Log of Assets*. We also include insurer-licensing-state fixed effects ($l_{i,s}$), an indicator for insurer i in licensing state s, and year fixed effects (z_t). Standard errors are double-clustered at the licensing-state and year levels. We use a very similar specification in all insurer-state level regressions.

As discussed in Bertrand and Mullainathan (2003), the availability of insurer-licensing-state level data (the equivalent of state of plant location in Bertrand and Mullainathan (2003)) signif-

[20]A score below 1.23 indicates that a company is financially distressed, while a score above 2.99 indicates that a company is financially sounds (Altman et al. (2017)). Given that companies with a Z-score between 1.23 and 2.99 cannot be categorized as financially distressed or financially sound without error, we exclude such firms from our analysis.

icantly strengthens the identification strategy. In addition, we follow the suggestions of Baker, Larcker, and Wang (2021) to ensure that our estimates are robust. In our setting, Section 711 is adopted at the insurer-domicile-state level. If only insurer-domicile-state level data were available, then one could be concerned that the passage of the reform is capturing other contemporaneous economic and regulatory changes, or the passage of the law itself is influenced by the economic and regulatory conditions of the domicile state. Insurer-licensing-state level data overcomes these concerns because it is unlikely that domicile-state regulators respond to the economic and institutional environment of the states in which their domiciled insurers are licensed to sell policies.

5 Results

5.1 Derivatives Usage after Section 711 Adoption

Table 3 presents results from our life-insurer level hedging regressions. The dependent variables are *Log of Derivatives*, *Derivatives (Yes = 1)* dummy, and *Assets & Liabilities Hedged*, in columns [1] – [3], [4] – [6], and [7] – [8], respectively.

[Table 3]

We find that *Pre-event High Leverage* $\times$ *PostSection*711, the interaction term of interest, enters all estimations in Table 3 with a significantly positive coefficient. Focusing on columns [2], [5], and [8], specifications with lagged *Log of Assets* as control, the coefficients on the interaction term indicate that derivatives notional, propensity to use derivatives, and the ratio of derivatives notional to the sum of assets, net liabilities, and derivatives notional increased for the treated group relative to the control group by 226% (=exp(1.183)-1), 5.2 pp, and 6.1 pp, respectively, following Section 711. In this analysis, we rely on a simple metric, whether the insurer's leverage is above the sample median prior to the domicile state passage of Section 711. In columns [3], [6], and [9], we show that our hedging results are robust, both statistically and economically, if we categorize an insurer as financially distressed if its Z-score plus, a private-firm version of the original Altman (1968) Z-score, is below 1.23, and financially sound if its Z-score plus is above 2.99 (Altman et al.

(2017)). For this analysis, we exclude insurers with a Z-score between 1.23 and 2.99, because these companies cannot be categorized as financially distressed or financially sound without error. In line with the logic of our identification strategy, these results suggest that hedging for highly leveraged insurers increased following Section 711 because derivatives counterparties are more inclined to engage in derivatives transactions with these insurers if they are more protected in the event of default.

As discussed, the dependent variable in columns [5] – [6] is the ratio of derivatives notional to the sum of assets, net liabilities, and derivatives notional. We scale by the sum of total assets and net liabilities because insurers use derivatives to reduce the risk of a change in the value or cash flow of both assets and liabilities (e.g., liabilities due variable annuity guarantees). We add derivatives notional to the denominator to ensure that the ratio ranges from 0 to 1. Table A3, in the Appendix, shows that our hedging results are very similar if we scale derivatives notional only by assets, or if we use other scaling metrics.

One potential concern with any difference-in-difference design is that the post treatment effect could be the consequence of a preexisting trend unrelated to the treatment itself. This is less of a concern in the case of a staggered difference-in-difference design because these potential preexisting trends would have to occur multiple times and be staggered like the actual treatment effects to explain the results. Nevertheless, we conduct formal parallel trends tests in Table 4. We re-estimate columns [2], [5], and [8] of Table 3 by adding interactions of the *Pre-event Costly External Finance* variable with a PreSection711 indicator equal to one in the year prior to the actual passage of Section 711. We repeat the estimations with PreSection711 indicators equal to one in the two years or the three years prior to the passage of the reform.

In the absence of preexisting trends, these placebo Pre-Section 711 interaction terms should be statistically insignificant. Table 4 confirms this expectation for our three hedging measures, where our main interaction term, *Pre-event Costly External Finance* $\times$ *PostSection*711, remains statistically significant, and all the placebo interactions are both economically and statistically insignificant.

[Table 4]

We also perform a yearly test of the parallel trend assumption by plotting yearly coefficients on the interaction term of interest, together with ninety-percent confidence intervals. The regression specifications are the same as those reported in columns [2], [5], and [8] of Tables 3, except that the effect of Pre-event High Leverage is allowed to vary by year for each year starting four years prior to Section 711 adoption and ending four years after the adoption. We also plot the estimate on the interaction of Pre-event High Leverage with an indicator equal to 1 starting in year five after the Act adoption and ending in 2017. As Figure 6 shows, there is no evidence of pre-reform trends for any of our three hedging measures. Figure A3 in the Appendix presents the same plots with ninety-five percent confidence intervals.

[Figure 6]

We also estimate the hedging regressions using the stacked regression estimator (Cengiz et al. (2019), the CS estimator (Callaway and Sant'Anna (2020)), and our base staggered difference-in-difference estimator while keeping insurers in the sample only for three years after the treatment.[21] These estimations help to mitigate the concern that our results could be driven by treatment heterogeneity across years where later years can impact the estimates. Table A4 in the Appendix shows that our hedging results are robust in these tests.

5.2 Negative Shocks and Exit after Section 711 Adoption

We argue that hedging allows financially distressed companies to attract more customers by stabilizing their financial condition (Purnanandam (2008)). To assess this effect, we test if the propensity of negative shocks to income and capital & surplus decreased for treated insurers relative to control companies after Section 711 adoption. We consider also a life insurer's propensity to exit the same due to receivership or other event. Table 5 presents these results.

In Panel A, the dependent variable is an indicator for insurers with negative *Net Income* (column [1]), or for insurers with *Net Income* in the current period less than 33%, 50%, 67%, or 75% of

[21]The stacked regression approach consists of "stacking" events in event-time (using eight-year time windows centered around each stacked-sample event), effectively preventing past treated firms could serve as comparison firms in the estimation. The CS estimator (Callaway and Sant'Anna (2020)) measures the aggregate average treatment effect on the treated (ATT), ensuring that only never-treated firms are used as comparison units. We are grateful to these authors for providing their STATA code and R package.

the Net Income in the previous period (columns [2] to [5]). In Panel B, the dependent variable is an indicator for insurers with *Capital* & *Surplus* (the ratio of capital and surplus to total assets) in the current period less than 33%, 50%, 67%, or 75% of the *Capital* & *Surplus* in the previous period (columns [1] to [4]). In Panel C, the dependent variable is an indicator for insurers exiting the sample due to receivership or other events (e.g., ceasing operations).

[Table 5]

In line with our prediction, results in Panel A show that the propensity to experience negative income shocks decreased for the treated group relative to the control group in the post Section 711 adoption period. The coefficient estimate on $Pre\text{-}event\ High\ Leverage \times\ PostSection711$ in column [1] is -0.076 (statistically significant at the 5% level), suggesting that, post Section 711, the propensity of having negative net income for highly leveraged insurers in Section 711 states went down by 7.6 pp. We reach similar conclusions in columns [2] - [5] for different level of shocks to insurer's net income.

Turning to capital & surplus shocks, we do not find a significant coefficient for the interaction term of interest when the dependent variable is an indicator for insurers with capital & surplus in the current period less than 33% of the capital & surplus in the previous period (i.e., insurers that lost 67% of their capital & surplus), Panel B, column [1]. However, coefficient estimates on $Pre\text{-}event\ High\ Leverage \times\ PostSection711$ are negative and significant in columns [2] - [4], suggesting that the propensity of capital & surplus to be less than 50%, 67%, and 75% of the previous year capital surplus decreased by 0.9 pp, 2.6 pp, and 3.2 pp, respectively, for the treated group relative to the control group in the post Section 711 adoption period.

Finally, Panel C shows that the propensity of exit due to receivership or other corporate event decreased by 1.7 pp for highly leveraged insurers relative to the control group following Section 711 adoption. This effect is sizable compared to sample average exit of 3.3%. Overall, these findings indicate that the financial stability of highly leverage insurers in Section 711 states increased relative to the control group in the post adoption period.

5.2.1 Systemic Risk of Life Insurers' Parent Companies after Section 711 Adoption

Our derivatives usage analysis indicates that post Section 711 life insurers likely to face higher potential financial distress costs increase their hedging as a result of their domicile states adopting Section 711. This increase in hedging led to an increase of firm financial stability. We now examine if Section 711 led to a reduction in the systemic risk contribution of life insurers' parent companies.

Our sample includes life insurers' parent companies identified as systemically risky in the New York University (NYU) Stern Volatility Lab database at least once during 2000-2017.[22] For these companies, we collect from the database data on systemic risk contribution ($), defined as the financial sector capital shortfall that would be experienced by a financial institution in the event of a crisis.

We use the ratio of systemic risk contribution to total assets of all life insurance affiliates within a group as dependent variable. We perform these regressions at the parent company level. In this test, *Pre-event High Leverage* is an indicator for parent companies with leverage above the sample median the first year one of the affiliates' domicile state passes Section 711. Control variables are obtained by combining insurer level data within each group. Regressions also include parent company fixed effects and year fixed effects.

[Table 6]

Table 6 presents these results. The coefficient on *Pre-event High Leverage* $\times$ *PostSection*711 is negative and statistically significant. We obtain a coefficient of -1.984, statistically significant at the 5% level, which suggests that systemic risk contribution for highly leveraged parent companies with affiliates in Section 711 states decreased by about 26.8% relative to the pre Section 711 average systemic risk contribution for the treated group of 7.403 (= -1.984/7.403 = -0.268 or -26.8%). Overall, the evidence in Table 6 indicates that increased access to hedging of highly leverage life

[22] Table A5 in the Appendix shows that, as of December 31, 2017, there are 5 insurance companies (highlighted in yellow) in the top 10 list of systemically important financial institutions. The top 20 list includes 8 insurance companies. 7 out of the 8 systemically important insurers have ratings of A or A+, which indicate excellent and superior ability to meet obligations, respectively. Genworth has ratings of B, indicating a fair ability to meet obligations. For all the companies, RBC ratios largely exceed 200%, which is the threshold below which the NAIC will require corrective actions. Leverage for these 9 companies is high, ranging from 85% to 95%, indicating concerns with their financial stability.

insurance groups following Section 711 contributed to improve the systemic risk profile of the group relative to unaffected parent companies.

5.3 Life Insurance Policy Sales after Section 711 Adoption

One of our key predictions is that by increasing financial stability, hedging helps insurers that are potentially likely to face ex ante costly external finance or potential financial distress to sell more policies. Table 7 presents results from premium regressions. The dependent variables are *Log of Life Insurance Premiums* and *Log of Annuities*, in columns [1] − [2] and [3] − [4], respectively. We perform this analysis at the insurer-state level. As discussed in Section 3, this allows to control for differences in the extent to which unpaid policyholders claims in case of insolvency are covered by the guaranty fund of the policyholder's residence state, as well as differences in regulations and economic conditions across states that could affect policy sales (life insurance and annuity premiums). To this end, all our estimations include insurer-licensing-state fixed effects and year fixed effects.

[Table 7]

The coefficient estimates on *Pre-event High Leverage*$\times$ $PostSection711$ and *Pre-event Low Z-score*$\times$ $PostSection711$ are positive and statistically significant at the 1% level across all four estimations in Table 7. Focusing on columns [1] and [3], specifications with *Pre-event High Leverage* as a proxy for distress, the coefficients on the interaction term suggests that life insurance premiums and annuities increased by about 13.3% and 20.7%, respectively, for the treated group relative to the control group in the years following Section 711. Evidence in columns [2] and [4] suggests that life insurance premiums and annuity increased by about 21.9% and 17.5%, respectively, when we use *Low Z-score*, based on Z-score plus, as a proxy for distress. In line with the logic of our identification strategy, these findings suggest that hedging allowed highly leveraged life insurers to sell more policies by increasing their financial stability Purnanandam (2008). Our results are also robust when we use three different modified versions of our main leverage measure accounting for reinsurance activities, parent's company leverage, and cash holdings, respectively. We present these results in Appendix Table A8. Altogether, these findings indicate that our results are robust to alternative proxies of costly external finance.

To deal with potential treatment heterogeneity, we also run our premium regressions using the stacked regression estimator (Cengiz et al. (2019), the CS estimator (Callaway and Sant'Anna (2020)), and our base staggered difference-in-difference estimator while keeping insurers in the sample only for three years after the treatment. Appendix Table A11 shows that our life insurance and annuity results are robust in these estimations. In addition, we exclude Connecticut, the first state to adopt Section 711 in 1998, and the results are also robust.

We test the parallel-trend assumption for the premium regressions by adding interactions of pre-event indicators with *Pre-event Costly External Finance*. We consider one year, two years, and three years prior to the actual event. As Table 8 shows, while our main post-event interactions remains highly significant, none of the pre-event interactions are statistically significant. These findings are reassuring that our life insurance and annuity premium results are unlikely to be driven by pre-existing trends.

[Table 8]

We also plot the yearly coefficients on the interaction term of interest, together with ninety-percent confidence intervals to examine for pre-trends. The regression specifications are the same as those reported in columns [1] and [3] of Tables 7, except that the Pre-event High Leverage is interacted with year dummies from four years prior to Section 711 adoption and to four years after the adoption. We also plot the estimate on the interaction of Pre-event High Leverage with an indicator equal to 1 starting in year five after the Act adoption and ending in 2017. Figures 7 displays no evidence of pre-reform trends for either our life insurance premium or annuity measures.

[Figure 7]

In Table 7, the control group includes the "universe" of other life insurers. One possible concern with this approach is that some characteristics of treated and control firms will be different (which could be problematic if there are reasons to believe that these characteristics could influence premiums in the post-treatment period). To deal with this issue, we match each high leverage insurer (treated) to its closest low leverage insurer (control), identified based on log of assets, net income, and exact matching on year. We perform our matching using the Abadie and Imbens (2006) bias-corrected matching estimator. After matching on these characteristics, treated and control firms are similar (descriptive statistics and distributional characteristics for the matched samples are in the Appendix, Table A6)[23]. Table 9 presents premium regression results for the matched sample.

