

Seeking Accounting Arbitrage: Evidence from the US Life Insurance Industry

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Abstract

This study examines how accounting rules induce the US life insurers to use “shadow insurance” to manage their regulatory capital, and whether they exploit shadow insurance to hold more risky assets when a new accounting rule creates more capital pressure. Shadow insurance refers to transactions ceding liabilities to captive reinsurers under less strict regulation to circumvent the regulatory capital requirement. I employ a recent adoption of Actuarial Guideline 43 (AG 43) as a shock to the strictness of reserve requirement under Statutory Accounting Principles, and conduct a difference-in-differences analysis. I find insurers subject to AG 43 engage more in shadow insurance transactions after the adoption of AG 43, and the impact of AG 43 is significantly stronger for more capital-constrained insurers and weaker for insurers domiciled in states with strong regulatory enforcement. In addition, I find insurers subject to AG 43 invest in less risky bonds on average, and only well-capitalized insurers exploit shadow insurance to hold more risky bonds. Overall, my results suggest insurers exploit an accounting arbitrage opportunity despite the fact that these transactions are subject to the regulatory monitoring. This evidence implies that when two different accounting regimes exist, changing one accounting regime may not always bring an intended regulatory result. Additionally, my evidence adds new insights to the literature on the real effects of accounting by showing the change in accounting measurement can affect firms’ capital management behavior and investment decisions.

Keywords: Real Effects of Accounting; Life Insurance, Reinsurance, Regulatory Arbitrage

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1. Introduction

This study examines how accounting rules induce the US life insurers to use “shadow insurance” to manage their regulatory capital, and whether they exploit shadow insurance to hold more risky assets when a new accounting rule creates more capital pressure. Shadow insurance refers to transactions ceding blocks of insurance policy claims to captive reinsurers under less strict regulation to fulfill statutory capital requirements (Irresberger and Peng, 2016).¹ US life insurers have engaged heavily in shadow insurance to circumvent the capital requirement regulation. According to Kojien and Yogo (2016b), the liabilities ceded to shadow reinsurers grew from \$11 billion in 2002 to \$364 billion in 2012. In 2013, a report published by the New York State Department of Financial Services published concerning the life insurers’ reinsurance practices with captive reinsurers, labeled as “shadow insurance,” generated substantial controversy over the use of captive reinsurance agreements in capital management (Schwarcz, 2015; Harrington, 2014).² The “shadow insurance” view asserts a captive reinsurance arrangement will lead to a substantial understatement of insurers’ insolvency risks due to inadequate regulatory oversight about captive reinsurers. On the other hand, a contrary view claims a captive reinsurance arrangement is an efficient way to manage capital to benefit policyholders by lowering insurance prices. Despite intense discussions surrounding shadow insurance, we have only limited empirical evidence regarding it, especially how accounting rules can affect insurers’ use of shadow insurance.

In this paper, I address two unanswered important questions concerning shadow insurance. First, I investigate whether accounting rules can induce life insurers to use more shadow insurance.

¹ U.S. insurers are required to meet minimum risk-based capital (RBC) requirement by solvency regulation. For detailed information about RBC, see http://www.naic.org/cipr_topics/topic_risk_based_capital.htm.

² The title of the report is “Shining a Light on Shadow Insurance.”

The US insurance industry is governed by its own regulatory accounting regime called statutory accounting principles (SAP), and life insurers are required to recognize liabilities, known as policy reserves, when they sell life insurance or annuities.³ Statutory reserves under SAP are much larger than reserves under generally accepted accounting principles (GAAP) because SAP requires more conservative assumptions about future mortality and investment yield than GAAP does. Policymakers and academics conjecture this reserve-requirement difference between SAP and GAAP could create an arbitrage opportunity because life insurers can increase statutory capital by ceding reserves to captive reinsurers that reports lower reserves under GAAP without removing actual risks embedded in insurance policies. Although this downside could be anticipated, the National Association of Insurance Commissioners (NAIC) has adopted a series of accounting rules that require higher statutory reserves.⁴ If shadow insurance is truly well monitored and governed by regulators, the impact of new accounting rules on shadow insurance use would be limited. On the other hand, insurers could aggressively exploit shadow insurance to circumvent the new accounting rules if regulatory supervision were not strong enough. However, no study has formally tested whether stricter statutory accounting rules actually increase use of shadow insurance, or how big that impact would be. My study intends to provide concrete evidence of whether US life insurers exploit accounting arbitrage when they face a stricter reserve requirement under SAP despite the fact that shadow insurance is subject to regulatory approval.

³ For more detailed information about SAP, refer to the NAIC's website page (http://www.naic.org/cipr_topics/topic_statutory_accounting_principles.htm).

⁴ The National Association of Insurance Commissioners (NAIC) is the US insurance standard-setting and regulatory support organization, and it is responsible for setting SAP. The NAIC has adopted new reserve rules such as Regulation XXX, Regulation AXXX, and AG43 from 2000 to 2009. All these new accounting rules require significantly larger statutory reserves compared to GAAP reserves.

Second, I examine whether life insurers exploit shadow insurance to hold more risky assets. An ongoing debate concerns the benefits and risks of using captive reinsurance arrangements, and existing empirical evidence is somewhat mixed. For example, Kojien and Yogo (2016b) found shadow insurance could reduce the marginal cost of policies and thus improve market efficiency. However, they also found shadow insurance could reduce risk-based capital and increase the default probability for life insurers. Although existing evidence is helpful in understanding the potential benefits and risks of shadow insurance, none of studies examined what insurers do with freed-up capital from shadow insurance transactions. Since the asset risk is a major input for calculation of risk-based capital ratio (RBC ratio), insurers' capital management is closely related to their choice of assets. Therefore, understanding effects of shadow insurance on insurers' investment decisions is critical to evaluating its potential risks.

To answer my research question, I employ a recent adoption of the new statutory reserve rule as a shock to the strictness of the reserve requirement under SAP, and conduct a difference-in-differences analysis as my main identification strategy. In September 2008, the NAIC adopted the new statutory reserve rule called Actuarial Guideline 43 (AG 43) for variable annuities (VAs).⁵ Although this new rule intends to better reflect the underlying risks of VAs, academics and standard setters worry it can create an additional incentive for insurers to engage in shadow insurance. Because AG 43 requires life insurers to record reserves for VAs based on historical tail scenarios, insurers are likely to experience a significant increase in their statutory reserves after a period of high volatility, such as the recent financial crisis (Kojien and Yogo, 2016a). In other

⁵ According to the NAIC, a variable annuity is defined as “an annuity contract that allows the policy owner to allocate contributions into various subaccounts of a separate account based upon the risk appetite of the annuitant” (http://www.naic.org/cipr_topics/topic_variable_annuities.htm).

words, a gap between the statutory and the GAAP reserves for VAs is likely to widen after the adoption of AG 43. Consequently, those insurers holding larger amounts of VAs would have bigger benefits from using shadow insurance. Because AG 43 applies only to VA products, I can classify insurers with VAs as a treatment group and the remaining insurers as a control group to employ the difference-in-differences method. To address concerns that unobservable fundamental differences between the two groups may drive my findings, I employ two additional empirical strategies. First, I conduct within-treatment group analysis using only the treatment group. Second, I investigate individual reinsurance transactions to check their outcomes are consistent with my hypothesis that the accounting rule has driven the use of shadow insurance.

Using data of individual life insurance entities over the 2006–2012 period, I find three main empirical results. First, I find insurers subject to AG 43 engage more in shadow insurance transactions after the adoption of AG 43. The economic magnitude is substantial: after the AG 43 adoption, the probability of insurers with VAs engaging in shadow insurance is about 8.5% higher than for those without VAs. Additionally, I find the impact of AG 43 is significantly stronger for more capital-constrained insurers and weaker for insurers domiciled in states with strong regulatory enforcement. This evidence suggests insurers' capital adequacy and state regulatory enforcement play important roles in shadow insurance use. Second, I find insurers earn more statutory capital gain via shadow insurance transactions compared to non-shadow insurance transactions.⁶ In terms of economic magnitude, an average insurer can earn more statutory capital gain by 0.9% ~ 1.9% of their asset size via shadow insurance. Additionally, I find the amount of

⁶ To improve the statutory capital via shadow insurance, insurers need to pay lower reinsurance premiums than statutory reserves released (i.e., statutory capital gain = statutory reserves released - reinsurance premium ceded).

statutory capital gain via shadow insurance becomes larger only for annuity reinsurance deals, and not for other reinsurance deals. This provides clear evidence that shadow insurance transactions are designed to earn more statutory capital gain, which is consistent with my hypothesis that the AG 43 adoption creates a bigger potential benefit for engaging in shadow insurance. Lastly, I find insurers subject to AG 43 invest in less risky bonds on average but some insurers exploit shadow insurance to hold riskier bonds. The adoption of AG 43 had an economically significant impact on insurers' investment behaviors: an average insurer in the treatment group lowers the yield spread by up to 15.5 bps and improves the credit rating of their bond investments by about 0.8 after the AG 43 adoption. This result is consistent with a notion that capital management and investment choice is closely related to each other, so insurers decrease their asset risks when higher capital pressure is created by the new accounting rule. However, I find that some well-capitalized insurers exploit shadow insurance to hold riskier bonds. This empirical evidence suggests insurers' intention to use shadow insurance to reach for yield depends on their capital adequacy.

My paper is related to several strands of the literature. First, it contributes to the discussion on shadow insurance, which is considered a new form of regulatory arbitrage that has gained attention since the recent financial crisis (see Harrington, 2014 and 2015; Schwarcz, 2015; Kojien and Yogo, 2016b; Irresberger and Peng, 2016). Although regulators, managers, and academics have heavily discussed shadow insurance, no empirical study provides direct evidence on whether stricter SAP accounting rules can affect insurers' engagement in shadow insurance. The lack of empirical study on this issue is surprising given that the recent adoption of AG 43 made insurers face a higher reserve requirement, and it could significantly affect insurers' decisions on shadow insurance use. My paper shows insurers exploit an arbitrage opportunity when the gap between statutory reserves and GAAP reserves widens although regulators are supposed to monitor these

actions. This result suggests accounting rules can have a significant impact on insurers' incentives to use shadow insurance, so a new accounting rule should be carefully designed and introduced.

Second, the paper is related to financial institutions' avoidance strategy to the capital regulation. A few studies have focused on banks' regulatory avoidance strategy using a so-called "shadow banking system," such as securitization vehicles, asset-backed commercial paper [ABCP] conduits, and so on (see Acharya et al., 2013). Because shadow insurance is also a financial alchemy to circumvent the capital requirement using off-balance-sheet transactions, it is similar to shadow banking in some aspects. However, unlike the US banking industry, the US insurance industry is subject to its own regulatory accounting regime, and SAP and GAP together create an additional regulatory friction. My paper sheds light on an undesirable outcome when the two different accounting regimes are interacted with the capital regulation, and suggests changing one accounting regime may not bring an intended regulatory result when firms can exploit another accounting regime outside of the regulatory accounting regime.

Lastly, my study is related to the literature on the real effects of accounting. The real consequences of accounting have gained increasing interest recently, but this area remains largely unexplored. Kanodia and Sapra (2016) state that the measurement and disclosure of accounting numbers have significant effects on the firms' real decisions, such as investment strategies, risk management, asset portfolios, and so on. Yet, most existing studies tend to focus on the real effects of financial reporting on firms' investment policies (e.g., Biddle et al., 2009; Badertscher et al., 2013). Leuz and Wysocki (2016) call for more empirical research on the real effects of accounting with respect to corporate investment and other real economy actions. Unlike the prior studies, I focus on how the change in accounting measurement can affect firms' capital management

behavior and investment decisions when the accounting rule interacts with the capital regulation. Therefore, my study adds new insights to the literature on the real effects of accounting, by not only showing a consequence of the accounting rule change, but also by identifying the mechanism through which that consequence arises.

2. Institutional Background

2.1 The US Insurance Industry Regulation and Captive Reinsurers

State insurance departments regulate the US insurance industry, and most insurers in the US are required to report regulatory financial statements in accordance with SAP. The NAIC, the US insurance standard setting and regulatory support organization, is responsible for setting SAP. Because SAP's primary objective is to ensure companies maintain enough capital to protect insurance policyholders, SAP is more conservative than GAAP. Along with SAP, the RBC ratio is the key element of solvency regulation in the insurance industry, and it is one of the important measures of capital adequacy and financial health for insurers; thus, insurers have a strong incentive to maintain the RBC ratio above their target level.⁷

In the early 2000s, the NAIC adopted new reserve rules called Regulation XXX /AXXX, which required life insurers to hold higher statutory reserves on newly issued term life insurance and universal life insurance with secondary guarantees.⁸ Life insurers responded by establishing captives that exclusively take reinsurance from affiliated companies because the reserve

⁷ More precisely, $RBC\ Ratio = \frac{\text{Total adjusted capital (TAC)}}{\text{Risk-based capital (RBC)}}$, where TAC consists primarily of capital and surplus, and RBC is the required capital that reflects both business and asset risks. The NAIC requires insurers to maintain an RBC ratio of 2 or higher, but regulators can take early actions if insurers suffer significant declines (Ellul et al., 2014 and 2015).

