Hedging, Contract Enforceability and Competition

Erasmo Giambona Anil Kumar Gordon M. Phillips *

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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 examine firms after a staggered state-level reform that reduces the costs of hedging by granting derivatives superpriority in case of insolvency. We show that firms that are likely to face costly external finance increase hedging and reduce risk and the probability of receivership. Firms that are likely to face costly external finance, also lower prices, increase policy sales and increase their market share post reform.

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*Giambona: Syracuse University, egiambon@syr.edu; Kumar: Aarhus University and Danish Finance Institute, email: akumar@econ.au.dk; Phillips: Tuck School of Business at Dartmouth and NBER, email: gordon.m.phillips@tuck.dartmouth.edu. We thank Shan Ge, Kristine Hankins, Anastasia Kartasheva, Ralph Koijen, Amiyatosh Purnanandam, David Scharfstein, Carola Schenone, Ishita Sen, and seminar participants at Cornell, Dartmouth, 2022 FIRS conference, Maryland, Michigan State University, 2021 NBER Insurance Group, 2022 NBER Summer Institute, Tsinghua University and Tulane University for their helpful comments. We also thank Sean M. McKenna from the National Organization of Life and Health Insurance Guaranty Associations for extensive discussions on the insolvency procedures of insurance companies. We are also thankful to Michael Etkin, Esq. from Lowenstein Sandler LLP and Shmuel Vasser, Esq. from Dechert LLP for discussions on the legal treatment of derivatives in insolvency.

1 Introduction

In this paper we examine how risk management and hedging impact firms and competition among firms in the insurance industry following staggered state-level financial reform that reduces the costs of hedging. The insurance industry is one of the largest industries in the U.S. and is also considered, like the banking industry, to be systemically important and subject to risk from its underlying financial assets. 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. Rampini and Viswanathan (2010) show that financially constrained firms hedge less given that both hedging and borrowing for investment require collateral. 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]

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. If financially constrained firms are able to increase hedging they will become better able to survive and avoid financial distress and the expected deadweight costs associated with distress. These previously constrained firms will be able to offer products with lower prices and less risk of distress and thus gain market share.[2]

Customer demand will thus be directly impacted by pricing and the ability of firms to survive if the product, like insurance, has a long life. Thus, we expect that for an individual firm who increases hedging, the demand curve will shift out and the firm supply curve will also shift out down. We illustrate these changes graphically in the next section. Overall, gains thus arise from reducing the deadweight costs of financial distress and expanding the set of parties willing to do business with

[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.

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

the firm. We directly show this mechanism as the probability of exit and large negative income shocks decline for insurers with ex costly external finance. If the market for derivative contracts is competitive, we expect that most of these gains will accrue to the insurance company undertaking hedging.

Of course, if hedging is beneficial, the question is what keeps firms with financial constraints from hedging more in all states? If counterparties are worried about the risk of the insurance firm and a lengthy receivership process given limited enforceability in receivership, they may be less willing to offer cost-effective hedging products to risky insurers.[3] We study life insurers whose value and sales depend on the insurer's ability to survive to when payouts will occur. We examine life insurers surrounding a state-level reform that grants derivative contracts superpriority in receivership and thus makes contracts more enforceable. As analyzed by Bolton and Oehmke (2015), this advantage of derivatives being privileged in bankruptcy can be efficient if superpriority provides cross-netting benefits to derivatives counterparties that provide hedging services.

This derivatives superpriority reform was introduced by Section 711 of the Insurer Receivership Model Act (IRMA). This act was first adopted by Connecticut in 1998 and has since then been adopted in a staggered fashion over time by 22 other states.[4,5] The reform enacted in 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 covenant (e.g., a rating downgrade), even if the company is not formally in receivership. This termination clause 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 thus allowing the counterparty to avoid the uncertainty typical of financial distress.[6]

[3] See "Enforceability: Everything You Need to Know" at the legal site *https://www.upcounsel.com/enforceability*.

[4] This staggered state-level reform is similar to the setting of Bertrand and Mullainathan (2003), with the addition that not all states adopt this reform. 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 the "never treated states" as control states throughout and show that there are no yearly pre-trends. We also conduct a number of placebo tests.

[5] There was also an accounting change in 2009 (Actuarial Guideline 43) studied by Sen (2021) that changed the regulatory liabilities for variable annuities for all insurers - thus it didn't differentially impact firms across states. We address this change later in our paper and as we discuss and show it does not significantly impact our findings.

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

This change reduced the counterparty risk of derivatives contracts as over 95% of derivatives contracts in the life insurance industry are over-the-counter (OTC) contracts.[7] After closing the position, the counterparty is not required to return collateral if the insurer is later placed in receivership. This reform effectively gives counterparties a special protection, or superpriority against the costly consequences of the automatic stay, which can subject creditors of an insolvent insurer, including policyholders, to a lengthy receivership proceeding.

We examine the financial stability and risk, 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 that insurers that are likely to face costly external finance that are closer to potential default 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 a Merton distance-to-default measure that captures a high future potential of bankruptcy. An increase in hedging is possible because derivatives counterparties are more likely to engage in derivatives transactions with highly leveraged insurers that are closer to default 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.

We find that insurers that are likely to face costly external finance and are closer to potential future default increase hedging after staggered state-level financial reform that reduces the costs of hedging. Specifically, we find a significantly large increase in the derivatives notional amount and the proportion of statutory liability hedged for firms with a higher ex ante probability of financial distress and are ex ante closer to potential default. The propensity to hedge increased by 6.8% for the treated group period relative to the control group in the post Section 711.

An important part of our thesis is that hedging allows life insurers to sell more policies by increasing their financial strength and reducing the expected deadweight costs of financial distress. We first thus examine the financial stability and risk of insurers with ex ante high measures of

[7] For example, in 2010 98.2% of all life insurers' derivatives were OTC (NAIC, Capital Markets Special Report, of which 57.2% were swaps, 39.7% were options, 3.1% were forward contracts.

financial distress. We find that the propensity of sizable negative capital shocks or to exit the sample because of receivership decreased by up to 1.6% and 2.0%, respectively, for insurers with ex ante high measures of costly external finance and potential future default post Section 711. We also find that measures of income volatility have decreased post Section 711 for these impacted insurers.[8]

We then examine the impact on sales and product market competition. We find that life insurance and annuity policy sales increase for the insurers with a higher ex ante potential costs of external finance relative to their control groups in the post Section 711 period.[9] 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 also find that insurers with potentially higher costs of external finance increase their market share sizably in both the life insurance and annuity segments relative to control companies following Section 711. Relatedly, we also find that affected companies are more likely 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 1.3% and 7.2%, respectively, for treated companies relative to control companies following Section 711.

As also discussed, by mitigating the risk that the value of financial assets decreases, hedging may allow life insurers to price their products more competitively. Consistent with this prediction, we find that policy prices decrease 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 find that the prices of life annuity and term annuity policies go down for the treated group relative to the control group in the post Section 711 period by about 3.9% and 3.4%, respectively. Similarly, we find that the price of the 10-year term life insurance policy decreases by about 3.4% for the affected insurers relative to control companies in the post event period, but has no effect on the price of universal life insurance policies.

We run a number of tests to assess the robustness of our results and include these in an online

[8]See Jarrow (2020) and DeAngelo and Stulz (2015) for insights on the role of hedging for the financial stability of insurers and banks, respectively.

[9]We also examine AM Best Ratings but these ratings do not change ex ante very much.

Appendix. We show that our results are robust to (1) accounting for differences between treated and control companies, (2) controlling for the actuarial change studied in Sen (2021), (3) controlling for domicile and licensing states regulatory and economic conditions, (4) using alternative proxies for costly external finance, (5) using random effects and the fixed effects Tobit models (Honoré (1992)), (6) sample selection issues, and (7) 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)).[10] We contribute to this literature by identifying an important driver of risk management for life insurance companies.

Our paper also adds to the growing academic interest in the stability and risk 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 (2021)) to risk management, insurance companies' investment choices (Becker and Ivashina (2015); Acharya, Philippon, and Richardson (2016); Ellul et al. (2022); Ge and Weisbach (2021)), and product pricing (Ge (2022)). 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 Titman (1994); Phillips (1995); Kovenock and Phillips (1997); and product pricing (Chevalier (1995); Chevalier and Scharfstein (1996)). We contribute to this literature by studying the effect of risk

[10]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).

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 (Froot, Scharfstein, and Stein (1993), 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 insurers. 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, showing the effect of Section 711 on insurers with ex ante high measures of costly external finance.

2 Life Insurance Companies and the Use of Derivatives

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.[11] A decrease in the value of these financial assets could affect the ability of an insurer to pay claims and lead to the seizing of the company by the National Association of Insurance Commissioners (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.

We focus on life insurance companies because the bulk of derivatives use 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)).

We view the potential gains to life insurance companies from hedging to come from two components. First, hedging can reduce the deadweight costs of financial distress. Telser (1966) and

[11] 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.

Bolton and Scharfstein (1990) consider 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. If financially constrained firms are able to increase hedging they will become better able to survive and avoid financial distress and the expected deadweight costs associated with distress. It will thus shift the distribution of profits such that the probability of entering the liquidation states goes down. These gains will not just accrue to the existing debtholders if subsequent debt contracts now can be written at a lower cost.

Second, and perhaps more importantly, previously financially constrained firms will be able to offer products with lower prices and less risk of distress and thus gain market share. Customer demand will thus be directly impacted by pricing and the ability of firms to survive if the product, like insurance, has a long life. Froot (2007) considers how when insurer's financial situation declines customer demand also falls because of customer's sensitivity to risk. Froot theoretically 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 to risk.[12] Thus, we expect that, for an individual firm who increases hedging, the demand curve will shift out as shown in Figure 1,

[Figure 1]

Figure 1 shows how demand for an insurer that has reduced probability of default is expected to increase and shift outward from D to D'. The supply curve is also predicted to shift downward and become flatter from S to S' given increased competition from financially constrained insurers as the marginal cost for issuing derivatives after states adopted Section 711 is expected to decrease from MC to MC' for the previously more risky insurer.[13] This figure thus illustrates our prediction that quantity of policies sold from insurers that increase hedging increase. Prices of policies sold by these insurers are also predicted to decrease given both the lower cost of financial inputs and given the increased competition - yielding a new equilibrium price and quantity (P', Q') as shown in the figure. Overall, unless the market for insurance products is perfectly competitive, we predict gains that arise from both reducing the deadweight costs of financial distress and expanding the set of

[12]Phillips, Cummins, and Allen (1998) shows empirically that insurers' demand is impacted when they face an increased probability of default.

[13]We thank Shan Ge for this point about marginal cost shifting downward for previously more risky insurers.

customers willing to do business with the firm. If the market for derivative contracts is competitive, we expect that most of these gains will accrue to the insurance company undertaking hedging.

We now turn to describing institutional details for the use of derivatives for life insurance companies. Figure 2 graphically presents the notional amount of life insurers' derivatives transactions.

[Figure 2]

Figure 2 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 years.

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

We first discuss the treatment of 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.[14] 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.[15] The main objective of IRMA is that policyholder claims are paid, while limiting liabilities for the

[14] 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 different insurance issues.

[15] 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.

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 trouble, 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 purchase 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. The purpose of the process is 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 57 or 4.9% (by number) of life insurers were placed in receivership (conservations, rehabilitations, and liquidations) during 2000−2017. Out of the 57 cases, 30 took place in 711 states, 23 before the passage of the reforms, and 7 after the reforms. The remaining 27 cases took place in non-711 states. 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 Reform of the Treatment of Derivatives in Insurance 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.[16] The latest state to join the safe harbor group is Wisconsin in 2015.

Figure 3 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 3]

These safe harbor provisions allow the derivatives counterparty of an insurance company domiciled in a Section 711 state to terminate the derivatives contract, net out all derivative contracts, and 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.[17] 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)[18] and if the insurance

[16] 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.

[17] 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.

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

company triggers an event of default (e.g., a rating downgrade) negotiated in the contract, even if the company is not formally in receivership.

The adoption of Section 711 thus 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. Not being subject to avoidance powers means that the counterparty can keep any proceeds transferred within a certain time frame prior to insolvency and thus need not be returned to the insurer's estate, when such transfer constitutes a preference.

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.[19] This variation suggests that the consequences of an insurance company financial distress 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 a 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.

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 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. These 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 sell 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. While the number of products

[19] 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.

increase, we also predict risk will go down with hedging. Thus to summarize the predictions: 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.

Our results cover a period that encompasses another regulatory change in 2009 (actuarial guideline 43) studied by Sen (2021). Thus, there may be a concern about attribution of our results to the passage of Section 711 vs. the passage of actuarial guideline 43. Actuarial guideline 43 changed the accounting of regulatory liabilities for variable annuities for all insurers but it didn't differentially impact firms across states, nor did it affect all liabilities. In tests that we conduct later in the paper, we show that this accounting change does not change the overall conclusions that we make in this paper about the benefits of the passage of Section 711. Both changes impacted derivatives usage.

Conceptually, there are several reasons that most of our results can be attributed to the passage of Section 711 and not the actuarial guideline change. First, while the accounting change affected all insurers in all states, we study staggered implementation of Section 711 over different years and have as controls insurers selling in Section 711 states but domiciled in states that do not pass the reform. These control firms are not impacted directly by Section 711 but in 2009 and later, all firms are impacted by the accounting change. Thus, in years after 2009, both our treatment firms and the control firms are impacted by the accounting change.

Second, we show that our results hold and are stronger for interest rate derivatives separated from equity based derivatives and also for annuities that are partially risk sensitive. Interest rate derivatives that are hedging effective were not impacted by the actuarial guideline 43. The accounting guideline 43 only impacts accounting for derivatives that used to hedge variable annuities that are risk sensitive, which are more likely to be equity based exposures as noted by Sen (2021). The reason is that it is harder to hedge equity based annuity products with equity derivatives which are short term and thus these hedges are not fully effective at hedging risk.