[Table 9]

Across both estimations in Table 9, the coefficients on $Pre\text{-}event\ High\ Leverage \times\ PostSection711$ is positive, statistically significant at 1% level, and economically larger compared to the coefficients for the interaction term in the base premium regressions in Table 7. Overall, these findings further suggest that differences between treated and control firms are unlikely to be the reason for our premium results and provide additional validation for our identification strategy.

Several additional tests, which we discuss in detail in the Appendix, further confirm the robustness of our premium findings. In brief, our results are robust to: (1) controlling for licensing-state × year fixed effects (Appendix Table A7); (2) using alternative leverage measures (Appendix Table A8); (3) relying on alternative estimation methods, such as the random effects and the fixed effects Tobit models (Honoré (1992)) (Appendix Table A9); (4) accounting for potential sample selection (Appendix Table A10); (5) controlling for treatment heterogeneity (Cengiz et al. (2019) and Callaway and Sant'Anna (2020)) (Appendix Tables A4 and A11).

In our identification strategy, hedging increases for highly leverage insurers after the passage of Section 711, and higher hedging allows treated companies to sell more policies (life insurance and annuity premiums). Next, we assess the effect of Section 711 on policy sales of highly leverage insurers in states affected by a high mortality "shock" prior to Section 711. To this end, we estimate a difference-in-difference-in-difference version of our premium regressions in which the variable of interest is $Pre\text{-}event\ High\ Leverage \times Pre\text{-}event\ High\ Mortality \times PostSection711$, where $Pre\text{-}event\ High\ Mortality$ is an indicator for insurer-licensing states with annual age-adjusted mortality rates (deaths per 100,000) above the sample median in the year before the insurer's

[23]The p-values for the mean difference t-tests and the Wilcoxon–Mann–Whitney rank-sum distributional tests in the matched sample are all largely above the 10% threshold (Table A6). This suggests that treated and control companies are similar in terms of characteristics and distributional assumptions in the matched sample.

domicile state adopted IRMA Section 711. Age-adjusted mortality rate data is from the United States Mortality Database website (*https://usa.mortality.org*).

Table 10 shows that *Pre-event High Leverage* $\times$ *PostSection*711 enters both the life insurance and annuity regressions with significantly positive coefficients, which are also very similar in size to the coefficients on the interaction term in the base premium regressions in Table 7. *Pre-event High Mortality* $\times$ *PostSection*711 enters both premium regressions with economically small and insignificant coefficients.

[Table 10]

The coefficients on the triple interaction terms are significantly positive for both the life insurance and annuity regressions, indicating that highly leverage life insurers, whose hedging has increased because of Section 711, are able to respond to the negative mortality shock and issue more policies. Life insurance products protect an individual's family in case of early death. A spike in mortality rates is clearly a negative shock for life insurance products, making it important for life insurers to have access to hedging instruments to be able to continue to sell life insurance policies. The triple interaction term is positive, but economically smaller for annuities. The smaller effect for annuities is perhaps unsurprising because an increase in mortality rates does not directly affect these instruments. Annuities are typically used to manage the risk of living too long and not having enough retirement savings. In case of early death, a spouse or other beneficiary would still be entitled to payments, suggesting that mortality rates play a limited role for these products.

5.4 Product Pricing after Section 711 Adoption

Our evidence shows that financial stability increases for life insurers likely to face higher costs of external finance following Section 711, and this is associated with an increase in policy sales. Hedging also reduces the risk that the value of financial assets decreases allowing highly leveraged insurers to sell more policies by pricing their products more competitively. To test this prediction, we collect detailed pricing information on two of the more popular life insurance products, guaranteed universal life polices and 10-year term life policies, and two of the more popular annuity products, life annuities and term annuities.[24] We combined this data with company-state level average policy prices, computed as the ratio of company-year state level premiums to number of policies.

Price quotes for the guaranteed universal life and the 10-year term life policies are extracted from Compulife. We collect the data for healthy non-smoking males and females aged 30, 40, 50, and 60 seeking $250,000 in death benefits. That means that, for each life insurer, we have up to eight yearly life insurance prices, one for each of the four age groups for the two genders. The data is available from 2003 – 2017 and 2002 – 2017 for the guaranteed universal life and the 10-year term life products, respectively. Price quotes for both annuity products are manually collected from reports published by the WebAnnuities Insurance Agency and are available from 2000 – 2017. For life annuities, we collect price quotes for both males and females aged 50, 55 and 60, up to six policy prices for each insurer. For term annuities, we collect prices for 5-year, 10-year, 15-year, 20-year, 25-year, and to 30-year maturity products, up to six policy prices for each insurer. We collect all price quotes as of December of each year. Policy level regressions include product and gender fixed effects.

[Table 11]

Table 11 presents results from pricing regressions. The coefficient of interest in column [1] is negative and statistically significant at 1% level, indicating that policy prices for the average policy at the company-state level went down by about 9.8% for highly leveraged insurers post Section 711. We do not find any change in the pricing of guaranteed universal life policies for highly leveraged life insurers following Section 711, column [2]. However, we find that the prices of 10-year term life policies (column [3]), life annuities (column [4]), and term annuities (column [5]) decreased by about 3.7%, 4.5%, and 4.8%, respectively, for treated companies relative to control companies in the post adoption period. In line with the logic of our identification strategy, this finding suggests that hedging (by limiting potential negative changes in the value of financial assets) allowed highly

[24]Because price markups are estimated in excess of actuarial values, which by definition are identical across companies for the same insurance products (Koijen and Yogo (2015)), using life insurance product prices is equivalent to using markups.

leveraged insurers to lower the prices of their insurance products and this led to an increase in policy sales (life insurance and annuities).

5.4.1 Number of Policies after Section 711 Adoption

Our evidence indicates that policy sales (life insurance and annuity premiums) increased post Section 711 significantly for life insurers likely to face ex ante higher costly external finance. As a complement to these findings, we study the effect of Section 711 on the number of policies. We note that life insurers report only aggregate information on the number of polices, and therefore we are unable to quantify separate effects for life insurance and annuity products. Table 12 reports number of policy regression results.

[Table 12 here]

In Table 12 column [2], specification with log of assets as control, the coefficient of 0.057, statistically significant at the 5% level, suggests that number of policies increased by about 5.7% for highly leverage life insurers relative to control companies following the adoption of Section 711 by their domicile state. In line with the logic of our identification strategy, these findings further suggest that hedging has important product market effects through higher financial stability and more competitive pricing.

5.5 Market Share after Section 711 Adoption

In this section, we examine how the increase in policy sales (life insurance and annuities) affected the competitive position for life insurers likely to face ex ante higher costly external finance. We examine market share for insurers for each state in which they operate relative to control companies post Section 711. We measure a life insurer's state level market share as the ratio of the insurer's policy sales in each state-year to total policy sales of the life insurers in that state-year, market share. We do this separately for life insurance and annuity policy sales and multiply the market share variables by 100 in our regressions. In addition, we build indicators for life insurers with policy sales in the top 25^{th} percentile of the state-year distribution of policy sales, market leadership. Once again, we do this separately for life insurance and annuity policy sales.

Table 13, Panels A and B report results from market share and market leadership regressions, respectively. Panel A, columns [1] and [2] show that life insurance and annuity market shares increased by 21.5% (obtained by scaling the interaction term coefficient of 0.042 by the sample average of 0.195) and 38.8% (= 0.080/0.206), respectively, for affected companies relative to control companies following Section 711.

[Table 13]

Relatedly, Panel B, columns [3] and [4] show that the propensity to be in the top 25^{th} percentiles of the life insurance and annuity policy sale distributions increased by 1 pp (or 4% relative to the sample average of 0.25) and 1.6 pp (or 6.4% relative to the sample average of 0.25), respectively, for highly leverage companies relative to the control group post Section 711. Overall, the evidence in Table 13 suggests that the increase in policy sales post Section 711 allowed affected life insurers to gain significant market share and leadership position relative to control companies.

5.6 Investments and Performance after Section 711 Adoption

In the last part of the paper, we examine the effect of Section 711 on insurance companies' investments and performance. Table 14 shows that post Section 711 life insurers likely to face ex ante higher costly external finance invest the additional life insurance premiums and annuities collected in the post Section 711 adoption period in bonds, real estate, loans to policyholders, and other long-term assets. We do not find significant effects for investment in stocks.

[Table 14]

In terms of magnitude, the coefficient estimate on $HighLeverage \times PostSection711$ in column [1] suggests that bond holdings for treated insurers increased by about 19.4% relative to unaffected companies in the post adoption period. Similarly, investments in real estate (column [3]), loans to policyholders (column [4]), and other long-term investments (column [5]) went up by 62.7% (=exp(0.487)-1), 52.4%, and 198%, respectively, for the treated group relative to the control group following Section 711.

We also examine if the higher policy sales post Section 711 led to better performance. Table 15 presents our income specifications results.

[Table 15]

We find that operating income (column [1]) and operating margin (column [2]) increased for highly leverage life insurers relative to unaffected companies following Section 711. This evidence suggests that the increase in policy sales (life insurance and annuity premiums) for the affected insurers in the post adoption period led to an improvement in operating performance possibly because hedging allowed these companies to contain operating costs sufficiently to obtain a better performance in spite of selling polices at a lower price. That is, hedging had beneficial effects for both insurers and policyholders. We also find an increase in investment income for the treated group relative to the control group in the post Section 711 period (column [3]), which, combined with the higher operating performance, led to an increase in net income (column [4]).

6 Conclusions

We study the effect of hedging and risk management on policy sales (life insurance premiums and annuities) and competition among life insurance companies. We examine firms that are likely to face ex ante higher costly external finance and potential financial distress and examine them after the staggered state-level adoption of Section 711 of the Insurer Receivership Model Act. This reform reduced the cost of hedging for firms likely to face ex ante higher costly external finance as it grants the derivatives counterparty of an insurance company the right to immediately terminate the contract and claim the collateral in case of default or receivership.

We find that hedging increases for insurers with higher ex ante measures of leverage and the risk of financial distress post-passage of Section 711. We show that the risk and financial instability of the impacted companies also decreases post-Section 711 passage. Our results show how product market competition is impacted. We find a significant increase in life insurance and annuity policy sales for companies that ex ante had higher measures of potential financial distress - leading to a sizable growth in market share for these insurers in the states in which they operate. We attribute these changes to an improvement in the competitive position of these insurers post-passage of Section 711 as the risk of financial distress decreased with the increased use of derivatives for these impacted firms.

Our findings can have important implications for policymakers concerned with the stability of the insurance industry. In the aftermath of the 2007 – 2008 financial crisis, regulators started to be concerned that insurance companies could be an important source of systemic risk. Our findings suggest that derivatives superpriority can contribute to mitigating systemic risk through two important channels including the direct effect on the stability of the insurance industry by facilitating access to hedging instruments (and stimulating insurance policy sales) and by helping to mitigate the risk that financial distress would spread from the insurance industry to the banking industry. These risk reductions can occur by allowing the non-defaulting derivatives counterparty of an insurance company, which is typically a commercial bank, to terminate the derivatives contract and claim the collateral in case of default.

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Table 1: **Key Variables.** This table provides detailed definitions of the key variables used in this article.

Variable	**Definition**
PostSection711	An indicator equals to one in the year of the passage of Section 711 by the insurer's domicile state and the following years, and zero otherwise. The variable is always zero for insurers that did not pass Section 711 during our sample period.
Life Insurance Premiums	Life insurance premiums (SNL key field 121229).
Annuities	Total annuities related to mortality and morbidity risk (SNL key field 121230), annuities not incorporating mortality and morbidity risk (SNL key field 121231), and unallocated annuities (SNL key field 121232).
Derivatives Notional	The notional amount of all derivatives contracts from the National Association of Insurance Commissioners (NAIC) Schedule DB.
Derivatives (Yes = 1)	An indicator for insurers reporting a derivatives notional value.
Assets & Liabilities Hedged	The ratio of derivatives notional to the sum of total assets, net liabilities, and derivatives notional.
Assets	Total assets (SNL key field 122915).
Net Income	The ratio of net income (SNL key field 122937) to total assets.
Leverage	The ratio of net liabilities to total assets, where net liabilities are calculated as total liabilities (SNL key field 122921) minus ceded reserves (SNL key fields' 121453 + 21451) plus assumed reserves (SNL key fields' 121439 + 121441).
Pre-event High Leverage Indicator	An indicator for insurers with Leverage above the sample median in the year before the insurer's domicile state adopted the Section 711.
Z Score Plus	The Z-score plus is a measure of potential financial distress from (Altman et al. 2017) that extends the original Altman's (1968) Z-score to private companies. Specific variables included to construct this score include: cash and cash equivalents (SNL key field 114210) to total assets (SNL key field 122915), retained earnings (SNL key field 114097) to total assets; pre-tax operating income (SNL key field 123445) to total assets; book equity (SNL key fields' 122915 - 122921) to total liabilities (SNL key field 122921); total sales (SNL key fields' 121229 + 121230 + 121231 + 121232) to total assets.
Pre-event Low Z Score	A dummy variable equal to one for insurers with Z-score plus below 1.23, the threshold for distress, and zero for insurers with Z-score plus above 2.99, the threshold for financial stability, in the year before the insurer's domicile state adopted the Section 711.

Table 2: **Summary Statistics.** The table reports descriptive statistics for the life insurance companies in our sample for the period 2000 – 2017 at the insurer-state level (Panels A, C1, D1) and at the insurer level (Panels B, C2, D2). Panels A and B report insurer-state and insurer level observations, respectively, for the entire sample. Panels C and D report insurer-state and insurer level observations for Pre-event High Leverage (treated) and Pre-event Low Leverage (control) insurers, respectively. Refer to Table 1 for variable definitions.