⁸ The motivation of XXX/AXXX adoption is to reflect significant improvements in mortality on statutory reserves (Routhenstein et al., 2015).

requirement under GAAP is much smaller and these captives are only subject to GAAP.⁹ In Appendix A, I provide a simple diagram of the captive reinsurance transaction (Figure A.1), and show how an operating life insurer can free up its capital through this transaction (Figure A.2 and A.3). In this example, the ceding insurer can easily achieve its target statutory capital of \$15 using accounting arbitrage even if the new accounting rule requires higher statutory reserves. This new financial alchemy to relax the capital requirement has been labeled as “shadow insurance” since the New York State Department of Financial Services published a report about it. Shadow insurance has no unique definition, so most captive reinsurance transactions could be viewed as shadow insurance in a broad sense.

Regulators and academics have pointed out several potential risks of shadow insurance (Kojien and Yogo, 2016a and 2016b; Irresberger and Peng, 2016; Schwarcz, 2015). First, shadow insurance is mostly funded by fragile sources of funding, such as conditional letters of credit (LOC) and naked parental guarantees.¹⁰ In particular, LOCs often have a shorter maturity than liabilities, so the captive reinsurer could default on its obligations if the corresponding bank does not renew these short-term LOCs, and this default will also jeopardize the ceding insurer as well. Second, captive reinsurers are subject to a less strict regulatory monitoring, because these reinsurers are generally not subject to risk-based capital regulation. Due to the lack of proper monitoring, captive reinsurers are often under-capitalized, and they could take more risky investments than ceding insurers. Consequently, a leverage ratio of the entire insurance group could be much larger than the ratio as they are seen at the individual insurer. Finally, the insurance industry becomes more

⁹ A traditional third-party reinsurance was not a good solution, because these transactions are often made through unaffiliated reinsurers that are also subject to SAP (Irresberger and Peng, 2016).

¹⁰ Naked parental guarantees are a promise that the parent company of captive reinsurers would cover potential losses if the captive reinsurer defaults, so it substitutes LOCs issued by a third-party bank.

interconnected with the banking industry via shadow insurance, thereby increasing the systemic risk of the financial system. In 2012, bank-issued LOCs for shadow insurance totaled approximately \$100 billion, which an amount sufficient to harm the stability of the financial system (Irresberger and Peng, 2016; Schwarcz, 2015).

2.2. Variable Annuities and AG 43

According to the NAIC, a variable annuity (VA) is defined as “an annuity contract that allows the policy owner to allocate contributions into various subaccounts of a separate account based upon the risk appetite of the annuitant” according to the NAIC. The total value of US VAs with guaranteed benefits has grown rapidly in recent years.¹¹ The US VAs market has developed with competitive market pressures, so VAs have become products with increasingly complex structures. Consequently, the existing approach to calculating statutory reserves was considered unsuitable for the risk profile of the complex products in the market (Junus and Motiwalla, 2009). In September 2008, the NAIC adopted a new statutory reserve rule called Actuarial Guideline 43 (AG 43) to appropriately measure the risks embedded in VAs. On December 31, 2009, AG 43 went into effect for all contracts issued on or after January 1, 1981.

Reserves under AG 43 are calculated by the maximum of the conditional tail expectation (CTE) and the standard scenario amount (SSA). A new component in AG 43 is the CTE part, and it is stochastically calculated based on many economic scenarios.¹² AG 43 does not necessarily intend to increase reserve amounts for VAs, but it is likely to increase reserves after a period of high volatility. Therefore, insurers that had written a substantial amount of VAs before the

¹¹ According to Koijen and Yogo (2016a), the total account value of US VAs associated with guaranteed benefits grew from \$875 billion in 2003 to \$1.726 trillion in 2013.

¹² Credible experience analysis must document and support the assumptions in the scenarios.

financial crisis were likely to face a significant increase in reserving and capital requirements because of the likelihood of embedded guarantees in VAs being deeply in the money around the adoption of AG 43 (Junus and Motiwalla, 2009). For this reason, regulators and academics conjecture the adoption of AG 43 could provide an additional incentive for the US life insurers to use shadow insurance more.

3. Model of Reinsurance for Annuity Insurers

I modify Kojien and Yogo's (2016b) model to develop a simple model that illustrates why captive reinsurance transactions occur in the annuity market. Kojien and Yogo's model provides economic mechanisms for insurance pricing and captive reinsurance in the life insurance market. My model differs from theirs in two main aspects. First, my model illustrates a mechanism of captive reinsurance for annuity rather than life insurance products. That is, I try to show the core of the captive reinsurance mechanism still holds despite different cash-flow schedules for annuity and life insurance products. Second, I allow the ceding insurer to set reinsurance premiums arbitrarily, because the difference between reinsurance premiums and statutory reserves released is critical for the magnitude of statutory capital gain via the captive reinsurance transaction. I make several simplifying assumptions to emphasize the economic mechanism.¹³

3.1. Actuarial Value for the Annuity

¹³ First, the operating insurance company does not raise statutory capital by issuing new equity, because issuing new equity is more expensive than gaining capital via the captive reinsurance. Second, a tax effect is not explicitly specified in my model, because it can create an additional friction and thus possibly obfuscate the mechanism of captive reinsurance. Third, the operating insurer optimally chooses the price for the annuity in an oligopolistic market. Finally, insurers sell the same type of annuity to homogeneous customers (i.e., the same mortality rate for all customers throughout their lives). Kojien and Yogo (2016b) make most of these assumptions in their model.

I focus on a life annuity with an M -year guarantee, which is a common and popular annuity product. This product pays the same amount of income for the first M years regardless of the policyholder's death, and then pays a promised amount thereafter until the death of the policyholder. Let N be the maximum attainable age, let $R (>1)$ be the constant discount rate, and let p be the probability of one-year survival. Then the actuarial value of an annuity per dollar is

$$V = \sum_{m=1}^M \frac{1}{R^m} + \sum_{m=M+1}^N \frac{p^m}{R^m} = \frac{1 - \frac{1}{R^M}}{R - 1} + \frac{\left(\frac{p}{R}\right)^{M+1} - \left(\frac{p}{R}\right)^{N+1}}{1 - \frac{p}{R}}. \quad (\text{M.1})$$

3.2. Insurers' Income Statements and Balance Sheets

Whereas the life insurance collects a premium periodically, the annuity collects a lump-sum premium at the beginning of the contract. Let P_t be the premium of policies sold at t , let $Q_t \geq 0$ be the quantity of policies sold at t , and let $B_t \geq 0$ be the quantity of reinsurance ceded to the captive reinsurer at t . In exchange for ceding liabilities, the operating insurer pays a reinsurance premium $F_t \leq P_t$ to the captive reinsurer. Then, the operating insurer's economic income at t is

$$\Pi_t = (P_t - V)Q_t - (F_t - V)B_t. \quad (\text{M.2})$$

SAP generally requires more conservative reserves than GAAP. Let $\rho > 0$ be the tightness of the reserve requirement, and then the operating insurer should recognize $(1 + \rho)V$ of reserves per dollar under SAP. Therefore, a statutory accounting income for the operating insurer is

$$S_t = [P_t - (1 + \rho)V]Q_t - [F_t - (1 + \rho)V]B_t. \quad (\text{M.3})$$

I distinguish the statutory income from the economic income because the holding company maximizes the economic income while managing its statutory capital under SAP. I construct a balance sheet for the operating insurer with statutory accounting numbers. The operating insurer's liabilities is

$$L_t = \sum_{s=0}^t \delta^s (1 + \rho)V(Q_{t-s} - B_{t-s}) = \delta L_{t-1} + (1 + \rho)V(Q_t - B_t), \quad (\text{M.4})$$

where δ captures the portion of policies sold at $t-1$ that remain in force at t .¹⁴

Next, I define the operating insurer's statutory capital at t as the sum of the statutory capital at $t-1$ and the statutory income at t :

$$K_t = K_{t-1} + S_t = K_{t-1} + [P_t - (1 + \rho)V]Q_t - [F_t - (1 + \rho)V]B_t. \quad (\text{M.5})$$

Then, the operating insurer's assets are derived from the accounting identity that the asset is the sum of capital and liability:

$$\begin{aligned} A_t &= K_t + L_t = K_{t-1} + S_t + \delta L_{t-1} + (1 + \rho)V(Q_t - B_t) \\ &= A_{t-1} - (1 - \delta)L_{t-1} + P_t Q_t - F_t B_t. \end{aligned} \quad (\text{M.6})$$

The captive reinsurer's income and balance sheet items are defined in a similar way, except the captive reinsurer follows GAAP instead of SAP. Under GAAP, the captive reinsurer is subject to a less tight reserve requirement. Following Kojien and Yogo (2016b), I capture this regulatory difference by setting the reserve tightness under GAAP ($\hat{\rho}$) to be smaller than ρ . Then, the captive reinsurer's income and balance sheet items are

$$\hat{\Pi}_t = (F_t - V)B_t. \quad (\text{M.7})$$

$$\hat{S}_t = [F_t - (1 + \hat{\rho})V]B_t. \quad (\text{M.8})$$

$$\hat{L}_t = \sum_{s=0}^t \delta^s (1 + \hat{\rho})VB_{t-s} = \delta \hat{L}_{t-1} + (1 + \hat{\rho})VB_t. \quad (\text{M.9})$$

$$\hat{K}_t = \hat{K}_{t-1} + \hat{S}_t = \hat{K}_{t-1} + [F_t - (1 + \hat{\rho})V]B_t. \quad (\text{M.10})$$

¹⁴ $(1 - \delta)$ portion of reserves decreases every year due to death or withdrawal. I do not consider gains from these attritions.

$$\hat{A}_t = \hat{K}_t + \hat{L}_t = \hat{K}_{t-1} + \hat{S}_t + \hat{L}_t = \hat{A}_{t-1} - (1 - \delta)\hat{L}_{t-1} + F_t B_t. \quad (\text{M.11})$$

3.3. The Holding Company's Maximization Problem

Koijen and Yogo (2016b) point out that the excessive use of shadow insurance could draw regulatory attention, and thus could incur a regulatory cost such as a scrutiny or an intervention. Following the same intuition, I consider the regulatory friction in a cost function. In addition, the regulatory friction is a function of the reinsurance premium (F_t). In my model, the difference between the reinsurance premium and statutory reserves released is crucial for the operating company to recognize statutory capital gain (i.e., $F_t - (1 + \rho)V$). In real transactions, the ceding insurer constructs a deal structure using both the reinsurance premium (F_t) and the economic reserve (V). However, I just allow the reinsurance premium to move for simplicity, because the economic intuition does not change. If the reinsurance premium were set too low, regulators would pay additional attention to determining whether the transaction is economically justifiable. Then, the regulatory cost function would be

$$C_t = C(K_t, \hat{K}_t, F_t). \quad (\text{M.12})$$

The cost function is continuous, differentiable, strictly decreasing, and strictly convex. The cost function is decreasing in capital (K_t and \hat{K}_t) and reinsurance premium (F_t) because a lower capital or reinsurance premium increases the likelihood of regulatory attention.

The holding company chooses the premium of annuity (P_t), the amount of captive reinsurance (B_t), and the reinsurance premium (F_t) to maximize joint economic profits of the operating insurer and the captive reinsurer as follows:

$$\max_{P_t, B_t, F_t} J_t = \Pi_t + \hat{\Pi}_t - C_t + \mathbb{E}_t[M_{t+1}J_{t+1}], \quad (\text{M.13})$$

$$\text{s. t. } F_t \leq P_t,$$

where M_{t+1} is a stochastic discount factor.

From the first-order conditions, we have following results¹⁵:

$$P_t = \left(1 - \frac{1}{\epsilon_t}\right)^{-1} \left(\frac{1 + k_t(1 + \rho)V - \lambda_t \frac{\partial P_t}{\partial Q_t}}{1 + k_t} \right), \quad (\text{M.14})$$

where $k_t = \frac{\partial J_t}{\partial K_t}$ is the marginal firm value of capital, and $\epsilon_t = -\frac{P_t}{Q_t} \frac{\partial Q_t}{\partial P_t}$ is the price elasticity of demand:

$$k_t \left(1 + \rho - \frac{F_t}{V}\right) = \hat{k}_t \left(1 + \hat{\rho} - \frac{F_t}{V}\right), \quad (\text{M.15})$$

$$B_t = \frac{f_t + \lambda_t}{\hat{k}_t - k_t}, \quad (\text{M.16})$$

where $f_t = \frac{\partial C_t}{\partial F_t} < 0$ is the marginal cost of the reinsurance premium.