Third, longer-dated hedges are more likely to be impacted positively by Section 711 as long-dated liabilities have the largest potential default risk and thus hedges that are long dated would experience a larger decrease in collateral costs as counterparties can seize the underlying collateral if insurers enter insolvency. In our data, 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. This means that the type of maturity mismatch for interest rate products (and related lack of hedging effectiveness) is unlikely to be sizable enough to impair hedging during our sample period, or affect the way insurers hedge based on whether products are sensitive to interest rates.

Koijen and Yogo (2017) further find that derivatives improve hedging effectiveness, and our replication of Koijen and Yogo in our setting (shown later) confirms that hedging reduces income volatility for treated firms post Section 711.

It is also 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.[20] 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.

[20]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.

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.[21]

Geographical heat maps in Figure 4 shows the distribution of life insurance companies by domicile and licensing state during our sample period.[22]

[Figure 4]

Panels A and B of Figure 4 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

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

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

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 4, Panel B with Figure 4, Panel A. Overall, Figure 4, 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 4, 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 5 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.[23]

[Figure 5]

Figure 5 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 6 show the total number of redomiciliations by life insurance companies in each year from 2000 to 2017, with the orange portion of the bars indicating those redomiciliations into a state that has passed Section 711.

[Figure 6]

Figure 6 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

[23]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

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 control firms, including 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 insurers that never collected at least one million premium in any given year during our sample. If an insurer starts reporting $0 premium from any given year and if its premium remains $0 until the end of our sample, then we remove such insurer-year observations from the year when they start reporting $0 premium. Lastly, we drop premium observations for insurers that report $0 premiums in states in which they are not licensed to operate.

[Table 2]

Table 2, Panel A shows that on average life insurers collected $6 million and $20.4 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 $208.9 million and $605.7 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 the control set of life insurers (pre-event low leverage in 711 states and high/low leverage insurers in non-

711 states), Panels C and D, respectively. High leverage companies are also clearly larger policy sellers, collecting on average \$34.4 million and \$9.7 million in annuity and life insurance premiums, respectively, in each licensing state, compared to \$8.1 million and \$2.8 million for the control set of insurers.

Derivatives Notional (\$ billions), the notional amount of all derivatives contracts, and *Hedging Ratio*, ratio of derivatives notional to total assets minus capital & surplus, for the average life insurer, are \$1.7 billion and 3.2%, respectively (Panel B). *Derivatives (Yes = 1)*, a dummy for insurers reporting a derivatives notional value, indicates that on average around 20% uses derivatives. Evidence in Panels C and D reveals that 34.7% of high leverage life insurers use derivatives compared to 11.6% of control firms, respectively. Assets are \$16 billion for high leverage insurers (Panel C), compared to \$2.6 billion for control 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.

In order to partially separate out the effect of Section 711 from the actuarial change 43 discussed earlier, we use detailed derivatives data characterized by risk type and identify interest rate, currency, credit and equity derivatives. We obtain this detailed data from the NAIC Schedule DB annual files. In these files, life insurers report, among others, contract level information concerning notional amount, maturity, counterparty, contract description, and, starting in 2010, whether derivatives are related to interest rate (IR) risk, credit risk (CR), foreign exchange (FX) risk, and equity (EQ) risk. For years prior to 2010 we identify the derivatives type and risk type hedged following the procedure of Sen (2021), which used text mapping of hedging positions in later years to identify the hedging and risk type in earlier years.

Leverage, the ratio of total liabilities minus ceded reserves plus assumed reserves to total assets, is 67.9% for the average life insurer (Panel B), with an average of 85.5% for high leverage companies (Panel C) and 57.7% for control set of firms (Panel D), respectively. The relatively high leverage is unsurprising for life insurers, reflecting liabilities associated to future policy claims. *Net Income*, the ratio of net income to total assets, is 0.6% and 1.8% for high leverage (Panel C) and control set of (Panel D) life insurers, respectively.

To account for differences between treated and control insurers, in all our regression we include insurer fixed effects (company level regressions), insurer-state fixed effects (company-state level regressions) and the ratio of 1 to assets. In robustness tests, we further match treated and control firms 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 risk, and policy sales (life insurance and annuity premiums) of pre-event high leverage insurers (treated group) relative to the control set of insurers (pre-event low leverage insurers in 711 state and high/low leverage insurers in non-711 states) 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:

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

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 *Hedging Ratio*, the ratio of derivatives notional to assets minus capital & surplus. 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 a proxy of ex ante Merton's distance-to-default (Merton (1974)) and identify if firms are below the sample median. We define distance-to-default as the ratio of operating cash flows minus liabilities to the volatility of operating cash flows using 4 years of ex ante consecutive observations.[24] $PostSection711$ 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 *1/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:

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

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 *1/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

[24] In the Appendix, we also present results using an indicator for when a firm's ex ante Altman Z-Score plus is below 1.23, which indicates that a company is financially distressed (Altman et al. (2017)).

level data (the equivalent of state of plant location in Bertrand and Mullainathan (2003)) significantly 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 standardized *Hedging Ratio*.

[Table 3]

We find that *Pre-event High Leverage* × *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 *1/Assets* as control, the coefficients on the interaction term indicate that derivatives notional, propensity to use derivatives, and the ratio of derivatives notional to regulatory liabilities (assets minus capital & surplus) all increased. The increase for the treated group relative to the control group was 409% (=exp(1.627)-1) for overall notional derivatives amount, 6.8% for the extensive margin of using derivatives, and 25.3% for the percentage of regulatory liabilities hedged, respectively, following Section 711.

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. In columns [3], [6], and [9], we show that our hedging results are robust, both statistically and economically, if we categorize as financially distressed those insurers with pre-event Merton's distance-to-default below the sample median. For example, the evidence in column [9] suggests that the percentage of regulatory liability hedged increased by 32% post reform.

As discussed, the dependent variable in columns [7] − [9] is the ratio of derivatives notional to assets minus capital & surplus. 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. Table A11 further shows that our results also hold when we use alternative proxies of costly external finance. First, we add captive reinsurance to leverage, and we use this alternative measure of leverage to identify highly leveraged insurers. In line with Koijen and Yogo (2016), the logic of this measure is that if insurers cede liabilities to captive reinsurers, this form of reinsurance is not effectively reducing the risk of financial distress.

Our second proxy uses the parent company leverage (for those insurers that belong to a group, about 39% in our sample) to assess financial strength. This measure is motivated by the evidence that parent companies transfer financial resources to their insurance affiliates in times of financial difficulties (e.g., Koijen and Yogo (2015); Barnes, Bohn, and Martin (2016)).

In our last proxy, we define leverage by subtracting cash and cash equivalents from the insurers' liabilities. Our hedging results are robust with these alternative proxies of financial distress (Table A11).[25] In Appendix Table A12, we show that our hedging results further hold, 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.[26]

In order to partially separate out the effect of Section 711 from the actuarial guideline change

[25]In unreported results, we also do not find any significant effect of Section 711 on reinsurance activities of insurers. Furthermore, results in Tables 3 and A11 (for hedging regressions) and Tables 8 and A13 (for premium regressions) show that including or excluding reinsurance activities in our leverage measure does not have any significant effect on our results.

[26]Z-score plus is calculated as as $0.717 \cdot X1 + 0.847 \cdot X2 + 3.107 \cdot X3 + 0.420 \cdot X4 + 0\ .998 \cdot X5$, where X1 is the ratio of cash and cash equivalents to total assets, X2 is the ratio of retained earnings to total assets; X3 is the ratio of pre-tax operating income to total assets; X4 is book equity to total liabilities; and X5 is total sales to total assets.

43 discussed earlier, we estimate the same regressions as in Table 3 separately for credit (CR) and foreign exchange (FX), interest rate (IR), and equity derivatives (EQ). We separate these out into derivatives that are used to hedge longer dated positions vs. equity derivatives which are more short term positions used to hedge equity guaranteed minimum benefit variable annuities.[27] The equity derivatives were more impacted by actuarial change 43 given it is an accounting change that allowed better marking-to-market for risky equity positions and some short-term risky interest rate sensitive annuities as it allowed firms to offset hedge losses with asset gains and vice versa. There is no expected impact of the accounting change on credit and foreign exchange derivatives so these derivatives in particular provide a cleaner test. In contrast, Section 711 would apply to all derivative positions but only in states that passed Section 711 and in these states Section 711 would also impact derivatives used for hedging underlying liabilities for which the actuarial change had limited impact.

Thus, in Table 4, we estimate the derivatives positions for credit risk (CR) and foreign exchange (FX) as well as interest rate (IR) and equity (EQ) derivatives separately. Inspection of the results in Table 4 reveal that the impact of Section 711 remains positive and significant irrespective of the type of the derivatives. The magnitude of the coefficient for equity derivatives is larger as firms' incentives to undertake these positions would be influenced by both the accounting change and the Section 711 change. The evidence in column [1] indicates an increase of 239% in the CR + FX notional amount for treated firms relative to control firms.

We find similar patterns when we use the distance-to-default as our measure of financial constraints, with the evidence in columns [2], [4], and [6] indicating increases of 114%, 407%, and 175% in the notional amounts of CR + FX, EQ, and IR, respectively. We likewise show similar results for our other hedging measure (ratio of derivatives notional to assets minus capital & surplus) separated out by derivative categories in Appendix Table A4.

We also estimate our hedging results using a measure of hedging exposure following the methodology in Sen (2021).[28] For these estimations, we focus on interest rate swaps, which represent more

[27] All equity based variable annuities were impacted by actuarial guideline 43, while guaranteed minimum death and income fixed income or interest rate based annuities were not impacted by actuarial guideline 43.

[28] Refer to Appendix E in Sen (2021) for details on the hedging exposure measure.

than half of all the derivatives used by life insurance companies during our sample period. Specifically, in columns [7] and [8], we use as dependent variable the ratio of hedging exposure for interest rate swaps to regulatory capital. Results in columns [7] and [8] show that our results are robust when we use this alternative measure of hedging.

[Table 4]

Further, to directly control for the effect of actuarial guideline 43, following Sen (2021), in Table 5, we present the derivative usage results of the longer dated hedges, (credit (CR) and foreign exchange rate (FX) and interest rate (IR)), and equity derivatives (EQ) controlling for the ratio of variable annuity (VA) liabilities sensitive to both interest rates and equity markets to assets. VA liabilities are net of ceded liabilities. This group of fully risk sensitive (FRS) variable annuity liabilities is the sum of guaranteed minimum accumulation benefit (GMAB) and guaranteed minimum withdrawal benefit (GMWB) annuities scaled by assets.[29] In line with Sen (2021), we measure FRS ratio in 2007, two year before actuarial guideline 43 came into effect, and interact them with $Post2009$, a dummy equal to 1 for years on or after 2009, and 0 before 2009. To facilitate the economic interpretation of the results, all variables are standardized in these regressions.

Table 5 shows that our main findings are economically very sizable and statistically significant in these estimations even after controlling for the FRS variable annuity liabilities. In Table A5, we estimate the same regressions as Table 5 using the natural logarithm of the sum of credit (CR), foreign exchange (FX), and interest rate (IR), and once again we find that our results hold after controlling for the effect of actuarial guideline 43. Overall, Table 5 highlights the importance of Section 711 for hedging, while contributing to mitigate the concern that our findings could be driven by the passage of the actuarial change studied in Sen (2021).

[Table 5]

[29]The VA liabilities data is obtained from regulatory financial statements filed by insurers with the NAIC under Section 9.2, General Interrogatories (Part 2). These financial statements provides VA liabilities (both gross underwritten as well as ceded) in two main columns depending upon the return guarantees: death benefit types and living benefit types, which can further be divided into four broad categories of return guarantees: GMAB, GMWB, GMIB, and GMDB.

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 Figure 7, which plots 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 7 shows, there is no evidence of significant 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 7]

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.[30] 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 A6 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 capital & surplus decreased for treated insurers relative to control companies

[30] 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 to 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.

after Section 711 adoption. We consider also a life insurer's propensity to exit the sample due to receivership or other event. Table 6 presents these results.

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

[Table 6]

In line with our prediction, results in Panel A show that the propensity to experience negative capital & surplus shocks decreased for the treated group relative to the control group in the post Section 711 adoption period. For example, in column [1], we obtain a negative and significant coefficient estimate on $Pre\text{-}event\ High\ Leverage \times\ PostSection711$, suggesting that the propensity of capital & surplus to be less than 50% of the previous year capital & surplus decreased by 1.2%, for the treated group relative to the control group in the post Section 711 adoption period.[31]

Panel B (column [3]) shows that the propensity of exit due to receivership or other negative corporate events decreased by 1.8% 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.[32] Results in column [2] and [4] indicate that our findings are very similar, both statistically and economically, when we use distance-to-default as a proxy of pre-event costly external finance.

In Table 7, we replicate the results from Koijen and Yogo (2017) who find that derivatives improve hedging effectiveness. We examine whether hedging effectiveness improves post Section 711 for impacted insurers relative to control firms. Our replication of Koijen and Yogo shown in Table 7 confirms that hedging reduces income volatility for treated firms post Section 711. Volatility

[31] We also explored if A.M. Best ratings increased post Section 711 but did not find evidence as these ratings change infrequently.

[32] Table A7 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. Leverage for these 9 companies is high, ranging from 85% to 95%, indicating potential concerns with their financial stability.

of net income less the volatility of adjusted net income declines both in the level (columns [1]-[2]) and sign (columns [3]-[4]).