	Mean	Median	SD	p25	p75	Obs.
	Panel A - Insurer-State Level Obs.					
Life Insurance Premiums ($ millions)	5.403	0.104	29.017	0.002	1.519	423,501
Annuities ($ millions)	18.473	0.001	222.922	0.000	0.765	387,348
	Panel B - Insurer-Level Obs.					
	Mean	Median	SD	p25	p75	Obs.
Life Insurance Premiums ($ millions)	168.925	3.419	740.760	0.038	49.740	14,898
Annuities ($ millions)	489.781	0.008	2,490.760	0.000	13.271	14,899
Derivatives Notional ($ billions)	1.400	0.000	10.300	0.000	0.000	14,974
Derivatives (Yes=1)	0.167	0.000	0.373	0.000	0.000	14,974
Assets & Liabilities Hedged	0.143	0.000	0.337	0.000	0.000	14,892
Assets ($ billions)	6.117	0.148	24.800	0.017	1.527	14,970
Leverage	0.643	0.711	0.366	0.379	0.882	14,892
Z-Score Plus	4.161	0.467	14.305	0.204	1.143	12,145
Net Income	0.014	0.009	0.057	-0.001	0.028	14,947
	Panel C - Treated Group: Pre-event High Leverage Insurers					
	C1: Insurer-State Level Obs.					
Life Insurance Premiums ($ millions)	9.221	0.310	41.464	0.013	3.448	186,145
Annuities ($ millions)	32.723	0.080	311.717	0.000	6.701	172,304
	C2: Insurer Level Obs.					
Derivatives Notional ($ billions)	3.630	0.000	17.100	0.000	0.094	4,800
Derivatives (Yes=1)	0.328	0.000	0.470	0.000	1.000	4,800
Assets & Liabilities Hedged	0.288	0.000	0.435	0.000	0.904	4,797
Assets ($ billions)	14.800	1.385	40.200	0.245	8.532	4,800
Leverage	0.869	0.864	0.241	0.777	0.932	4,797
Z-Score Plus	0.600	0.309	3.350	0.155	0.532	4,402
Net Income	0.008	0.007	0.035	0.001	0.015	4,800
	Panel D - Control Group: Pre-event Low Leverage Insurers					
	D1: Insurer-State Level Obs.					
Life Insurance Premiums ($ millions)	2.408	0.035	11.561	0.001	0.691	237,356
Annuities ($ millions)	7.055	0.000	106.600	0.000	0.017	215,044
	D2: Insurer Level Obs.					
Derivatives Notional ($ billions)	0.345	0.000	3.800	0.000	0.000	10,174
Derivatives (Yes=1)	0.090	0.000	0.287	0.000	0.000	10,174
Assets & Liabilities Hedged	0.074	0.000	0.251	0.000	0.000	10,095
Assets ($ billions)	2.040	0.046	9.519	0.010	0.418	10,170
Leverage	0.536	0.534	0.366	0.232	0.805	10,095
Z-Score Plus	6.185	0.699	17.415	0.264	4.316	7,743
Net Income	0.017	0.012	0.064	-0.002	0.037	10,147

Table 3: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption.** This table presents estimations from derivatives regressions. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in columns [1] - [3] is Log of Derivatives, which is defined as the natural logarithm of the yearly derivatives notional value. The dependent variable in columns [4] - [6] is Derivatives (Yes = 1), which is an indicator for insurers reporting a derivatives notional value. The dependent variable in columns [7] - [9] is Assets & Liabilities Hedged, which is the ratio of derivatives notional to the sum of total assets, net liabilities, and derivatives notional. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the domicile-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Derivatives			Derivatives (Yes = 1)			Assets & Liabilities Hedged		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Pre-event High Leverage × PostSection711	1.372**	1.183**		0.056**	0.052**		0.063**	0.061**	
	(0.533)	(0.499)		(0.025)	(0.025)		(0.030)	(0.028)	
Pre-event Low Z-score × PostSection711			1.332***			0.051**			0.063**
			(0.474)			(0.022)			(0.025)
PostSection711	−0.716	−0.418	−0.425	−0.021	−0.009	0.005	−0.057*	−0.049	−0.052
	(0.498)	(0.484)	(0.492)	(0.023)	(0.022)	(0.023)	(0.032)	(0.032)	(0.034)
Lagged Log of Assets		0.961***	0.924***		0.042***	0.047***		0.031***	0.041***
		(0.207)	(0.190)		(0.009)	(0.009)		(0.009)	(0.009)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	N.A.	Absorbed	Absorbed	N.A.	Absorbed	Absorbed	N.A.
Pre-event Low Z-score	N.A.	N.A.	Absorbed	N.A.	N.A.	Absorbed	N.A.	N.A.	Absorbed
Observations	14,637	14,453	11,851	14,726	14,543	11,932	14,663	14,484	11,873
Number of Companies	1,158	1,142	1,088	1,159	1,143	1,088	1,156	1,140	1,085
Within - R^2	0.091	0.115	0.127	0.087	0.100	0.118	0.085	0.093	0.114

Table 4: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption: Pre-trend Tests.** This table presents estimations from derivatives regressions. The sample includes life insurance company level data for the period 2000 – 2017. In panel A, PreSection711$_{-1,-1}$ is an indicator equal to one in the year prior to the actual passage of Section 711. In panel B, PreSection711$_{-1,-2}$ is an indicator equal to one in the two years prior to Section 711. In panel C, PreSection711$_{-1,-3}$ is indicator equal to one in the three years prior to the actual passage of Section 711. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the domicile-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	Panel A: Placebo Event One Year Prior to Actual Event			Panel B: Placebo Event Two Years Prior to Actual Event			Panel C: Placebo Event Three Years Prior to Actual Event		
Dep. variables:	Log of Derivatives	Derivatives (Yes = 1)	Assets & Liabilities Hedged	Log of Derivatives	Derivatives (Yes = 1)	Assets & Liabilities Hedged	Log of Derivatives	Derivatives (Yes = 1)	Assets & Liabilities Hedged
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Pre-event High Leverage × PostSection711	1.202**	0.053**	0.064**	1.216**	0.055**	0.064**	1.196**	0.055**	0.065**
	(0.511)	(0.025)	(0.030)	(0.519)	(0.025)	(0.031)	(0.522)	(0.025)	(0.031)
Pre-event High Leverage × PreSection711$_{-1,-1}$	0.194	0.008	0.008						
	(0.234)	(0.015)	(0.011)						
Pre-event High Leverage × PreSection711$_{-1,-2}$				0.177	0.014	0.009			
				(0.255)	(0.015)	(0.014)			
Pre-event High Leverage × PreSection711$_{-1,-3}$							0.058	0.011	0.009
							(0.323)	(0.016)	(0.014)
PostSection711	−0.354	−0.006	−0.049	−0.383	−0.009	−0.051	−0.516	−0.017	−0.057
	(0.522)	(0.023)	(0.034)	(0.554)	(0.025)	(0.035)	(0.599)	(0.026)	(0.038)
PreSection711$_{-1,-1}$	0.430	0.025*	0.008						
	(0.427)	(0.013)	(0.026)						
PreSection711$_{-1,-2}$				0.109	−0.002	−0.002			
				(0.346)	(0.019)	(0.019)			
PreSection711$_{-1,-3}$							−0.268	−0.022	−0.017
							(0.448)	(0.024)	(0.022)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	14,453	14,543	14,484	14,453	14,543	14,484	14,453	14,543	14,484
Number of Companies	1,142	1,143	1,140	1,142	1,143	1,140	1,142	1,143	1,140
Within - R^2	0.115	0.100	0.091	0.115	0.100	0.091	0.115	0.100	0.091

Table 5: **Propensity of Shocks to Income, Capital & Surplus, and Exit after Section 711 Adoption.** This table presents estimations from negative income shock regressions (Panel A), negative capital & surplus shock regressions (Panel B), and exit regression (Panel C). The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in column [1] of Panel A is an indicator for insurers with Net Income < 0. The dependent variable in column [2] of Panel A is an indicator for insurers with Net Income in the current period less than 33% of Net Income in the previous period. The dependent variables in columns [3] – [5] of Panel A are defined similarly. The dependent variable in column [1] of Panel B is an indicator for insurers with Capital & Surplus (the ratio of capital and surplus to total assets) in the current period less than 33% of Capital & Surplus in the previous period. The dependent variables in columns [2] – [4] of Panel B are defined similarly. The dependent variable in column [1] of Panel C is an indicator for insurers placed in receivership or exiting the sample. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the domicile-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	Panel A - Propensity of Negative Income Shocks				
Dep. variables:	Net Income < 0 Dummy (Yes = 1)	Net Income < 33% of Previous Year Net Income Dummy (Yes = 1)	Net Income < 50% of Previous Year Net Income Dummy (Yes = 1)	Net Income < 67% of Previous Year Net Income Dummy (Yes = 1)	Net Income < 75% of Previous Year Net Income Dummy (Yes = 1)
	[1]	[2]	[3]	[4]	[5]
Pre-event High Leverage × PostSection711	-0.076^{**}	-0.072^{***}	-0.055^{*}	-0.060^{*}	-0.062^{**}
	(0.034)	(0.034)	(0.030)	(0.032)	(0.029)
PostSection711	-0.019	-0.005	-0.015	-0.017	0.002
	(0.055)	(0.038)	(0.045)	(0.045)	(0.047)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	14,543	14,537	14,537	14,537	14,537
Number of Companies	1,143	1,141	1,141	1,141	1,141
Within - R^2	0.095	0.101	0.100	0.096	0.095

	Panel B - Propensity of Negative Capital & Surplus Shocks			
Dep. variables:	Capital & Surplus < 33% of Previous Year Capital & Surplus Dummy (Yes = 1)	Capital & Surplus < 50% of Previous Year Capital & Surplus Dummy (Yes = 1)	Capital & Surplus < 67% of Previous Year Capital & Surplus Dummy (Yes = 1)	Capital & Surplus < 75% of Previous Year Capital & Surplus Dummy (Yes = 1)
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	-0.003	-0.009^{**}	-0.026^{***}	-0.032^{***}
	(0.003)	(0.004)	(0.002)	(0.007)
PostSection711	0.002	-0.001	0.004	-0.002
	(0.004)	(0.004)	(0.008)	(0.019)
Year Fixed Effects	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed
Observations	14,406	14,406	14,406	14,406
Number of Companies	1,138	1,138	1,138	1,138
Within - R^2	0.067	0.073	0.069	0.073

Table 5 continued.

	Panel C - Propensity of Exit
Dep. variable:	Exit due to Receivership or Other Events Dummy (Yes = 1)
	[1]
Pre-event High Leverage × PostSection711	-0.017^{***}
	(0.005)
PostSection711	-0.018
	(0.034)
Year Fixed Effects	Yes
Domicile State × Year Fixed Effects	Yes
Insurer Fixed Effects	Yes
Pre-event High Leverage	Absorbed
Observations	14,543
Number of Companies	1,143
Within - R^2	0.113

Table 6: **Systemic Risk of Life Insurance Parent Companies after Section 711 Adoption.** This table presents estimations from systemic risk regressions. The sample includes life insurance parent companies categorized as systemically risky at least one year during the period 2000 – 2017 in the NYU Stern Volatility Lab database (*https://vlab.stern.nyu.edu/docs/srisk*). We extract from the database life insurance parent company data on Systemic Risk Contribution ($), defined as the financial sector capital shortfall that would be experienced by a financial institution in the event of a crisis. We sum insurer level data within each group to obtain parent level information related to the insurance business. The dependent variable is Systemic Risk, defined as the ratio of Systemic Risk Contribution to assets. The regression controls for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the domicile-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variable:	Systemic Risk
	[1]
Pre-event High Leverage × PostSection711	-1.984^{**}
	(0.790)
PostSection711	-0.628
	(1.187)
Year Fixed Effects	Yes
Parent Company Fixed Effects	Yes
Pre-event High Leverage	Absorbed
Observations	384
Number of Companies	28
Within - R^2	0.205

Table 7: **Life Insurance Premiums and Annuities after Section 711 Adoption.** This table presents estimations from life insurance and annuity premium regressions. The sample includes life insurance company-state level data for the period 2000 – 2017. The dependent variable in columns [1] - [2] is Log of Life Insurance Premiums, which is defined as the natural logarithm of life insurance premiums. The dependent variable in columns [3] - [4] is Log of Annuities, which is defined as the natural logarithm of total annuities. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Life Insurance Premiums		Log of Annuities	
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	0.133***		0.207***	
	(0.030)		(0.044)	
Pre-event Low Z-score × PostSection711		0.219***		0.175**
		(0.066)		(0.079)
PostSection711	0.007	−0.093*	−0.173***	−0.229***
	(0.038)	(0.052)	(0.030)	(0.062)
Year Fixed Effects	Yes	Yes	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	N.A.	Absorbed	N.A.
Pre-event Low Z-score	N.A.	Absorbed	N.A.	Absorbed
Observations	417,196	372,373	381,155	343,089
Number of Companies	1,128	1,086	1,129	1,114
Number of Company-State Obs.	31,626	30,930	29,002	28,537
Within - R^2	0.091	0.097	0.045	0.030

Table 8: **Life Insurance Premiums and Annuities after Section 711 Adoption: Pre-Trend Tests** This table presents estimations from life insurance and annuity premium regressions. The sample includes life insurance company-state level data for the period 2000 – 2017. In panel A, $\text{PreSection711}_{-1,-1}$ is an indicator equal to one in the year prior to the actual passage of Section 711. In panel B, $\text{PreSection711}_{-1,-2}$ is an indicator equal to one in the two years prior to Section 711. In panel C, $\text{PreSection711}_{-1,-3}$ is indicator equal to one in the three years prior to the actual passage of Section 711. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	Panel A: Placebo Event One Year Prior to Actual Event		Panel B: Placebo Event Two Years Prior to Actual Event		Panel C: Placebo Event Three Years Prior to Actual Event	
Dep. Variables	Log of Life Insurance Premiums	Log of Annuities	Log of Life Insurance Premiums	Log of Annuities	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]	[3]	[4]	[5]	[6]
Pre-event High Leverage × PostSection711	0.137^{***}	0.216^{***}	0.136^{***}	0.215^{***}	0.134^{***}	0.210^{***}
	(0.029)	(0.041)	(0.028)	(0.040)	(0.029)	(0.040)
Pre-event High Leverage × $\text{PreSection711}_{-1,-1}$	0.040	0.117				
	(0.039)	(0.078)				
Pre-event High Leverage × $\text{PreSection711}_{-1,-2}$			0.020	0.053		
			(0.042)	(0.067)		
Pre-event High Leverage × $\text{PreSection711}_{-1,-3}$					0.002	0.015
					(0.044)	(0.061)
PostSection711	0.007	-0.178^{***}	0.006	-0.180^{***}	0.011	-0.179^{***}
	(0.041)	(0.028)	(0.044)	(0.030)	(0.048)	(0.033)
$\text{PreSection711}_{-1,-1}$	−0.015	−0.070				
	(0.041)	(0.044)				
$\text{PreSection711}_{-1,-2}$			−0.011	−0.038		
			(0.034)	(0.031)		
$\text{PreSection711}_{-1,-3}$					0.007	−0.016
					(0.035)	(0.035)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	417,196	381,155	417,196	381,155	417,196	381,155
Number of Companies	1,128	1,129	1,128	1,129	1,128	1,129
Number of Company-State Obs.	31,626	29,002	31,626	29,002	31,626	29,002
Within - R^2	0.092	0.045	0.092	0.045	0.092	0.045