The above results provide two important implications regarding shadow insurance use. First, equation (M.15) suggests the holding company allocates the capital between the operating insurer and the captive insurer by appropriately weighting the tightness of the reserve requirements. This capital allocation implies the operating insurer will increase the amount of captive reinsurance as the reserve requirement becomes stricter (i.e., ρ increases). As ρ increases, the marginal firm-value capital of the operating insurer ($k_t = \frac{\partial J_t}{\partial K_t}$) becomes smaller relative to the marginal firm-

¹⁵ Proofs are provided in Appendix B.

value capital of the captive insurer ($\hat{k}_t = \frac{\partial J_t}{\partial \hat{K}_t}$). That is, $k_t^{\rho^{high}} < k_t^{\rho^{low}} \Leftrightarrow K_t^{\rho^{high}} > K_t^{\rho^{low}}$ because

the benefit of additional capital has diminishing returns. Therefore, I have the first proposition:

Proposition 1: *The operating insurer increases the amount of captive reinsurance as the capital regulation becomes stricter.*

Second, equation (M.16) suggests the reinsurance premium (F_t) will decrease as the reserve requirement becomes stricter (i.e., ρ increases). From the first result, the captive reinsurance use goes up as ρ increases (i.e., $\frac{\partial B_t}{\partial \rho} > 0$) and $\hat{k}_t - k_t$ gets larger as well. Then, $f_t^{\rho^{high}} + \lambda_t > f_t^{\rho^{low}} + \lambda_t \Leftrightarrow F_t^{\rho^{high}} < F_t^{\rho^{low}}$ because the regulatory cost function is convex in the reinsurance premium (F_t). This result is intuitive because the operating insurer wants to obtain higher statutory capital gain via the shadow-insurance transaction as the regulatory pressure becomes higher. Consequently, the operating insurer sets the reinsurance premium smaller to earn more statutory capital gain. Therefore, I have the second proposition:

Proposition 2: *The operating insurer decreases the reinsurance premium as the capital regulation becomes stricter; that is, the operating insurer adjusts the transfer price to earn more statutory capital when it faces more capital pressure.*

3.4. Hypothesis Development

The adoption of AG 43 was expected to increase reserves for VAs (i.e., ρ increases) and thus decrease the statutory capital. Given this expectation, Proposition 1 suggests insurers with VAs are more likely to engage in shadow insurance after the adoption of AG, because they face more capital pressure due to the increased reserves under the new accounting rule. Based on this rationale, I test the following hypothesis:

H1: Insurers subject to AG 43 engage more in shadow insurance transactions following its adoption.

Understanding how other economic factors can interact with shadow insurance use is important, because this understanding will provide meaningful insight for future standard setting. I first examine the role of insurers' capital adequacy on shadow insurance use. One might think the relationship between the capital adequacy and shadow insurance use would be unambiguously negative because the major motivation of shadow insurance is to lessen reserve strain and free up surplus. However, regulators and insurance rating agencies more closely monitor those capital-constrained insurers, so regulatory costs of using shadow insurance would be high for them as well. For this reason, testing the following hypothesis would be helpful to understand the relative benefits and costs of shadow insurance for capital-constrained insurers.

H1a: The impact of AG 43 on shadow insurance use is stronger for more capital-constrained insurers.

Another interesting question would concern the role of regulatory enforcement in shadow insurance. Harrington (2015) points out that the captive reinsurance transaction is subject to strict regulation because the ceding insurer's state regulator must approve the terms of the transaction. Because the effect of AG 43 adoption on insurers' incentives for shadow insurance could be anticipated, the impact of AG 43 on shadow insurance use would be limited if regulators closely monitor and govern shadow insurance. However, the effectiveness of regulations varies significantly across states because different states have shown different attitudes toward the captive insurance transaction. For example, some states such as Vermont and South Carolina have actively marketed to attract captive reinsurers for many years because regulators could earn

benefits such as tax revenues and regulatory jobs by domiciling captive reinsurers (Schwarcz, 2015). Thus, these states with a favorable attitude are likely to be lenient regarding regulations of captive reinsurance transactions. On the other hand, New York is well known for its strict regulations of captive reinsurance transactions. For example, New York requires the ceding insurer to provide unconditional collateral to back up the captive reinsurance transaction, whereas other states permit less reliable types of collateral such as conditional LOCs (Schwarcz, 2015). This cross-sectional variation across states suggests regulatory enforcement could be a critical factor for insurers' decisions on shadow insurance use. Therefore, I test the following hypothesis:

H1b: The impact of AG 43 on shadow insurance use is weaker for insurers domiciled in states with strong regulatory enforcement.

Next, I investigate individual reinsurance transactions to check whether insurers actually earn more statutory capital gain via shadow insurance transactions compared to non-shadow insurance transactions. To improve the statutory capital via shadow insurance, insurers need to pay lower reinsurance premiums than statutory reserves released (i.e., reinsurance premium ceded < statutory reserves released). This type of transaction is often called “financial reinsurance” because its main purpose is to enhance statutory capital rather than transfer insurance risks.¹⁶ Figure A.3 in Appendix A illustrates how the operating insurer can earn statutory capital gain via a captive insurance transaction. In this example, the operating insurer pays the reinsurance premium of \$95 to the captive reinsurer in exchange for release of the statutory reserves of \$110. Therefore, the operating insurer can increase the statutory capital of \$15 (\$110 - \$95) via this transaction. Consistent with this stylized example, Proposition 2 also suggests the operating insurer would

¹⁶ Introduction to Reinsurance Boot Camp (<https://www.soa.org/Files/Pd/2015/reinsurance-boot-camp/2015-05-reinsurance-camp-presentations.pdf>).

lower the reinsurance premium (F_i) (i.e., the transfer price) as the statutory reserve requirement becomes stricter in order to earn more statutory capital. Therefore, if operating insurers' actual motivation for shadow insurance is to earn arbitrage statutory capital gain, the statutory capital gain via shadow insurance becomes larger after the adoption of AG 43. Moreover, this tendency would be more distinct for VA reinsurance transactions because AG 43 only applies to VAs. Based on this rationale, I test the following hypothesis:

H2: Insurers earn more statutory capital gain via shadow insurance transactions, and this tendency becomes stronger after the adoption of AG 43, especially for VA transactions.

Finally, I examine the impact of AG 43 adoption on insurers' investment behaviors and whether insurers exploit shadow insurance to hold higher-yield portfolios. Empirical evidence for the potential risks of shadow insurance is scant. The most renowned evidence would be Kojien and Yogo (2016b), who show what the operating insurer's balance sheet would look like if shadow insurance were put back on its balance sheet. They found the adjusted RBC ratio would decrease and the default probability would increase for shadow insurance users. Although this evidence suggests shadow insurance users become more leveraged at the group level, whether life insurers use shadow insurance in order to bear additional risks in their asset portfolios is unclear. When insurers face more capital pressure due to the new accounting rule, they are expected to reduce risks on the asset side by making less risky investments, because the asset risk is an important input for calculating risk-based capital. However, two scenarios are possible for the interaction between shadow insurance and investment decision. On one hand, shadow insurance and investment decisions can move in opposite directions. Life insurers have a general propensity to buy riskier bonds in order to achieve higher yields (Becker and Ivashina, 2015); therefore, insurers

could exploit shadow insurance to circumvent the new rule and hold riskier and higher-yield assets. On the other hand, shadow insurance and investment decisions can move in the same direction due to the regulatory cost. For example, more capital-constrained insurers may want to fully utilize shadow insurance to maintain their target RBC ratios but cannot because they also face a higher regulatory cost of using shadow insurance. Thus, instead of fully utilizing shadow insurance, they reduce risks on the asset side by holding safer portfolios and reduce reserves on the liability side by using shadow insurance. Both scenarios are possible, and the adequacy of the capital is likely to be an important factor for the direction of the interaction between shadow insurance and the investment decision. Therefore, I test the following hypothesis:

H3: Insurers subject to AG 43 would make less risky investments; however, well-capitalized insurers (facing a small regulatory cost of using shadow insurance) could exploit the shadow insurance in order to hold riskier and higher-yield portfolios.

4. Research Design and Data

4.1. Identification Strategy

I employ a recent adoption of AG 43 as a shock to the accounting arbitrage opportunity and conduct a difference-in-differences analysis to answer my research question. Using the AG 43 adoption as a shock for my analysis provides two advantages. First, I can clearly identify a treatment group and a control group using the scope of AG 43. AG 43 applies to all individual, group, deferred, and immediate VAs; that is, only life insurers with these products are subject to AG 43. Therefore, I classify insurers with VAs as the treatment group and insurers without VAs as the control group, and conduct the difference-in-differences analysis. To identify those insurers holding VAs, I use information from the statutory financial statements. All US life insurers are

required under the section of “General Interrogatories” in their statutory financial statements to report whether they have VAs with guaranteed benefits.¹⁷ Because almost all VAs carry some type of guarantees, classifying insurers that answer “yes” to this question as the treatment group would be reasonably accurate. Second, AG 43 was retroactively applied to all contracts issued on or after January 1, 1981. This retroactive application can reduce a concern that a life insurer endogenously chose its business portfolio by taking account of the impact of possible reserve accounting rule changes at the initiation of its VA business. Another possible concern about using AG 43 as a shock to the strictness of reserve requirements is that insurers could get away from the influence of AG 43 by simply not selling new VAs. However, this is not the case for the AG 43 adoption, because it applied retroactively to all VA contracts remaining in force. Therefore, we can assume those insurers that answered “yes” to the question about having VAs were actually subject to the AG 43, and the impact of AG 43 on their reserves were plausibly exogenous.

Despite the above strengths, the treatment and the control groups could differ along many other dimensions, so the parallel-trends assumption is a critical issue. For example, differences in firm characteristics or business models between the two groups could drive both the choice of having VAs and using shadow insurance, in which case, other confounders could drive the identified effect of the AG 43 adoption. To assess the validity of the parallel-trends assumption, in Figure 1, I plot the estimated treatment effects for the entire sample period by including indicators (year $\{0,1\}$ *VA) except year 2008, which serves as the benchmark period (Christensen et al., 2016). The Panel A, B, and C of Figure 1 present the estimated coefficients for the dependent variables of Shadow $\{0,1\}$, $\text{Log}(1+\text{Shadow amount})$, and *Shadow Ratio*, respectively. Ideally, we

¹⁷ Precisely, Q9.1 in Part2 – Life Interrogatories.

expect to see zero effects during the pre-period of AG 43 and then a sharp increase right after the AG 43 adoption if the parallel-trends assumption perfectly holds. The plots show a significant jump after the AG 43 adoption (year 2009), which is consistent with my hypothesis about the impact of AG 43 on shadow insurance use. However, the plots also indicate some non-zero coefficients during the pre-period of AG 43 (e.g., year 2007 in Panel A and B), which could be a possible concern.

To address the above concern, I use two additional empirical strategies. First, I conduct within-treatment group analysis using only the treatment group. In the statutory financial statements, life insurers are also required to disclose the total value of VAs associated with any guaranteed benefits.¹⁸ Using this information, I can measure the relative importance of VAs in insurers' total assets. Then, I can use the continuous variations within the treatment group to test whether those insurers that hold relatively more VAs engage more in shadow insurance. However, within-treatment analysis does not come without a cost, because restricting the sample results in a loss of almost 80% of observations. For this reason, I conduct within-treatment analysis only for testing the main hypotheses, but use the entire sample for cross-sectional tests that require considerably more variations and statistical power. Second, I conduct analysis using individual reinsurance transactions. Specifically, I compare VA reinsurance transactions (subject to AG 43) to other reinsurance transactions (not subject to AG 43) within the same life insurance company. Using all three empirical strategies, I try to provide convincing evidence for my hypothesis that the new accounting rule has driven the use of shadow insurance.

4.2. Data Construction

¹⁸ Precisely, Q9.2 in Part2 – Life Interrogatories.

I use annual statutory financial statements for fiscal years 2006–2012 from SNL Financial. This period covers three years of the pre- and post-AG 43-adoption period that I can use for comparison. I combine three different data sets: reinsurance transactions, firm-level financial information, and investment transactions.