[Table 7]

5.3 Competition after Section 711 Adoption

5.3.1 Life Insurance Policy Sales

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 8 presents results from premium regressions. The dependent variables are *Log of Life Insurance Premiums* and *Log of Annuities*, in columns [1] and [2], 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). Thus, all our estimations include insurer-licensing-state and year fixed effects.

[Table 8]

The coefficient estimates on $Pre\text{-}event\ High\ Leverage \times\ PostSection711$ are positive and statistically significant at the 1% level across all four estimations in Table 8. In economic terms, the coefficients on the interaction term in columns [1]-[2] suggest that life insurance premiums and annuities increased by about 18.6% and 36%, respectively, for the treated group relative to the control group in the years following Section 711. 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)). In columns [3]-[4] we re-run our policy sales results by interacting our main variable of interest with indicators for whether the insurer is large or small. Pre-event Large Firm is an indicator for insurers with 1/Assets below the sample median in the year before the insurer's domicile state adopted Section 711. Pre-event Small Firm is an indicator for insurers with 1/Assets above the sample median in the year before the insurer's domicile state adopted Section 711. Both Pre-event Large Firm and Pre-event Small Firm are always zero for firms in the control states. We find that treated life insurance companies experienced increased sales following adoption of Section 711 by their domicile state irrespective of whether they are large or small, indicating beneficial effects of the derivatives reforms for the entire insurance industry. The effect is slightly larger in magnitude for small firms consistent with these firms being more likely to be financially constrained.

Our results are also robust when we use three different modified versions of our main leverage measure accounting for captive reinsurance, parent's company leverage, and cash holdings, respectively. See our discussion about Table A11 for additional details on these alternative leverage measures. We present these results in Appendix Table A13. Our premium results further hold when we use a proxy of Merton's distance-to-default (Table A14). 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 A17 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 (derivatives data is unavailable in 1998), and the results are also robust (Appendix Table A16).

We test the parallel-trend assumption for the premium regressions by plotting 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 [2] of Tables 8, except that 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 8 displays no evidence of significant pre-reform trends for either our life insurance premium or annuity measures.

[Figure 8]

In Table 8, the control group includes the "universe" of other life insurers, pre-event low leverage insurers in 711 states and high/low leverage insurers in non-711 states. 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, in any given Section 711 event year, we match each pre-event high leverage insurer (treated) to its closest control insurer based on pre-event 1/assets and net income 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 A8).[33] 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 and statistically significant at the 1% level. 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.[34]

Several additional tests further confirm the robustness of our premium findings. In brief, our results are robust to: (1) controlling for licensing-state × year fixed effects (which allows us to compare treated and control companies exposed to similar time-varying state regulatory and economic conditions) (Appendix Table A10); (2) using alternative leverage measures (Appendix Table A13) and distance-to-default as proxies for costly external finance (Appendix Table A14); (3) relying on alternative estimation methods, such as the random effects (Tobin (1958); Amemiya (1973); Bernheim (1991)) and the fixed effects Tobit models (Honoré (1992)) (Appendix Table A15); (4) Excluding Connecticut from our sample (derivatives data is unavailable in 1998, the year when the state passed Section 711) (Appendix Table A16); (5) controlling for treatment heterogeneity (Cengiz et al. (2019) and Callaway and Sant'Anna (2020)) (Appendix Table A17); (6) estimating the

[33]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 A8). This suggests that treated and control companies are similar in terms of characteristics and distributional assumptions in the matched sample.

[34]As Table A9 in the online Appendix shows, our hedging results also hold in the matched sample.

effect of Section 711 on policy sales of highly leverage insurers in states affected by a high mortality "shock" prior to Section 711 (Appendix Table A18). In line with the logic of our empirical design, Table A18 shows 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.[35]

5.3.2 Quantity and Pricing of Insurance Policies Post-Section 711

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 both quantity and pricing for life insurance products. First, we study the effect of Section 711 on the number of policies. These are complement to our findings 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. 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. Column [1] in Table 10 reports number of policy regression results. The coefficient on our main interaction term is 0.135, statistically significant at the 1% level, suggesting that number of policies increased by about 13.5% for highly leverage life insurers relative to control companies following the adoption of Section 711 by their domicile state.

[Table 10]

To examine the effect of Section 711 on policy price, we collect detailed pricing information on 10-year term life insurance policies, and two of the more popular annuity products, life annuities and term annuities.[36]

[35] 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 smaller effect for annuities (size of the coefficient on the triple interaction term in Table A18) is 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.

[36] Because price markups are estimated in excess of actuarial values, which by definition are identical across com-

Price quotes for 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 2002 – 2017 for the 10-year term life products. 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.

Columns [2] - [4] in Table 10 present results from pricing regressions. We find that the prices of 10-year term life policies (column [2]), life annuities (column [3]), and term annuities (column [4]) decreased by about 3.4%, 3.9%, and 3.4%, 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 leveraged insurers to lower the prices of their insurance products and this led to an increase in policy sales (life insurance and annuities). Overall, these findings suggest that hedging has important product market effects through higher financial stability and more competitive pricing.

5.3.3 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

panies for the same insurance products (Koijen and Yogo (2015)), using life insurance product prices is equivalent to using markups.

share variables by 100 in our regressions. We also exclude companies in each state that had zero sales in that year in life insurance and annuity products as we are looking at the intensive margin.

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.

Overall, some simple statistics show that the market for insurance is relatively fragmented in nearly all states. The DOJ considers an HHI of 2500 or greater to be evidence of high concentration and an HHI of less than 1500 to be competitive. HHIs between 1500-2500 are considered to be moderately concentrated. Examining life insurance, in 2005, the average HHI across states was 303 with the maximum HHI of 2268 in Delaware. Excluding Delaware, a small state, the 2nd highest HHI was 853 for New Jersey. So except for Delaware, state insurance markets are all very competitive. Texas, for example, had a HHI in 2005 of only 189. Looking at market shares, the average market share was less than 1 percent, with a 99th percentile of only 3.47%.

When we look at 2015, 10 years later, insurance markets are still very fragmented. In 2015, the average HHI across states was 312, a slight insignificant increase with the maximum HHI of 1459 in Arkansas. The 2nd highest state-level HHI was 590 for Connecticut. Delaware had increased competition by 2015 as the HHI declined to 443. Competition remained high in Texas as it had an HHI in 2015 of only 222. Market shares were also very low. The average market share increased some but was still less than 1%, with a 99th percentile of only 4.57%. Thus, all state markets are competitive.

Table 11, Panels A and B report results from market share and market leadership regressions, respectively. For Panel A, columns [1] and [2] show that life insurance and annuity market share increase significantly for affected insurers. For life insurance this increase is 0.056 percentage points, which, while quite small (less than 1%), is large relative to the sample average of 0.30%. For annuities, market share increases by 0.235 percentage points for affected companies relative to control companies following Section 711. Again a very small increase of less than 1% point, but large relative to the average market share of 0.45 percent.

[Table 11]

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 1.3% (or 5.2% relative to the sample average of 0.25) and 7.2% (or 28% 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 11 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.

5.4 Performance after Section 711 Adoption

In the last part of the paper, we examine the effect of Section 711 on insurance companies' performance. Table 12 presents our income specifications results.

[Table 12]

We find that both operating income (column [1]) and net income (column [2]) increased for highly leveraged 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 performance. The increase in performance plausibly occurred because hedging allowed these companies to increase policy sales above the cost of servicing them in spite of selling polices at a lower price. That is, hedging had beneficial effects for both insurers that hedge as well as for policyholders.

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 that were ex ante closer to default 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 the act 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 were ex ante closer to default with higher ex ante leverage post-passage of Section 711. We show that the risk of the impacted companies also decreases post-Section 711 passage. Our results show that 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 and default - leading to a 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. First, derivatives superpriority can increase the stability of the insurance industry by facilitating access to hedging instruments (and stimulating insurance policy sales). Second, access to derivatives can help mitigate the risk of financial distress. 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.
Hedging Ratio	The ratio of derivatives notional to total assets (SNL key field 122915) minus capital & surplus (SNL key field 122923).
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.
Distance-to-Default	The ratio of operating cash flow (SNL key field 123445) minus liabilities (SNL key field 122921) to volatility of operating cash flows using 4 years of past consecutive observations.
Pre-event Low Distance-to-Default	An indicator for insurers with distance-to-default below the sample median 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)	5.967	0.177	30.443	0.007	1.949	383,382
Annuities ($ millions)	20.413	0.002	234.253	0.000	1.332	350,530
	Panel B - Insurer-Level Obs.					
	Mean	Median	SD	p25	p75	Obs.
Life Insurance Premiums ($ millions)	208.888	10.418	818.688	0.978	83.792	12,047
Annuities ($ millions)	605.730	0.300	2,757.258	0.000	37.322	12,047
Derivatives Notional ($ billions)	1.729	0.000	11.422	0.000	0.000	12,069
Derivatives (Yes=1)	0.201	0.000	0.401	0.000	0.000	12,069
Hedging Ratio	0.032	0.000	0.108	0.000	0.000	12,063
Assets ($ billions)	7.486	0.293	27.438	0.035	2.437	12,068
Leverage	0.679	0.748	0.637	0.460	0.884	12,045
Net Income	0.014	0.008	0.113	0.000	0.025	12,068
	Panel C - Treated Group: Pre-event High Leverage Insurers					
	C1: Insurer-State Level Obs.					
Life Insurance Premiums ($ millions)	9.689	0.400	42.449	0.024	3.835	177,155
Annuities ($ millions)	34.391	0.139	319.475	0.000	7.923	163,945
	C2: Insurer Level Obs.					
Derivatives Notional ($ billions)	3.937	0.000	17.784	0.000	0.138	4,409
Derivatives (Yes=1)	0.347	0.000	0.476	0.000	1.000	4,409
Hedging Ratio	0.059	0.000	0.142	0.000	0.022	4,409
Assets ($ billions)	15.989	1.669	41.758	0.303	10.040	4,409
Leverage	0.855	0.860	0.227	0.778	0.926	4,406
Net Income	0.006	0.006	0.036	0.001	0.014	4,409
	Panel D - Control Group: Pre-event Low Leverage Insurers & High/Low Leverage Insurers in Non-711 States					
	D1: Insurer-State Level Obs.					
Life Insurance Premiums ($ millions)	2.770	0.085	12.362	0.002	0.989	206,227
Annuities ($ millions)	8.131	0.000	114.403	0.000	0.053	186,585
	D2: Insurer Level Obs.					
Derivatives Notional ($ billions)	0.457	0.000	4.371	0.000	0.000	7,660
Derivatives (Yes=1)	0.116	0.000	0.321	0.000	0.000	7,660
Hedging Ratio	0.016	0.000	0.078	0.000	0.000	7,660
Assets ($ billions)	2.591	0.090	10.817	0.019	0.625	7,659
Leverage	0.577	0.582	0.762	0.345	0.817	7,639
Net Income	0.018	0.012	0.139	-0.001	0.036	7,659

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 *Hedging Ratio*, which is the ratio of derivatives notional to total assets minus capital & surplus. *Leverage* is net liabilities/total assets and *Distance-to-Default* is (operating cash flows – liabilities)/volatility of past operating cash flows. Both are measured in the year prior to Section 711 passage. 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)			Hedging Ratio		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Pre-event High Leverage × PostSection711	1.612**	1.627**		0.067**	0.068**		0.253**	0.253**	
	(0.653)	(0.651)		(0.031)	(0.031)		(0.091)	(0.091)	
Pre-event Low Distance-to-Default × PostSection711			1.460**			0.058*			0.320***
			(0.658)			(0.032)			(0.090)
PostSection711	−1.217	−1.213	−1.202	−0.038	−0.038	−0.036	−0.173	−0.171	−0.226
	(0.893)	(0.897)	(0.951)	(0.039)	(0.040)	(0.043)	(0.182)	(0.184)	(0.193)
Lagged 1/Assets		0.142**	−0.130*		−0.010**	−0.009**		0.002	−0.004
		(0.059)	(0.064)		(0.004)	(0.004)		(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 Distance-to-Default	N.A.	N.A.	Absorbed	N.A.	N.A.	Absorbed	N.A.	N.A.	Absorbed
Observations	11,861	11,774	11,774	11,947	11,860	11,860	11,941	11,857	11,857
Number of Companies	886	880	880	886	880	880	886	880	880
Adjusted - R^2	0.809	0.809	0.809	0.746	0.746	0.746	0.623	0.623	0.624

Table 4: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption: Different Risk Categories.** This table presents estimations from derivatives regressions, with derivatives categorized by risk type. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in columns [1] - [2] is the natural logarithm of the yearly notional value of the sum of credit risk (CR) and foreign exchange (FX) derivatives. The dependent variables in columns [3] - [4] and [5] - [6] are the natural logarithm of the yearly notional value of equity (EQ) and interest rate (IR) derivatives, respectively. The dependent variable in columns [7] - [8] is the ratio of hedging exposure computed for IR swaps scaled by capital & surplus. All regressions control for lagged 1/Assets. *Leverage* is net liabilities/total assets and *Distance-to-Default* is (operating cash flows – liabilities)/volatility of past operating cash flows. Both are measured in the year prior to Section 711 passage. 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:	Panel A: Log of Derivatives						Panel B: Hedging Exposure /Regulatory Capital	
	CR + FX		EQ		IR		IR Swaps	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Pre-event High Leverage × PostSection711	1.222***		1.650**		1.166***		0.020**	
	(0.326)		(0.645)		(0.370)		(0.007)	
Pre-event Low Distance-to-Default × PostSection711		0.759**		1.624**		1.011*		0.021**
		(0.347)		(0.631)		(0.491)		(0.008)
PostSection711	−1.835**	−1.620*	−0.669	−0.747	−1.698*	−1.667*	−0.014	−0.015
	(0.807)	(0.790)	(0.821)	(0.844)	(0.844)	(0.917)	(0.015)	(0.016)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	N.A.	Absorbed	N.A.	Absorbed	N.A.	Absorbed	N.A.
Pre-event Low Distance-to-Default	N.A.	Absorbed	N.A.	Absorbed	N.A.	Absorbed	N.A.	Absorbed
Observations	11,819	11,819	11,798	11,798	11,815	11,815	11,860	11,860
Number of Companies	880	880	880	880	880	880	880	880
Adjusted - R^2	0.729	0.728	0.720	0.720	0.779	0.779	0.408	0.409