Table 9: **Life Insurance Premiums and Annuities after Section 711 Adoption: Matched-Sample Analysis.** This table presents estimations from life insurance premium and annuity regressions. In any given Section 711 event year, we match each Pre-event High Leverage insurer (treated) to its closest Pre-event Low Leverage insurer (control) identified from the universe of life insurance companies in the S&P Global SNL Insurance Statutory Financials database based on Log of Assets and Net Income using the Abadie and Imbens' (2006) bias-corrected matching estimator. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. Variables	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]
Pre-event High Leverage × PostSection711	0.388***	0.571***
	(0.060)	(0.097)
PostSection711	−0.237***	−0.572***
	(0.069)	(0.104)
Year Fixed Effects	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed
Observations	158,663	151,598
Number of Companies	209	211
Number of Company-State Obs.	10,147	9,891
Within - R^2	0.074	0.108

Table 10: **Life Insurance Premiums and Annuities in High Mortality States after Section 711 Adoption.** This table presents estimations from life insurance and annuity premium regressions in high mortality states. Pre-event High Mortality is an indicator for insurer-licensing states with annual age-adjusted mortality rates (deaths per 100,000) above the sample median in the year before the insurer's domicile state adopted IRMA Section 711. The sample includes life insurance company-state level data for the period 2000 – 2017. Age-adjusted mortality rate data is from the United States Mortality Database website (*https://usa.mortality.org*). The dependent variable in column [1] is Log of Life Insurance Premiums, which is defined as the natural logarithm of life insurance premiums. The dependent variable in column [2] is Log of Annuities, which is defined as the natural logarithm of total annuities. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]
Pre-event High Leverage × PostSection711 × Pre-event High Mortality	0.065^{**}	0.046^{**}
	(0.031)	(0.021)
Pre-event High Leverage × PostSection711	0.120^{***}	0.187^{***}
	(0.026)	(0.043)
PostSection711 × Pre-event High Mortality	−0.025	0.011
	(0.027)	(0.019)
PostSection711	0.006	-0.175^{***}
	(0.038)	(0.031)
Year Fixed Effects	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed
Pre-event High Mortality	Absorbed	Absorbed
Pre-event High Leverage × Pre-event High Mortality	Absorbed	Absorbed
Observations	417,196	381,155
Number of Companies	1,128	1,129
Number of Company-State Obs.	31,626	29,002
Within - R^2	0.092	0.045

Table 11: **Prices of Life Insurance Products after Section 711 Adoption.** This table presents estimations examining the prices for different insurance products including the average policy price (column [1], life insurance guaranteed universal life (column [2]), 10-year term life policies (column [3]), life annuity (column [4]) and term annuities (columns [5]). Prices are defined as the ratio of total premiums collected by a certain insurer in a given state-year to total number of policies by the same insurer in a given state-year. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year and domicile-state and year levels in column [1] and columns [2]-[5], respectively, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variable:	Log of Policy Prices				
	Average Policy	Guaranteed Universal Life Policy	10-Year Term Life Policy	Life Annuity	Term Annuity
	[1]	[2]	[3]	[4]	[5]
Pre-event High Leverage × PostSection711	-0.098^{**}	0.056	-0.037^{**}	-0.045^{***}	-0.048^{***}
	(0.039)	(0.048)	(0.017)	(0.015)	(0.016)
PostSection711	0.064^{**}	0.032	-0.001	-0.010	0.024^{*}
	(0.029)	(0.067)	(0.017)	(0.008)	(0.014)
Product Fixed Effects	N.A.	Yes	Yes	Yes	Yes
Gender Fixed Effects	N.A.	Yes	Yes	Yes	N.A.
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	N.A.	N.A.	N.A.	N.A.
Domicile State × Year Fixed Effects	No	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	335,519	3,320	10,171	6,621	1,415
Number of Companies	885	68	157	53	46
Number of Company-State Obs.	26,103	N.A.	N.A.	N.A.	N.A.
Within - R^2	0.040	0.555	0.158	0.146	0.183

Table 12: **Number of Policies after Section 711 Adoption.** This table presents estimations from number of policies regressions. The sample includes life insurance company-state level data for the period 2000 – 2017. The dependent variable is Log of number of policies, which is defined as the natural logarithm of number of policies. Regression controls for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variable:	Log of Number of Policies
	[1]
Pre-event High Leverage × PostSection711	0.057**
	(0.026)
PostSection711	0.019
	(0.035)
Year Fixed Effects	Yes
Insurer-Licensing-State Fixed Effects	Yes
Insurer Fixed Effects	Absorbed
Pre-event High Leverage	Absorbed
Observations	344,451
Number of Companies	911
Number of Company-State Obs.	26,690
Within - R^2	0.075

Table 13: **Market Share and Leadership after Section 711 Adoption.** This table presents estimations from market share and leadership regressions. The sample includes life insurance company-state level data for the period 2000 – 2017. The dependent variable in column [1] is the ratio of life insurance premiums to total life insurance premiums collected by all the insurers in each state-year. The dependent variable in column [2] is the ratio of annuities to total annuities collected by all the insurers in each state-year. We multiply the dependent variables in columns [1]-[2] by 100. The dependent variables in columns [3] and [4] are indicators for life insurers with life insurance premiums and annuities, respectively, above the respective state-year sample 75^{th} percentile. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	Panel A: Market Share		Panel B: Market Leadership	
Dep. variables:	Market Share: Life Insu. Premiums	Market Share: Annuities	Life Insu. Prem. $> 75^{th}$ %tile Dummy (Yes = 1)	Annuity $> 75^{th}$ %tile Dummy (Yes = 1)
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	0.042***	0.080***	0.010***	0.016***
	(0.007)	(0.015)	(0.003)	(0.005)
PostSection711	−0.005	−0.007	0.006	−0.018***
	(0.003)	(0.006)	(0.005)	(0.005)
Year Fixed Effects	Yes	Yes	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed
Observations	417,196	381,155	418,943	382,902
Number of Companies	1,128	1,129	1,128	1,129
Number of Company-State Obs.	31,626	29,002	31,755	29,133
Within - R^2	0.013	0.009	0.014	0.020

Table 14: **Investments by Life Insurance Companies after Section 711 Adoption.** This table presents estimations from investment regressions. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variables in columns [1] to [5] are defined as the natural logarithm of investments in bonds, stocks, real estate and mortgage loans, loans to policyholders, and other long-term investments, respectively. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the domicile-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Bonds	Log of Stocks	Log of Real Estate Investment	Log of Loan to Policyholders	Log of Investment: Others
	[1]	[2]	[3]	[4]	[5]
Pre-event High Leverage × PostSection711	0.194**	0.065	0.487**	0.421**	1.092***
	(0.085)	(0.218)	(0.217)	(0.148)	(0.198)
PostSection711	−0.238	0.652	−0.578	−0.715**	−0.962***
	(0.150)	(0.386)	(0.355)	(0.286)	(0.300)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	14,688	14,686	14,687	14,675	14,676
Number of Companies	1,157	1,157	1,157	1,157	1,157
Within - R^2	0.144	0.063	0.080	0.080	0.131

Table 15: **Income of Life Insurance Companies after Section 711 Adoption.** This table presents estimations from income regressions. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in column [1] is the ratio of operating income to total assets. The dependent variable in column [2] is the ratio of operating income to operating revenue. The dependent variable in column [3] is the ratio of investment income to total assets. The dependent variable in column [4] is the ratio of net income to total assets. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the domicile-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Operating Income	Operating Margin	Investment Income	Net Income
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	0.007**	0.066***	0.004**	0.007**
	(0.002)	(0.018)	(0.001)	(0.003)
PostSection711	0.005	−0.006	0.001	0.002
	(0.004)	(0.030)	(0.001)	(0.003)
Year Fixed Effects	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed
Observations	14,475	14,123	14,537	14,537
Number of Companies	1,140	1,131	1,141	1,141
Within - R^2	0.076	0.079	0.340	0.075

Figure 1: **Derivatives Notional Amount ($ trillion) of Life Insurance Companies.** This graph presents yearly derivatives notional amounts for life insurance companies for the years 2000 – 2017. Section 711's states are reported in red above the derivatives notional amount bar corresponding to the adoption year.

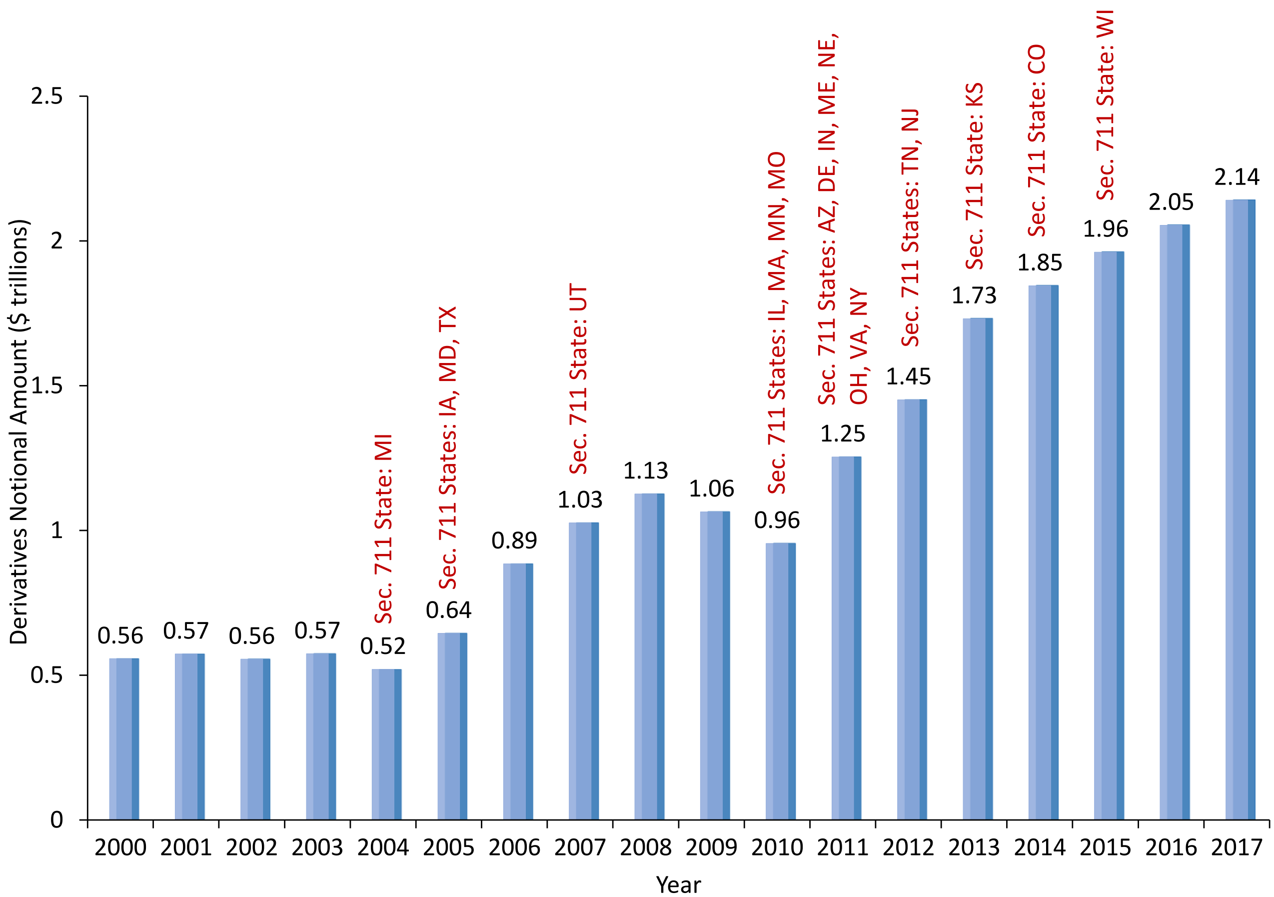


Figure 2: **IRMA Section 711 States by Adoption Year.** This figure displays the states that have adopted Section 711 of the National Association of Insurance Commissioner's (NAIC) Insurer Receivership Model Act (IRMA). The Section 711 adopting states are colored in red, with the darker red indicating an earlier adoption year.