For the reinsurance transactions, I build both firm-level and transaction-level data sets. I use the firm-level data for testing hypotheses 1s, and I use the transaction-level data for testing hypothesis 2. To identify shadow insurance transactions, I use Part 3.1 (Reinsurance Ceded) of the Schedule S section in the statutory statements following prior literature (see Kojen and Yogo, 2016a and 2016b; Irresberger and Peng, 2016). Part 3.1 of Schedule S section contains all reinsurance transactions ceded to affiliated and unaffiliated entities at each year-end. Therefore, I can measure the amounts of reinsurance ceded to shadow insurers, which I define as affiliated and unauthorized reinsurers without an A.M. Best rating, following existing studies.¹⁹ The amount of reinsurance ceded is computed as the sum of reserve credit taken and the modified coinsurance reserve for each transaction. I then sum up all reinsurance transactions at the firm-year level.

To construct the firm-level financial data, I apply several filters following Irresberger and Peng (2016). I exclude firm-year observations with negative total assets, negative liabilities, negative surplus, or negative premiums written to avoid any reporting errors. Further, I include only companies whose total assets are greater than \$1 million. The final sample includes 824 life insurers and 5,397 firm-years. Using this final firm-level sample, I create several firm

¹⁹ A.M. Best is a provider of ratings, financial data, and news with an exclusive insurance industry focus. SNL Financial only provides the most recent available A.M. Best ratings, so I assume insurers that are not currently covered by the A.M Best rating were not covered at the time of the reinsurance transaction either.

characteristics to be included as controls in regressions. The complete set of variable definitions is provided in Appendix C.

For the investment transactions, I use Part 3 of the Schedule D section in the statutory statements. This section contains detailed transactions of all long-term bonds and stocks acquired during the current year. Among these investments, I focus on the bonds investment because Getmansky et al. (2016) suggest more than 79% of life insurers' financial assets are invested in fixed-income securities, so they are arguably the most important securities in life insurers' asset portfolios. Moreover, Becker and Ivashina (2015) showed that life insurers have a general propensity to hold riskier bonds in order to achieve higher yields, so the bonds investment is a good place to examine insurers' choice of investment assets.

I use two proxies for the bond risk: (i) the spread between the yield to maturity and the benchmark Treasury-bond yield (i.e., yield spread) and (ii) the numerically scaled credit rating. Estimating yield spreads is empirically challenging because insurers not only acquire bonds at issuance, but also buy them from the secondary market, and yield to maturity of a bond continues to vary as it gets closer to maturity. Therefore, I need to track the yield of a certain bond over time and find an exact yield at the time of an insurer's acquisition. Thus, I obtain bond yields at issue as well as their trading over time as follows. First, I collect promised yields at issuance from Mergent FISD, and then estimate yield spreads by matching Treasury bonds based on the maturity. Because Treasury-bond yields are available discontinuously such as 1-month, 3-month ... and 30-year, I use the linear interpolation to obtain benchmark yields between these points. Next, I employ the Trade Reporting and Compliance Engine (TRACE) database to track bond yields over time. TRACE contains information of bond transactions in the secondary market, such as reports dates,

yields, and prices. After cleaning the TRACE data to eliminate reporting errors following Dick-Nielsen's (2009) methodology, I identify all trades before and after three days around the bond acquisition date of insurers and take the median value of bond yields. Then, I estimate yield spreads by matching Treasury bonds based on the maturity following the way described above. Finally, I calculate the value-weighted average yield spreads at the firm-year level based on the actual cost of each bond.

I obtain credit ratings for Moody's, Standard & Poor's, and Fitch from Mergent FISD, and match the most recent rating with the insurers' acquisition date regardless of rating agencies. Then, I convert these ratings to numbers, with higher values indicating worse ratings (e.g., Aaa=AAA=1, Aa1=AA+=2 ... and D=24). Next, I calculate the value-weighted average credit ratings at the firm-year level as I did for the yield spread.

4.3. Summary Statistics

Table 1 reports summary statistics for the firm-level variables by the treatment and the control group.²⁰ Panel A shows that about 8.7% of the sample is shadow insurance observations; however, Panels B and C suggest shadow insurance is more pervasive in the treatment group than in the control group (29.8% vs. 3.7%), which is consistent with hypothesis 1. Panels B and C also suggest the treatment group is different from the control group in many dimensions. For example, the treatment group is generally larger, less profitable, and less capitalized than the control group. These differences imply firm characteristics should be properly controlled in analysis to address the endogeneity issue. I address this need in various ways: (i) explicitly including them as controls, (ii) including firm fixed effects, and (iii) conducting within-treatment-group analysis. Panel D

²⁰ All continuous variables are winsorized at the 1st and 99th percentiles.

reports Pearson correlations for all relevant variables. Both treatment variables (*VA* and *VA Position*) are positively correlated with the shadow variables (*Shadow*, *Log(1+Shadow amount)*, and *Shadow Ratio*), which suggests the treatment group is positively associated with the use of shadow insurance. On the other hand, correlations between treatment variables and bond risk variables are not as consistent, because treatment variables are positively correlated with *Credit Rating*, whereas they are not strongly correlated with *Yield Spread*. However, we cannot draw any serious interpretations from pairwise correlations.

5. Empirical Results

5.1. Test of H1s

To test whether insurers subject to AG 43 engage more in shadow insurance transactions after the adoption of AG 43 (hypothesis 1), I estimate the following regression using OLS:

$$Shadow_{i,t} = \beta_0 + \beta_1 VA_i + \beta_2 POST_t + \beta_3 VA_i * POST_t + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon_{i,t}, \quad (1)$$

where δ_t and λ_i are year and firm fixed effects.²¹ For the dependent variable *Shadow*_{*i,t*}, I use three different variables: *Shadow {0,1}*, *Log(1+Shadow amount)*, and *Shadow Ratio = Shadow amount/Total reinsurance amount*.²² *VA*_{*i,t*} is an indicator taking the value of 1 if an insurer *i* has VAs at the end of year 2008 (right before the AG 43 adoption), and *POST*_{*t*} is an indicator taking the value of 1 after the adoption of AG 43, that is, on or after 2009. *X*_{*i,t*} are control variables such

²¹ The *POST* variable is dropped when year fixed effects are added, and *VA* is dropped when firm fixed effects are added. However, I include these variables in my models because I use different specifications with and without fixed effects for some tests. This statement applies to all other regressions in the paper.

²² I estimate a OLS (or a linear probability model) for the indicator variable *Shadow {0,1}* to avoid the incidental parameters problem of a probit/logit model when fixed effects are included in panel data setting.

as *Log (Assets)*, *Log (TPW)*, *Profitability*, *Current*, *ROE*, *Leverage*, *Lag RBC ratio*, *Financial Crisis*, and *Public*. All variables are defined in Appendix C.

Panel A of Table 2 reports results of equation (1) for three dependent variables using both year and firm fixed effects. My interest is the coefficient of $VA_i * POST_t$, and they are significantly positive at least at the 5% level for all three dependent variables. In terms of economic magnitude, the coefficient for column (1) is 0.085, which implies the probability of using shadow insurance for the treatment group is 8.5% higher than for the control group after the AG 43 adoption.

Panel B of Table 2 shows within-treatment analysis for hypothesis 1. In this test, I use the relative importance of VAs in insurers' total assets (*VA Position*) instead of the indicator of having VAs. Thus, I use continuous variations within the treatment group to examine whether insurers with relatively more VAs engage more in shadow insurance. The results are mostly consistent with the cross-group-analysis results in Panel A, except the coefficients under some specifications are not statistically significant. The weak statistical power is somewhat anticipated because I lose almost 80% of observations in the within-treatment analysis. However, coefficients are significantly positive at least at the 10% level for most specifications. In terms of economic magnitude, the coefficient for *Shadow {0,1}* can be roughly interpreted as showing that a one-standard-deviation increase in *VA Position* increases the probability of using shadow insurance by 4.8 ~ 6.8% for the average insurer with VAs after the AG 43 adoption.²³ Therefore, both the cross-group analysis and the within-treatment-group analysis provide consistent evidence that insurers with VAs actually engaged more in shadow insurance transactions after the adoption of AG 43.

²³ The standard deviation of *VA Position* for the treatment group is 0.348, and then I obtain the estimates by $0.137*0.348 = 4.8\% \sim 0.194*0.348 = 6.8\%$.

Next, I investigate cross-sectional variations among shadow insurance users. First, I examine whether the impact of AG 43 on shadow insurance use is stronger for more capital-constrained insurers (hypothesis 1a). To test this hypothesis, I estimate the following regression:

$$\begin{aligned} Shadow_{i,t} = & \beta_0 + \beta_1 VA_i + \beta_2 POST_t + \beta_3 RBC Ratio_{i,t-1} \\ & + \beta_4 VA_i * POST_t + \beta_5 VA_i * POST_t * RBC Ratio_{i,t-1} + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon_{j,t}, \end{aligned} \quad (2)$$

where $RBC Ratio_{i,t-1}$ is the lagged RBC ratio, which proxies the capital adequacy of insurer i in the previous year, and I use two variables: i) *Lag RBC Ratio Low* $\{0,1\}$ is an indicator taking the value of 1 if Lag RBC Ratio is below the median in a given year, and ii) *Lag RBC Ratio* is a continuous variable. All other variables are defined as before.

Table 3 presents the results of equation (2), and the first three columns are tests for three dependent variables using different specifications with year and firm fixed effects. My interest is the coefficient of $VA_{i,t} * POST_t * RBC Ratio_{i,t-1}$, and I expect it to be positive for the first three columns but negative for the last three columns if the impact of AG43 is stronger for capital-constrained insurers. The estimated coefficients are significant at least at the 10% level for *Shadow* $\{0,1\}$ and $Log(1+Shadow \text{ amount})$. The coefficient for column (1) means the probability of less capitalized insurers using shadow insurance is 8% higher than for well-capitalized insurers in the treatment group after the AG 43 adoption. The coefficient for column (4) can be roughly interpreted as meaning a one-standard-deviation increase in *Lag RBC Ratio* decreases the probability of using shadow insurance by 2.7% for the average insurer in the treatment group after the AG 43 adoption. This interpretation suggests the capital health of the insurer has a significant impact on the decision to use shadow insurance, and this is consistent with a common belief that life insurers use the captive reinsurance transactions to relax capital constraints.

Second, I examine whether the impact of AG 43 on shadow insurance use is weaker for insurers domiciled in states with strong regulatory enforcement (hypothesis 1b). To test this hypothesis, I estimate the following regression:

$$\begin{aligned} Shadow_{i,t} = & \beta_0 + \beta_1 VA_i + \beta_2 POST_t + \beta_3 Enforcement_{i,t} \\ & + \beta_4 VA_i * POST_t + \beta_5 VA_i * POST_t * Enforcement_{i,t} + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon_{i,t}, \end{aligned} \quad (3)$$

where $Enforcement_{i,t}$ is a proxy for the state regulatory enforcement. I use three different proxies for the regulatory enforcement: *Strong State {0,1}*, *High Staff {0,1}*, and *Log(1+Staff Ratio)*. *Strong State {0,1}* is an indicator taking the value of 1 if an insurer is domiciled in the state of New York. New York is known for its strict regulation, so many insurance groups set up a New York-based company separately to deal with this strict regulation. Moreover, the insurance department in New York explicitly pointed out potential risks of captive reinsurance transactions by publishing the report “Shining a Light on Shadow Insurance,” so we can reasonably assume New York regulates shadow insurance more strictly compared to other states. *High Staff {0,1}* and *Log(1+Staff Ratio)* are calculated based on the ratio of the number of staff in the state insurance department to the number of domiciled domestic insurers in that state. *High Staff {0,1}* is an indicator taking the value of 1 if the staff ratio is above the median in a given year, and *Log(1+Staff Ratio)* is a continuous variable. The intuition behind these measures is that the intensity of monitoring for the shadow insurance activity is directly related to available work forces in the state regulation department. I obtain the data for state insurance department resources from “Insurance Department Resources Report,” which is published annually by the NAIC.²⁴

²⁴ All reports are available at http://www.naic.org/prod_serv_publications.htm.

Table 4 presents the results of equation (3), and I only report results with both year and firm fixed effects. My interest is the coefficient of $VA_i * POST_t * Enforcement_{i,t}$, which I expected to be negative if the regulatory enforcement can reduce the shadow insurance use. The estimated coefficients are significantly negative at least at the 10% level for most specifications, so the regulatory enforcement seems to be an important factor in the decision regarding shadow insurance use. Economic magnitude is also significant; for example, the coefficient from column (1) is -0.086, which means the probability of using shadow insurance after the AG 43 adoption is lower by 8.5% for the average insurer in the treatment group domiciled in New York. The staff ratio has an impact on the continuous dependent variables ($Log(1+Shadow\ amount)$ and $Shadow\ Ratio$) rather on for the probability of using shadow insurance ($Shadow\{0,1\}$), but the sign of the coefficients for $Shadow\{0,1\}$ is negative, which is consistent with my hypothesis. Overall, my empirical evidence suggests the impact of AG 43 on shadow insurance use was weaker for insurers domiciled in states with strong regulatory enforcement.