Table 5: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption: Controlling for the Effect of Actuarial Guideline 43.** This table presents estimations from standardized derivatives regressions, controlling for the effect of actuarial guideline 43. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in columns [1] - [2] is the natural logarithm of the yearly notional value of the sum of credit risk (CR) and foreign exchange (FX) derivatives. The dependent variables in columns [3] - [4] and [5] - [6] are the natural logarithm of the yearly notional value of equity (EQ) and interest rate (IR) derivatives, respectively. *FRS* is the sum of guaranteed minimum accumulation benefit (GMAB) and guaranteed minimum withdrawal benefit (GMWB) annuities scaled by assets. *FRS* is measured in 2007. *Post2009* is a dummy variable equal to 1 for years on or after 2009, and 0 before 2009. All regressions control for lagged 1/Assets. *Leverage* is net liabilities/total assets and *Distance-to-Default* is (operating cash flows – liabilities)/volatility of past operating cash flows. Both are measured in the year prior to Section 711 passage. 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:	Log of Derivatives					
	CR + FX		EQ		IR	
	[1]	[2]	[3]	[4]	[5]	[6]
Pre-event High Leverage × PostSection711	0.206***		0.245**		0.163***	
	(0.056)		(0.097)		(0.053)	
Pre-event Low Distance-to-Default × PostSection711		0.129**		0.245**		0.143*
		(0.060)		(0.096)		(0.071)
PostSection711	−0.323**	−0.288*	−0.099	−0.114	−0.245*	−0.241*
	(0.142)	(0.140)	(0.123)	(0.128)	(0.122)	(0.132)
FRS × Post2009	0.069**	0.072**	0.093***	0.095***	0.035	0.037
	(0.032)	(0.033)	(0.030)	(0.031)	(0.025)	(0.026)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	N.A.	Absorbed	N.A.	Absorbed	N.A.
Pre-event Low Distance-to-Default	N.A.	Absorbed	N.A.	Absorbed	N.A.	Absorbed
FRS	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	11,819	11,819	11,798	11,798	11,815	11,815
Number of Companies	880	880	880	880	880	880
Adjusted - R^2	0.730	0.730	0.722	0.722	0.780	0.780

Table 6: **Propensity of Shocks to Capital & Surplus and Exit after Section 711 Adoption.** This table presents estimations from negative capital & surplus shock regressions (Panel A) and exit regression (Panel B). The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in columns [1]-[2] of Panel A is an indicator for insurers with Capital & Surplus (the ratio of capital and surplus to total assets) in the current period less than 50% of Capital & Surplus in the previous period. The dependent variable in columns [3]-[4] of Panel B is an indicator for insurers placed in receivership or exiting the sample. All regressions control for lagged 1/Assets. *Leverage* is net liabilities/total assets and *Distance-to-Default* is (operating cash flows – liabilities)/volatility of past operating cash flows. Both are measured in the year prior to Section 711 passage. 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 Capital & Surplus Shocks		Panel B - Propensity of Exit	
Dep. variables:	Capital & Surplus $<$ 50% of Previous Year Capital & Surplus Dummy (Yes = 1)		Exit due to Receivership or Other Events Dummy (Yes = 1)	
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	-0.012^{***}		-0.018^{**}	
	(0.004)		(0.008)	
Pre-event Low Distance-to-Default × PostSection711		-0.016^{**}		-0.020^{***}
		(0.006)		(0.005)
PostSection711	0.001	0.004	−0.010	−0.008
	(0.006)	(0.006)	(0.026)	(0.026)
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	N.A.	Absorbed	N.A.
Pre-event Low Distance-to-Default	N.A.	Absorbed	N.A.	Absorbed
Observations	11,827	11,827	11,860	11,860
Number of Companies	878	878	880	880
Adjusted - R^2	0.066	0.067	0.130	0.130

Table 7: **Change in Hedging Adjusted Income Volatility after Section 711 Adoption.** This table presents estimations from change in hedging adjusted income volatility regressions. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in columns [1]-[2], Δ Volatility, is defined as volatility of net income minus volatility of adjusted net income. Volatility of (adjusted) net income is the standard deviation of (adjusted) net income using 4 years of past consecutive observations to the average value of assets estimated over the same period. Adjusted net income is defined as net income minus the sum of net investment income and total capital gains from derivatives (Koijen and Yogo (2017)). The dependent variable in column [3]-[4], Δ Volatility Dummy, is an indicator that takes the value 1 if Δ Volatility < 0. All regressions control for lagged 1/Assets. *Leverage* is net liabilities/total assets and *Distance-to-Default* is (operating cash flows – liabilities)/volatility of past operating cash flows. Both are measured in the year prior to Section 711 passage. 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:	Δ Volatility		Δ Volatility Dummy	
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	-0.0004^{**}		0.066^{**}	
	(0.0002)		(0.023)	
Pre-event Low Distance-to-Default × PostSection711		-0.0004^{*}		0.078^{**}
		(0.0002)		(0.032)
PostSection711	0.0004	0.0004	−0.046	−0.057
	(0.0003)	(0.0003)	(0.045)	(0.049)
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	N.A.	Absorbed	N.A.
Pre-event Low Distance-to-Default	N.A.	Absorbed	N.A.	Absorbed
Observations	11,797	11,797	11,860	11,860
Number of Companies	878	878	880	880
Adjusted - R^2	0.335	0.335	0.475	0.476

Table 8: **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] and [3] is Log of Life Insurance Premiums, which is defined as the natural logarithm of life insurance premiums. The dependent variable in column [2] and [4] is Log of Annuities, which is defined as the natural logarithm of total annuities. Pre-event Large Firm is an indicator for insurers with 1/Assets below the sample median in the year before the insurer's domicile state adopted the Section 711. Pre-event Small Firm is an indicator for insurers with 1/Assets above the sample median in the year before the insurer's domicile state adopted the Section 711. Both Pre-event Large Firm and Pre-event Small Firm are always zero for firms in the control states. All regressions control for lagged 1/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	Log of Life Insurance Premiums	Log of Annuities
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	0.186***	0.360***		
	(0.035)	(0.067)		
Pre-event Large Firm × Pre-event High Leverage × PostSection711			0.172***	0.396***
			(0.033)	(0.072)
Pre-event Small Firm × Pre-event High Leverage × PostSection711			0.268**	0.511***
			(0.097)	(0.102)
PostSection711	−0.041	−0.325***	−0.037	−0.354***
	(0.040)	(0.047)	(0.040)	(0.052)
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	373,425	339,395	373,425	339,395
Number of Companies	846	849	846	849
Number of Company-State Obs.	28,033	25,717	28,033	25,717
Adjusted - R^2	0.926	0.902	0.926	0.902

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 control insurer based on pre-event 1/assets and net income using the Abadie and Imbens' (2006) bias-corrected matching estimator. All regressions control for lagged 1/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	0.320***	0.309***
	(0.051)	(0.087)
PostSection711	−0.246***	−0.380***
	(0.061)	(0.070)
Year Fixed Effects	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed
Observations	248,013	188,654
Number of Companies	375	373
Number of Company-State Obs.	15,548	12,791
Adjusted - R^2	0.935	0.899

Table 10: **Quantity and Pricing of Life Insurance Products after Section 711 Adoption.** This table presents estimations examining the number of policies (column [1]) and prices for different insurance products including 10-year term life policies (column [2]), life annuity (column [3]) and term annuities (columns [4]). All regressions control for lagged 1/Assets. Refer to Table 1 for detailed variable definitions. 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]-[4], respectively, and reported inside parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Dep. variable:	Log of Number of Policies	Log of Policy Prices		
	Number of Policies	10-Year Term Life Policy	Life Annuity	Term Annuity
	[1]	[2]	[3]	[4]
Pre-event High Leverage × PostSection711	0.135^{***}	-0.034^{*}	-0.039^{***}	-0.034^{***}
	(0.034)	(0.017)	(0.011)	(0.005)
PostSection711	−0.047	0.029	−0.010	0.021
	(0.035)	(0.038)	(0.026)	(0.037)
Product Fixed Effects	N.A.	Yes	Yes	Yes
Gender Fixed Effects	N.A.	Yes	Yes	N.A.
Year Fixed Effects	Yes	Yes	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	N.A.	N.A.	N.A.
Domicile State × Year Fixed Effects	No	Yes	Yes	Yes
Insurer Fixed Effects	Absorbed	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed
Observations	334,794	10,155	6,621	1,415
Number of Companies	785	154	53	46
Number of Company-State Obs.	25,759	N.A.	N.A.	N.A.
Adjusted - R^2	0.936	0.971	0.873	0.989

Table 11: **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 1/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	0.056***	0.235***	0.013**	0.072***
	(0.010)	(0.039)	(0.005)	(0.017)
PostSection711	−0.008	−0.074***	0.006	−0.066***
	(0.006)	(0.021)	(0.005)	(0.014)
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	338,680	196,433	338,680	196,433
Number of Companies	790	578	790	578
Number of Company-State Obs.	25,948	16,869	25,948	16,869
Adjusted - R^2	0.803	0.637	0.818	0.756

Table 12: **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 net income to total assets. All regressions control for lagged 1/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 [1]	Net Income [2]
Pre-event High Leverage × PostSection711	0.010*	0.011**
	(0.005)	(0.004)
PostSection711	0.002	−0.005
	(0.008)	(0.007)
Year Fixed Effects	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes
Insurer Fixed Effects	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed
Observations	11,835	11,860
Number of Companies	880	880
Adjusted - R^2	0.248	0.111

Figure 1:

Figure 1: Illustration of Effect of Hedging on Insurer Price and Quantity

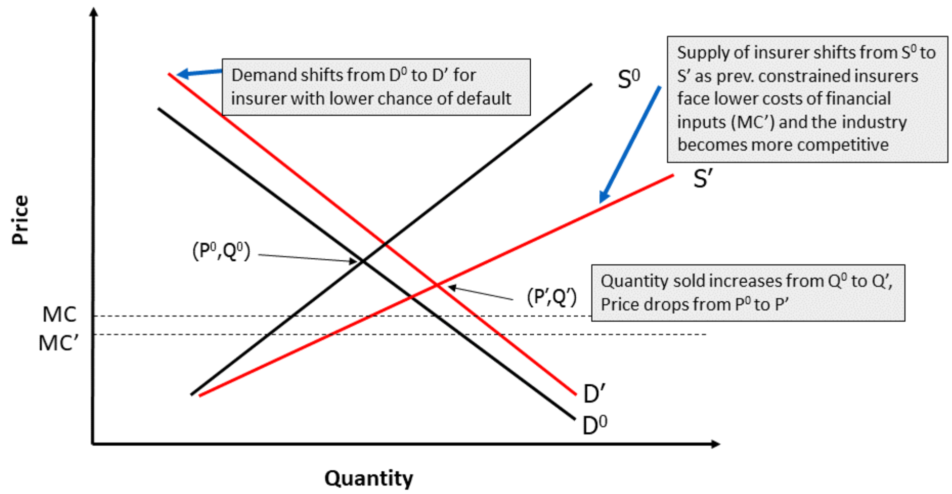


Figure 2: **Derivatives Notional Amount ($ trillion) of Life Insurance Companies.** This graph presents yearly derivatives notional amounts for life insurance companies for the years 2000 – 2017. Section 711's states are reported in red above the derivatives notional amount bar corresponding to the adoption year.