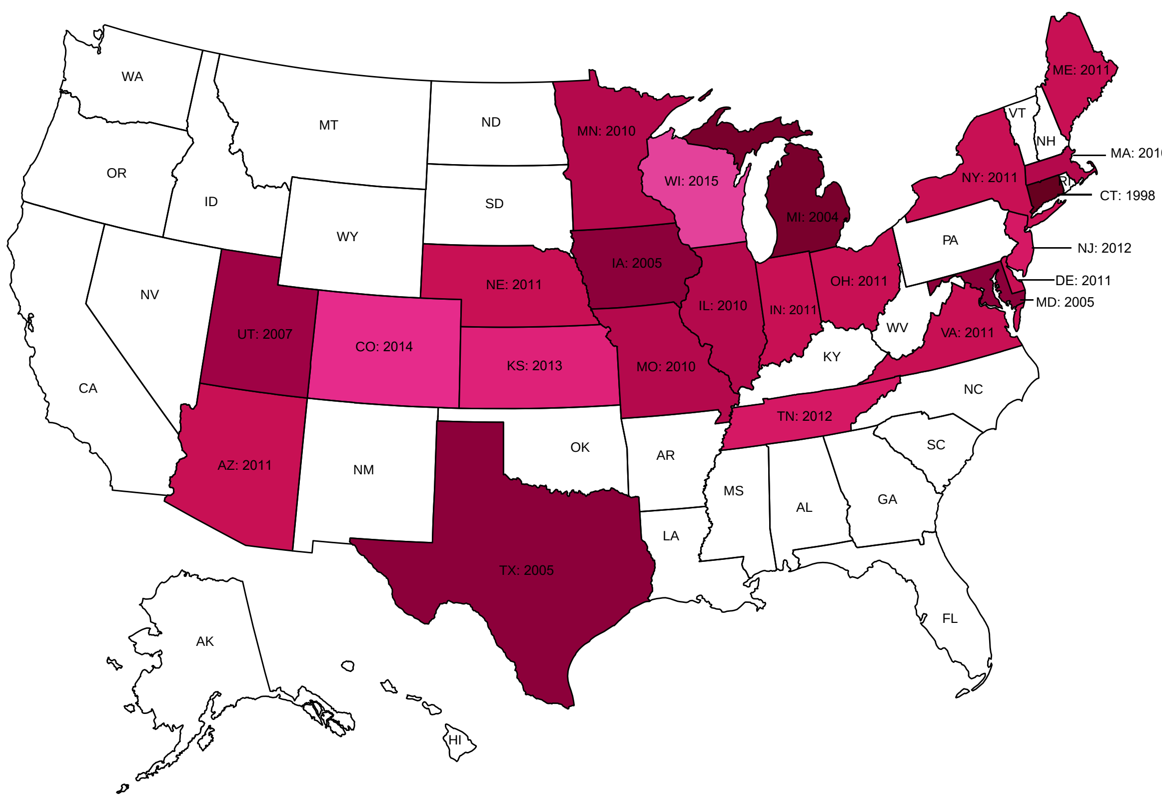
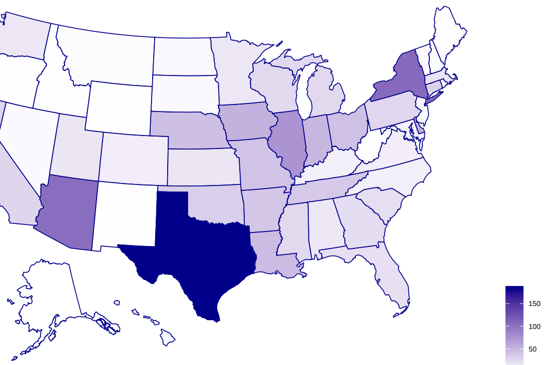
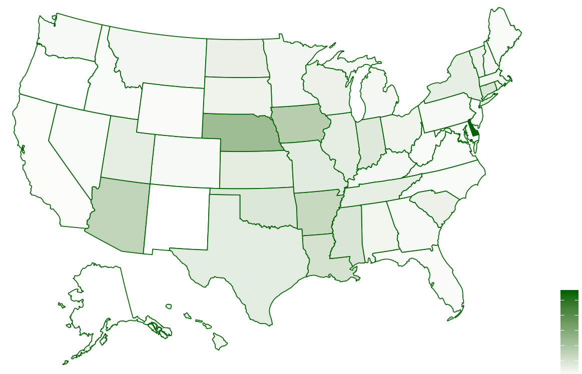


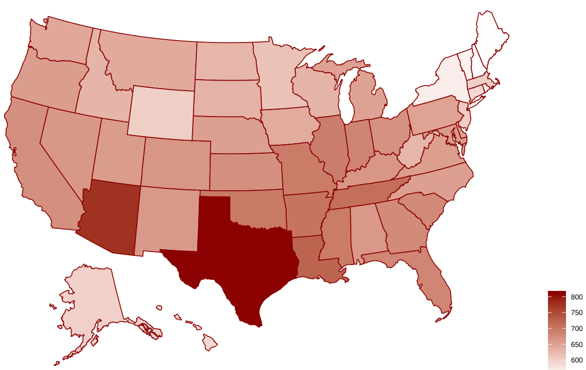
Figure 3: **Number of Life Insurance Companies by Domicile and Licensing State.** This figure displays geographical heat maps of the number of life insurance companies in the period 2000 – 2017 by domicile state (Panel A) and by domicile state population (Panel B), where population is the average state population in 2000 – 2017. We generate similar graphs for the number of life insurance companies by licensing state (Panel C) and by licensing state population (Panel D). We consider a company domiciled in certain state if the company reports being domiciled in that state. We consider a company licensed in a certain state if the company reports being licensed in that state or if the company collects insurance premiums in that state. Population data is from the U.S. Census Bureau.



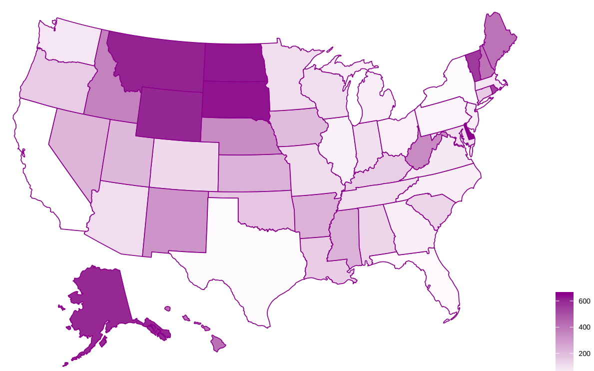
(A) No. of Domiciled Insurers



(B) No. of Domiciled Insurers/Population (million)



(C) No. of Licensed Insurers



(D) No. of Licensed Insurers/Population (million)

Figure 4: **Number of Life Insurance Companies Licensed in One, Two, or Multiple States.** This graph displays the number of life insurance companies and the percentage of life insurers out of the total number of companies licensed (or reporting positive premiums if not licensed) in one state or multiple states for the period 2000 – 2017.

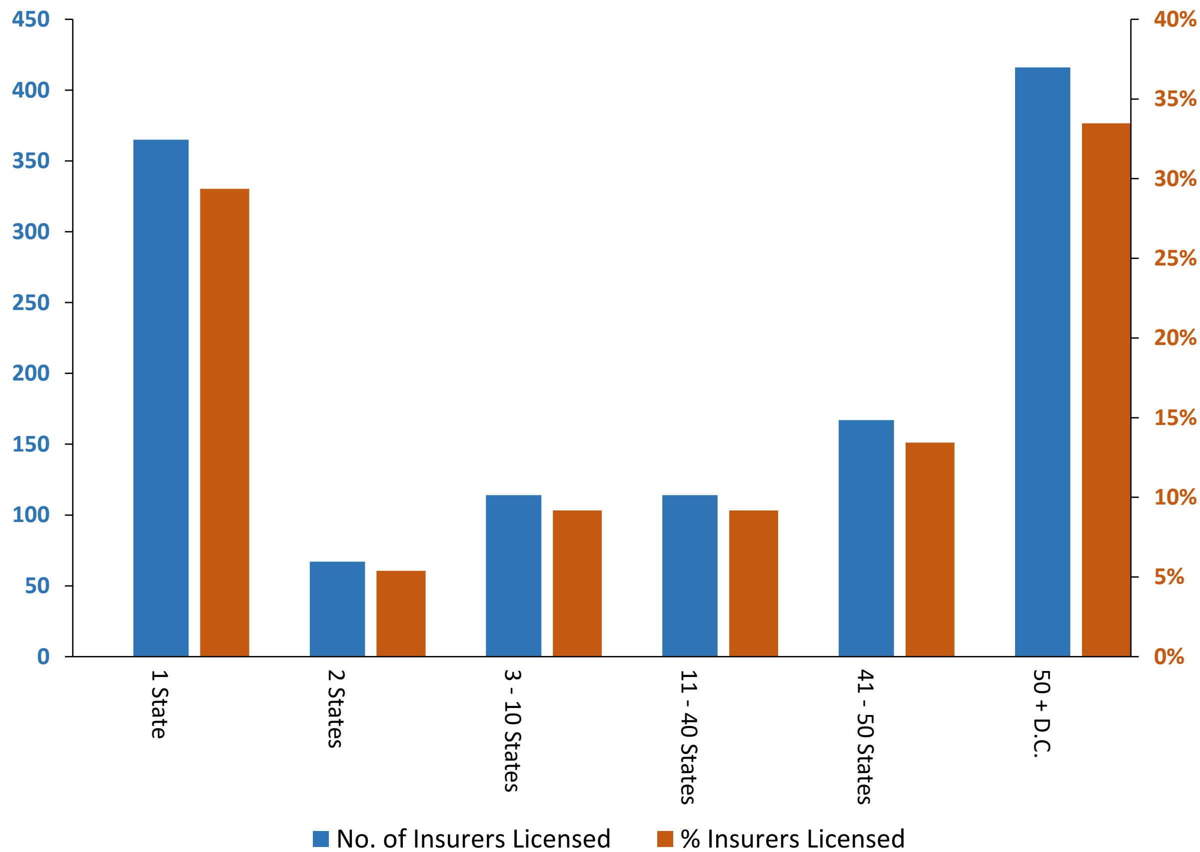
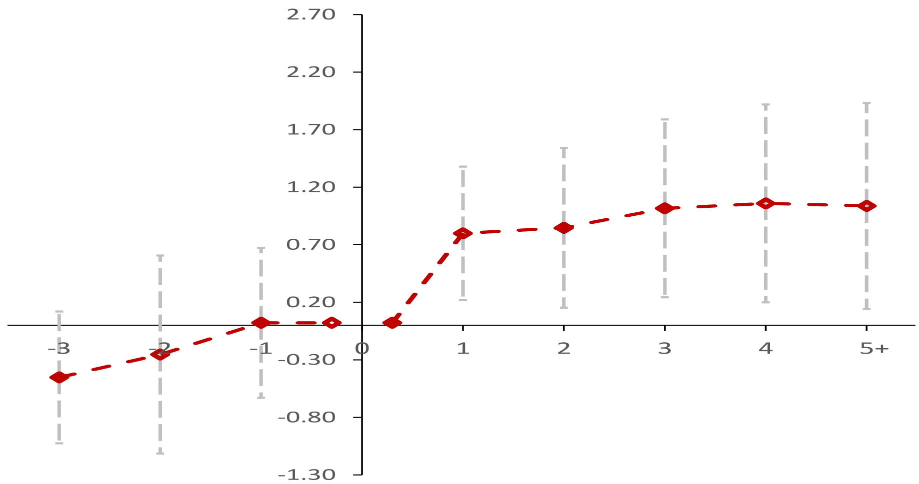
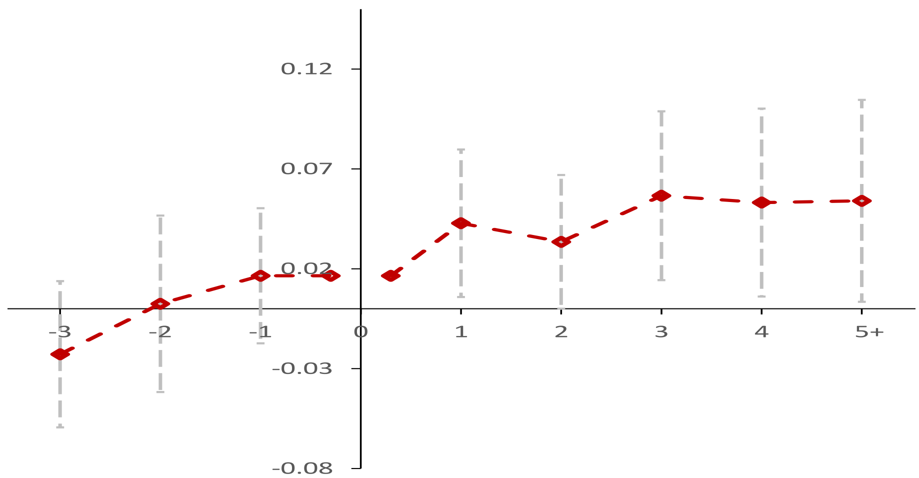


Figure 5: **Redomiciliations after Section 711 Adoption.** This graph shows the number of life insurance companies changing domicile state (redomiciliation) in a given year during the years 2000 – 2017. The blue and orange portions of the bars represent redomiciliations in Non-Section 711 and Section 711 states, respectively. Section 711's states are reported in red above the number of redomiciliations bar corresponding to the adoption year. The Section 711 adoption year data is hand collected from the NAIC reports, the websites of state insurance departments, and news agencies. Redomiciliations data is from the NAIC historical demographic annual files.

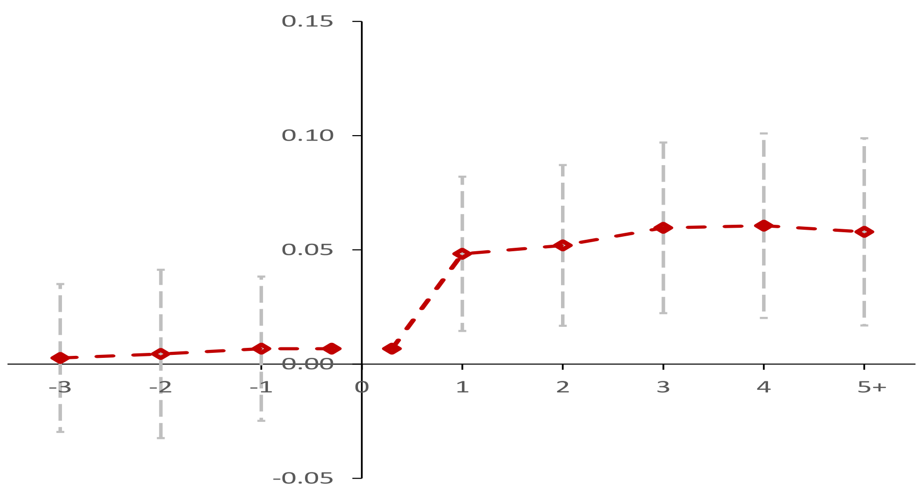
Figure 6: **Derivatives Usages of Life Insurance Companies around Section 711 Adoption: Treated vs. Control Insurers.** This figure reports the point estimates from Log of Derivatives (Panel A), Derivatives (Yes =1) (Panel B), and Assets & Liabilities Hedged (Panel C) regressions. The sample includes life insurance company level data for the period 2000 – 2017. The regression specifications are the same as those reported in columns [2], [5], and [8] of Tables 3, except that the effect of Pre-event High Leverage is allowed to vary by year for each year starting four years prior to Section 711 adoption and ending four years after the adoption. We also plot the estimate on the interaction of Pre-event High Leverage with an indicator equal to 1 starting in year five after the Act adoption and ending in 2017. Ninety-percent confidence intervals are also plotted.