5.2. Robustness Tests of H1

The AG 43 was adopted right after the recent financial crisis, thus a concern that shadow insurance use could be driven mainly by life insurers' poor performances during the financial crisis needs to be addressed. Kojien and Yogo (2016a) found the VA business experienced significant losses during the financial crisis, especially in 2008. I sort insurers based on their profitability (pretax operating income to total revenue) in 2008 and create *Profitability Low {0,1}*, an indicator taking the value of 1 if profitability is below the median. Then, I estimate the following regression:

$$\begin{aligned}
 Shadow_{i,t} = & \beta_0 + \beta_1 VA_i + \beta_2 POST_t + \beta_3 Profitability\ Low\ \{0,1\}_i \\
 & + \beta_4 VA_i * POST_t + \beta_5 VA_i * POST_t * Profitability\ Low\ \{0,1\}_{i,t} + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon_{i,t},
 \end{aligned}
 \tag{4}$$

where all variables are defined as before.

Table 5 presents the results of equation (4), and I only report results for the tightest specification because other specifications provide similar results. The coefficient of $VA_i * POST_t * Profitability\ Low\ \{0,1\}_{i,t}$ is expected to be significantly positive if shadow insurance use is driven mainly by the poor performance during the financial crisis. However, none of coefficients is significant at the 10% level. Therefore, this result alleviates the concern that the increase in shadow insurance use is driven by the poor performance, but not by the AG 43 adoption.

Another concern is that insurers could anticipate the AG 43 adoption, so some insurers could divest the VA business before 2009 to avoid AG 43. However, no such insurers are found in my sample. Additionally, I allow the treatment group (i.e. $VA=1$) to vary each year instead of fixing it based on the balance of VAs at the end of year 2008. The results are not tabulated because they remain similar to the current results both economically and statistically.

5.2. Test of H2

Next, I examine whether insurers earn more statutory capital gain via shadow insurance transactions, and whether this tendency becomes stronger after the adoption of AG 43, especially for VA transactions (hypothesis 2). I use the transaction-level data instead of the firm-level data to test this hypothesis. By using the transaction-level data, I can compare shadow insurance transactions and non-shadow insurance transactions within an insurer, and check whether insurers earn more statutory capital gain from the shadow insurance transaction. To do this, I restrict the sample with positive statutory capital gain transactions (i.e., statutory reserves released – reinsurance premium ceded > 0), and test whether amounts of statutory capital gain become larger for VA transactions after the AG 43 adoption. Schedule S in the statutory filing specifies types of

reinsurance for each transaction, so I can observe what types of insurance products were ceded to reinsurers. For example, “individual annuity coinsurance” means a reinsurance transaction that the annuities sold to individuals were ceded. Therefore, I can identify whether each transaction is for an annuity or a life insurance product. However, I do not observe whether the transaction is for VAs or fixed annuities, so my annuity sample contains both types of annuities, and thus results should be carefully interpreted.

I first estimate the following regression to test whether insurers earn more statutory capital gain via shadow insurance transactions in general:

$$Gain_{i,j,t} = \beta_0 + \beta_1 Shadow_Deal_{i,j,t} + \gamma X_{i,t} + \delta_t + \lambda_i + \eta_k + \epsilon_{i,j,t}, \quad (5)$$

where δ_t , λ_i , and η_k are year, firm, and reinsurance-type fixed effects. For the dependent variable $Gain_{i,j,t}$, I use two different variables: i) $Gain\ Deal\ \{0,1\}$ is an indicator taking the value of 1 if statutory capital gain is positive, and ii) $Gain/Asset$ is the amount of statutory capital gain normalized by assets. $Shadow_Deal_{i,t}$ is an indicator taking the value of 1 if a reinsurance transaction was ceded to affiliate, unauthorized, and unrated reinsurers.

Panel A of Table 6 presents the results of equation (5). The first four columns are tests for $Gain\ Deal\ \{0,1\}$ using all transactions, and the last four columns are tests for $Gain/Asset$ using only gain transactions. The results are consistent with my hypothesis. Positive coefficients of $Shadow_Deal_{i,t}$ from the first four columns imply insurers are more likely to earn statutory capital gain via shadow insurance transactions. In terms of economic magnitude, the probability to earn positive statutory capital gain is higher by up to 19% for a shadow insurance transaction. The results in the last four columns suggest shadow insurance transactions are designed to earn more statutory capital gain compared to non-shadow insurance transactions. In terms of economic

magnitude, on average, insurers earn statutory capital gain more by 0.9% ~ 1.9% of their asset size through shadow insurance. This percentage translates to approximately \$54.1 million ~ \$114.2 million for the average life insurer in the sample.²⁵ This transaction-level analysis provides clear evidence that insurers earn more statutory capital gain via shadow insurance.

Next, I test whether amounts of statutory capital gain via shadow insurance transactions become larger after the adoption of AG 43, especially for VA transactions. I test this hypothesis by estimating the following regression with only gain transactions:

$$\begin{aligned}
 \text{Gain/Asset}_{i,j,t} = & \beta_0 + \beta_1 VA_i + \beta_2 POST_t + \beta_3 \text{Shadow_Deal}_{i,j,t} + \beta_4 VA_i * POST_t \\
 & + \beta_5 VA_i * POST_t * \text{Shadow_Deal}_{i,j,t} + \gamma X_{i,t} + \lambda_i + \delta_t + \eta_k + \epsilon_{i,j,t},
 \end{aligned} \tag{6}$$

where all variables are defined as before.

Panel B of Table 6 presents the results of equation (6). The first four columns compare insurers with and without VAs (i.e., treatment vs. control group) using only annuity transactions, column (5) is the within-treatment-group analysis using only annuity transactions, and the last four columns are falsification tests using all other transactions. My interest is the sum of two coefficients ($VA_i * POST_t + VA_i * POST_t * \text{Shadow_Deal}_{i,j,t}$), and I expect it to be positive for the annuity transactions, but not for the other types of transactions. All estimated coefficients are consistent with my hypothesis: the sum of coefficients for the annuity sample is significantly positive for both the cross-group analysis and the within-treatment-group analysis. In terms of economic magnitude, the amount of statutory capital gain via the shadow insurance went up by 2.3% of the asset size on average. On the other hand, coefficients for the other sample are negative

²⁵ The mean asset size for the sample is \$6,012 million, and then I obtain the estimates by \$6,012*0.009 = 54.1 ~ \$6,012*0.019 = \$114.2 million.

and statistically insignificant. These results suggest the annuity reinsurance deals became structured to earn more statutory capital gain after the AG 43 adoption, which is consistent with my hypothesis that the AG 43 adoption creates bigger potential capital gain from a shadow insurance transaction. One caveat is that my test uses the entire annuity sample containing both fixed annuities and VAs, so it cannot confirm the effect is truly driven by VAs and not by fixed annuities. However, given that no accounting-rule change occurred for the fixed annuity around the AG 43 adoption, the likelihood that the VA was the primarily driver of the identified effect is more reasonable.

5.3. Test of H3

Finally, I examine whether insurers subject to AG 43 would make less risky investments, and whether they exploit the shadow insurance to hold riskier and higher-yield portfolios. I first estimate the following regression to examine the impact of AG 43 on investment behaviors:

$$Bond\ Risk_{i,t} = \beta_0 + \beta_1 VA_i + \beta_2 POST_t + \beta_3 VA_i * POST_t + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon_{i,t}, \quad (7)$$

where the dependent variable $Bond\ Risk_{i,t}$ are *Yield Spread* and *Credit Rating*. *Yield Spread* is the value-weighted average yield spreads of bonds acquired by insurer i in period t , where individual bond spreads are the spread between the yield to maturity and the benchmark Treasury-bond yield. *Credit Rating* is the value-weighted average credit rating of bonds acquired by insurer i in period t , where individual credit ratings are numerically scaled credit agencies' letter ratings from 1 to 24, where 1 = the safest, and 24 = the riskiest.

Panel A of Table 7 reports the results of equation (7). The first three columns are tests for *Yield Spread*, and last three columns are tests for *Credit Rating*. I expect the coefficient of $VA_{i,t} * POST_t$ to be negative because insurers need to reduce asset risks when they face more capital

pressure created by the new accounting rule. The results are consistent with this hypothesis; most coefficients are significantly negative at least at the 10% level except for column (1). For *Yield Spread*, an average insurer in the treatment group lowered the yield spread by up to 15.5 bps after the AG 43 adoption. This finding is economically significant because the sample mean of the yield spread is 193.9 bps, and 15.5 bps is about 8% of the sample mean. For *Credit Rating*, an average insurer in the treatment group improved the credit rating of their bond investments by about 0.8 after the AG 43 adoption. This finding is also economically significant because a 0.8 decrease in the numeric value can be converted to almost one letter upgrade (e.g., from A- to A). Thus, the adoption of AG 43 had an economically significant impact on insurers' investment behaviors.

Next, I estimate the following regression to examine whether insurers exploit shadow insurance to hold high-yield bonds:

$$\begin{aligned}
 \text{Bond Risk}_{i,t} = & \beta_0 + \beta_1 VA_i + \beta_2 POST_t + \beta_3 Shadow_{i,t} \\
 & + \beta_4 VA_i * POST_t + \beta_5 VA_i * POST_t * Shadow_{i,t} + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon_{i,t},
 \end{aligned} \tag{8}$$

where all variables are defined as before.

Panel B of Table 7 presents the results of equation (8), and I only report results with both year and firm fixed effects. I am interested in the coefficient of $VA_{i,t} * POST_t * Shadow_{i,t}$, and the sign of the coefficient could be either positive or negative. If insurers reduce risks on the asset side while removing reserves on the liability side using shadow insurance, the sign would be negative. On the other hand, if insurers exploit the additional capital buffer obtained from shadow insurance to hold riskier bonds, it would be positive. Columns (1) and (5) are tests for the entire sample, and the coefficients are negative but statistically insignificant for both *Yield Spread* and *Credit Rating*. Columns (2) – (4) and (6) – (8) are tests for subsamples based on terciles of the

lagged RBC ratio. The tercile 1 sample is the least capitalized group, and the tercile 3 sample is the most capitalized group. The pattern of estimated coefficients is interesting because it is increasing in the lagged RBC ratio. That is, shadow insurance users with low RBC ratios tend to hold relatively low-yield bonds, whereas shadow insurance users with high RBC ratios tend to hold relatively high-yield bonds. This implies only well-capitalized insurers exploit shadow insurance to hold riskier bonds. However, the statistical significance is very weak, so this interpretation is only about the pattern of coefficients and is not statistically valid.

Next, I examine the sum of two coefficients ($VA_i * POST_t + VA_{i,t} * POST_t * Shadow_{i,t}$); that is, I check whether shadow insurance users take riskier investments after the AG 43 adoption. The estimated coefficients are negative for the tercile 1 and 2 samples, but are positive or at least statistically no different from zero for the tercile 3 sample. These findings imply only well-capitalized shadow insurance users hold higher-yield portfolios or at least maintain the same yield portfolios after the AG 43 adoption, which is consistent with hypothesis 3.

6. Conclusion

This study provides evidence on how accounting rules induce the US life insurers to use “shadow insurance” to manage their regulatory capital, and whether they exploit shadow insurance to hold more risky assets. I employ the recent adoption of AG 43 as a shock to the strictness of the reserve requirement under SAP, and conduct a difference-in-differences analysis. I find insurers subject to AG 43 engage more in shadow insurance transactions after the adoption of AG 43, and the impact of AG 43 is significantly stronger for more capital-constrained insurers and weaker for insurers domiciled in states with strong regulatory enforcement. This evidence suggests insurers’ capital adequacy and state regulatory enforcement play important roles in shadow insurance use.

I also find insurers earn more statutory capital via shadow insurance transactions, and this tendency becomes stronger after the adoption of AG 43, especially for annuity transactions, but not for other reinsurance transactions. This finding provides clear evidence that shadow insurance transactions are designed to earn more statutory capital using accounting arbitrage. Finally, I find insurers subject to AG 43 invest in less risky bonds on average, and only well-capitalized insurers exploit shadow insurance to hold riskier bonds. This empirical evidence suggests insurers' intention to use shadow insurance to maximize investment yields depends on their capital adequacy.

My study provides several implications to the discussion on shadow insurance use. First, insurers exploit an arbitrage opportunity when the gap between statutory reserves and GAAP reserves widens, despite the fact that these transactions are subject to regulatory approval. Second, interacting the two different accounting regimes with the capital regulation could lead to an undesirable regulatory outcome, so changing one accounting regime may not be enough to bring an intended regulatory result when two accounting regimes exist. Third, studies have not discussed the potential risk of shadow insurance on the asset side, but my evidence suggests well-capitalized insurers seem to exploit shadow insurance to hold riskier securities.