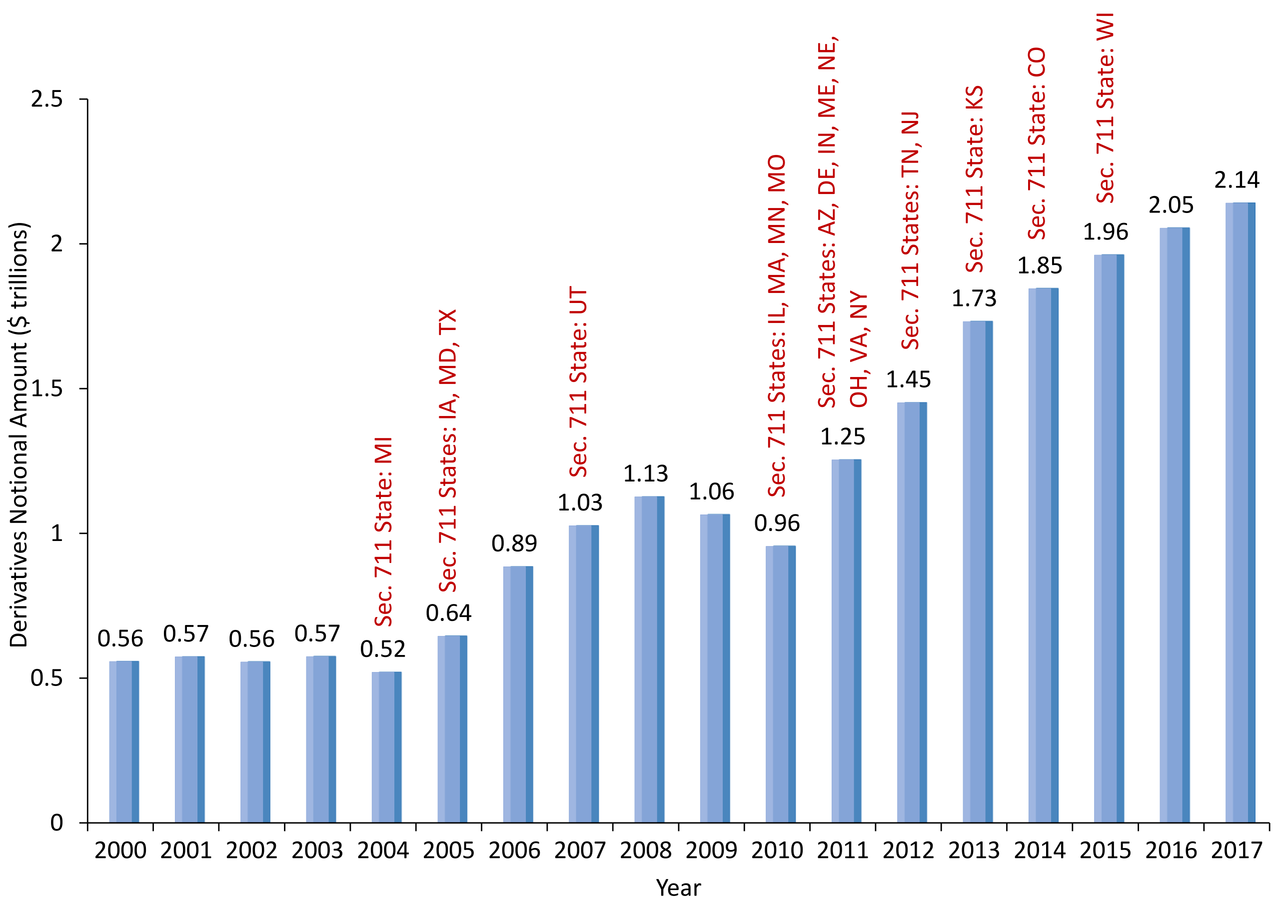


Figure 3: **IRMA Section 711 States by Adoption Year.** This figure displays the states that have adopted Section 711 of the National Association of Insurance Commissioner's (NAIC) Insurer Receivership Model Act (IRMA). The Section 711 adopting states are colored in red, with the darker red indicating an earlier adoption year.

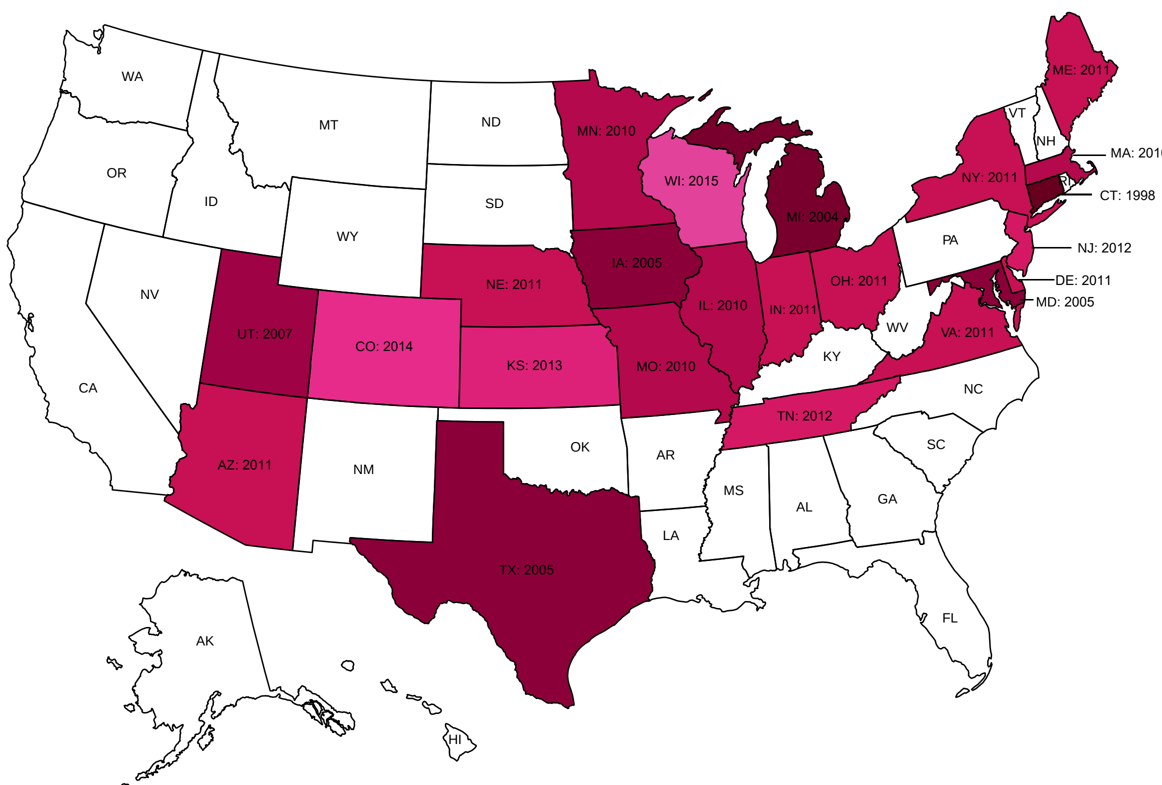
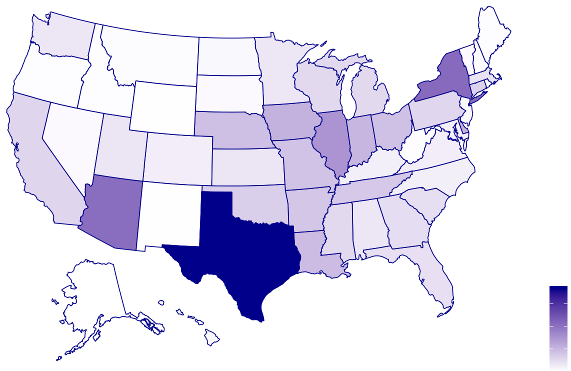
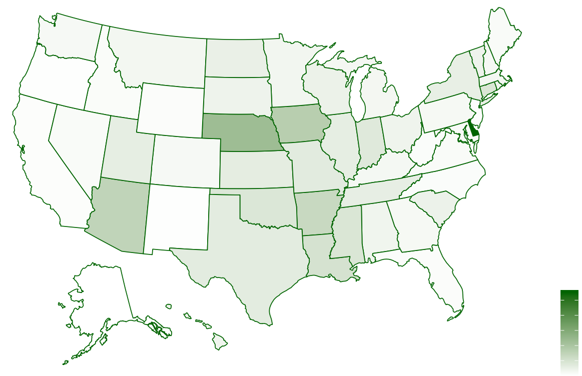


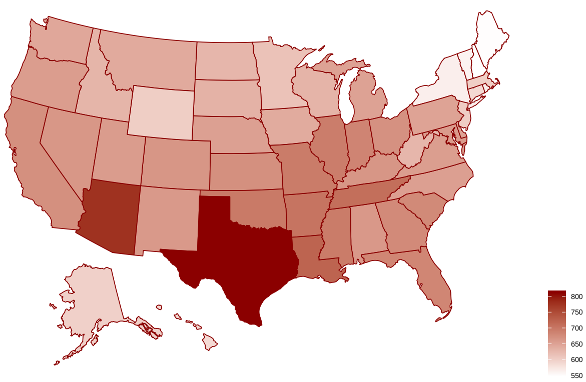
Figure 4: **Number of Life Insurance Companies by Domicile and Licensing State.** This figure displays geographical heat maps of the number of life insurance companies in the period 2000 – 2017 by domicile state (Panel A) and by domicile state population (Panel B), where population is the average state 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.



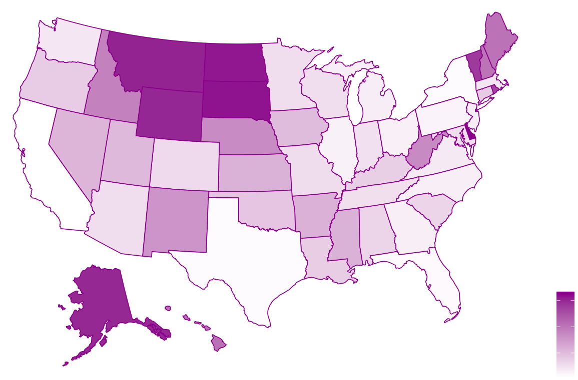
(A) No. of Domiciled Insurers



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



(C) No. of Licensed Insurers



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

Figure 5: **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.

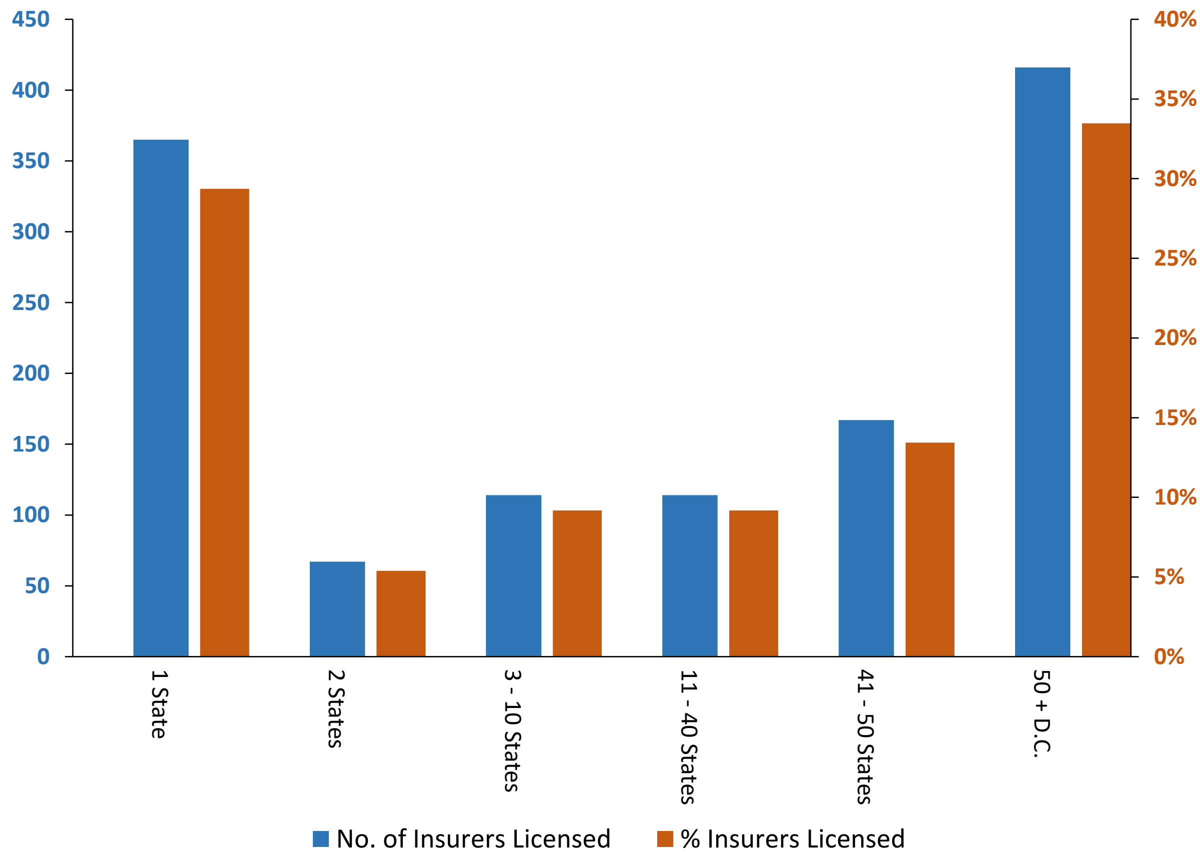
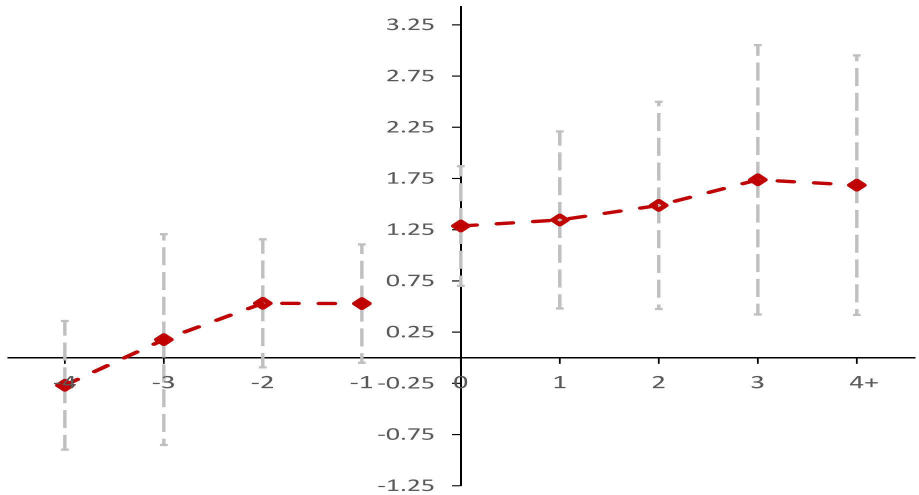
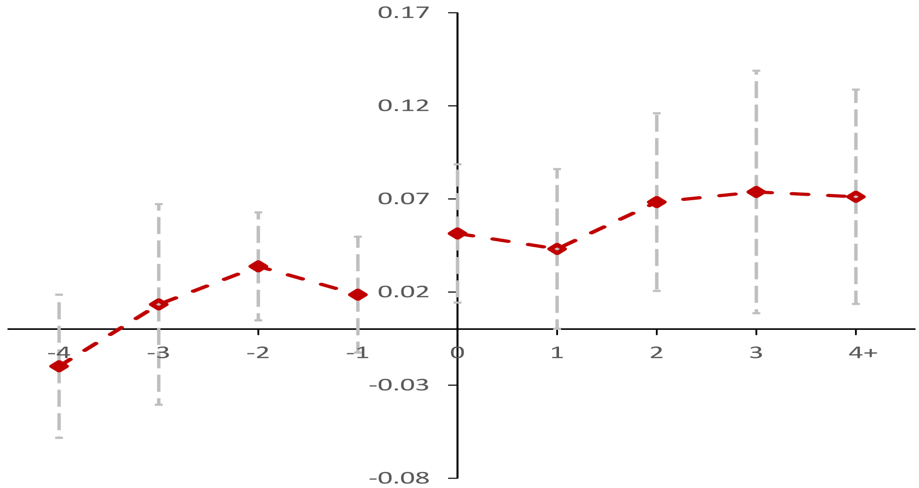


Figure 6: **Redomiciliations after Section 711 Adoption.** This graph shows the number of life insurance companies changing domicile state (redomiciliation) in a given year during the years 2000 – 2017. The blue and orange portions of the bars represent redomiciliations in Non-Section 711 and Section 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.

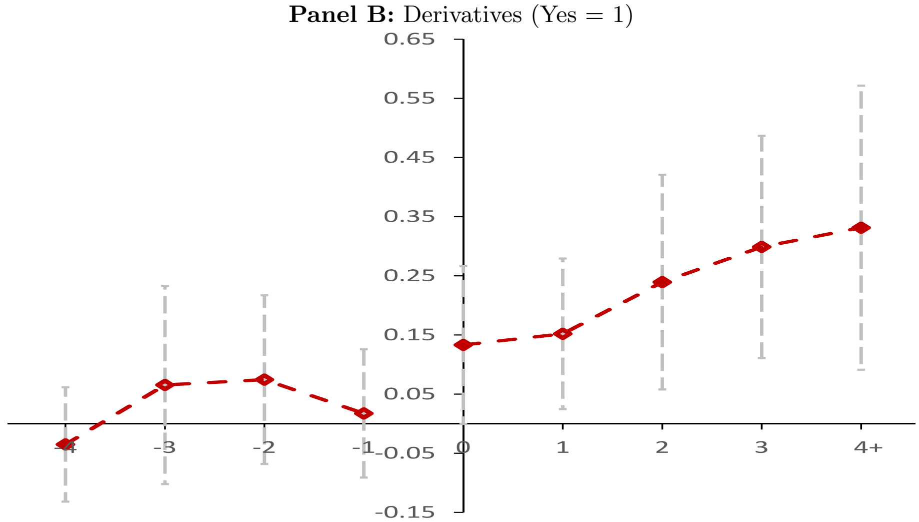
Figure 7: **Derivatives Usages of Life Insurance Companies around Section 711 Adoption: Treated vs. Control Insurers.** This figure reports the point estimates from Log of Derivatives (Panel A), Derivatives (Yes =1) (Panel B), and Hedging Ratio (Panel C) regressions. The sample includes life insurance 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 three 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 four after the Act adoption and ending in 2017. Ninety-percent confidence intervals are also plotted.



Panel A: Log of Derivatives

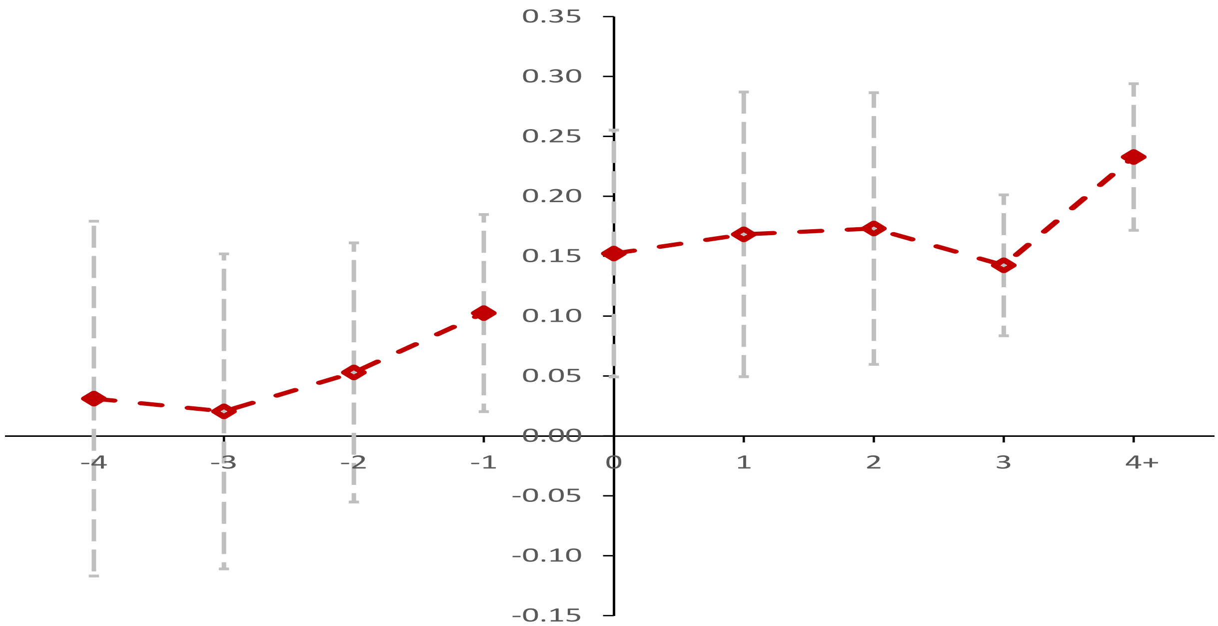


Panel B: Derivatives (Yes = 1)

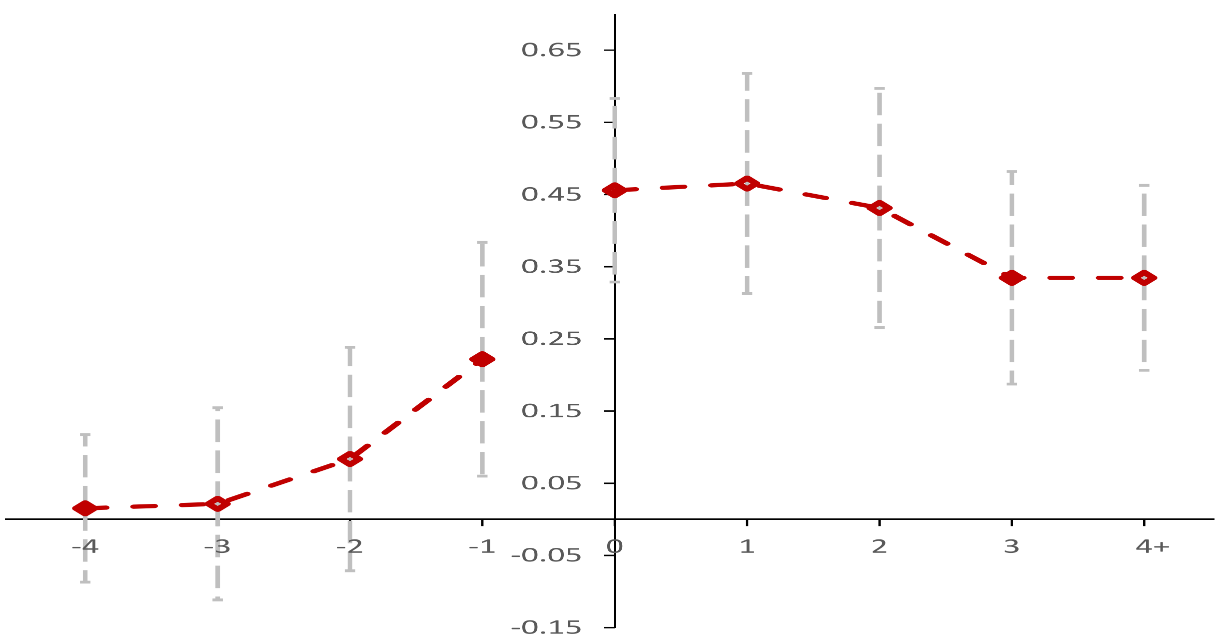


Panel C: Hedging Ratio

Figure 8: **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 [2] of Table 8, 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 three 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 four 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

Online Appendix to

Hedging, Contract Enforceability and Competition

Erasmo Giambona Anil Kumar Gordon M. Phillips

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.

Giambona: Syracuse University, egiambon@syr.edu; Kumar: Aarhus University and Danish Finance Institute, email: akumar@econ.au.dk; Phillips: Tuck School of Business at Dartmouth and NBER, email: gordon.m.phillips@tuck.dartmouth.edu. We thank Shan Ge, Kristine Hankins, Anastasia Kartasheva, Ralph Koijen, Amiyatosh Purnanandam, David Scharfstein, Carola Schenone, Ishita Sen, and seminar participants at Cornell, Dartmouth, 2022 FIRS conference, Maryland, Michigan State University, 2021 NBER Insurance Group, 2022 NBER Summer Institute, Tsinghua University and Tulane University for their helpful comments. We also thank Sean M. McKenna from the National Organization of Life and Health Insurance Guaranty Associations for extensive discussions on the insolvency procedures of insurance companies. We are also thankful to Michael Etkin, Esq. from Lowenstein Sandler LLP and Shmuel Vasser, Esq. from Dechert LLP for discussions on the legal treatment of derivatives in insolvency.

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 1/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 + Derivatives Notional)	Derivatives Notional/ (Liabilities + Derivatives Notional)	Derivatives Notional/ (Net Liabilities + Derivatives Notional)	Derivatives Notional/ (Assets + Liabilities + Derivatives Notional)	Derivatives Notional/ (Assets + Net Liabilities + Derivatives Notional)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Pre-event High Leverage × PostSection711	0.257**	0.251**	0.200**	0.255**	0.265***	0.261***	0.223**	0.261***	0.257**
	(0.094)	(0.091)	(0.090)	(0.093)	(0.090)	(0.087)	(0.088)	(0.091)	(0.095)
PostSection711	−0.166	−0.169	−0.160	−0.167	−0.172	−0.176	−0.180	−0.171	−0.175
	(0.189)	(0.184)	(0.206)	(0.187)	(0.178)	(0.175)	(0.190)	(0.181)	(0.192)
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	11,860	11,856	11,835	11,860	11,860	11,856	11,835	11,860	11,838
Number of Companies	880	880	880	880	880	880	880	880	880
Adjusted - R^2	0.628	0.622	0.601	0.625	0.659	0.656	0.641	0.644	0.639

Table A4: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption: Different Risk Categories.** This table presents estimations from derivatives regressions, with derivatives categorized by risk type. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable is the Hedging Ratio which is the ratios of the sum of the notional value of CR, and FX derivatives to assets minus capital & surplus, columns [1] - [2]; the notional value for IR derivatives to assets minus capital & surplus, columns [3] - [4]; the notional value for equity (EQ) derivatives to assets minus capital & surplus, columns [5] - [6]. All regressions control for lagged 1/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:	Hedging Ratio					
	CR + FX		IR		EQ	
	[1]	[2]	[3]	[4]	[5]	[6]
Pre-event High Leverage × PostSection711	0.110**		0.195**		0.354**	
	(0.051)		(0.086)		(0.144)	
Pre-event Low Distance-to-Default × PostSection711		0.129***		0.189***		0.390**
		(0.045)		(0.063)		(0.146)
PostSection711	−0.064	−0.082	−0.150	−0.157	−0.401	−0.444
	(0.082)	(0.067)	(0.106)	(0.109)	(0.275)	(0.281)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	N.A.	Absorbed	N.A.	Absorbed	N.A.
Pre-event Low Distance-to-Default	N.A.	Absorbed	N.A.	Absorbed	N.A.	Absorbed
Observations	11,857	11,857	11,857	11,857	11,857	11,857
Number of Companies	880	880	880	880	880	880
Adjusted - R^2	0.608	0.608	0.681	0.681	0.524	0.524

Table A5: **Derivatives Usage of Life Insurance Companies after Section 711 Adoption: Controlling for the Effect of Actuarial Guideline 43.** This table presents estimations from standardized derivatives regressions, controlling for the effect of actuarial guideline 43. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable is the natural logarithm of the yearly notional value of the sum of interest rate (IR), credit risk (CR), and foreign exchange (FX) derivatives. FRS is the sum of guaranteed minimum accumulation benefit (GMAB) and guaranteed minimum withdrawal benefit (GMWB) annuities scaled by assets. FRS is measured in 2007. Post2009 is a dummy variable equal to 1 for years on or after 2009, and 0 before 2009. All regressions control for lagged 1/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:	Log of Derivatives (IR + CR + FX)	
	[1]	[2]
Pre-event High Leverage × PostSection711	0.178***	
	(0.061)	
Pre-event Low Distance-to-Default × PostSection711		0.109*
		(0.060)
PostSection711	−0.299**	−0.267*
	(0.138)	(0.141)
FRS × Post2009	0.037	0.040
	(0.023)	(0.023)
Year Fixed Effects	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes
Insurer Fixed Effects	Yes	Yes
Pre-event High Leverage	Absorbed	N.A.
Pre-event Low Distance-to-Default	N.A.	Absorbed
FRS	Absorbed	Absorbed
Observations	11,806	11,806
Number of Companies	880	880
Adjusted - R^2	0.795	0.795

Table A6: **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)	Hedging Ratio
	[1]	[2]	[3]
	Panel A - Cengiz et al.'s (2019) Stacked Regression Estimator		
Pre-event High Leverage × PostSection711	0.955***	0.033**	0.203***
	(0.280)	(0.016)	(0.045)
	Panel B - Callaway and Sant'Anna's (2020) (CS) Estimator		
Pre-event High Leverage × PostSection711	0.779**	0.030*	0.226***
	(0.361)	(0.018)	(0.057)
	Panel C - Base Staggered Estimator with Only 3 Years After Event in the Sample		
Pre-event High Leverage × PostSection711	1.315***	0.052**	0.190**
	(0.431)	(0.021)	(0.079)

Table A7: **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 A8: **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 1/Assets and Net Income in the matched sample. In any given Section 711 event year, we match each pre-event high leverage insurer (treated) to its closest control insurer based on pre-event 1/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
1/Assets	Treated	0.0110	-0.0007	0.888	0.892	203
	Control	0.0117				172
Net Income	Treated	0.0118	0.0014	0.711	0.702	203
	Control	0.0104				172

Table A9: **Derivatives Usage after Section 711 Adoption: Matched-Sample Analysis.** This table presents estimations from derivatives regressions. In any given Section 711 event year, we match each pre-event high leverage insurer (treated) to its closest control insurer based on pre-event 1/assets and net income using the Abadie and Imbens' (2006) bias-corrected matching estimator. The dependent variable in column [1] is Log of Derivatives, which is defined as the natural logarithm of the yearly derivatives notional value. The dependent variable in column [2] is Derivatives (Yes = 1), which is an indicator for insurers reporting a derivatives notional value. The dependent variable in column [3] is Hedging Ratio, which is the ratio of derivatives notional to total assets minus capital & surplus. The dependent variable in column [4] is the natural logarithm of the yearly notional value of the sum of credit risk (CR) and foreign exchange (FX) derivatives. The dependent variables in columns [5] and [6] are the natural logarithm of the yearly notional value of equity (EQ) and interest rate (IR) derivatives, respectively. The dependent variable in column [7] is the ratio of hedging exposure computed for IR swaps scaled by capital & surplus. All regressions control for lagged 1/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	Log of Derivatives [1]	Derivatives (Yes = 1) [2]	Hedging Ratio [3]	Log of Derivatives (CR+FX) [4]	Log of Derivatives (EQ) [5]	Log of Derivatives (IR) [6]	Hedging Exposure/ Regulatory Capital (IR Swaps) [7]
Pre-event High Leverage × PostSection711	2.072**	0.095**	0.308***	1.015*	1.428**	1.462***	0.018*
	(0.778)	(0.041)	(0.070)	(0.554)	(0.665)	(0.482)	(0.009)
PostSection711	−2.105	−0.048	−0.385	−3.478**	−0.841	−2.613*	−0.032
	(1.474)	(0.061)	(0.351)	(1.403)	(1.254)	(1.486)	(0.033)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event High Leverage	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	6,038	6,109	6,107	6,073	6,058	6,065	6,109
Number of Companies	364	364	364	364	364	364	364
Adjusted - R^2	0.803	0.738	0.631	0.726	0.717	0.773	0.411

Table A10: **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 1/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	0.185***	0.361***
	(0.035)	(0.067)
PostSection711	−0.040	−0.323***
	(0.040)	(0.047)
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	373,425	339,395
Number of Companies	846	849
Number of Company-State Obs.	28,033	25,717
Adjusted - R^2	0.926	0.902

Table A11: **Derivatives Usage after Section 711 Adoption: Alternative Leverage Measures.** This table presents estimations from derivatives regressions using alternative leverage measures. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in columns [1], [4], and [7] is Log of Derivatives, which is defined as the natural logarithm of the yearly derivatives notional value. The dependent variable in columns [2], [5], and [8] is Derivatives (Yes = 1), which is an indicator for insurers reporting a derivatives notional value. The dependent variable in columns [3], [6], and [9] is Hedging Ratio, which is the ratio of derivatives notional to total assets minus capital & surplus. All regressions control for lagged 1/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.

	Adding Captive Reinsurance to Leverage			Using Parent Company Leverage			Subtracting Cash & Cash Equivalents from Leverage		
Dep. Variables	Log of Derivatives [1]	Derivatives (Yes = 1) [2]	Hedging Ratio [3]	Log of Derivatives [4]	Derivatives (Yes = 1) [5]	Hedging Ratio [6]	Log of Derivatives [7]	Derivatives (Yes = 1) [8]	Hedging Ratio [9]
Pre-event High Leverage (Adjusted) × PostSection711	1.475**	0.063**	0.211**	1.461**	0.057*	0.256**	1.964***	0.086**	0.315***
	(0.584)	(0.028)	(0.074)	(0.617)	(0.030)	(0.099)	(0.674)	(0.032)	(0.080)
PostSection711	−1.094	−0.034	−0.144	−1.281	−0.038	−0.201	−1.447	−0.050	−0.213
	(0.864)	(0.038)	(0.194)	(0.897)	(0.038)	(0.187)	(0.896)	(0.040)	(0.181)
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	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Pre-event High Leverage (Adjusted)	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
Observations	11,856	11,942	11,939	11,774	11,860	11,857	11,497	11,583	11,582
Number of Companies	883	883	883	880	880	880	871	871	871
Adjusted - R^2	0.809	0.746	0.622	0.809	0.746	0.622	0.809	0.745	0.622

Table A12: **Derivatives Usage after Section 711 Adoption: Using Z-Score Plus.** This table presents estimations from derivatives regressions using Z-Score Plus, a measure of potential financial distress from Altman et al. (2017) that extends the original Altman's (1968) Z-score to private companies. The sample includes life insurance company level data for the period 2000 – 2017. The dependent variable in column [1] is Log of Derivatives, which is defined as the natural logarithm of the yearly derivatives notional value. The dependent variable in column [2] is Derivatives (Yes = 1), which is an indicator for insurers reporting a derivatives notional value. The dependent variable in column [3] is Hedging Ratio, which is the ratio of derivatives notional to total assets minus capital & surplus. The dependent variable in columns [4] and [8] is the natural logarithm of the yearly notional value of the sum of credit risk (CR) and foreign exchange (FX) derivatives. The dependent variables in columns [5] and [9] and [6] and [10] are the natural logarithm of the yearly notional value of equity (EQ) and interest rate (IR) derivatives, respectively. The dependent variable in column [7] is the ratio of hedging exposure computed for IR swaps scaled by capital & surplus. FRS is the sum of guaranteed minimum accumulation benefit (GMAB) and guaranteed minimum withdrawal benefit (GMWB) annuities scaled by assets. FRS is measured in 2007. Post2009 is a dummy variable equal to 1 for years on or after 2009, and 0 before 2009. All regressions control for lagged 1/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	Log of Derivatives	Derivatives (Yes = 1)	Hedging Ratio	Log of Derivatives (CR+FX)	Log of Derivatives (EQ)	Log of Derivatives (IR)	Hedging Exposure/ Regulatory Capital (IR Swaps)	Log of Derivatives (CR+FX)	Log of Derivatives (EQ)	Log of Derivatives (IR)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Pre-event Low Z-score	1.925***	0.076**	0.317***	1.413***	2.384***	0.869*	0.024**	0.227***	0.336***	0.113*
× PostSection711	(0.696)	(0.033)	(0.093)	(0.340)	(0.745)	(0.417)	(0.011)	(0.053)	(0.106)	(0.055)
PostSection711	−1.023	−0.004	−0.218	−3.562***	−0.984	−1.304	−0.020	−0.423***	−0.138	−0.175
	(0.930)	(0.040)	(0.216)	(0.761)	(1.037)	(0.897)	(0.017)	(0.126)	(0.146)	(0.121)
FRS × Post2009								0.065*	0.079**	0.038
								(0.033)	(0.028)	(0.026)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Domicile State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-event Low Z-score	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed	Absorbed
FRS	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	Absorbed	Absorbed	Absorbed
Observations	8,837	8,913	8,911	8,877	8,858	8,871	8,913	8,877	8,858	8,871
Number of Companies	804	804	804	804	804	804	804	804	804	804
Adjusted - R^2	0.813	0.750	0.622	0.722	0.718	0.780	0.405	0.723	0.719	0.781

Table A13: **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. The dependent variable in columns [1], [3], and [5] is Log of Life Insurance Premiums, which is defined as the natural logarithm of life insurance premiums. The dependent variable in column [2], [4], and [6] is Log of Annuities, which is defined as the natural logarithm of total annuities. All regressions control for lagged 1/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	0.128^{***}	0.297^{***}	0.138^{***}	0.246^{**}	0.196^{***}	0.340^{***}
	(0.039)	(0.082)	(0.041)	(0.087)	(0.035)	(0.067)
PostSection711	0.001	-0.277^{***}	-0.025	-0.278^{***}	-0.049	-0.322^{***}
	(0.033)	(0.054)	(0.042)	(0.071)	(0.031)	(0.050)
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	Absorbed	Absorbed
Observations	376,048	341,795	373,425	339,395	371,203	337,223
Number of Companies	849	852	846	849	837	840
Number of Company-State Obs.	28,087	25,785	28,033	25,717	28,011	25,693
Adjusted - R^2	0.926	0.902	0.926	0.902	0.927	0.901

Table A14: **Life Insurance Premiums and Annuities after Section 711 Adoption: Using Distance-to-Default.** This table presents estimations from life insurance and annuity premium regressions using distance-to-default to identify insurers facing ex ante costly external finance. The sample includes life insurance company-state level data for the period 2000 – 2017. 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 1/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 [1]	Log of Annuities [2]
Pre-event Low Distance-to-Default × PostSection711	0.315***	0.379***
	(0.061)	(0.090)
PostSection711	−0.142***	−0.355***
	(0.031)	(0.061)
Year Fixed Effects	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed
Pre-event Low Distance-to-Default	Absorbed	Absorbed
Observations	373,425	339,395
Number of Companies	846	849
Number of Company-State Obs.	28,033	25,717
Adjusted - R^2	0.926	0.902

Table A15: **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 1/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	0.185***	0.788***	0.205***	0.903***
	(0.009)	(0.023)	(0.024)	(0.065)
PostSection711	−0.042***	−0.798***	−0.042*	−0.869***
	(0.008)	(0.023)	(0.022)	(0.062)
Pre-event High Leverage	1.414***	4.445***		
	(0.066)	(0.077)		
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	374,564	340,373	374,564	340,373
Number of Companies	877	882	877	882
Number of Company-State Obs.	29,172	26,695	29,172	26,695
Chi^2 (p-value)	<0.001	<0.001	<0.001	<0.001

Table A16: **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 1/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	0.184***	0.358***
	(0.035)	(0.067)
PostSection711	−0.092**	−0.383***
	(0.040)	(0.052)
Year Fixed Effects	Yes	Yes
Insurer-Licensing-State Fixed Effects	Yes	Yes
Insurer Fixed Effects	Absorbed	Absorbed
Pre-event High Leverage	Absorbed	Absorbed
Observations	357,969	324,587
Number of Companies	828	831
Number of Company-State Obs.	27,123	24,820
Adjusted - R^2	0.926	0.901

Table A17: **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 [1]	Log of Annuities [2]
	Panel A - Cengiz et al.'s (2019) Stacked Regression Estimator	
Pre-event High Leverage × PostSection711	0.158***	0.218***
	(0.008)	(0.014)
	Panel B - Callaway and Sant'Anna's (2020) (CS) Estimator	
Pre-event High Leverage × PostSection711	0.201***	0.080**
	(0.016)	(0.023)
	Panel C - Base Staggered Estimator with Only 3 Years After Event in the Sample	
Pre-event High Leverage × PostSection711	0.146***	0.444***
	(0.033)	(0.078)

Table A18: **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 1/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	0.081*	0.058**
	(0.041)	(0.024)
Pre-event High Leverage × PostSection711	0.150***	0.335***
	(0.030)	(0.065)
PostSection711 × Pre-event High Mortality	−0.038	−0.001
	(0.032)	(0.025)
PostSection711	−0.024	−0.325***
	(0.042)	(0.046)
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	373,425	339,395
Number of Companies	846	849
Number of Company-State Obs.	28,033	25,717
Adjusted - R^2	0.926	0.902

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

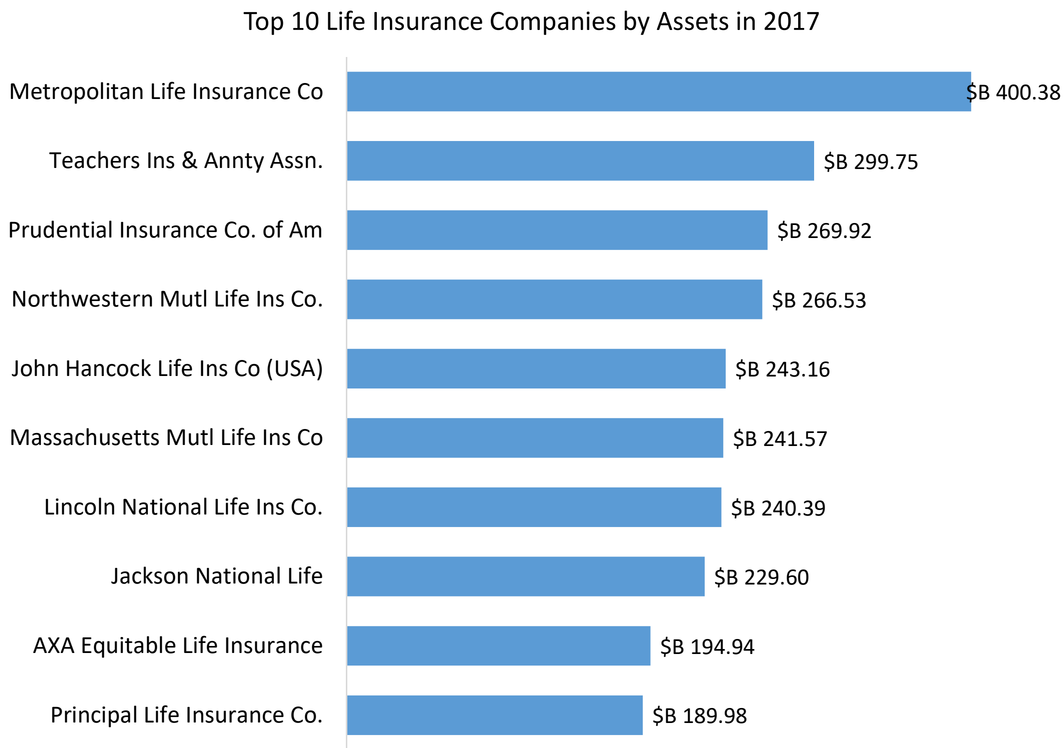
$ 0.54 TRILLION

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.