Panel A: Log of Derivatives

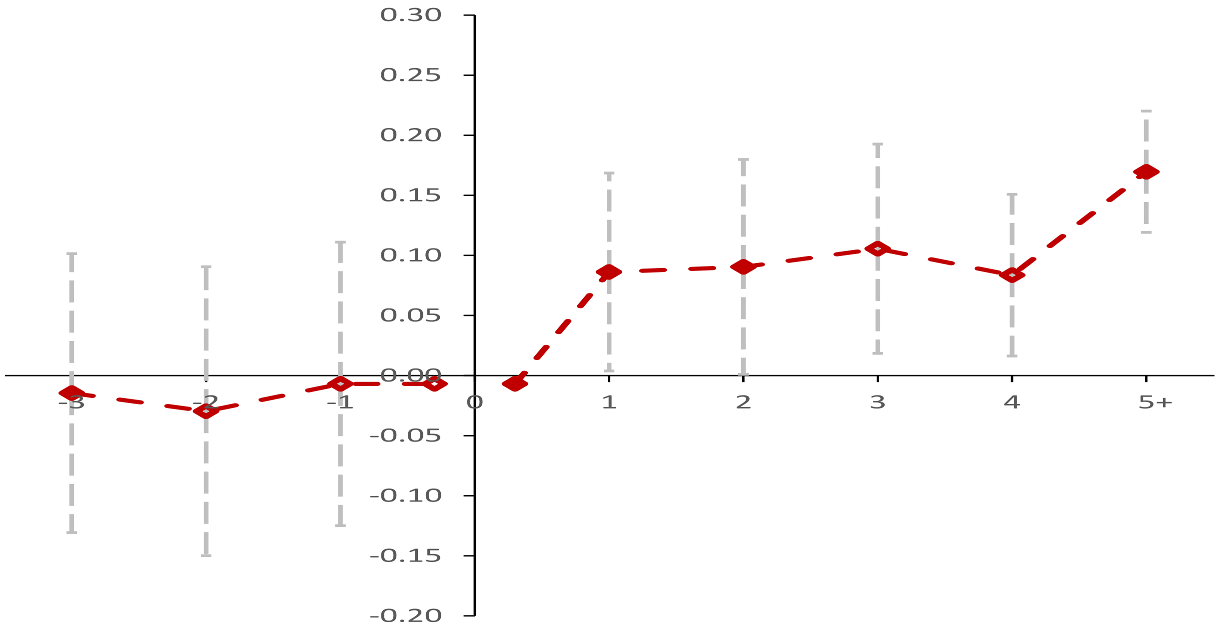


Panel B: Derivatives (Yes = 1)

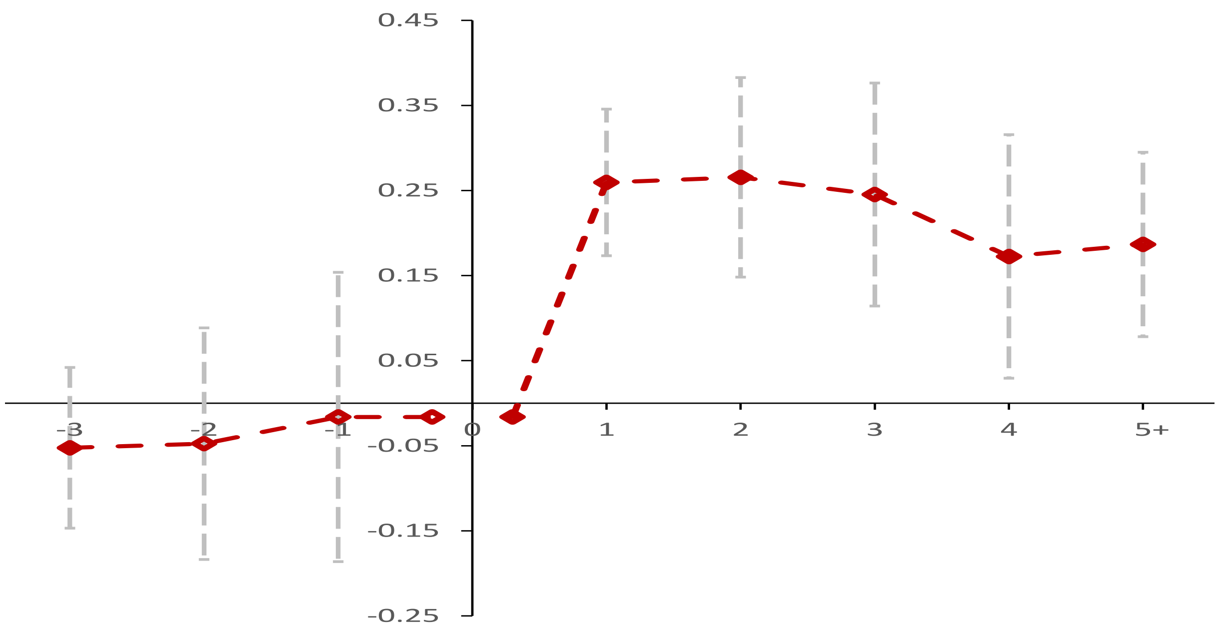


Panel C: Assets & Liabilities Hedged

Figure 7: **Life Insurance Premiums and Annuities around Section 711 Adoption: Treated vs. Control Insurers.** This figure reports the point estimates from Log of Life Insurance Premiums (Panel A) and Log of Annuities (Panel B) regressions. The sample includes life insurance company-state level data for the period 2000 – 2017. The regression specifications are the same as those reported in column [1] and [3] of Table 7, except that the effect of Pre-event High Leverage is allowed to vary by year for each year starting four years prior to Section 711 adoption and ending four years after the adoption. We also plot the estimate on the interaction of Pre-event High Leverage with an indicator equal to 1 starting in year five after the Act adoption and ending in 2017. Ninety-percent confidence intervals are also plotted.



Panel A: Log of Life Insurance Premiums



Panel B: Log of Annuities

Appendix to

Hedging and Competition

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This Draft: August 24, 2021

Abstract

Keywords: Competition, risk management, hedging, financial stability, policy sales (life insurance and annuities), policy prices, market share, market leadership, derivatives superpriority.

JEL classification: D02; D22; D43; G22; G28; G31; G32; G33.

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Table A1: **Life Insurance Companies by Domicile and Licensing State.** This table reports the number of life insurance companies (% out of the total number of companies) domiciled (columns 2 and 5) and licensed (columns 3 and 6) in each state for the period 2000 – 2017. We consider a company domiciled in certain state if the company reports being domiciled in that state. We consider a company licensed in a certain state if the company reports being licensed in that state or if the company collects insurance premiums in that state.

State [1]	No. of Domiciled Companies (%) [2]	No. of Licensed Companies (%) [3]	State [4]	No. of Domiciled Companies (%) [5]	No. of Licensed Companies (%) [6]
AK	0 (0.00%)	599 (48.19%)	MT	3 (0.24%)	642 (51.65%)
AL	17 (1.37%)	662 (53.26%)	NC	11 (0.89%)	654 (52.61%)
AR	39 (3.14%)	704 (56.64%)	ND	5 (0.40%)	628 (50.52%)
AZ	104 (8.37%)	777 (62.51%)	NE	44 (3.54%)	653 (52.53%)
CA	29 (2.33%)	672 (54.06%)	NH	3 (0.24%)	548 (44.09%)
CO	12 (0.97%)	665 (53.50%)	NJ	5 (0.40%)	603 (48.51%)
CT	31 (2.50%)	589 (47.39%)	NM	1 (0.08%)	661 (53.18%)
DC	5 (0.40%)	619 (49.80%)	NV	4 (0.32%)	664 (53.42%)
DE	55 (4.43%)	651 (52.37%)	NY	106 (8.53%)	566 (45.53%)
FL	21 (1.69%)	683 (54.95%)	OH	43 (3.46%)	670 (53.90%)
GA	23 (1.85%)	678 (54.55%)	OK	33 (2.66%)	697 (56.07%)
HI	5 (0.40%)	588 (47.30%)	OR	2 (0.16%)	657 (52.86%)
IA	53 (4.27%)	641 (51.57%)	PA	28 (2.25%)	650 (52.29%)
ID	2 (0.16%)	630 (50.68%)	RI	4 (0.32%)	569 (45.78%)
IL	75 (6.04%)	693 (55.75%)	SC	22 (1.77%)	679 (54.63%)
IN	50 (4.03%)	685 (55.11%)	SD	4 (0.32%)	633 (50.93%)
KS	18 (1.45%)	672 (54.06%)	TN	38 (3.06%)	710 (57.12%)
KY	11 (0.89%)	665 (53.50%)	TX	184 (14.81%)	811 (65.25%)
LA	46 (3.70%)	722 (58.09%)	UT	18 (1.45%)	658 (52.94%)
MA	19 (1.53%)	601 (48.35%)	VA	12 (0.97%)	656 (52.78%)
MD	10 (0.81%)	659 (53.02%)	VT	4 (0.32%)	561 (45.13%)
ME	2 (0.16%)	550 (44.25%)	WA	16 (1.29%)	645 (51.89%)
MI	26 (2.09%)	651 (52.37%)	WI	26 (2.09%)	631 (50.76%)
MN	17 (1.37%)	615 (49.48%)	WV	2 (0.16%)	628 (50.52%)
MO	41 (3.30%)	695 (55.91%)	WY	1 (0.08%)	602 (48.43%)
MS	26 (2.09%)	695 (55.91%)			

Table A2: **Life Insurance Companies Licensed in One, Two, or Multiple States.** This table reports the number of life insurance companies (% out of the total number of companies) licensed (or reporting positive premiums if not licensed) in only one state or multiple states for the period 2000 – 2017.

No. of states	No. of Companies Licensed
1	365 (29.36%)
2	67 (5.39%)
3	22 (1.77%)
4	16 (1.29%)
5	19 (1.53%)
6	14 (1.13%)
7	19 (1.53%)
8	11 (0.88%)
9	5 (0.40%)
10	8 (0.64%)
11-40	114 (9.17%)
41	8 (0.64%)
42	5 (0.40%)
43	5 (0.40%)
44	14 (1.13%)
45	11 (0.88%)
46	14 (1.13%)
47	16 (1.29%)
48	13 (1.05%)
49	23 (1.85%)
50	58 (4.67%)
51	416 (33.47%)
Total	1243 (100.00%)

Table A3: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption: Using Alternative Measures of Derivatives Usage.** This table presents estimations from derivatives regressions. The sample includes life insurance company level data for the period 2000 – 2017. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the domicile-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Derivatives Notional/ Assets	Derivatives Notional/ Liabilities	Derivatives Notional/ Net Liabilities	Derivatives Notional/ (Assets + Liabilities)	Derivatives Notional/ (Assets + Net Liabilities)	Derivatives Notional/ (Assets + Derivatives Notional)	Derivatives Notional/ (Liabilities + Derivatives Notional)	Derivatives Notional/ (Net Liabilities + Derivatives Notional)	Derivatives Notional/ (Assets + Liabilities + Derivatives Notional)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Pre-event High Leverage × PostSection711	21.462**	23.000**	21.469**	11.098**	11.713**	0.062**	0.062**	0.064**	0.062**
	(7.648)	(8.212)	(9.694)	(3.945)	(4.427)	(0.029)	(0.030)	(0.030)	(0.029)
PostSection711	−5.921	−7.105	−12.541	−3.158	−5.113	−0.048	−0.049	−0.053	−0.048
	(11.695)	(12.730)	(19.013)	(6.036)	(7.758)	(0.029)	(0.029)	(0.033)	(0.029)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	14,537	14,442	14,396	14,537	14,484	14,537	14,442	14,396	14,537
Number of Companies	1,141	1,139	1,139	1,141	1,140	1,141	1,139	1,139	1,141
Within - R^2	0.086	0.085	0.091	0.086	0.089	0.090	0.090	0.090	0.091

Table A4: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption: Robustness to Treatment Heterogeneity.** This table presents estimations from staggered difference-in-difference derivatives regressions, robust to treatment heterogeneity. The sample includes life insurance company level data for the period 2000 – 2017. Panel A results are based on the stacked regression estimator of Cengiz et al. (2019), using eight-year time windows centered around each stacked-sample event. Panel B results are based on the aggregate average treatment effects on the treated (ATT) estimator of Callaway and Sant'Anna (2020) (CS). Panel C results are based on our base staggered difference-in-difference estimator, keeping life insurers in Section 711 states only for three years after Section 711 adoption. Refer to Table 1 for detailed variable definitions. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Derivatives	Derivatives (Yes = 1)	Assets & Liabilities Hedged
	[1]	[2]	[3]
	Panel A - Cengiz et al.'s (2019) Stacked Regression Estimator		
Pre-event High Leverage × PostSection711	0.705***	0.026**	0.032***
	(0.228)	(0.013)	(0.012)
	Panel B - Callaway and Sant'Anna's (2020) (CS) Estimator		
Pre-event High Leverage × PostSection711	0.709**	0.030*	0.031**
	(0.331)	(0.017)	(0.015)
	Panel C - Base Staggered Estimator with Only 3 Years After Event in the Sample		
Pre-event High Leverage × PostSection711	0.922***	0.035**	0.044**
	(0.320)	(0.017)	(0.021)

Table A5: **Systemically Important Financial Institutions.** This table reports the list of systemically important financial institution as of December 31, 2017 in the NYU Stern Volatility Lab database (*https://vlab.stern.nyu.edu/docs/srisk*). SRISK% ($ m), Systemic Risk Contribution, is the percentage ($ amount in millions) of financial sector capital shortfall that would be experienced by the financial institution in the event of a crisis. Institutions with a high percentage of capital shortfall in a crisis are not only the biggest losers in a crisis but also are the entities that create or extend the crisis. A.M. Best Ratings and RBC Ratio are averages across all insurance affiliates within an insurance group. Leverage is the parent company leverage. Insurance companies are highlighted in yellow.

Institution	SRISK %	SRISK ($ m)	A.M. Best Ratings	RBC Ratio	Leverage
Citigroup Inc	24.61	47,692			
Goldman Sachs Group Inc/The	13.77	26,681			
Prudential Financial Inc	12.27	23,778	A+	1,219	0.93
Morgan Stanley	11.07	21,454			
Bank of America Corp	6.26	12,131			
MetLife Inc	5.21	10,104	A+	753	0.92
Voya Financial Inc	4.02	7,783	A	1,011	0.95
JPMorgan Chase & Co	3.96	7,673			
Brighthouse Financial Inc	3.58	6,931	A	1,236	0.93
Genworth Financial Inc	3.14	6,093	B	565	0.85
Ally Financial Inc	3.04	5,895			
Capital One Financial Corp	2.73	5,290			
Lincoln National Corp	2.67	5,173	A+	974	0.94
Citizens Financial Group Inc	1.24	2,413			
American International Group Inc	0.42	809	A	924	0.87
CIT Group Inc	0.29	557			
Principal Financial Group Inc	0.24	469	A+	891	0.95
Texas Capital Bancshares Inc	0.20	393			
FNB Corp/PA	0.20	380			
BankUnited Inc	0.19	376			

Table A6: **Pre-Section 711 Adoption Mean Difference and Distributional Tests for Treated and Control Insurers.** This table reports the mean difference t-test p-value and the Wilcoxon–Mann–Whitney rank-sum test p-value of Log of Assets and Net Income in the matched sample for premium regressions. In any given Section 711 event year, we match each Pre-event High Leverage insurer (treated) to its closest Pre-event Low Leverage insurer (control) identified from the universe of life insurance companies in the S&P Global SNL Insurance Statutory Financials database based on Log of Assets and Net Income using the Abadie and Imbens' (2006) bias-corrected matching estimator. Refer to Table 1 for detailed variable definitions.

Characteristics of Treated and Control Insurers: Matched Sample		Mean	Treated-Control	Mean Difference t-Test p-value	Wilcoxon-Mann-Whitney rank-sum Test p-value	No. of Matched Companies
Log of Assets	Treated	15.730	0.106	0.604	0.647	140
	Control	15.624				133
Net Income	Treated	0.007	<-0.001	0.944	0.999	140
	Control	0.007				133

Additional Tests. In this section, we provide additional details on the tests discussed in the main text. We do not discuss tables that have been sufficiently discussed in the main text.

In Table A7], we control for licensing-state $\times$ year fixed effects, which allows us to compare treated and control companies exposed to similar time-varying state regulatory and economic conditions. Table A7 shows that the coefficients on the interaction term of interest are very similar in magnitude and statistical significance to the main life insurance premium and annuity results in Table 7 after adding these fixed effects.

[Table A7]

We also assess the robustness of our findings to alternative measures of leverage. In our main test, we subtract ceded reserves from total liabilities in our calculation of leverage. However, to the extent that insurers cede liabilities to captive reinsurers, ceding liabilities does not reduce the risk of financial distress (Koijen and Yogo (2016)). To account for this possibility, we use an alternative measure of leverage in which we add captive reinsurance (reinsurance with unauthorized companies) to net liabilities. We then use this alternative measure of leverage to identify highly leveraged insurers. Table A8, columns [1] and [2] show that our premium results are robust when we use this alternative measure of leverage.

[Table A8]

In our main analysis, we rely on insurer-level leverage to assess financial strength. However, about 39% of the life insurance companies in our sample belong to a group, and evidence suggests that parents (typically, insurance holding companies, 90%, and banks, 10%) transfer financial resources to their insurance affiliates in times of financial difficulties (e.g., Koijen and Yogo (2015); Barnes, Bohn, and Martin (2016)). To account for the financial strength of the insurance group, in Table A8, columns [3] and [4], we assign the insurer's parent leverage to the life insurers in our sample that are part of a group. As the coefficient estimate on $\textit{Pre-event High Leverage} \times \textit{PostSection}711$ in columns [3] and [4] shows, our premium regressions hold in these estimations.

Finally, in columns [5] and [6], we define leverage by subtracting cash and cash equivalents from the insurers' liabilities. Once again, we find that our premium regressions are robust to using this alternative measure of leverage. Overall, Table A8 suggests that our results are robust to using alternative proxies of financial distress.

Because our insurer-state level premium data are truncated at zero, we also estimate our policy sales (life insurance and annuity premiums) models using Tobit random effects (Tobin (1958); Amemiya (1973); Bernheim (1991)) and Tobit fixed effects (Honoré (1992))[1] regressions.

Table A9, Panels A and B report results for the Tobit random effects and Tobit fixed effects estimations, respectively. As Table A9 shows, the coefficient estimates on $Pre\text{-}event\ High\ Leverage \times PostSection711$, with either the Tobit random effects model (Panel A) or the Tobit fixed effects model (Panel B), are positive, statistically significant at the 1% level, and very similar in size to the coefficients in the base linear fixed effects estimations for the life insurance and annuity premium regressions in Table 7. Overall, these findings suggest that our premium regressions are robust to alternative estimation methods.

[Table A9]

We also run our main premium regressions dropping from the sample insurance companies domiciled in Connecticut. We do so because Connecticut passed Section 711 in 1998, while derivatives data is only available from 2000. Therefore, we cannot assess how the 1998 event affected derivatives usage of high leverage firms domiciled in Connecticut. Table A10 shows that our premium results are very similar to the full sample results in Table 7 if we exclude Connecticut life insurers from our sample.

[Table A10]

To control for potential treatment heterogeneity, we also run our premium regressions using the stacked regression estimator (Cengiz et al. (2019)), the CS estimator (Callaway and Sant'Anna (2020)), and our base staggered difference-in-difference estimator while keeping insurers in the sample only for three years after the treatment. Appendix Table A11 shows that our life insurance and annuity results are robust in these estimations.

[Table A11]

[1] Source: *http://www.princeton.edu/~honore/stata/*

Table A7: **Life Insurance Premiums and Annuities after Section 711 Adoption: Controlling for Licensing-Year Fixed Effects.** This table presents estimations from life insurance premium and annuity regressions with additional licensing state × year fixed effects. The sample includes life insurance company-state level data for the period 2000 – 2017. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]
Pre-event High Leverage × PostSection711	0.132***	0.207***
	(0.030)	(0.043)
PostSection711	0.007	−0.173***
	(0.038)	(0.030)
Licensing State × Year Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed
Observations	417,196	381,155
Number of Companies	1,128	1,129
Number of Company-State Obs.	31,626	29,002
Within - R^2	0.094	0.047

Table A8: **Life Insurance Premiums and Annuities after Section 711 Adoption: Alternative Leverage Measures.** This table presents estimations from life insurance premium and annuity regressions using alternative leverage measures. The sample includes life insurance company-state level data for the period 2000 – 2017. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	Adding Captive Reinsurance to Leverage		Using Parent Company Leverage		Subtracting Cash & Cash Equivalents from Leverage	
Dep. Variables	Log of Life Insurance Premiums [1]	Log of Annuities [2]	Log of Life Insurance Premiums [3]	Log of Annuities [4]	Log of Life Insurance Premiums [5]	Log of Annuities [6]
Pre-event High Leverage (Adjusted) × PostSection711	0.087^{***}	0.148^{**}	0.088^{**}	0.143^{**}	0.132^{***}	0.171^{***}
	(0.029)	(0.054)	(0.031)	(0.053)	(0.024)	(0.041)
PostSection711	0.040	-0.131^{***}	0.026	-0.149^{***}	0.006	-0.157^{***}
	(0.031)	(0.032)	(0.034)	(0.041)	(0.031)	(0.031)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Pre-event High Leverage (Adjusted)	Absorbed	Absorbed	Absorbed	Absorbed	Not Absorbed	Not Absorbed
Observations	420,187	383,949	417,196	381,155	412,969	377,122
Number of Companies	1,131	1,132	1,128	1,129	1,087	1,089
Number of Company-State Obs.	31,678	29,072	31,626	29,002	31,550	28,930
Within - R^2	0.091	0.045	0.091	0.045	0.091	0.046

Table A9: **Life Insurance Premiums and Annuities after Section 711 Adoption: Tobit Models.** This table presents estimations from Tobit random effect regressions (Panel A) and Tobit fixed effects regressions (Panel B). The sample includes life insurance company-state level data for the period 2000 – 2017. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

	Panel A: Random Effects Tobit		Panel B: Fixed Effects Tobit	
Dep. variables:	Log of Life Insurance Premiums	Log of Annuities	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	0.124***	0.191***	0.124***	0.195***
	(0.006)	(0.010)	(0.017)	(0.020)
PostSection711	0.014**	−0.163***	0.011	−0.166***
	(0.006)	(0.009)	(0.77)	(0.017)
Pre-event High Leverage	0.657***	1.268***		
	(0.029)	(0.032)		
Year Fixed Effects	Yes	Yes	Yes	Yes
Insurer-Licensing-State Fixed Effects	No	No	Yes	Yes
Insurer Fixed Effects	No	No	Absorbed	Absorbed
Pre-event High Leverage	Not Absorbed	Not Absorbed	Absorbed	Absorbed
Observations	418,504	382,436	418,504	382,436
Number of Companies	1,216	1,219	1,216	1,219
Number of Company-State Obs.	32,934	30,283	32,934	30,283
Chi^2 (p-value)	<0.001	<0.001	<0.001	<0.001

Table A10: **Life Insurance Premiums and Annuities after Section 711 Adoption: Excluding Connecticut.** This table presents estimations from life insurance premium and annuity regressions. The sample includes life insurance company-state level data for the period 2000 – 2017. We exclude from the sample life insurers domiciled in Connecticut. All regressions control for lagged log of assets. Refer to Table 1 for detailed variable definitions. Standard errors are heteroskedasticity-robust and double-clustered at the licensing-state and year levels, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]
Pre-event High Leverage × PostSection711	0.125***	0.214***
	(0.029)	(0.046)
PostSection711	−0.024	−0.230***
	(0.035)	(0.034)
Year Fixed Effects	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed
Observations	398,667	363,166
Number of Companies	1,102	1,103
Number of Company-State Obs.	30,528	27,918
Within - R^2	0.105	0.039

Table A11: **Life Insurance Premiums and Annuities after Section 711 Adoption: Robustness to Treatment Heterogeneity.** This table presents estimations from staggered difference-in-difference life insurance and annuity premium regressions, robust to treatment heterogeneity. The sample includes life insurance company-state level data for the period 2000 – 2017. Panel A results are based on the stacked regression estimator of Cengiz et al. (2019), using eight-year time windows centered around each stacked-sample event. Panel B results are based on the aggregate average treatment effects on the treated (ATT) estimator of Callaway and Sant'Anna (2020) (CS). Panel C results are based on our base staggered difference-in-difference estimator, keeping life insurers in Section 711 states only for three years after Section 711 adoption. Refer to Table 1 for detailed variable definitions. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variables:	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]
	Panel A - Cengiz et al.'s (2019) Stacked Regression Estimator	
Pre-event High Leverage × PostSection711	0.101***	0.129***
	(0.006)	(0.007)
	Panel B - Callaway and Sant'Anna's (2020) (CS) Estimator	
Pre-event High Leverage × PostSection711	0.141***	0.103**
	(0.012)	(0.019)
	Panel C - Base Staggered Estimator with Only 3 Years After Event in the Sample	
Pre-event High Leverage × PostSection711	0.103***	0.283***
	(0.032)	(0.064)

Figure A1: **The U.S. Life Insurance Industry in 2017.** Panel A presents key figures about life insurance companies in 2017. Panel B shows the different types of assets under management by life insurers in 2017.

TOTAL ASSETS UNDER MANAGEMENT

$ 7.13 TRILLION

TOTAL LIABILITIES

$ 6.62 TRILLION

TOTAL DERIVATIVES NOTIONAL AMOUNT

$ 2.14 TRILLION

TOTAL LIFE INSURANCE PREMIUMS

$ 159.48 BILLION

TOTAL ANNUITIES

$ 472.26 BILLION

(A) **Key Figures**

COMPOSITION OF ASSETS UNDER MANAGEMENT ($ 7.13 TRILLION):

BONDS

$ 3.37 TRILLION

STOCKS

$ 2.29 TRILLION

Real Estate

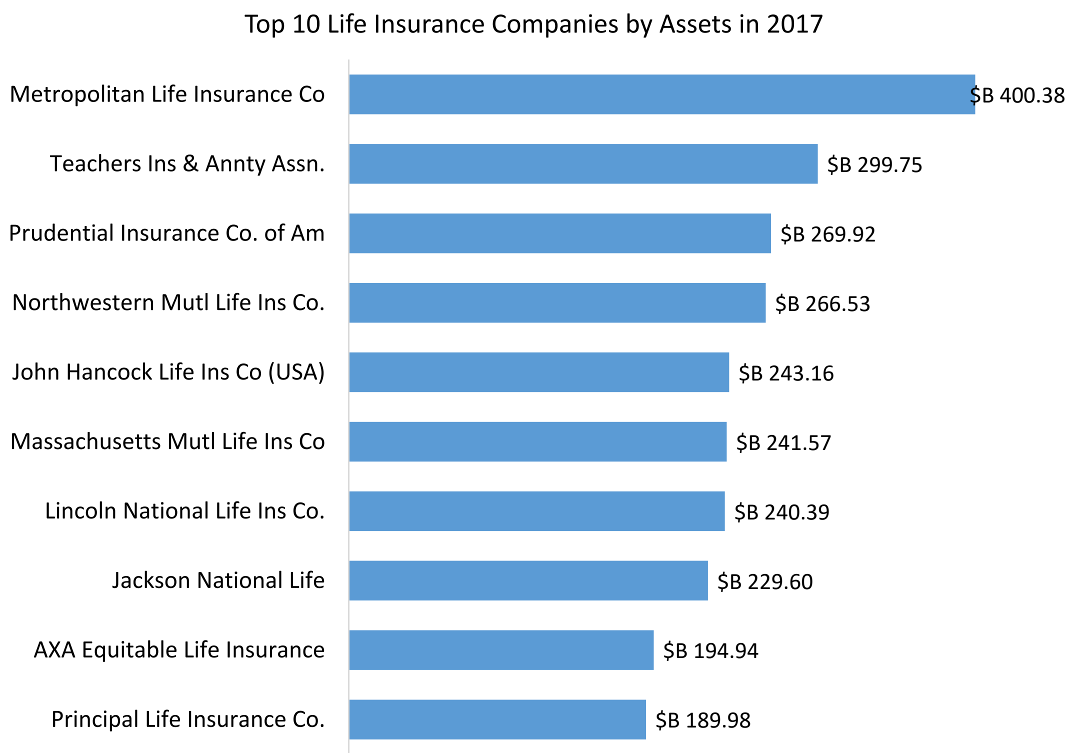
$ 0.54 TRILLION

Loans To Policyholders & Other Investments

$ 0.93 TRILLION

(B) **Assets Under Management**

Figure A2: **Biggest and Smallest Life Insurance Companies.** This graph presents the top 10 and the bottom 10 life insurers by 2017 assets.



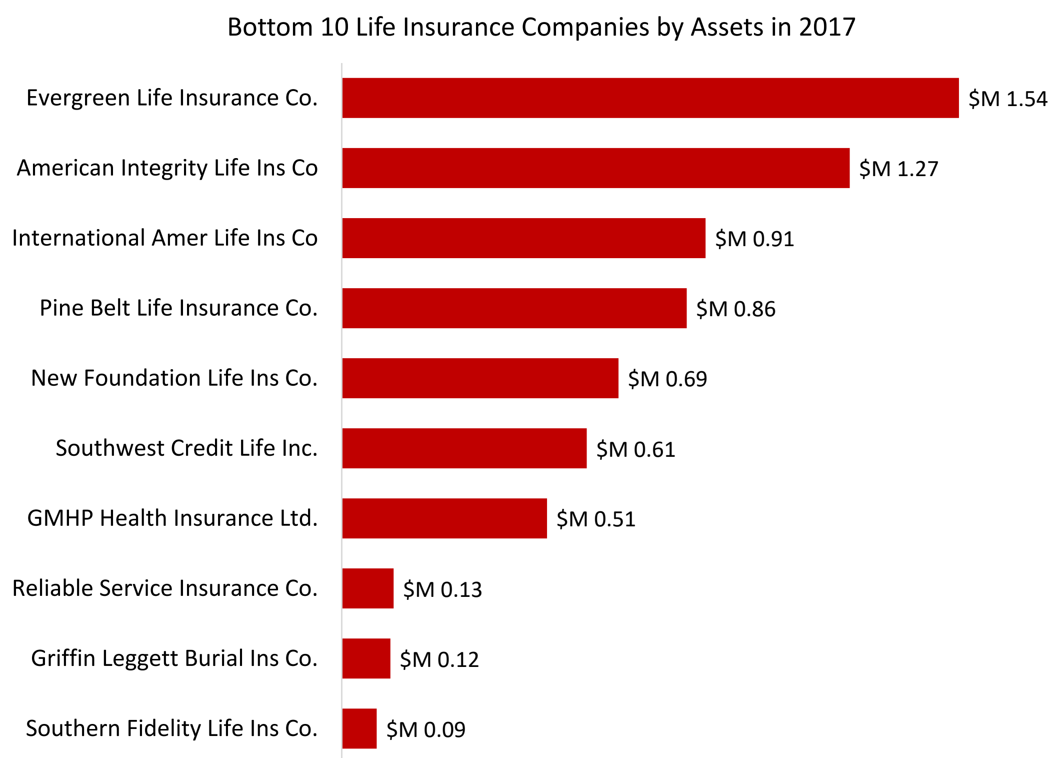
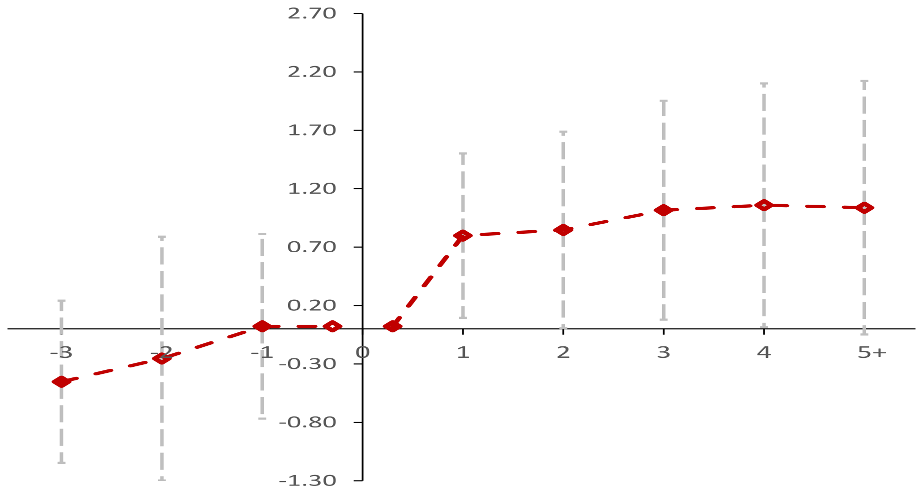
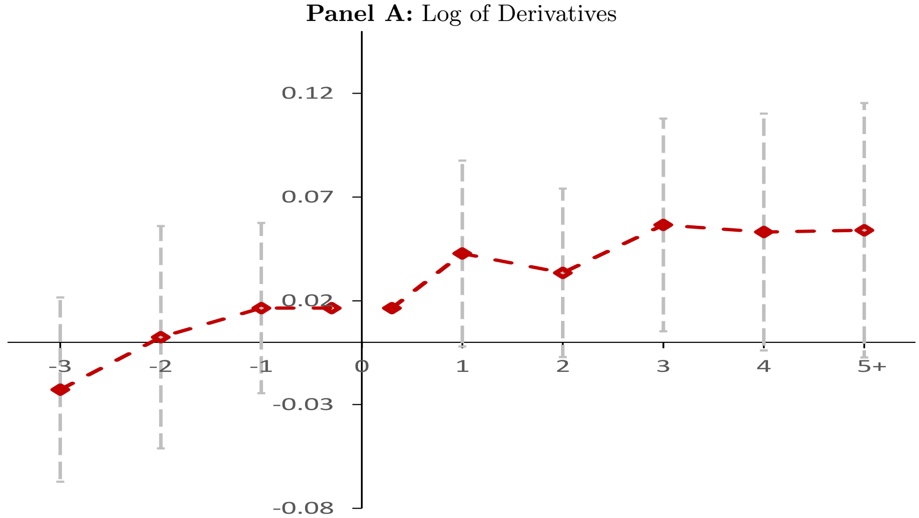


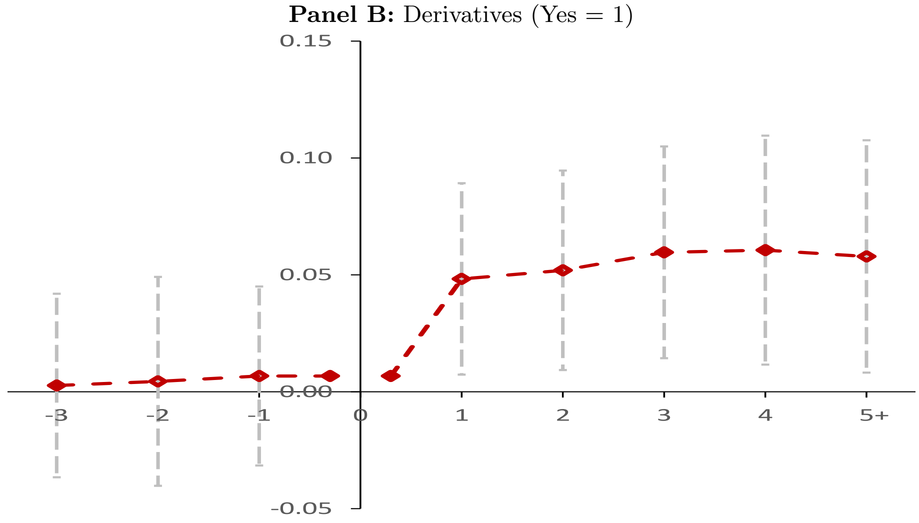
Figure A3: **Derivatives Usages of Life Insurance Companies around Section 711 Adoption: Treated vs. Control Insurers.** This figure reports the point estimates from Log of Derivatives (Panel A), Derivatives (Yes =1) (Panel B), and Assets & Liabilities Hedged (Panel C) regressions. The sample includes life insurance company level data for the period 2000 – 2017. The regression specifications are the same as those reported in columns [2], [5], and [8] of Tables 3, except that the effect of Pre-event High Leverage is allowed to vary by year for each year starting four years prior to Section 711 adoption and ending four years after the adoption. We also plot the estimate on the interaction of Pre-event High Leverage with an indicator equal to 1 starting in year five after the Act adoption and ending in 2017. Ninety-five-percent confidence intervals are also plotted.



Panel A: Log of Derivatives

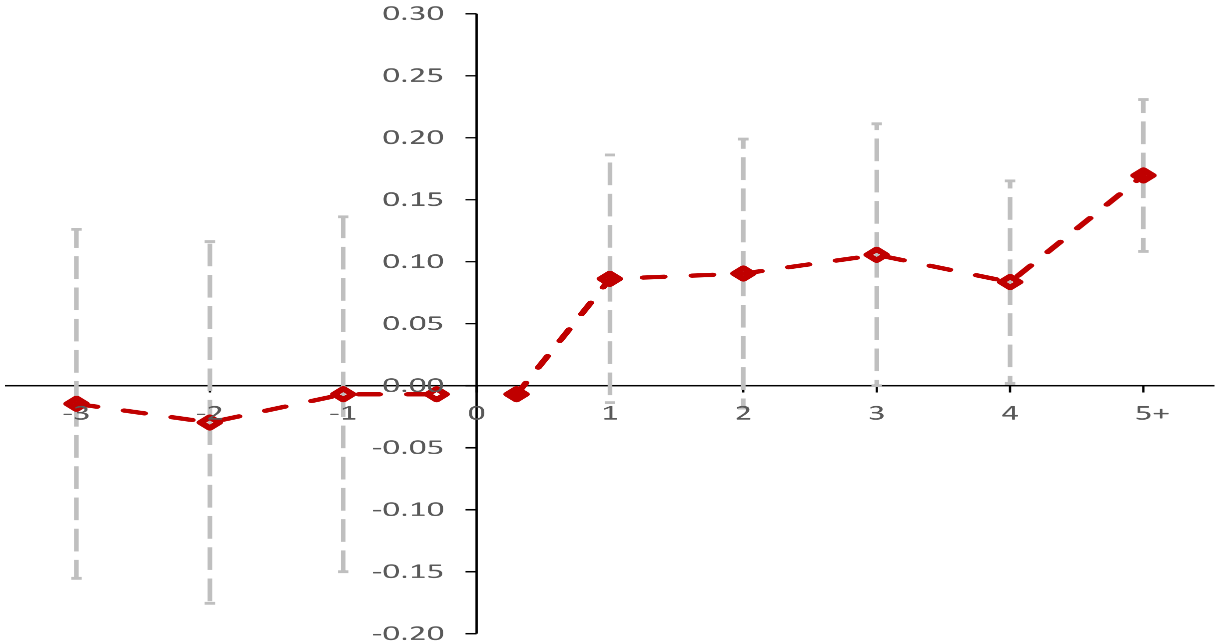


Panel B: Derivatives (Yes = 1)

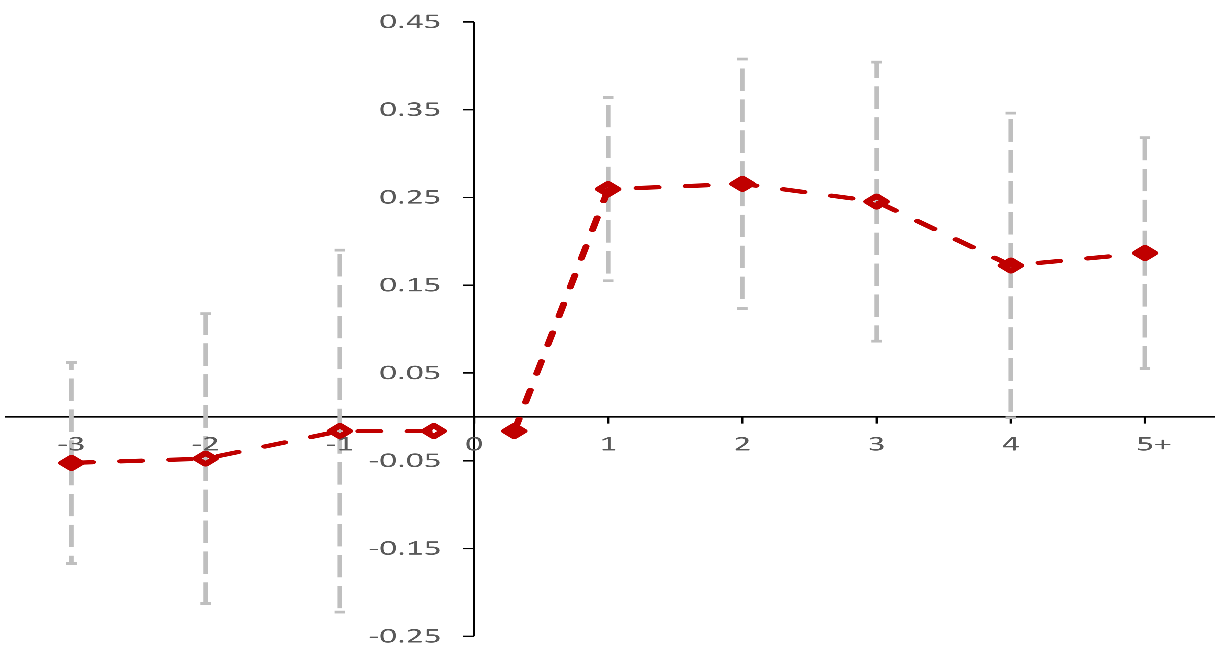


Panel C: Assets & Liabilities Hedged

Figure A4: **Life Insurance Premiums and Annuities around Section 711 Adoption: Treated vs. Control Insurers.** This figure reports the point estimates from Log of Life Insurance Premiums (Panel A) and Log of Annuities (Panel B) regressions. The sample includes life insurance company-state level data for the period 2000 – 2017. The regression specifications are the same as those reported in column [1] and [3] of Table 7, except that the effect of Pre-event High Leverage is allowed to vary by year for each year starting four years prior to Section 711 adoption and ending four years after the adoption. We also plot the estimate on the interaction of Pre-event High Leverage with an indicator equal to 1 starting in year five after the Act adoption and ending in 2017. Ninety-five-percent confidence intervals are also plotted.



Panel A: Log of Life Insurance Premiums



Panel B: Log of Annuities