Finally yet importantly, my study adds new insights to the literature on the real effects of accounting. My evidence suggests the change in accounting measurement can affect firms' capital management behavior and investment decisions when the accounting rule interacts with the capital regulation.

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Appendix A. Example of the Captive Insurance Transaction

Figure A.1 illustrates a simple structure of a captive reinsurance transaction in which a letter of credit is used to collateralize a captive reinsurer's obligations to a ceding insurer.²⁶ Under this transaction, the operating insurer cedes statutory reserves and transfers assets to the captive reinsurer equal to the amount of economic reserves.²⁷ The captive reinsurer is required to hold the assets backing the economic reserves in a trust account at a bank. Additionally, the gap between statutory and economic reserves is required to be collateralized by a letter of credit (Harrington, 2015; Schwarcz, 2015).

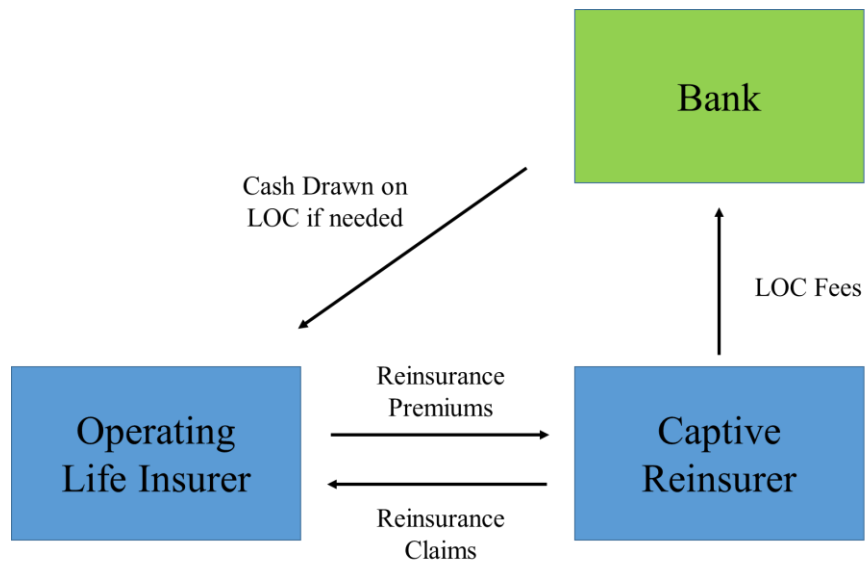


Figure A.1. Example of the captive insurance backed by LOC.

²⁶ The diagram is originally from a slide in Society of Actuaries' conference. See <https://www.soa.org/Files/Pd/2015/valuation-actuary-symposium/2015-boston-val-act-41.pdf>.

²⁷ Economic reserves is calculated based on best estimate assumptions and expected cash flows, and it is close to GAAP reserves.

Next, I illustrate how the operating insurer exploits accounting arbitrage when a shock to the reserve requirement under SAP occurs. This stylized example is modified based on an example in Kojien and Yogo (2016b). Suppose the operating insurer initially has \$10 in bonds and no liabilities, so has statutory capital of \$10. The operating insurer sells an annuity for a \$100 premium, and it records a \$95 statutory reserve. However, that amount would be \$90 under GAAP because GAAP reserves are smaller. The operating insurer gains a \$5 profit by selling this annuity, so its statutory equity becomes \$15 as we can see in Figure A.2.

Operating insurer (under SAP)

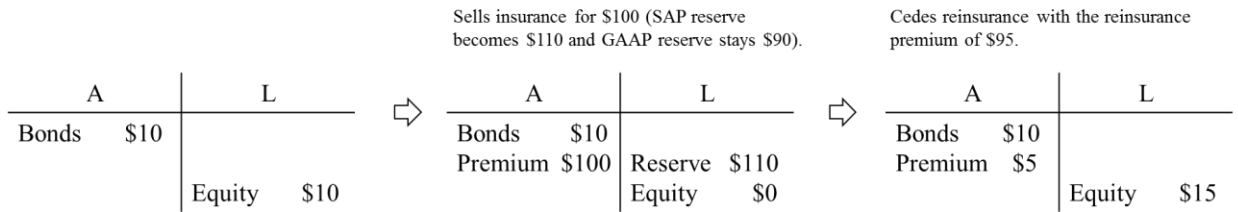
		Sells insurance for \$100 (SAP reserve of \$95 and GAAP reserve of \$90).			
A		L		A	
Bonds	\$10		⇒	Bonds	\$10
		Equity		Premium	\$100
		\$10			
				Reserve	\$95
				Equity	\$15

Figure A.2. Operating insurer’s B/S before the adoption of new statutory reserve rule.

Hereafter, I assume the operating insurer’s target statutory capital is \$15. Now suppose a new accounting rule requires a higher reserve for the same product, so the operating insurer has to record a \$110 statutory reserve instead of \$95. To maintain statutory capital of \$15, the operating insurer cedes all reserves to the captive reinsurer in exchange for the \$95 reinsurance premium, because the reserve would be only \$90 under GAAP. The captive reinsurer is required to hold a trust fund with \$90 in bonds as collateral, and the gap between the SAP and GAPP reserve (or economic reserve) is collateralized by a bank letter of credit (LOC) (Harrington, 2015). Here, a LOC will not be recognized on the balance sheet until the claim is actually made, and for simplicity,

I ignore a LOC fee the captive reinsurer should pay to the bank. As a result of this captive reinsurance transaction, the operating insurer maintains \$15 in statutory capital, and the captive reinsurer has an additional \$5 in cash that could be used for other purposes, such as a commission or a dividend to the holding company (Koijen and Yogo, 2016b).

Operating insurer (under SAP)



Cedes reinsurance with the reinsurance premium of \$95.

Captive reinsurer (under GAAP)



Figure A.3. Operating and captive insurers' B/S after the adoption of new statutory reserve rule.

Appendix B. Proofs of the Solution

Let $\lambda_t \geq 0$ be the Lagrange multiplier for the constraint $F_t \leq P_t$. The Lagrangian for the maximization problem in (13) becomes:

$$\mathcal{L}_t = J_t + \lambda_t(P_t - F_t).$$

The first order condition for the premium (P_t) is:

$$\begin{aligned} \frac{\partial \mathcal{L}_t}{\partial P_t} &= \frac{\partial J_t}{\partial P_t} + \frac{\partial \lambda_t(P_t - F_t)}{\partial P_t} = \frac{\partial(\Pi_t + \hat{\Pi}_t)}{\partial P_t} + \frac{\partial J_t}{\partial K_t} \frac{\partial K_t}{\partial P_t} + \lambda_t \\ &= Q_t + (P_t - V) \frac{\partial Q_t}{\partial P_t} + k_t \left(Q_t + (P_t - (1 + \rho)V) \frac{\partial Q_t}{\partial P_t} \right) + \lambda_t = 0, \end{aligned}$$

where $k_t = \frac{\partial J_t}{\partial K_t}$ is the marginal firm-value of capital.

By rearranging the above first order condition, we have:

$$P_t = \left(1 - \frac{1}{\epsilon_t}\right)^{-1} \left(\frac{1 + k_t(1 + \rho)V - \lambda_t \frac{\partial P_t}{\partial Q_t}}{1 + k_t} \right),$$

where $\epsilon_t = -\frac{P_t}{Q_t} \frac{\partial Q_t}{\partial P_t}$ is the price elasticity of demand.

Next, the first order condition for the amount of captive reinsurance (B_t) is:

$$\begin{aligned} \frac{\partial \mathcal{L}_t}{\partial B_t} &= \frac{\partial J_t}{\partial B_t} = \frac{\partial J_t}{\partial K_t} \frac{\partial K_t}{\partial P_t} + \frac{\partial J_t}{\partial \hat{K}_t} \frac{\partial \hat{K}_t}{\partial P_t} \\ &= -k_t(F_t - (1 + \rho)V) + \hat{k}_t(F_t - (1 + \hat{\rho})V) = 0, \\ &\Leftrightarrow k_t \left(1 + \rho - \frac{F_t}{V}\right) = \hat{k}_t \left(1 + \hat{\rho} - \frac{F_t}{V}\right). \end{aligned}$$

Finally, the first order condition for the reinsurance premium (F_t) is:

$$\begin{aligned}
\frac{\partial \mathcal{L}_t}{\partial F_t} &= \frac{\partial J_t}{\partial F_t} + \frac{\partial \lambda_t (P_t - F_t)}{\partial F_t} = \frac{\partial J_t}{\partial K_t} \frac{\partial K_t}{\partial F_t} + \frac{\partial J_t}{\partial \hat{K}_t} \frac{\partial \hat{K}_t}{\partial F_t} - \lambda_t \\
&= -k_t B_t + \hat{k}_t B_t - \frac{\partial C_t}{\partial F_t} - \lambda_t = 0, \\
&\Leftrightarrow B_t = \frac{f_t + \lambda_t}{\hat{k}_t - k_t},
\end{aligned}$$

where $f_t = \frac{\partial C_t}{\partial F_t} < 0$ is the marginal cost of reinsurance premium.

Appendix C. Description of Variables

Variable	Definition
<i>Firm-Level Variables</i>	
Asset (\$ thousands)	Thousand-dollar amount of the statutory book value of asset.
Log (Assets)	Natural logarithm of asset.
Credit Rating	Value weighted average credit rating of bonds acquired by an insurer during the year, and individual credit ratings are numerically scaled credit agencies' letter ratings from 1 to 24, 1 is the most safe rating and 24 is the most risky rating.
Current liquidity	Net admitted cash and short-term investments as a percent of liabilities excluding separate account business.
Financial Crisis {0,1}	Indicator variable taking one for the recent financial crisis period, i.e., 2007-2009.
Growth (%)	Admitted assets growth rate, as provided in SNL Financial.
High Staff {0,1}	Indicator variable taking one if Staff Ratio is above the median in a given year.
Leverage	Total liabilities to total assets.
Post {0,1}	Indicator taking one after the adoption of AG 43, i.e., on or after 2009.
Profitability	Pretax operating income to total revenue.
Public {0,1}	Indicator variable taking one if an insurer is public (i.e. has a ticker symbol).
RBC Ratio	Authorized control level RBC ratio in the current year.
Lag RBC Ratio	Authorized control level RBC ratio in the previous year.
Lag RBC Ratio Low {0,1}	Indicator variable taking one if Lag RBC Ratio is below the median in a given year.
ROE	Annualized income after taxes as a percent of average capital and surplus, as provided in SNL Financial.
Strong State {0,1}	Indicator variable taking one if an insurer is domiciled in New York state in a given year.
Log(1+Staff Ratio)	Log (1+number of staff in the state insurance department/number of domiciled domestic insurers in the state).
Shadow {0,1}	Indicator variable taking one if an insurer had a shadow reinsurance transaction in the current year.
Shadow amount (\$ thousands)	Reinsurance ceded to affiliated, unauthorized, and unrated reinsurers. It is computed as the sum of reserve credit taken and modified coinsurance reserve for each transaction, then I sum up all reinsurance transactions at the firm-year level.
Log(1+Shadow amount)	Natural logarithm of 1 + Shadow amount.
Shadow Ratio	Ratio of shadow amount to total reinsurance amount.
Total Premiums Written (TPW) (\$ thousands)	Direct premiums written plus premiums assumed.
Log (TPW)	Natural logarithm of TPW.
VA {0,1}	Indicator taking one if an insurer has VAs at the end of year 2008.
VA Position	Total value of variable annuities associated with guaranteed benefits / Total assets for an insurer at the end of year 2008.
Yield Spread	Value weighted average yield spreads of bonds acquired by an insurer during the year, and individual bond spreads are the spread between the yield to maturity and the benchmark Treasury bond yield.

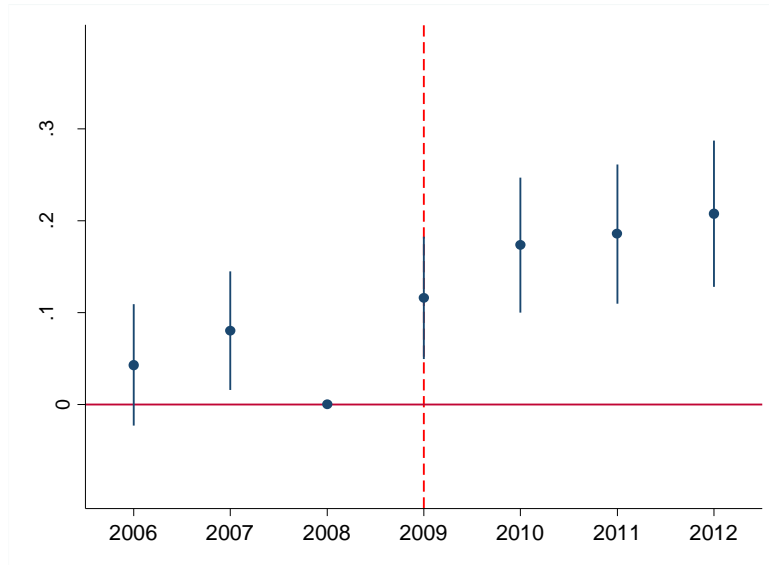
Transaction-level Variables

Ceded difference (\$ thousands)	Reinsurance ceded minus Premium ceded.
Gain Deal {0,1}	Indicator variable taking one if statutory capital gain is positive
Gain/Asset	Amount of statutory capital gain normalized by assets
Premium ceded (\$ thousands)	Premium ceded for each transaction.
Reinsurance ceded (\$ thousands)	Sum of reserve credit taken and modified coinsurance reserve for each transaction.
Shadow_Deal {0,1}	Indicator variable taking one if this reinsurance transaction was ceded to affiliate, unauthorized, and unrated reinsurers.