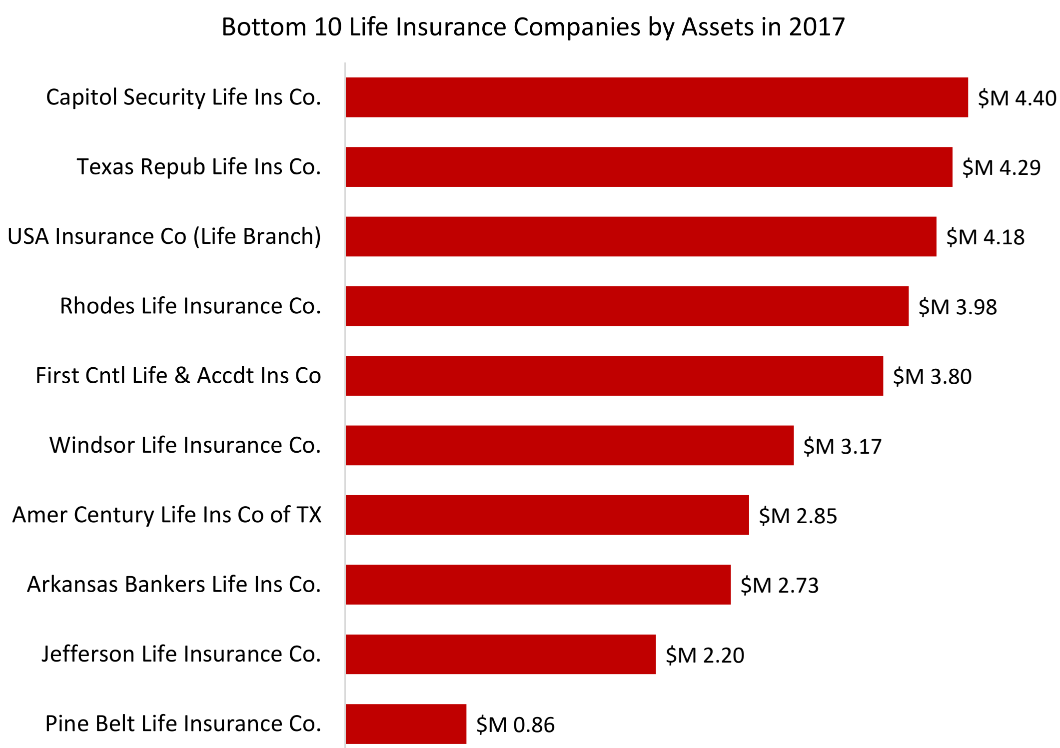
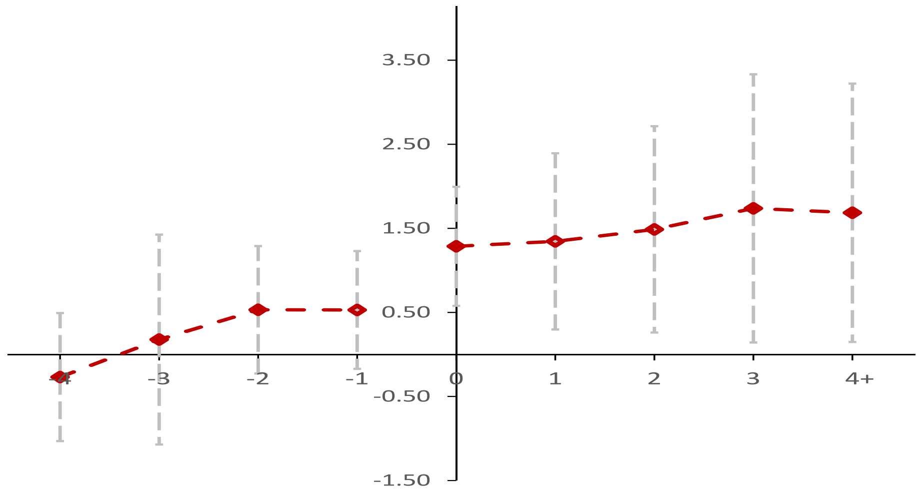
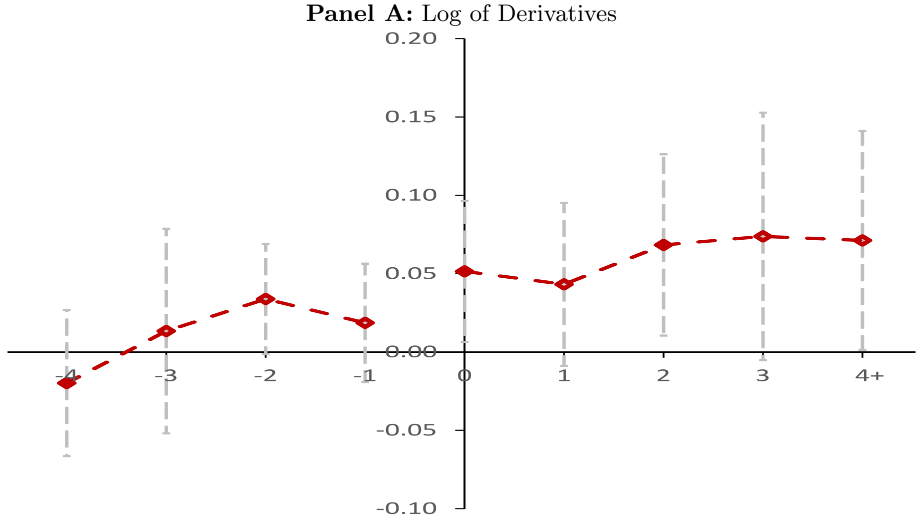


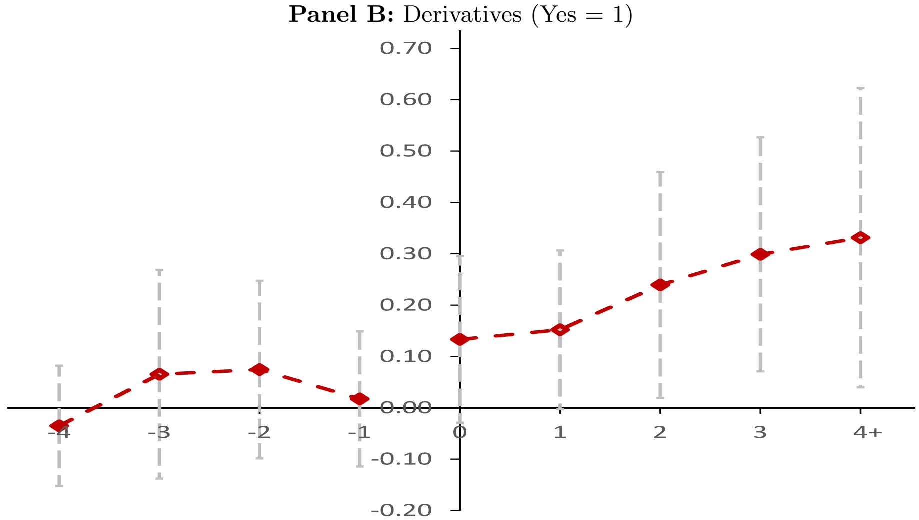
Figure A3: **Derivatives Usages of Life Insurance Companies around Section 711 Adoption: Treated vs. Control Insurers.** This figure reports the point estimates from Log of Derivatives (Panel A), Derivatives (Yes =1) (Panel B), and Hedging Ratio (Panel C) regressions. The sample includes life insurance 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 three 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 four after the Act adoption and ending in 2017. Ninety-five-percent confidence intervals are also plotted.



Panel A: Log of Derivatives

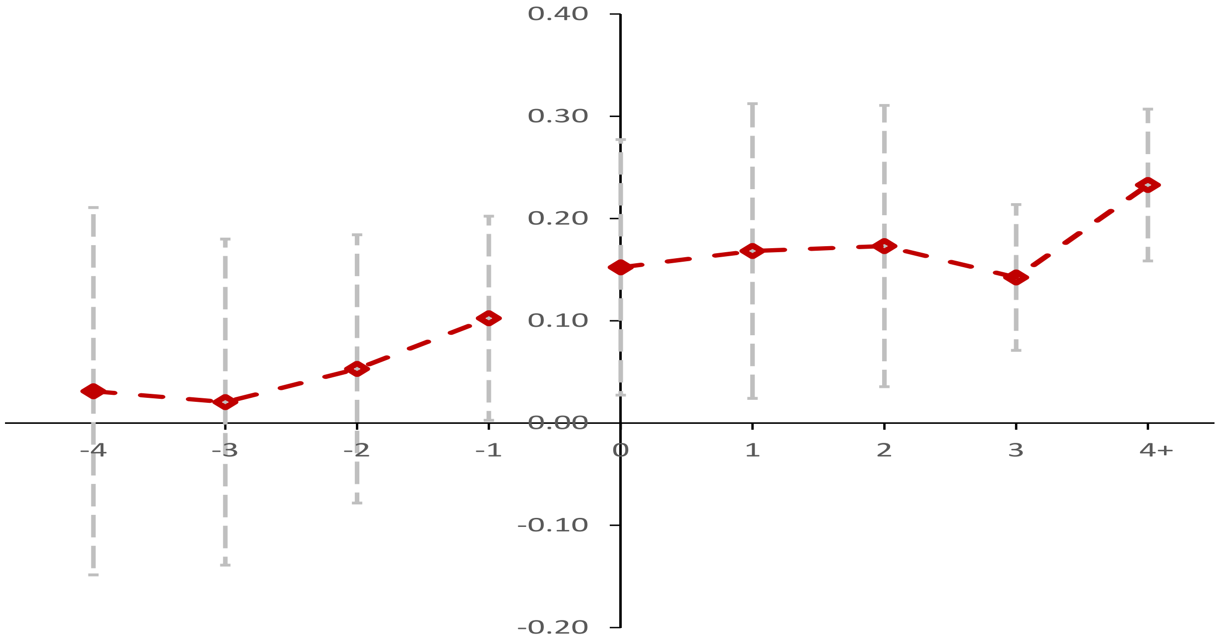


Panel B: Derivatives (Yes = 1)

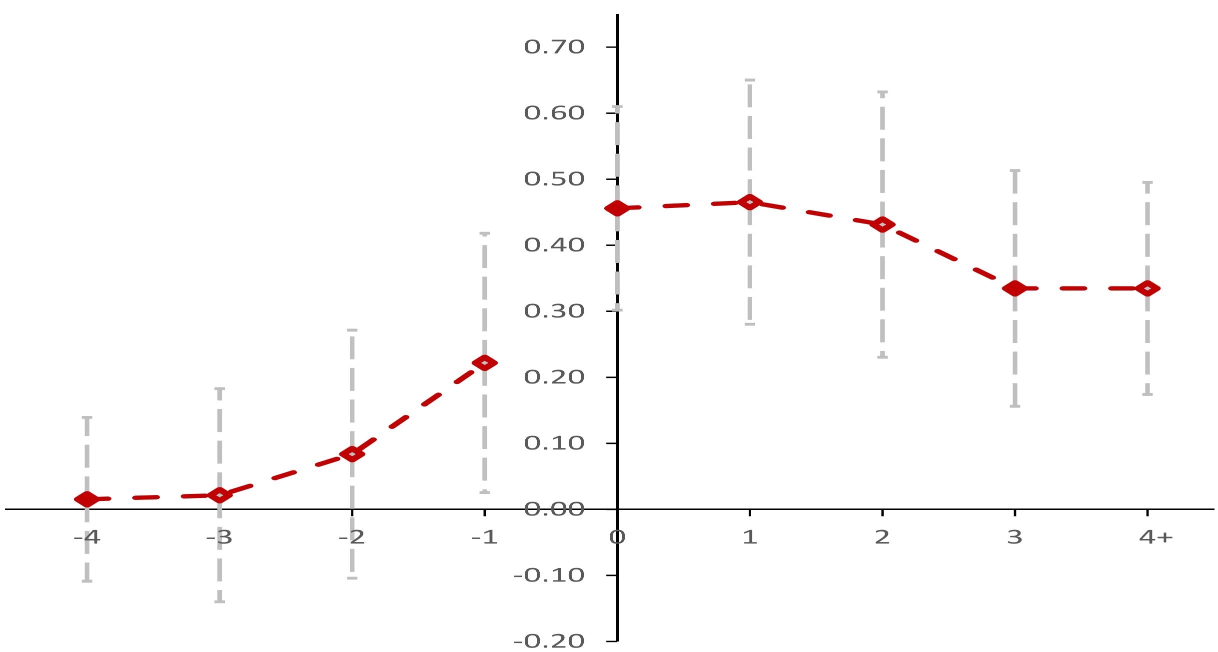


Panel C: Hedging Ratio

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 8, 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 three 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 four 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