Figure 1. Pattern of Shadow Insurance Use around the AG 43 Adoption

This figure displays OLS regression coefficient estimates and 95% confidence intervals based on standard errors clustered at the firm level. I use the baseline specification from Equation 1 (i.e., full set of control variables without fixed effects). To map out the pattern in shadow insurance use, I include indicators (year $\{0,1\}$ *VA) for every year period in the sample except 2008, which serves as the benchmark period (i.e., the coefficient is set to zero). The dependent variables are *Shadow* $\{0,1\}$, $\text{Log}(1+\text{Shadow amount})$, and *Shadow Ratio* for Panel A, B, and C, respectively.

Panel A. Shadow $\{0,1\}$



Panel B. $\text{Log}(1+\text{Shadow amount})$

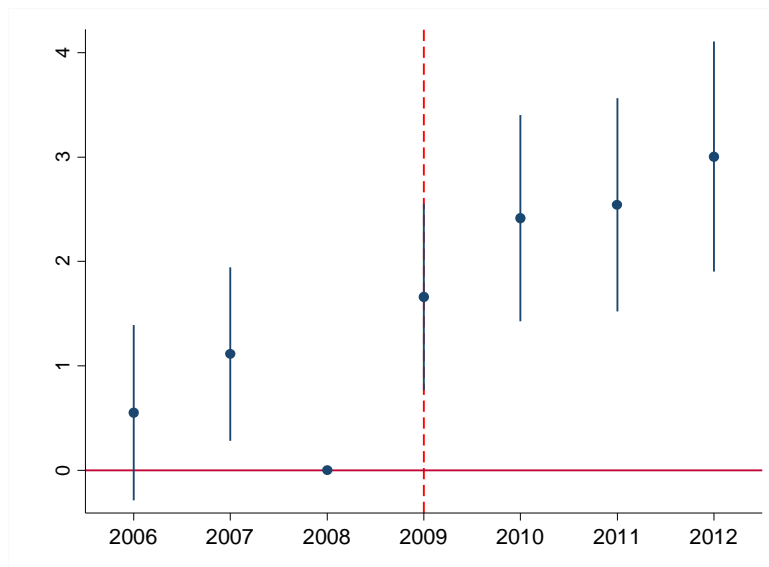


Figure 1. Continued

Panel C. Shadow Ratio

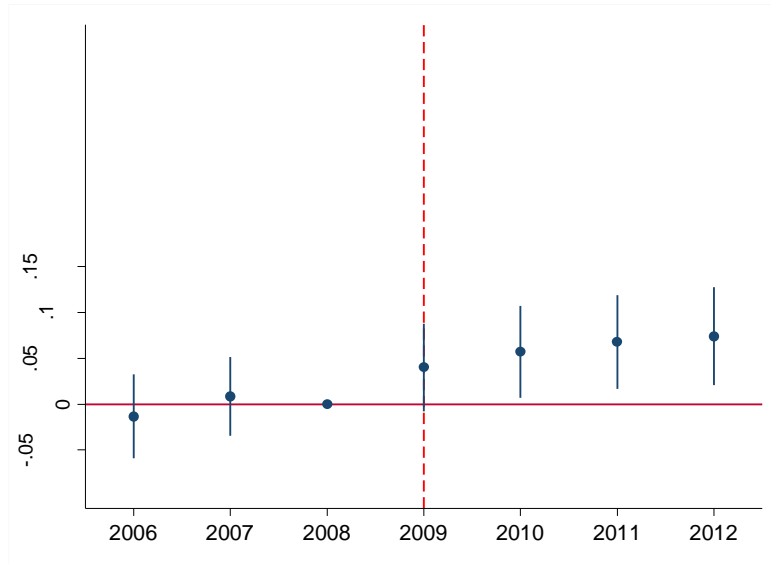


Table 1. Summary Statistics for Firm-Level Data

This table presents descriptive statistics for the firm-level variables. Panel A provides summary statistics for the entire sample, and Panels B and C provide summary statistics for the treatment and the control group, respectively. Panel D provides pairwise Pearson correlations among variables used in my analysis.

Panel A: All Sample

VARIABLES	Mean	Std. dev.	Min.	Median	Max.	N
Asset (\$ thousands)	6,011,750	19,939,889	1,528	183,859	134,500,000	5,397
Total Premiums Written (TPW)	824,962	2,514,573	0	48,675	16,845,714	5,397
Log (Assets)	12.310	2.825	7.331	12.122	18.717	5,397
Log (TPW)	10.613	3.126	1.734	10.971	16.648	5,178
Profitability	0.077	0.399	-2.289	0.064	1.043	5,397
Current liquidity	0.959	3.589	-0.014	0.073	26.569	5,064
ROE	4.313	21.724	-98.895	5.267	66.022	5,363
Leverage	0.655	0.294	0.002	0.780	0.973	5,397
RBC ratio	37.867	99.215	1.916	10.026	656.548	4,988
Growth	0.054	0.222	-0.564	0.028	1.403	5,101
Public {0,1}	0.266	0.442	0.000	0.000	1.000	5,397
Shadow {0,1}	0.087	0.282	0.000	0.000	1.000	5,397
Log(1+Shadow amount)	1.077	3.625	0.000	0.000	16.061	5,397
Shadow Ratio	0.054	0.192	0.000	0.000	0.972	4,011
Yield Spread	1.939	1.246	0.212	1.646	8.294	4,218
Credit Rating	6.192	2.085	1.000	6.508	11.112	4,208
VA	0.192	0.394	0.000	0.000	1.000	5,397
VA Position	0.059	0.195	0.000	0.000	1.153	5,397

Panel B: Insurers with VAs (Treatment)

VARIABLES	Mean	Std. dev.	Min.	Median	Max.	N
Asset (\$ thousands)	25,713,844	37,357,362	2,279	9,103,540	134,500,000	1,036
Total Premiums Written (TPW)	3,037,837	4,409,464	67	975,967	16,845,714	1,036
Log (Assets)	15.792	1.978	7.731	16.024	18.717	1,036
Log (TPW)	13.549	2.215	4.206	13.791	16.648	1,036
Profitability	0.054	0.239	-2.289	0.051	1.043	1,036
Current liquidity	0.158	1.051	-0.014	0.031	26.569	998
ROE	2.985	24.513	-98.895	6.967	66.022	1,036
Leverage	0.888	0.135	0.069	0.924	0.973	1,036
RBC ratio	17.730	45.098	1.916	9.370	595.805	998
Growth	0.063	0.197	-0.564	0.038	1.403	1,005
Public {0,1}	0.443	0.497	0.000	0.000	1.000	1,036

Shadow {0,1}	0.298	0.458	0.000	0.000	1.000	1,036
Log(1+Shadow amount)	3.980	6.264	0.000	0.000	16.061	1,036
Shadow Ratio	0.136	0.282	0.000	0.000	0.972	1,013
Yield Spread	1.939	0.986	0.212	1.763	8.294	991
Credit Rating	7.010	1.390	1.000	7.096	11.112	990
VA Position	0.310	0.348	0.000	0.152	1.153	1,036

Panel C: Insurers without VAs (Control)

VARIABLES	Mean	Std. dev.	Min.	Median	Max.	N
Asset (\$ thousands)	1,331,317	6,829,288	1,528	79,459	134,500,000	4,361
Total Premiums Written (TPW)	299,271	1,330,412	0	24,771	16,845,714	4,361
Log (Assets)	11.483	2.320	7.331	11.283	18.717	4,361
Log (TPW)	9.878	2.880	1.734	10.353	16.648	4,142
Profitability	0.083	0.428	-2.289	0.068	1.043	4,361
Current liquidity	1.156	3.947	-0.014	0.100	26.569	4,066
ROE	4.631	20.992	-98.895	4.895	66.022	4,327
Leverage	0.600	0.295	0.002	0.684	0.973	4,361
RBC ratio	42.904	108.033	1.916	10.305	656.548	3,990
Growth	0.052	0.227	-0.564	0.026	1.403	4,096
Public {0,1}	0.223	0.417	0.000	0.000	1.000	4,361
Shadow {0,1}	0.037	0.189	0.000	0.000	1.000	4,361
Log(1+Shadow amount)	0.388	2.115	0.000	0.000	16.061	4,361
Shadow Ratio	0.026	0.140	0.000	0.000	0.972	2,998
Yield Spread	1.940	1.315	0.212	1.612	8.294	3,227
Credit Rating	5.940	2.196	1.000	6.235	11.112	3,218

Table 1 – continued

Panel D: Pearson Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) VA	1.000														
(2) VA Position	0.625	1.000													
(3) Shadow {0,1}	0.364	0.349	1.000												
(4) Log(1+Shadow amount)	0.390	0.374	0.961	1.000											
(5) Shadow Ratio	0.250	0.259	0.769	0.820	1.000										
(6) Yield Spread	0.000	-0.015	-0.016	-0.010	0.003	1.000									
(7) Credit Rating	0.218	0.129	0.106	0.118	0.099	0.393	1.000								
(8) Log (Assets)	0.601	0.390	0.379	0.403	0.295	0.049	0.368	1.000							
(9) Log (TPW)	0.470	0.312	0.349	0.365	0.270	0.032	0.292	0.846	1.000						
(10) Profitability	-0.029	-0.019	-0.016	-0.024	-0.009	0.039	0.041	0.021	-0.056	1.000					
(11) Current liquidity	-0.111	-0.069	-0.077	-0.075	-0.050	0.005	-0.077	-0.262	-0.329	-0.034	1.000				
(12) ROE	-0.030	-0.048	0.007	-0.010	0.006	-0.066	0.038	0.037	0.055	0.341	-0.026	1.000			
(13) Leverage	0.385	0.263	0.227	0.240	0.174	0.061	0.230	0.647	0.575	-0.089	-0.462	-0.018	1.000		
(14) Growth	0.019	0.016	0.017	0.027	0.020	-0.028	-0.005	0.058	0.078	-0.051	-0.001	0.009	0.081	1.000	
(15) RBC ratio	-0.102	-0.064	-0.089	-0.086	-0.059	-0.041	-0.133	-0.311	-0.395	0.039	0.565	-0.022	-0.487	-0.065	1.000
(16) Public {0,1}	0.196	0.196	0.241	0.245	0.177	-0.048	0.097	0.287	0.279	0.048	-0.013	0.098	0.087	0.025	-0.068

Table 2. Test of H1 - The Impact AG 43 Adoption on Shadow Insurance Use

This table presents evidence that insurers with VAs engage more in shadow insurance after the adoption of AG 43. Panel A reports the estimation of equation (1) using the entire sample. The dependent variables are *Shadow* {0,1}, *Log(1+Shadow amount)*, and *Shadow Ratio*. The independent variable of interest is *VA*POST*. All variables are defined in Appendix C. For Panel A, I only report results with both year and firm fixed effects. Panel B reports the estimation of equation (1) using only the treatment-group sample. For this analysis, I use the relative importance of VAs in insurers' total assets (*VA Position*) instead of the indicator for having VAs (*VA*). All dependent variables are identical to those in Panel A, but I use three different specifications: no fixed effects, year fixed effects only, and both year and firm fixed effects. Numbers in parentheses are standard errors corrected for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: All-sample analysis – Insurers with VAs vs. Insurers without VAs

VARIABLES	(1) Shadow {0,1}	(2) Log(1+Shadow amount)	(3) Shadow Ratio
VA*POST	0.085*** (0.025)	1.305*** (0.313)	0.049*** (0.016)
Log (Assets)	0.002 (0.012)	0.055 (0.145)	0.005 (0.015)
Log (TPW)	-0.001 (0.005)	0.005 (0.051)	-0.001 (0.007)
Profitability	0.011 (0.009)	0.059 (0.100)	-0.003 (0.011)
Current liquidity	-0.000 (0.000)	-0.000 (0.004)	0.000 (0.000)
ROE	-0.000 (0.000)	-0.001 (0.002)	0.000 (0.000)
Leverage	-0.011 (0.030)	-0.059 (0.284)	0.005 (0.030)
Growth	-0.010 (0.012)	-0.139 (0.127)	-0.023* (0.013)
Lag RBC Ratio	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Constant	-0.034 (0.136)	-1.112 (1.809)	-0.056 (0.147)
Observations	4,752	4,752	3,721
Adj. R-squared	0.797	0.823	0.816
Year FE	YES	YES	YES
Firm FE	YES	YES	YES

Table 2 – continued

Panel B: Within-treatment-sample analysis

VARIABLES	(1) Shadow {0,1}	(2) Shadow {0,1}	(3) Shadow {0,1}	(4) Log(1+Shad ow amount)	(5) Log(1+Shad ow amount)	(6) Log(1+Shad ow amount)	(7) Shadow Ratio	(8) Shadow Ratio	(9) Shadow Ratio
VA Position*POST	0.194** (0.083)	0.189** (0.084)	0.137 (0.090)	3.140*** (1.094)	3.098*** (1.105)	2.257* (1.197)	0.114* (0.067)	0.110 (0.068)	0.102* (0.061)
Observations	991	991	991	991	991	991	968	968	968
Adj. R-squared	0.261	0.261	0.799	0.273	0.273	0.814	0.129	0.128	0.799
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
Firm FE	NO	NO	YES	NO	NO	YES	NO	NO	YES

Table 3. Test of H1a – Cross-sectional Test (Capital Adequacy)

This table presents evidence that the impact of AG 43 on shadow insurance use is stronger for more capital-constrained insurers. The estimating equation is (2) with the entire sample. I use three dependent variables: *Shadow* {0,1}, *Log(1+Shadow amount)*, and *Shadow Ratio*. The independent variable of interest is *VA*POST*Lag RBC Ratio Low* {0,1} for the first three columns, and *VA*POST*Lag RBC Ratio* for the last three columns. All control variables are included in the regression but omitted in the table for brevity, and they are defined in Appendix C. I only report results with both year and firm fixed effects. Numbers in parentheses are standard errors corrected for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) Shadow {0,1}	(2) Log(1+Shad ow amount)	(3) Shadow Ratio	(4) Shadow {0,1}	(5) Log(1+Shad ow amount)	(6) Shadow Ratio
VA*POST* Lag RBC Ratio Low {0,1}	0.0804*** (0.0306)	0.9307** (0.4044)	0.0034 (0.0212)			
VA*POST* Lag RBC Ratio				-0.0006* (0.0003)	-0.0075* (0.0038)	-0.0001 (0.0002)
VA*POST	0.0434* (0.0248)	0.8018** (0.3117)	0.0468** (0.0205)	0.0934*** (0.0264)	1.4118*** (0.3327)	0.0503*** (0.0164)
Observations	4,876	4,876	3,764	4,752	4,752	3,721
Adj. R-squared	0.795	0.824	0.816	0.797	0.824	0.816
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES

Table 4. Test of H1b – Cross-sectional Test (Regulatory Enforcement)

This table presents evidence that the impact of AG 43 on shadow insurance use is weaker for insurers domiciled in states with strong regulatory enforcement. The estimating equation is (3) with the entire sample. I use three dependent variables: *Shadow {0,1}*, *Log(1+Shadow amount)*, and *Shadow Ratio*. The independent variable of interest is *VA*POST*Strong State {0,1}* for the first three columns, *VA*POST*High Staff {0,1}* for the next three columns, and *VA*POST*Log(1+Staff Ratio)* for the last three columns. All control variables are included in the regression but omitted in the table for brevity, and they are defined in Appendix C. I only report results with both year and firm fixed effects. Numbers in parentheses are standard errors corrected for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) Shadow {0,1}	(2) Log(1+Shad ow amount)	(3) Shadow Ratio	(4) Shadow {0,1}	(5) Log(1+Shad ow amount)	(6) Shadow Ratio	(7) Shadow {0,1}	(8) Log(1+Shad ow amount)	(9) Shadow Ratio
VA*POST* Strong State {0,1}	-0.086** (0.039)	-1.105** (0.546)	-0.052* (0.031)						
VA*POST*High Staff {0,1}				-0.041 (0.033)	-0.791* (0.444)	-0.055** (0.022)			
VA*POST* Log(1+Staff Ratio)							-0.076 (0.058)	-1.443* (0.828)	-0.081** (0.036)
VA*POST	0.105*** (0.030)	1.561*** (0.377)	0.062*** (0.018)	0.101*** (0.031)	1.590*** (0.375)	0.069*** (0.019)	0.145** (0.059)	2.444*** (0.778)	0.114*** (0.033)
Observations	4,752	4,752	3,721	4,752	4,752	3,721	4,747	4,747	3,721
Adj. R-squared	0.798	0.824	0.816	0.797	0.824	0.817	0.797	0.824	0.817
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 5. Robustness Test of H1 – Performance during the Financial Crisis

This table presents evidence that addresses a concern that shadow insurance use could be driven mainly by life insurers' poor performances during the financial crisis. The dependent variables are *Shadow {0,1}*, *Log(1+Shadow amount)*, and *Shadow Ratio*. The independent variable of interest is *VA*POST*Profitability Low* and it is expected to be statistically insignificant. *Profitability* and *ROE* are excluded from control variables because of the inclusion of *Profitability Low*, but all other variables are same as in the previous tests. I only report results with both year and firm fixed effects. Numbers in parentheses are standard errors corrected for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) Shadow {0,1}	(2) Log(1+Shadow amount)	(3) Shadow Ratio
VA*POST *Profitability Low {0,1}	0.030 (0.044)	0.552 (0.580)	0.009 (0.031)
VA*POST	0.063* (0.034)	0.900** (0.452)	0.043 (0.027)
Observations	4,753	4,753	3,721
Adj. R-squared	0.797	0.824	0.816
Year FE	YES	YES	YES
Firm FE	YES	YES	YES

Table 6. Test of H2 – Shadow Insurance and Statutory Capital Gain

This table presents evidence that insurers earn more statutory capital via shadow insurance transactions, and this tendency becomes stronger after the adoption of AG 43, especially for VA transactions. For both tests, I use the transaction-level data instead of the firm-level data. Panel A reports the estimation of equation (5). The first four columns are tests for the dependent variable *Gain Deal* {0,1} using all transactions, and the last four columns are tests for *Gain/Asset* using only gain transactions. The independent variable of interest is *Shadow_Deal* {0,1}. I use four different specifications: (i) no fixed effects, (ii) year fixed effects only, (iii) year and reinsurance-type fixed effects, and (iv) year, reinsurance type, and firm fixed effects. All control variables are included in the regression but omitted in the table for brevity, and they are defined in Appendix C. Panel B reports the estimation of equation (6) using only gain transactions. The first column compares the treatment and the control group using only annuity transactions, the second column is the within-treatment-group analysis using only annuity transactions, and the last column is a falsification test using other reinsurance transactions. The independent variables of interest are $VA*POST*Shadow_Deal$ {0,1} and the sum of two coefficients ($VA*POST+VA*POST*Shadow_Deal$ {0,1}). For Panel B, I only report the tightest specification with all fixed effects. Numbers in parentheses are standard errors corrected for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The impact of shadow insurance on statutory capital gain

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Sample				Gain Sample			
	Gain Deal {0,1}	Gain Deal {0,1}	Gain Deal {0,1}	Gain Deal {0,1}	Gain/Asset	Gain/Asset	Gain/Asset	Gain/Asset
Shadow_Deal {0,1}	0.190*** (0.023)	0.190*** (0.023)	0.073** (0.035)	0.040 (0.028)	0.019*** (0.007)	0.019*** (0.007)	0.010** (0.004)	0.009** (0.004)
Observations	140,038	140,038	139,530	139,530	88,254	88,254	87,904	87,904
Adj. R-squared	0.009	0.009	0.092	0.170	0.085	0.085	0.167	0.331
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	YES	NO	YES	YES	YES
Type FE	NO	NO	YES	YES	NO	NO	YES	YES
Firm FE	NO	NO	NO	YES	NO	NO	NO	YES

Table 6 – continued

Panel B: The impact of the AG 43 adoption on statutory capital gain for shadow insurance deals

VARIABLES	(1)	(2)	(3)
	Annuity Sample	Annuity Sample	Other Sample
	Cross Group	Within Treatment	(Falsification)
	Gain/Asset	Gain/Asset	Gain/Asset
VA*POST*Shadow_Deal {0,1}	0.019*		-0.006
	(0.010)		(0.004)
VA*POST	0.005		-0.001*
	(0.003)		(0.000)
VA Position*POST*Shadow_Deal {0,1}		0.037**	
		(0.017)	
VA Position*POST		0.002	
		(0.006)	
VA*POST+			
VA*POST*Shadow Deal {0,1}	0.023**		-0.006
F-Statistic	4.85		2.21
VA Position*POST+		0.039***	
VA Position*POST*Shadow_Deal {0,1}			
F-Statistic		8.79	
Observations	3,289	2,001	84,615
R-squared	0.504	0.410	0.319
Controls	YES	YES	YES
Year FE	YES	YES	YES
Type FE	YES	YES	YES
Firm FE	YES	YES	YES

Table 7. Test of H3 – Shadow Insurance and Yield Spread

This table presents evidence that insurers subject to AG 43 would make less risky investments; however, they could exploit the shadow insurance to hold riskier and higher-yield portfolios. Panel A reports the estimation of equation (7) using the entire sample at the firm level. The first three columns are tests for the dependent variable *Yield Spread*, and the last three columns are tests for the dependent variable *Credit Rating*. The independent variable of interest is $VA*POST$. I use three different specifications: no fixed effects, year fixed effects only, and both year and firm fixed effects. All control variables are included in the regression but omitted in the table for brevity, and they are defined in Appendix C. Panel B reports the estimation of equation (8) for the entire sample at the firm level. The first four columns are tests for the dependent variable *Yield Spread*, and the last four columns are tests for the dependent variable *Credit Rating*. I only report results with both year and fixed effects. Columns (1) and (5) are tests for the entire sample, whereas Column (2) – (4) and (6) – (8) are tests for subsamples based on terciles of the lagged RBC ratio. The tercile 1 sample is the least capitalized group, and the tercile 3 sample is the most capitalized group. The independent variable of interest is $VA*POST*Shadow \{0,1\}$ and the sum of two coefficients ($VA*POST + VA*POST*Shadow \{0,1\}$). All control variables are included in the regression but omitted in the table for brevity, and they are defined in Appendix C. Numbers in parentheses are standard errors corrected for heteroscedasticity and clustered at the firm level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The impact of AG 43 on the yield spread and credit rating

VARIABLES	(1) Yield Spread	(2) Yield Spread	(3) Yield Spread	(4) Credit Rating	(5) Credit Rating	(6) Credit Rating
VA*POST	-0.109 (0.075)	-0.155** (0.075)	-0.143* (0.079)	-0.756*** (0.127)	-0.761*** (0.128)	-0.780*** (0.137)
Observations	3,888	3,888	3,888	3,879	3,879	3,879
Adj. R-squared	0.094	0.180	0.509	0.181	0.199	0.592
Controls	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES
Firm FE	NO	NO	YES	NO	NO	YES

Table 7 – continued

Panel B: The impact of the interaction between AG 43 adoption and shadow insurance on the yield spread and credit rating

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Sample	Lag RBC Ratio Tercile=1	Lag RBC Ratio Tercile=2	Lag RBC Ratio Tercile=3	All Sample	Lag RBC Ratio Tercile=1	Lag RBC Ratio Tercile=2	Lag RBC Ratio Tercile=3
VARIABLES	Yield Spread	Yield Spread	Yield Spread	Yield Spread	Credit Rating	Credit Rating	Credit Rating	Credit Rating
VA*POST*Shadow {0,1}	-0.094 (0.121)	-0.409* (0.214)	-0.072 (0.186)	0.415 (0.256)	-0.337 (0.208)	-0.402 (0.282)	-0.459 (0.332)	0.434 (0.475)
VA*POST	-0.101 (0.082)	0.016 (0.160)	-0.360** (0.141)	0.054 (0.187)	-0.668*** (0.158)	-0.733*** (0.256)	-0.973*** (0.247)	-0.175 (0.326)
VA*POST+ VA*POST*Shadow {0,1}	-0.194*	-0.393**	-0.432**	0.469*	-1.006***	-1.134***	-1.432***	0.26
F-Statistic	2.72	4.07	5.62	3.71	26.8	18.80	16.36	0.30
Observations	3,888	1,423	1,458	1,007	3,879	1,418	1,456	1,005
Adj. R-squared	0.509	0.535	0.479	0.561	0.592	0.621	0.599	0.607
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES