Ex-Post Loss Sharing in Consumer Financial Markets *

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Abstract

Insurance companies sell consumer financial products called variable annuities that combine mutual funds with minimum return guarantees over long horizons, retaining considerable market risk. I show that the guarantees embedded in variable annuities turned deeply in the money after the financial crisis. However, over the last decade, insurers removed more than $429 billion in variable annuities by having consumers exchange them into less generous products. The more generous policies were exchanged the most. I develop a structural model of consumer exploitation in insurance markets that pins down the degree of consumer inattention and the reputational costs faced by firms. I find that 20% of consumers neglect important contract characteristics, insurers pay 13 cents in reputational costs per dollar exploited, while moving to a fiduciary standard raises reputational costs by a further 8 cents per dollar and reduces exchanges by half.

JEL Codes: G22, G24, G28, G52, G53, D14, D18

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I. Introduction

With the secular decline in Social Security and defined benefit pension plans around the world, life insurance companies have increasingly become the main alternative provider of market risk insurance for households' retirement savings. In the United States, life insurance companies sell consumer financial products called variable annuities which combine mutual funds with minimum return guarantees over long horizons and an option to annuitize assets into retirement. Over the past few decades, variable annuities have been extremely popular, becoming the largest single item on the US life insurers balance sheets, with over $1.58 trillion in assets in 2018.

The minimum return guarantees in variable annuities are hard to hedge as available traded options have shorter maturities, so insurance companies retain large residual exposures to market risk. The risks embedded in these guarantees materialized during the Great Financial Crisis, when some of the largest variable annuity writers applied for government financial support. While insurers have responded by raising prices and cutting benefits on new sales (Koijen and Yogo (2020)) and moving part of their liabilities off-balance sheet through reinsurance (Koijen and Yogo (2016)), a large fraction of the generous variable annuities sold before the financial crisis are still in force.

In this paper, I show that the guarantees embedded in variable annuities were deeply in-the-money for most of the post-crisis period. By 2011, a policyholder who bought a variable annuity in 2007 could expect at least 130 cents in present value benefits for every dollar invested with the insurance company. This amounts to $26,000 in excess annuity benefits for the average contract. Second, over the last decade, insurance companies have removed more than $429 billion in legacy variable annuities by having policyholders give up their existing policies for newer, less generous policies via what is called a "1035 exchange". In fact, 40% of all variable annuity sales over the last decade originated from 1035 exchanges. Third, it is precisely the more generous variable annuity policies that got exchanged the most.

My results suggest that a large number of policyholders appear to be willing to forgo potentially tens of thousands of dollars in variable annuity benefits to exchange their existing policies. I consider, and eventually rule out several demand-side explanations. I show that exchanges do not typically provide tax, liquidity or collateral benefits, and in any case not large enough to compensate for the lost annuity benefits. Policyholders do not appear to exchange out of default concerns, due to life events such as divorce or death of a spouse, lower life expectancy or because they do not value annuities in general. If anything, the average exchange buyer is younger, poorer and generally less financially sophisticated than the average variable annuity owner, belongs to a highly rated

insurance company, trades his annuity for another annuity from the same company, and elects the same type of life annuity benefits in the new contract. I argue that the observed exchange pattern is plausibly not reflective of rational consumer behavior, and in fact show that it is consistent with supply-side consumer exploitation.

Insurers have strong incentives to exchange generous policies. When variable annuities are in the money, the expected payouts to policyholders exceed what insurers receive back in fees. Servicing generous variable annuity policies are negative NPV opportunities for insurers, which would prefer to have them exchanged rather than honoured (economic profits motive). Moreover, the changes in variable annuity valuations since the financial crisis has exposed variable annuities as the main source of volatility in insurance companies reserves. Variable annuity reserves have increased five-fold in 2008 and remained at elevated levels ever since (Drexler et al. (2017)). In theory, insurers could hedge uncertainty in the valuation of reserves through offsetting derivative positions. In practice, insurers do not fully hedge variable annuity risk for various economic and institutional reasons. First, insurers may not be able to hedge because minimum return guarantees have longer maturity than traded options. Insurers could roll over shorter maturity options but that exposes them to model risk. Funds are actively managed, and many external managers deviated considerably from their hedging benchmarks prior to the financial crisis, amplifying basis risk (Sun (2009)). Second, insurers may not want to hedge because insurance regulation does not reward hedging of market equity (Sen (2019)). A hedging program that smooths market equity could actually increase the volatility of statutory equity. As hedging is problematic, insurers may want to derisk their portfolios altogether (hedging motive).

I then inspect the mechanism through which variable annuities get exchanged. Around 98% of variable annuity exchanges go through brokers. Exchange customers have long established relationships with their brokers, and rank their broker's advice as the primary reason behind their exchange, so clearly brokers play an important role in these transactions. Brokers have an incentive to exchange, as insurance companies compensate them more for selling than servicing. What is less clear is how insurers incentivize brokers to exchange predominantly their most generous policies.

To answer this question, I scrape over 20 years of insurance companies variable annuity filings with the SEC to extract data on brokerage compensation. I uncover a large discretionary component in total compensation paid to brokers and show that it correlates with variable annuity exchanges both in the time series and the cross-section. Second, I show that insurance companies have tilted the brokerage commission structure to lower incentives to service existing policies and

that has incentivized exchanges. Third, I match the identity of brokerage houses receiving discretionary compensation with their disciplinary histories from the Financial Industry Regulatory Authority. Insurers are more likely to pay brokerage houses with a higher incidence of (alleged) misconduct, that employ brokers who themselves have a longer history of regulatory actions. I then parse through brokers variable annuity misconduct records to understand what are the typical sales tactics that brokers use to mislead consumers. I find that brokers make frequent omissions and misrepresentations that understate the value of their customers' existing policies. The characteristics most commonly omitted are precisely the ones that consumers neglect based on their demand coefficients, and the losses associated with these omissions (up to $40,000 for the average customer) are quantitatively large enough to rationalize the present value losses in the data.

I then turn to the potential costs of consumer exploitation. In the time series, insurers do not exchange all policies at once, but do it gradually over a decade, even though the policies have not become more valuable or policyholders have arguably not become more naive over time. In the cross-section, insurers exchange only the most generous policies, but leave slightly less generous, but still deeply in the money policies, relatively untouched. This suggests an important role for exploitation or reputational costs. I provide some evidence that exchanges respond to reputational costs. First, I exploit the adoption of stricter selling standards in NY State but not the rest of the US in 2019 as a quasi-natural experiment to show that raising brokers to a fiduciary standard reduces 1035 exchanges by half. The effect is strongest (-65%) for the most generous and hence questionable exchanges. I estimate that adopting the NY fiduciary duty rule in the second half of 2019 prevented an estimated $3.09 billion in variable annuity exchanges statewide. Second, I find that insurance companies that no longer sell variable annuities, that do not operate other lines of insurance business and subsidiaries of private equity firms (all proxies for low reputational costs) exchange more.

To rationalize my findings, I develop a structural model of consumer exploitation in insurance markets. A subset of policyholders neglect important contract characteristics which raises the potential for exploitation. Insurers exploit inattentive customers to maximize economic profits and relax financial constraints but face potentially important reputational costs. I show how I can use the model to jointly pin down the share of inattentive customers and the reputational costs faced by firms. I estimate the model on contract-level data on variable annuity exchanges. First, I find that 20% of policyholders neglect important contract characteristics. Second, insurers extract around $1.62 billion in present value from inattentive households through 1035 exchanges in 2018

alone. Third, consumer exploitation is costly. Insurers face 13.3 cents in reputational costs for every dollar in account value exploited. Fourth, financially constrained companies exploit more. Fifth, I compute the change in marginal cost implied by the drop in replacement intensities resulting from the imposition of the New York Fiduciary Duty. I find that marginal reputation costs have increased by about 8 cents per dollar on average. That is, the cost of exploiting a $100,000 policy has risen on average by $8,000 as a result of fiduciary duty.

I leverage the estimated model to construct counterfactuals. First, I show that imposing a nationwide fiduciary standard in 2018 (as proposed by the US Department of Labor) would have prevented $1.27 billion in exploited annuity benefits by increasing exploitation costs. Second, I estimate that a 1 percentage point decline in interest rates would increase consumer exploitation by 140%. Conversely, shutting down consumer exploitation would erase $30 billion in insurer surplus, lower ratings by 1 notch and add $11.4 billion in expected losses to policyholders over the next 15 years. Finally, I use the model to explain why insurance companies did not exploit naive policyholders when first selling the policies before the financial crisis, and provide evidence confirming that insurers have only started to screen naive consumers after the crisis.

My results cast doubt on consumers' ability to value variable annuity benefits and raise questions about the quality of advice in this key retirement savings market. They point to the limits of private sector provided aggregate risk insurance and highlight the consequences of financial institutions risk management for consumer protection.

Related Literature

My paper lies at the intersection of financial intermediation and household finance. Some of the most common consumer financial products offer protection against aggregate risk over the long run (e.g. fixed rate mortgages against interest rate risk, variable annuities against market and longevity risk, long term care insurance against longevity and health expenditure risk). The size of these markets illustrates the importance of aggregate risk insurance for household welfare (Allen and Gale (1994), Calvet et al. (2020), Hombert and Lyonnet (2020)). Intermediaries writing these products can share aggregate risks in the financial markets through hedging, reinsurance or securitisation. Collateral constraints (Rampini and Viswanathan (2010)), regulatory frictions (Sen (2019)) or incomplete markets (Koijen and Yogo (2020)) impede hedging, with many financial intermediaries retaining considerable aggregate risk on their balance sheets. I document a new link between the risk management of financial intermediaries and consumer protection. Failure to share risks in the

financial markets ex-ante may lead to loss sharing in the product markets ex-post through consumer exploitation.

This paper adds to a literature on the value of salesforce to financial intermediaries. Egan et al. (2019), Hastings et al. (2017) show that salesforce create value by lowering the price sensitivity of demand and increasing markups on new contracts. In the mortgage market, Robles-Garcia (2019) shows that brokers can create value by lowering distribution costs. However, in many consumer financial markets (e.g. pensions, annuities, life and health insurance, mortgages), a substantial share of brokerage compensation goes towards servicing existing contracts. I explain this fact by proposing a novel value channel: financial intermediaries invest in brokers to form relationships with customers so they could retain these customers for as long as they are profitable, but get them out of their products when they become unprofitable. Brokers are valuable because they provide risk management services via consumer exploitation.

My paper also speaks to the value of salesforce to consumers and consumer protection regulation. The fact that consumer financial markets are highly intermediated (Egan et al. (2019)) suggests there is an economic friction that intermediation is trying to alleviate. The nature of that friction is critical for brokerage regulation. If the friction is search costs, then brokers are merely providing information to otherwise rational consumers and should not be held to any standard of care. This has been one the main industry arguments against regulation for decades (Bhattacharya et al. (2019)). If the friction is bounded rationality, then brokers are providing advice and should be held up to a fiduciary standard (Campbell et al. (2011), Campbell (2016), Carlin and Gervais (2012), Inderst and Ottaviani (2012)). The literature has had some difficulties in separating the two frictions (Hortaçsu and Syverson (2004), Pozzi et al. (2020)). I provide a setting where search frictions are minimal: the consumer is given a choice between what he currently owns and an alternative product recommended by the broker, and chooses suboptimally, providing a more direct test of conflicted advice.

The fact that questionable exchanges concentrate in consumers that are poorer and more risk averse also indicates a potentially important distributional aspect. Poorer customers lose and may even cross-subsidise richer customers if competition forces insurance companies to return profits from exploitation as subsidies in the primary market (Gabaix and Laibson (2006)).

My paper contributes to the ongoing debate on regulating advice in the variable annuity market. The Great Financial Crisis has triggered a surge of interest in regulating consumer financial products, including retirement savings products, in the United States. The 2015 revisions to the Employee

Retirement Income Security Act (ERISA) increased the fiduciary responsibilities of retirement fund brokers. However, variable annuity salesforce are not classified as fiduciaries, despite repeated attempts by the U.S. Congress (through Dodd-Frank), the U.S. Department of Labor (DOL), the SEC and various state legislatures. Opponents argue that conflicts of interest are minimal. I provide evidence of large costs of conflicted advice in the variable annuity exchange market and show that a fiduciary rule can alleviate these costs, adding to an emerging literature (Bhattacharya et al. (2019), Egan et al. (2020)) that has only looked at variable annuity sales.

Also, much of the regulatory discussion on intermediary standards of care in the variable annuity market focuses on the idea that switching occurs early in the life of the policy (NY Department of Financial Services, 2019). There, consumers lose 3-7% of the funds as surrender penalties, brokers earn on average 6% as sales commissions, while the benefit to the insurer is unclear. Instead, I show that most of the exchanges concentrate in older deep-in-the-money policies where losses to the consumer are much greater (up to 30% of the funds) and both the broker and the insurer benefit.

Finally, my findings could extend to any consumer financial market where financial intermediaries bear significant aggregate risk over long horizons, consumers neglect valuable product characteristics and there are gaps in consumer protections. I show that the same exchange pattern is present in the UK defined benefit pensions market, and discuss similarities with the US long-term care insurance market.

Institutional Background

Variable annuities are retirement and savings products which offer minimum return guarantees. At purchase, the policyholder allocates her savings into tax-advantaged mutual funds. For an additional fee, the insurance company guarantees a minimum rate of return regardless of the performance of the underlying funds.

There are four broad types of guarantees, depending on how the guaranteed returns are being paid out to policyholders. In a guaranteed minimum *accumulation* benefit (GMAB), the policyholder receives the greater of the rate of return on the mutual fund (the account value) or a guaranteed rate of return (5% p.a.) at some pre-specified maturity date. In a guaranteed minimum *death* benefit (GMDB), the policyholder gets the greater of the account value and a guaranteed amount, conditional on death during the coverage period. In a guaranteed minimum *income* benefit (GMIB), the policyholder can convert the accumulated benefit into a life-time annuity, where the annuity rate is either a preset rate or the current market annuity rate. Finally, in a guaranteed

withdrawal benefit, the policyholder can withdraw a fixed percentage of the accumulated benefit for life (GLWB) or for a preset period (GMWB).

Variable annuities are typically sold to households through brokers. The broker may be an employee of the insurer issuing the variable annuity, or work for an unaffiliated bank or broker-dealer. Insurers compensate brokers for selling and servicing variable annuities with kickbacks and commissions. These payments are made directly by the variable annuity issuer to the broker, rather than being paid by the end investor. This means that conditional on the characteristics of the variable annuity, consumers should be indifferent about brokerage compensation. This compensation only reflects the way surplus is being split between the insurer and the broker.

Variable annuities are securities under the federal law and are therefore regulated by the SEC. When issuing a new variable annuity, an insurance company must file a registration statement with the SEC containing a prospectus and a statement of additional information. The prospectus contains descriptive information on the insurer underwriting the annuity, the investment options (mutual funds) available to policyholders, contract fees and characteristics, benefit fees and characteristics, and distribution (including brokerage compensation). Prospectuses filed at registration are then updated through 485BPOS post-effective amendment filings, commonly at annual intervals.

Consumers can replace one variable annuity for another in a variable annuity exchange. Essentially all variable annuity exchanges are 1035 exchanges. Named after Article 1035 in the US Tax Code, a 1035 exchange allows a policyholder to transfer funds from an existing variable annuity to another variable annuity issued by the same of a different insurance company on a tax-free basis. Importantly, only the account value (the value of mutual funds) carries over in an exchange. Any favourable terms or benefits accumulated under the old contract are being lost.

Both insurers and brokers can originate exchanges. Most wholesale exchange offers (made by an insurer to all or a subset of its policyholders) must be filed with and approved by the SEC. Retail exchange offers (made by an affiliated or unaffiliated broker to an individual) are exempted. This is why most exchanges in the data are originated by brokers. Starting with 2018, insurance companies must report data on total (retail and wholesale) variable annuity exchanges in their annual SEC N-CEN filings.

Any broker selling or exchanging variable annuities must hold both an insurance license issued by the state insurance commissioner and a securities license issued by the SEC. Brokers are therefore regulated both at the state level and the federal level. When intermediating a variable annuity, brokers are held to a suitability standard, which means they are prohibited from making recommen-

dations for unsuitable variable annuity products. This is weaker than the fiduciary duty imposed on stockbrokers and financial advisers, which requires them to make recommendations in the best interest of their clients, and in practice, many questionable exchanges might not fail the suitability standard.

II. Data

I extract data from multiple sources to build a comprehensive database of the US variable annuity market. What is unique to my setting are the data on variable annuity exchanges and variable annuity brokerage compensation.

A. Sales and Characteristics

Morningstar Annuity Intelligence provides quarterly variable annuity assets and sales at the contract level since 1999. Sales are broken down by distribution channel (bank, broker dealer, captive agent or direct sale), clientele (retail vs employer-sponsored) and the tax treatment of contributions (qualified vs non-qualified). Morningstar also provides a textual summary of the prospectus for each contract, from which I extract a history of contract fees and characteristics. The key contract characteristics are the base contract expense, the surrender charges and schedules, the number of investment options, and the types of guaranteed living and death benefits that are offered. For each guaranteed benefit, the key characteristics are the type (i.e., GLWB, GMWB, GMIB, GMAB or GMDB), the fee, the rollup rate (the guaranteed rate of return during the accumulation period), and the withdrawal rate where applicable. Morningstar provides the open and close dates for each contract and guaranteed benefit, from which I construct a history of contract and benefit availability.

B. Exchanges

Second, I extract contract-level data on variable annuity 1035 exchanges from insurance companies SEC filings. Starting with 2018, all insurance companies selling variable annuities must fill form N-CEN with the SEC. The filing is done annually and is at the level of insurance company separate account. Each separate account has one or several variable annuity contracts, and each contract is identified by a unique contract identification number. For every contract, I have the name, number of policies and amount of assets in force, the number of policies sold and the amount of premium received through 1035 exchanges, the number of policies redeemed and the amount of assets redeemed through 1035 exchanges, and whether the exchange is broker or insurer initiated.

C. *Brokerage Compensation*

Third, I scrape all variable annuity filings filed with the SEC since electronic filing started in 1995 and extract data on brokerage commissions and total brokerage compensation from the variable annuity prospectuses and statements of additional information contained therein. Information on brokerage compensation appears as an item in the prospectus and another item in the statement of additional information and is reported both in the initial registration forms (forms N-3 or N-4) which are filed whenever a contract is being issued for the very first time, amendments to these initial registration forms (forms N-3A N-4A) which correct mistakes or omissions in the initial registration filings, as well as 485POS (A/B) post-effective amendments which are normally filed every year or as soon as there are material changes to the information provided in previous filings. Aside from commissions, the total compensation includes performance-based bonuses, gifts, loans forgiven, cash for trainings, trips and entertainment. The data is further described in the section on the role of brokers.

D. *Brokers Disciplinary Records*

Fourth, I match the brokerage houses receiving addtional variable annuity compensation with their disciplinary records from the Financial Industry Regulatory Authority (FINRA) BrokerCheck database. For each brokerage house, I have a full history of disciplinary records, as well as the identity of all brokers ever affiliated with the firm, their full employment histories and their career-long disciplinary records. For each disclosure, I observe the date, the status (final, pending, on appeal), the product involved, the allegations made, the court, regulator or arbitrator ruling over the case, the sanction, and any fines, penalties or awards granted. For disclosures made by individual brokers, I also observe the firm they were affiliated with when events leading to the allegations ocurred (for a detailed description of the BrokerCheck database, see Egan et al. (2019)).

E. *Demographics*

Fifth, I collect aggregate demographics on variable annuity sales, broken down into new and replacement buyers, from LIMRA Secure Retirement Institute. Specifically, I observe the distribution of buyers' age, household financial assets, household debt, household income, risk appetite as well as their gender, marital status, work status, reason for purchase, and length of advisor relationship. I then merge it with demographics on variable annuity ownership from the Survey of Consumer Finances. I observe the distribution of owners' age, education, income, wealth and risk tolerance.

F. *Benefit Utilization*

Sixth, I collect quarterly data on aggregate variable annuity benefit election rates, surrender rates and the distribution of acumulated benefits and contract values by benefit × issue quarter from the annual LIMRA Secure Retirement Institute and the US Society of Actuaries joint Variable Annuity Benefit Utilisation Studies (LIMRA and SOA (2011-2017)). This allows me to track, for each benefit × issue quarter, the evolution of account values and accumulated benefits over time.

G. *Statutory Reserves*

Finally, I collect data on variable annuity statutory reserves from the annual financial statements filed by US life insurance companies with the National Association of Insurance Commissioners (NAIC). The Variable Annuity Supplement (starting with 2017) and General Interrogatories Part 2, Table 9.2 (prior to 2017) of the NAIC annual statements report the account value and the reserve value of variable annuities. The account value is the market value of the mutual funds, while the reserve value is the statutory value of the guarantees, gross of reinsurance but net of hedging. For each insurer, I compute the variable annuity reserve valuation ratio as the ratio of total reserves to total account value.

H. *Merging*

I merge the Morningstar data with the SEC data by contract name and with the NAIC data by company name. The FINRA data is merged by brokerage house name. The aggregate data is merged at the year or quarter level.

I. *Summaries*

At the end of 2018, there were $1.58 in variable annuity assets held in separate accounts (mutual funds) across 18 million individual policies, with the average policy holding $86,000. About 160,000 people exchanged their variable annuities for a total of $23 billion. The average amount exchanged was $145,000. 41% of exchanges originate in contracts where insurers make direct mail offers to existing customers (on which the brokers may follow-up), while the remainder 59% go exclusively through brokers (Table I). In terms of demographics, the average replacement buyer is poorer (lower household income and wealth), more risk averse, and has a longer, more established advisor relationship than the average new buyer, and is younger than the average variable annuity owner (Table II). The great majority of 1035 exchanges (75%) come from contracts which have guaranteed

lifetime withdrawal benefits (GLWB) and go into contracts that have the same type of benefits (69%). Most exchanged contracts were issued before the financial crisis (70%), when withdrawal benefits were both substantially cheaper (0.6% vs 1.0% annual fee) and substantially more generous (5% vs 4% annual withdrawal rate) than those available at the time of exchange (Figure D2). Insurers seem more effective than brokers at targeting their customers, given that policies are larger ($210k vs $108k) and more likely to have guaranteed lifetime withdrawal benefits (91% vs 70%) when an insurer initiates the exchange. Given the prevalence of GLWBs in variable annuity exchanges (as well as assets and sales), the remainder of the paper will (largely) focus on GLWB contracts.

III. Variable Annuity Valuation

In this section, I provide a lower bound on the value of the most common variable annuity contract in the US market - a variable annuity with a guaranteed lifetime withdrawal benefit. I show how this valuation can be used to pin down a lower bound on the value of exchanges, and finally take it to the data.

A. A Stylised GLWB Variable Annuity

Suppose that at some time 0, a policyholder invests an amount S_0 in a variable annuity with a guaranteed lifetime withdrawal benefit. The insurance company would set up an account with an account value S_0 and would invest it in mutual funds. At the same time, the insurance company would record a shadow account X_0 called the benefit base. At the time of issuance, $S_0 = X_0$. Over time, the account value S_t grows at the rate of return on the mutual fund, net of withdrawals and fees. By contrast, the benefit base grows at a predefined rollup rate $g \geq 0$. The policyholder may redeem S_t, but not X_t. X_t may only be annuitized at some predefined annuity rate w. Suppose that at any time τ, the policyholder decides to exercise her option to annuitize X_τ. This converts X_τ into a stream of fixed annual withdrawals wX_τ for life. When the policyholder dies, any residual account value is paid out as a death benefit.

B. An Immediately Exercisable GLWB

Consider a variable annuity with a guaranteed lifetime withdrawal benefit (GLWB) immediately exercisable at age n (I relax this assumption in Appendix A2). Let S_t be the account value at time t, X_t the benefit base at time t, π_n the one-year survival probability at age n, and w the annual withdrawal rate under the contract. Also let $M_{t,t+s}$ denote a strictly positive stochastic discount

factor discounting payoffs from $t+s$ to t and $Y_{t,t+s}$ the term structure of gross (risk-free) interest rates of maturity s at time t such that $Y^s_{t,t+s} = \mathbb{E}_t\left[M_{t,t+s}\right]^{-1}$. The value of the variable annuity with a guaranteed lifetime withdrawal benefit immediately exercisable for an individual of age n (per unit of account value) can be decomposed into three terms:

$$V_{GLWB_t(n)} = V_{LB_t(n)} + V_{DB_t(n)} + V_{W_t(n)} \tag{1}$$

where $V_{LB_t(n)}$ stands for the value of living benefits under the contract, $V_{DB_t(n)}$ is the residual death benefit and $V_{W_t(n)}$ is the value of waiting. The value of living benefits can be written as:

$$V_{LB_t(n)} \geq \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} w_{et}}{Y^s_{t,t+s}} \tag{2}$$

where w_{e_t} is the effective annual withdrawal rate per dollar of account value as of time t, defined as the contractual withdrawal rate w adjusted for the ratio of the benefit base to the account value:

$$w_{e_t} = w \times {}^{X_t}/_{S_t} \tag{3}$$

Equation (2) says that the value of the living benefits in a variable annuity with GLWB is at least as great as the value of a life annuity with the annuity rate equal to the effective withdrawal rate. The inequality accounts for the fact that withdrawals under the living benefit can accelerate in certain circumstances (e.g. you can withdraw at a higher rate if you go into a nursing home) or can step up rather than stay constant, leading to a present value that is greater than that of a life annuity with an identical annuitization rate. The value of the residual death benefit can be written as:

$$V_{DB_t(n)} \geq \sum_{s=1}^{\infty} \prod_{l=0}^{s-2} \pi_{n+l}(1 - \pi_{n+s-1}) \times \mathbb{E}_t\left[M_{t,t+s} \max\{0, {}^{S_{t+s}}/_{S_t}\}\right] \geq 0 \tag{4}$$

where S_{t+s} is the residual account value after withdrawals and fees, as of time $t+s$. So the residual death benefit is just the present value sum of a stream of options paying the residual account value (if any) conditional on death, and is essentially a death contigent contract with an uncertain payoff. The first inequality accounts for the fact that the insurance company may additionally guarantee a minimum death benefit that may be higher than the residual account value. Last, the value of

waiting can be written as:

$$V_{W_t(n)} = \max\{0, \mathbb{E}_t \left[M_{t,t+s} V_{GLWB_{t+s}(n+s)}\right] - V_{GLWB_t(n)}\} \geq 0 \quad \forall s > 0 \tag{5}$$

which is the option to exercise the GLWB benefit at a later date provided it is value-maximizing. From equations (1)(5), it results that the value of a variable annuity immediately exercisable at age n is greater than the value of a life annuity with an annuity rate equal to the effective withdrawal rate under the policy. In other words, the value of a life annuity age n with an annuity rate equal to w_{e_t} provides a lower bound on the value of the GLWB variable annuity.

$$V_{GLWB_t(n)} \geq \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} w_{e_t}}{Y^s_{t,t+s}} \tag{6}$$

C. Value Extracted through Exchanges

Assume that the policyholder decides to exchange her existing variable annuity for a new variable annuity contract (offered by the same or a different insurance company). Further assume, as in practice, that such an exchange is tax-free. In a variable annuity exchange, the policyholder transfers the account value from one variable annuity to another. In doing so, it renounces any accumulated benefits (X^{old}_t) or terms under the old contract (w^{old}, g^{old}) and buys the right to new benefits at prevailing prices. The benefit base X_t resets to S_t. The value that an insurance company extracts from a variable annuity exchange per unit of account value is simply the value of the old contract minus the value of the new contract:

$$(V^{old}_{GLWB_t(n)} - V^{new}_{GLWB_t(n)}) \tag{7}$$

which can be decomposed into:

$$(V^{old}_{GLWB_t(n)} - 1) + (1 - V^{new}_{GLWB_t(n)}) \tag{8}$$

where the first term is the value gain obtained from lapsing the old contract and the second term is the value gain obtained from selling a new contract. Insurers are generally prohibited from differentiating between new and exchange buyers when setting terms on new contracts and the value gain from surrendering the old contract vs. selling the new contract may accrue to different

companies. This means that there is little leeway (or incentive) for gains on surrendering old contracts to subsidize losses on new contracts. So assuming insurers do not sell new contracts at a loss ($V^{new}_{GLWB_t(n)} \leq 1$)[1], the value from exchanges is at least as great as the value from surrenders:

$$(V^{old}_{GLWB_t(n)} - V^{new}_{GLWB_t(n)}) \geq (V^{old}_{GLWB_t(n)} - 1) \tag{9}$$

which by equation (6) becomes:

$$(V^{old}_{GLWB_t(n)} - V^{new}_{GLWB_t(n)}) > \left(\sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} w_{e_t}}{Y^s_{t,t+s}} - 1 \right) \tag{10}$$

The RHS of equation (10) can be estimated in the data (for any given n) and gives a lower bound on the value gained by insurers from variable annuity exchanges under the assumption that insurers do not sell new policies at a loss. The amount of life annuity benefits in excess of the account value backing those benefits is also a lower bound on the value gained by insurers from exchanges.

D. Taking the Valuation to the Data

I take equation (6) to the data. I take the mortality rates from the US Society of Actuaries Basic Mortality Tables, treasury yields from Gürkaynak et al. (2007) and the ratio of average benefit base to contract values from LIMRA.

The upper chart of Figure 1 plots the present value of the life annuity implied by a representative GLWB variable annuity policy sold before the financial crisis, at the time of issue. The plot assumes a 5% lifetime withdrawal rate (the most common contractual withdrawal rate at the time) for an individual aged 60 (close to the age of the average exchange buyer) and assumes the individual begins withdrawals immediately. The lifetime benefits are assumed to be risk-free. By placing 1 dollar in a GLWB variable annuity in 2007Q4, an individual could only expect about 66 cents per dollar in life annuity benefits if it would exercise immediately. The remainder to 100 cents per dollar must account for any remaining benefits under the contract, distribution costs and the insurers' markup.

The bottom chart of Figure 1 plots again the present value of a 5% withdrawal rate life annuity

[1] I allow for underpricing in Appendix B6. Also note that if annuity fund managers had investment skill, then the value of the assets inside the fund could be higher than the value of the assets outside the fund, such that $V^{new}_{GLWB_t(n)} > 1$ without implying a loss for the insurance company. I implicitly assume no arbitrage opportunities in the mutual fund markets (Berk and Green (2004)). That is, managers either do not have skill, or if they had, they either extracted all surplus, or consumers invested enough such that all investment opportunities would be exploited.

exercisable at age 60 for a policy issued in 2007Q4, but now evaluated at various points after the financial crisis. By 2011, an individual who bought a GLWB variable annuity in 2007Q4 and is now aged 60 could expect to get at least 130 cents in life annuity benefits for every dollar of account value by exercising her GLWB. To give a sense of magnitudes, the present value of the average immediate life annuity that an individual aged 60 could buy on the market over the same period ranged between 93 and 99 cents per dollar. An immediate life annuity is a simple contract which has none of the other benefits of a variable annuity. The results so far suggest that if the policyholder would instead exchange the contract rather than exercise the GLWB, she would forgo a premium of at least 30 cents per dollar (in present value terms).

I then decompose the change in the premium/discount of the life annuity value relative to the account value over time into three components: changes in interest rates, changes in benefit base to account value and changes in mortality assumptions. A rise in the benefit base relative to the account value indicates that the return on the mutual fund net of fees falls below the guaranteed return (the rollup rate). Figure 2 plots the results and shows that while lower interest rates have made variable annuity benefits more valuable by discounting the lifetime income component less aggressively, the primary driver behind the rise in the value of legacy variable annuities after the crisis were overly generous guarantees – the guaranteed returns have well exceeded the net realized returns on the mutual funds (I will discuss the relative importance of gross returns, fees and guarantees in driving this result in Appendix A4).

E. A History of 1035 Exchanges

I back out a history of variable annuity exchanges from 3 different sources. First, starting with 2014, LIMRA collects data on variable annuity replacement premiums at the aggregate US level. Second, since 2011, NAIC collects state-level data on the share of variable annuity replacement contracts in newly issued contracts as part of their Market Conduct Annual Statements. Two states: Illinois and Wisconsin, collect these data since 2006. I weight the state-specific series by US state-level variable annuity sales data from Morningstar Annuity Intelligence and extrapolate the share of variable annuity replacements to the aggregate US. Because per policy, replacement premiums are considerably larger than new premiums (SEC data suggests the average replacement premium was \$205.9k while the average new premium was \$93,4k in 2018, see Table I) I adjust the NAIC numbers up by a factor of 1.5. Comparing the resulting NAIC aggregates with LIMRA aggregates over the period 2014-2017 confirms this is a conservative assumption. Third, I add data on aggregate variable

annuity exchanges from SEC N-CEN filings for 2018 and 2019.

Figure 3 plots the aggregate 1035 exchange volume since 2006. The fact that there were variable annuity exchanges before the financial crisis is not surprising, given that some of the cheapest (low fee) and most generous products were being rolled out that period. That said, most of the variable annuity exchanges happen after the financial crisis, with a peak around 2014-2015. Overall, between 2010 and 2019, at least $429 billions in variable annuities were replaced through 1035 exchanges.

F. 1035 Exchanges and Contract Generosity

Next, I examine the relationship between variable annuity exchanges and contract generosity cross-sectionally to find that the more generous contracts got exchanged the most.

Specifically, where contract-level data on exchanges are available (i.e. starting in 2018), I define the replacement intensity at the contract level as the share of variable annuity exchanges in beginning of period assets, and regress it on contract effective withdrawal rates (wX_t/S_t). I choose the effective withdrawal rate because in the cross-section, the only source of variation in $V_{GLWB_t(n)}$ is wX_t/S_t (as discount and mortality rates are common across all contracts). Figure 5 and Table III plot the results and show that there is an almost monotonous relationship between contract generosity and replacement intensities: a 1% higher effective withdrawal rate is associated with a 0.5% higher replacement intensity on average. The relationship holds when equal- or asset-weighted, within groups, within contract issue years and controlling for a rich set of policyholder, contract and company characteristics.

There is no publicly available data on contract-level replacement intensities before 2018. To proxy for contract replacement intensities, I examine the attrition patterns of contracts with and without guaranteed living benefits (GLBs) issued prior to the great financial crisis. I split retail variable annuity assets into all contracts, contracts on sale up to mid-2011 that offered GLBs during 2004-2008, and contracts on sale up to mid-2011 that did not offer GLBs during 2004-2008. I then plot the evolution of aggregate variable annuity contract value for the three samples (Figure 4).

I find that contracts offering GLBs during 2004-2008 (the most generous contracts in my sample) experienced substantially larger attrition rates after the crisis. By 2019, there were only 55 cents left in account value for every 1 dollar in account value available in 2011, compared to 80 cents per dollar for contracts not offering GLBs. However, contracts with GLBs mechanically have higher attrition rates as exercising the income benefits depletes the account value. I show that differences in benefit withdrawals cannot explain the result. To do this, I build a hypothetical portfolio of

variable annuities having the same fees, investment allocation, withdrawal and mortality experience as the average GLB contract and plot its contract value evolution over time. By 2019, there were still 80 cents per dollar in the hypothetical series compared to just 55 cents in the GLB sample.

IV. Demand-Side Explanations

I begin by investigating the consumer and contract characteristics most associated with variable annuity exchanges. I then consider, and eventually rule out, several leading explanations that could have rationalized why demand for exchanges increases in contract generosity.

A. What Drives Variable Annuity Exchanges

In Table III, I regress contract level replacement intensities on a large set of contract characteristics. I consider the party initiating the exchange (the broker vs the insurance company, which is important, as the insurer could provide better terms)[2], investor clientele (whether the annuity was bought on the retail market or as part of an employer-sponsored plan such as 401(a) or 457(b)), investor tax status (qualified such as IRA, where contributions are made from pre-tax money vs non-qualified), the insurance company's AM Best rating, the share class and the mortality and expense charge (which together govern the contract fee), the number of investment options, the type of death benefit and the effective withdrawal rate on the living benefit. I find that the replacement intensity is 0.4-1.8% higher when the insurance company initiates the exchange (which is intuitive, as the insurance company can waive surrender charges on the existing and the new contract plus any front-end and back-end sales loads, making the new contract both cheaper and more liquid), 0.7-1% higher when the policyholder is retail, 0.2% higher when the contract is non-qualified (as I will show in subsection C, variable annuity exchanges may provide some tax advantages for non-qualified contracts), is higher when the old contract is more expensive (as shown by the coefficient on the base contract fee and the fact that is strongest in the most expensive share classes like B and X) and falls with the number of existing investment options, suggesting that consumers are willing to exchange to get diversification benefits. Consumers do not appear to replace out of default concerns (the

[2]Specifically, I identify exchanges initiated by insurance companies under Investment Company Act Rule 11a-2. The rule permits an offer to exchange one variable annuity contract for another variable annuity contract of the same or an affiliated insurer without obtaining Commission approval as long as (i) the exchange is made on the basis of the relative net asset values of the securities being exchanged (ii) no surrender charge is deducted at the time of the exchange; and (iii) if both the old and new contracts are subject to surrender charges, then the insurer credits the period during which the contract owner held the old contract in computing the surrender charge for the new contract (the so-called tacking requirement). Offers that do not meet these criteria, such as those providing bonuses to existing policyholders, require the explicit Commission's approval. I discuss these cases in subsection F.

coefficient on the rating is negative, to be further discussed in subsection B). Finally, replacement increases with the generosity of existing living benefits (as discussed in Section III), but also of the existing death benefits: contracts that promise to pay at least the initial premium as death benefit get exchanged more than contracts that only pay the residual account value, and contracts that pay the highest anniversary account value as opposed to just a return of premium get exchanged even more. This suggests that either consumers neglect accumulated living and death benefits, or there is an important omitted variable that drives exchanges in spite of contract generosity. I consider several possibilities below. Readers more interested in the supply side can skip to Section V.

B. Default

Up to now, I have assumed that the stream of lifetime income that a consumer is giving up by surrendering an old variable annuity contract was risk-free. The presence of default risk increases the rate at which the stream of income payments is discounted and reduces its expected present value. This reduces the expected loss from surrendering old contracts and could make exchanges more palatable. I take several steps to argue that the observed variable annuity exchange pattern is inconsistent with a default explanation.

First, there are good reasons to believe variable annuity benefits are reasonably safe. The assets backing the variable annuity benefits are stored in a separate account that would normally retain its separate status in the event of the insolvency of the issuing insurer. That means other claimholders cannot lay claim on the assets in a bankruptcy and reorganization. Next, if the annuity benefits exceed the assets in the separate account and the insurer cannot fund the difference, the state guarantee association steps in. All life insurance companies licensed to sell variable annuities in a given state are required to be members of that state's guaranty corporation. All 50 states, the District of Columbia, and Puerto Rico have life insurance guaranty associations or corporations. State guarantee associations have generous statutory limits (typically up to $250,000 in present value of annuity benefits) which means that only the very largest contracts do not get fully covered. The funding for the guaranty associations comes from fees offset by tax rebates on solvent insurers, so are essentially funded by transfers from the state budget. Last, there is a precedent established during the 2008/9 Financial Crisis, when the U.S. Treasury Department granted approval for 6 large variable annuity writers: Hartford Financial, Prudential Financial, Lincoln National, Principal Financial, Ameriprise Financial and Allstate Corporation, to take part in the Troubled Asset Relief Program and recapitalize their balance sheets following variable annuity losses. This suggests that

the federal government is willing to step in in case of a large-scale inability of variable annuity writers to honour their liabilities.

Second, since discounting the lifetime annuity component of a variable annuity at a risk-free rate results in a present value of benefits in excess of the account value, I ask what is the parallel shift in the discount curve required for the policyholder to breakeven when exchanging its lifetime annuity for the account value. Since the lifetime annuity is only one component in the value of a variable annuity, the required parallel shift is a lower bound on the shift necessary to rationalise variable annuity exchanges through a rational default explanation. I find that one would require a rate shift of +200bps over most of the post-crisis period to breakeven (Figure D8). I show this is inconsistent with actual data on insurance companies ratings and CDS spreads over this period.

Third, if consumers would be exchanging old policies into new policies out of default concerns and had common beliefs about the default risk of the various variable annuity providers, one should see mass moving from one set of companies considered risky to another set of companies considered safe. Instead, I show that groups which are the largest source of 1035 outflows are also the main recipients of these funds (Figure 6). Actually, the ratio of group-level 1035 inflows to outflows is close to unity, suggesting that most 1035 exchanges are probably internal within-group transactions.

Last, it is precisely the companies deemed safest (judging by their AM Best ratings and statutory capital ratios) that exchange the most. When moving to the supply side, I will show that this negative relationship between replacement intensities and perceived creditworthiness is largely explained by what is called shadow insurance (see Table DIV). Operating insurance subsidiaries move exposures to less regulated reinsurance subsidiaries belonging to the same group, making the operating companies look better capitalised in the eyes of regulators, credit rating agencies and ultimately consumers, although none of the risk gets transferred. In fact, it was these large and ex-ante safer insurance companies using shadow insurance that were the most affected during the Great Financial Crisis and the Covid Pandemic (see Figure 11). Shadow insurance will be important in separating a demand from a supply side explanation of exchanges: exchanges occur because they relax insurers financial constraints, and not because they reflect consumers default concerns.

C. Tax, Liquidity, Collateral and Affordability

In general, replacing a variable annuity through a 1035 exchange provides little or no tax, liquidity or collateral-posting benefits. Under US Tax Code Art. 1035, an exchange of a variable annuity for another is a tax-free event and does not change the tax status of either the contributions or the

earnings component of the account value. Owners are not required to make additional premium payments to maintain benefits (as would be the case for life (Gottlieb and Smetters (2021)) or long term care insurance (Liu and Liu (2019)), prompting policyholders to reduce coverage due to affordability constraints). Expenses are directly subtracted from the account value, and only as long as there is money in the account. 1035 exchanges do not provide immediate liquidity (one can only withdraw after 180 days by law). And because they are expensive (a broker charges 6-7% in commissions per transaction), the insurer applies surrender fees in the early years of the contract to recover the distribution costs, making the new contract substantially less liquid than the old contract. Finally, the collateral-posting ability of the account assets (policyholders can borrow against or pledge a portion of their account value as collateral for personal or business loans) does not change.

In Appendix C1, I will also show that partial 1035 exchanges (exchanging a portion of the account value with the intention of subsequently withdrawing it) provides a tax advantageous way of withdrawing money for a subset of policyholders that face different tax treatment of earnings versus contributions (such as non-qualified owners). However, I find that partial 1035 exchanges account for only a small part of the data and cannot explain the results.

Collectively, the arguments provided in this section suggest that cross-sectional variation in replacement rates cannot be explained by tax, collateral or liquidity considerations related to 1035 exchanges.

D. Life Events

Partial 1035 exchanges may also arise out of divorces and inheritance. When the owners of a joint variable annuity policy get divorced, the annuity may be split, with one party moving its share of the account value into a new annuity through a partial 1035 exchange, while the other party assuming the remainder of the existing policy. The residual owner in the joint policy may also want to switch to a single policy, as it typically involves a lower fee for the same benefit or a higher benefit for the same fee. However, fees have increased so much and benefits decreased so much over the last decade (Figure D2) that one is generally better off alone in an old joint policy than in a new single policy. Last, starting with 2013, the IRS allows individuals who inherit annuities from their spouses and consider that a new annuity is better suited to their needs to do a tax-free 1035 exchange.

However, demographic data on variable annuity replacement buyers shows that only 11% of

variable annuity replacement buyers are divorced and only 7% are widowed (Table II). That is, even if divorce or the death of a spouse would be the primary reason behind their decision to exchange their annuities, that would only account for 18% of the cases.

E. Adverse Selection

One could argue that is precisely people in poor health with lower life expectancies that are most likely to exchange (as they value life annuities the least). I bring several arguments against this hypothesis. First, the average exchange buyer is considerably younger than the average owner (62.5Y vs 70Y). Second, 76% of people who exchange purchase life annuity benefits again in the new product. Third, since the financial crisis, many insurers have initiated wholesale (generic) exchange offers to their customers, where they offer bonuses as high as 20% over the cash surrender value to incentivize exchanges (see Figure D17 for an example). If insurers were concerned about getting adversely selected in the exchange market, they would have screened customers in these offers, which has not happened.

F. Exchange Terms

The fact that insurers are willing to pay consumers to derisk their liabilities points to important financial or hedging constraints, but might also imply that exchanges are more advantageous to the average costumer than my valuation would suggest. I show that most exchange transactions in my sample do not have bonuses, and actually removing those that have does not affect my results.

According to Section 11 of the Investment Company Act, when an insurer makes an exchange offer involving bonuses to its policyholders, it must submit the offer for approval to the SEC and publish it on Edgar. I extract all exchange offers launched by insurance companies after 2010 from their variable annuity filings with the SEC. I identify 206 exchange offers made between 2012-2019 over 89 unique contracts. 80 out of the 89 contracts were indeed variable annuities issuing guaranteed benefits during 2004-2008, which are the most generous benefits in my sample. Only 43 offers, targeting 4.3% of the assets in force, were still active in 2018. I replicate the relationship between contract generosity and replacement intensity excluding contracts subject to exchange offers. The relationship, shown in Figure 8, goes through, suggesting that advantageous exchange terms cannot explain the results.

V. Supply-Side Factors

The Role of Brokers

I next turn to the mechanism of how exchanges get sold, with an emphasis on the role of brokers. I look at the compensation that insurance companies provide to brokers to service or exchange existing policies, the identity of the brokerage houses receiving this compensation, and their disciplinary histories. The second part of this section turns to the incentives of insurance companies.

A. Compensation Structure

I extract information on brokerage compensation from variable annuity prospectuses and statements of additional information filed by insurance companies with the SEC. I obtain compensation data from 14,938 filings from 432 variable annuity separate accounts over the period 1995-2019. I focus on two measures of brokerage compensation: the maximum upfront commission payable upon sale, as a percentage of premium, and the total amount of brokerage compensation paid.

When selling a new contract, insurance companies offer brokers a menu of commission options to choose from. Brokers can choose a higher upfront commission as percentage of premiums, payable upon sale, at the expense of a lower trail commission, as a percentage of account assets, payable for a number of years after sale. The maximum upfront commission usually corresponds to a zero trail commission and is a useful way to summarize the total brokerage commission paid upon sale.[3] On top of that, insurance companies pay brokers additional non-commission-based compensation used to cover various distribution costs, performance-based bonuses, loans forgiven, cash for trainings, trips and entertainment.

Sales commissions alone are not designed to incentivize generous exchanges. This is because most sales commissions depend on the contract being sold, rather than where the money comes from (new vs existing policyholders, generous vs less generous existing policies). By contrast, insurance companies yield considerable discretion regarding the timing, the amount, and the identity of the brokers receiving additional compensation, and may potentially tailor this compensation to incentivize exchanges.

[3]Commission rates are high. The average contract pays around 6% of premiums in upfront commissions, or around 1% of assets per year in trail commissions. Upfront commissions can be as high as 16%, and trail commissions can go up to 2.5% per year (Figure D10).

B. *Aggregate Evidence*

I combine contract level data on maximum upfront commission rates from SEC filings with contract level sales histories from Morningstar Annuity Intelligence to compute an aggregate dollar amount of upfront compensation paid to brokers each year. I then compare this amount with total brokerage compensation paid to back out the aggregate amount of additional (discretionary) compensation paid to brokers.

I find that total payments to variable annuity salesforce are relatively large ($10-20 Bn/year) (Figure 9). This is more than 10% of annual variable annuity sales. On average, additional compensation accounts for a substantial portion in total brokerage compensation (38.68% between 2001-2018). In the time series, additional compensation is substantially more volatile/ procyclical than upfront commissions. The additional compensation share was just 14% in 2002 and 26% in 2009, compared to 41-52% between 2004-2008, or 45-46% of total brokerage compensation in 2013/2014. Additional compensation is only weakly correlated to aggregate variable annuity assets, which confirms that I am not merely capturing misreported trail commissions, but rather a more discretionary component in compensation. More importantly, I show that aggregate discretionary compensation strongly correlates with aggregate 1035 exchanges (correlation 0.5-0.6) (Figure 10).

C. *Cross-Sectional Evidence*

To test the relationship between exchanges and brokerage compensation in the cross-section, I compute the total amount of discretionary compensation paid at the separate account level by taking the total brokerage compensation and subtracting total upfront commissions (defined as contract sales $\times$ upfront commission rates, aggregated to the separate account level). I then regress the contract level replacement intensity on discretionary compensation intensity (i.e. per dollar of account value) in 2018 (Table IV, to be extended). Since discretionary compensation varies at the separate account rather than contract level (because total brokerage compensation is only available at that level), I cluster standard errors at the separate account level (and repeat the regression aggregated at the separate account level in the last column, for reference). I find that discretionary compensation is positively related to exchanges in the cross-section. A 1% higher discretionary compensation intensity is associated with a 0.98% higher replacement intensity. The result controls for a rich set of contract characteristics and fixed effects that I have shown to correlate with demand.

I next dive into the institutional details of how brokers get compensated. Each insurance group has one or several subsidiaries called principal underwriters or distributors which are responsible

for hiring, supervising and compensating the brokers selling and servicing the policies. Policies sold through the same distributor are typically marketed through the same network of brokerage firms. Moreover, the extent to which an insurance company can make certain payments or amend existing broker benefits is governed by the law of the state in which the distributor is domiciled. I observe both the identity of the distributor and the state in which it is domiciled, and control for them using distributor (state) fixed effects (columns III and IV). I find that even within the same distributor company, contracts receiving more servicing compensation get replaced more.

I then look at how the effectiveness of discretionary compensation varies with other decisions at the disposal of the insurer (column V). I find that paying discretionary compensation to brokers and launching an exchange offer at the same time roughly doubles the impact of each dollar of brokerage compensation (the fact that insurers rarely make exchange offers suggests there is a countervailing force in terms of both higher discounts offered to customers and higher reputational costs from press exposure. I discuss these factors in Section VI).

Finally, the results are stronger in contracts where I more cleanly identify discretionary servicing compensation. In particular, a large source of measurement error in servicing compensation comes from mismeasured sales compensation. For instance, by assuming all sales compensation is received upfront, I overstate sales commissions in the first year of the policy and understate them in subsequent years. Also, a lot of discretionary compensation is paid for achieving sales targets on new policies, which is unrelated to exchanges. The measurement error biases the coefficient on servicing compensation towards zero. In column VI, I isolate the effect of sales compensation by looking at contracts belonging to companies no longer selling variable annuities. I find that $1 in discretionary servicing compensation converts about $3.1 in exchanges on average.

D. Changes in Compensation Structure

Over the last few years, several large variable annuity writers have cut trail commissions on generous variable annuity policies. As lowering trail commissions reduces brokers incentives to service existing policies, regulators have speculated that insurance companies are incentivizing brokers to replace their legacy variable annuities.[4] In this section, I exploit an unanticipated change in servicing compensation to test this hypothesis.

In September 2018, Ohio National announced it would unilaterally terminate all selling agree-

[4]In January 2019, the NY Department of Financial Services (DFS) has launched an investigation into NSLAC (National Security Life and Annuity Company, the NY subsidiary of Ohio National, after having observed evidence that some brokers are advising their clients to surrender or replace their policies as a result of the elimination of trail commissions on NSLAC policies.

ments including brokerage compensation for all in-force non-group variable annuities sold by its subsidiaries through independent (third party) channels. Captive agents were exempted. Prior to this move, brokers servicing Ohio National contracts were entitled, as part of their original selling agreements, to servicing compensation in the form of trail commissions for as long as the contracts were in force. The usual trail was about 1% of assets under management per year. Instead, brokers were offered an updated servicing agreement stipulating that they could keep the trails on a subset of serviced contracts, but with Ohio National retaining the right to cancel these payments at any point during the life of the contract. Trails for contracts featuring guaranteed minimum income benefits (GMIB), a popular rider allowing policyholders to convert a guaranteed amount into a life annuity after a fixed waiting period, would cease immediately. The measure would take effect at year-end.

I identify all variable annuity contracts issued by Ohio National, and group them by name. All contracts within the same group are variants of the same contract which differ only in terms of the period active (e.g. 2006-2008) and jurisdiction (NY vs. the rest of US). For every contract variant, I observe the distribution channels and whether it offers a GMIB rider. I then exploit two sources of variation in treatment intensity. First, all contracts sold through independent channels are subject to increased uncertainty regarding future trail compensation. Second, contracts sold through independent channels offering GMIBs in particular are subject to an immediate commission cut. I define, for each contract variant, the treatment intensity as the share of historical sales made through independent channels. To test whether contract variants with higher shares of independent brokers have higher replacement intensities as a result of the trail commission announcement, I regress replacement intensity on the treatment intensity, a post-announcement dummy and a treatment intensity $\times$ post interaction (Table V). To control for differences in average replacement intensities across contracts, I add contract (pair) fixed effects:

$$RepInt_{ijt} = \alpha_j + \beta_1 Treat_{ij} + \beta_2 Post_t + \beta_3 Treat_{ij} \# Post_t + \epsilon_{ijt} \tag{11}$$

where i denotes variants, j denotes contracts and t denotes time. Two other developments affecting replacement intensities were ongoing at about the same time as Ohio National's announcement. First, during 2018 and the early months of 2019, Ohio National launched a number of buyout offers. These offers promised policyholders bonuses for switching their existing contracts for newer contracts, but were limited only to variants with GMIB riders sold prior to October 2012, as they were among the most generous in force and were approaching annuitization as the waiting period

expired. Second, starting with July 2019, contract variants domiciled in NY State became subject to a fiduciary duty, a stricter intermediary standard under which brokers recommendations to exchange would face increased scrutiny. In columns II and III, I repeat the analysis controlling for exposures to buyouts and fiduciary duty.

$$RepInt_{ijt} = \alpha_j + \beta_1 Treat_{ij} + \beta_2 Post_t + \beta_3 Treat_{ij} \# Post_t + \beta_4 Buyout_{ij} + \beta_5 NY_{ij} \# Post_t + \epsilon_{ijt} \quad (12)$$

Finally, to capture the effect of the actual commission cut (as opposed to uncertainty regarding future commission cuts) on replacement intensity, in column IV I repeat the analysis focusing only on contract variants offering GMIBs.

In all specifications, the interaction term is the coefficient of interest and measures the causal effect of brokerage compensation on replacement intensity. I find that cuts in servicing compensation (or increased likelihood of future cuts) lead brokers to exchange more policies. Specifically, in the context of Ohio National, my difference in difference estimates suggest that the 2018 buyback offers were mostly carried through captive agents – employees of Ohio National whose incentives are most closely aligned with their employer's. The replacement intensity is 4% for the captive channel and only 1.4% for the independent channel in the pre period. In the post period, exchanges through the captive channel fell, in the absence of further buyout offers, but the exchanges through the independent channel picked up strongly (by 3.6% to 4.6%) in response to the cut in trail commissions. This is in line with both anecdotal evidence and regulatory reports (see DFS, 2019) according to which Ohio National might have cut trail commissions in retaliation for independent brokers' poor performance in the previous-year's exchange offers.

E. Intermediary Standards of Care

If brokers play an important role in facilitating questionable 1035 exchanges, then one should see a drop in 1035 exchanges if brokers moved to a stricter standard of care, and a bigger drop for more questionable exchanges. I use the imposition of Best Interest Regulation 187 in July 2019 in NY state, but not in the rest of the US, to test this hypothesis.

To aid identification, I exploit a unique institutional feature in the NY insurance regulation. Historically, the state of New York was generally acknowledged to have a more rigorous insurance regulation than other jurisdictions in the United States. (Pottier and Sommer (1998)) Besides its stringency, a unique feature of New York insurance law is its extraterritoriality: according to the Appleton Rule of 1939, once an insurer becomes licensed to do business in New York State, it

must comply with the more stringent New York regulation nationwide. To enter New York State, an insurer can either establish a subsidiary domiciled in New York or obtain a license to operate in New York as a foreign insurer. On the one hand, the legal costs of incorporation and the maintenance of books and records provided an incentive to operate as a foreign insurer rather than to establish and maintain a New York-domiciled subsidiary. On the other hand, the extraterritorial dimension of New York's stringent insurance law, with the accompanying high regulatory compliance costs, provided an incentive to enter New York via a domiciled subsidiary in order to avoid subjecting the insurer's nationwide operations to New York regulations. As a result, most insurance companies in the United States have set up separate subsidiaries operating in NY State and the rest of the US. More importantly, most of these companies offer identical variable annuity contracts and benefits in both subsidiaries. Prior to NY Best Interest Regulation 187, brokers selling variable annuities in NY State were held to a weaker suitability standard. When NY Regulation 187 entered in force, it required brokers to intermediate in the best interest of their clients, effectively raising them to a fiduciary standard in NY State, but not elsewhere in the US (there was no other fiduciary regulation enacted in 2019 in the rest of the US. See Figure D11 for a detailed sequence of events).

I identify 302 pairs containing 633 contracts issued by the same parent insurance company which are identical up to their name, observable contract characteristics, investment options and benefit availability, only that one contract is authorised for sale in the New York State, while the other is authorised for sale in the rest of the US except New York State.[5]

To identify the effect of brokerage standards of care on 1035 exchanges, I compute the replacement intensity (defined as the share of 1035 outflows in beginning of period assets) and regress the replacement intensity at a contract level i on a NY dummy, a 2019 dummy, and the interaction between the two. To control for differences in average replacement intensity across pairs of contracts, I add contract pair fixed effects.

$$RepInt_{ijt} = \alpha_j + \alpha_1 NY_{ij} + \alpha_2 Post_t + \alpha_3 NY_{ij} \# Post_t + \epsilon_{ijt} \tag{13}$$

Within a contract pair j, the 2019 dummy captures differences in the replacement intensity between

[5]In Figures D14 and D15 in the appendix, I provide evidence of two such contracts, while in Table DIII, I run a balancing test to show that these matched contracts are also similar along other characteristics, such as their investor clientele (retail vs group contracts), their tax treatment (qualified vs non-qualified money), their distribution channels (independent broker vs insurance agent vs direct response) and the extent to which insurance companies incentivise exchanges, either through buyouts or brokerage servicing compensation. In Figure D12, I run a parallel-trends-type analysis to show that redemptions out of these contracts have also been similar historically. Finally, Figure D13 shows that while the incidence of variable annuity-related complaints has been fairly similar in NY State and the rest of the US prior to the regulation, this has reduced in NY State but not the rest of US after the regulation.

2018 and 2019 for all contracts (NY and non-NY). The NY dummy measures differences in the replacement intensity between NY and non-NY contracts for both years. The interaction effect is the coefficient of interest. Within a pair of otherwise identical (on observables) contracts, it measures the incremental effect of selling in NY in 2019 and is intended to capture the causal effect of Regulation 187 on replacement activity.

I find that imposing a best interest standard in NY over the second half of 2019 lowered replacement intensity by 2.52% of beginning of period assets (Table VI). Given that NY State had 123Bn in variable annuity assets at the start of 2019, my results suggest that best interest standard applied over the latter half of 2019 prevented 3.1Bn in variable annuity exchanges statewide.

To test whether the imposition of fiduciary duty has disproportionately impacted the most questionable exchanges, I repeat the analysis on the subset of contracts offering guaranteed living benefits (GLBs) and partition the sample into contracts selling guaranteed living benefits between 2004-2008 (the most generous contracts in my sample) and contracts not selling guaranteed living benefits during that period. I find that the effect of fiduciary duty on replacement intensity is almost entirely concentrated among the most generous contracts (and hence most questionable exchanges). Imposing fiduciary duty in NY over the second half of 2019 reduced replacement intensity in generous contracts by 3.95% of beginning of period assets, compared to 0.48% for their less generous counterparts.

Finally, I extend the sample to 2020. When the pandemic hit, many other states that were planning to impose their own fiduciary rules (e.g. MA, MD, NJ, NV) either abandoned or postponed legislation indefinitely, with New York remaining the only US state applying a stricter regulation. I show that the persistent wedge in brokerage regulation has created persistent differences in replacement intensities across otherwise identical NY and non-NY contracts (see column (6) of Table VI and Figure D12).

F. Past Misconduct

I next extract the identity of the brokerage houses receiving discretionary compensation from insurance companies variable annuity filings with the SEC and match with their disciplinary records from FINRA's BrokerCheck database. I examine all charges made against the brokerage firms themselves (pointing to more systematic (alleged) failures to comply with the rules), as well as against the individual brokers employed by the firms. First, firms intermediating variable annuities are substantially more likely to have had regulatory disclosures (61%) than the average brokerage firm (39%)

over the last 20 years (Table DI). Second, within the firms intermediating variable annuities, firms recorded as receiving discretionary variable annuity compensation have a higher likelihood of regulatory disclosures (80% vs 53%) and conditional on disclosure, a larger number of them (25.7 vs 5.7). This is true for all disclosures, as well as disclosures specifically involving variable annuities. Third, within the firms intermediating variable annuities, brokers employed by firms receiving additional compensation are more likely to have had disciplinary records and consumer complaints. A more careful examination of the type and severity of misconduct, the products involved, charges made, the court, regulator or arbitrator awarding the damages, as well as the timing (does misconduct precede reception of discretionary compensation or comes after it) is currently in progress.

G. Common Sales Tactics

I then parse through the subset of FINRA disciplinary actions that are targeted at variable annuity exchanges to understand what are the most common sales tactics that brokers employ to mislead consumers.

Most US states require brokers to provide a side-by-side comparison of the fees and characteristics of the policies involved in an exchange. Since these forms are standardised, I have requested a representative annuity comparison report commonly used by brokers from Morningstar Annuity Intelligence. I find that the average consumer has to evaluate about 10 different fees and over 50 different contract and benefit characteristics. In addition, brokers are required to disclose any benefits that the customer has accumulated under the existing contract. For example, when the minimum return guaranteed exceeds the return on the mutual fund, the benefit base increases relative to the account value, and that increases the death and living benefits in the old contract. Importantly, these benefits are forfeited in an exchange. Since this information is customer specific, it is not included in the comparison report, but rather in a separate policyholder quarterly account statement (see Figure D18 for an example). Finally, under New York State Insurance Regulation 60, brokers are also required to provide a comparative illustration of the contract and rider values for both contracts under hypothetical market scenarios.

I examine conclusions from two random samples based on two FINRA investigations into MetLife Securities Inc., a subsidiary of MetLife, and Fifth Third Securities, an independent brokerage house (a more systematic examination is available in Table DII). The investigations covered 37,000 variable annuity exchanges executed between 2009 and 2015 and cumulating over $3.2 billion in account value. FINRA found that between 72% and 77% of variable annuity replacements contained at

least one material misrepresentation or omission that made the old contract look less advantageous. In 52% of replacements, brokers omitted to disclose that customers would forfeit accumulated living benefits, and in 21% of the cases, accumulated death benefits. In the subset of policies exchanged in NY State, FINRA found that the calculators required to provide comparative illustrations contained at least 19 separate deficiencies resulting in understatements of accumulated benefits under the old contract. The calculators were used to prepare tens of thousands of hypothetical illustrations and were last tested in 2003.

To understand the impact of (omitting) accumulated living benefits on variable annuity valuation, I compute the value of the life annuity implied by a GLWB variable annuity with and without accumulated living benefits by forcing the benefit base X_t to equal the account value S_t:

$$\Delta LB_t(n) = \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} w^{Xt/St}}{Y_{t,t+s}^{s}} - \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} w}{Y_{t,t+s}^{s}} \tag{14}$$

I estimate equation (14) for a representative contract with a 5% withdrawal rate exercisable at age 60, issued at various points before the financial crisis and evaluated at different points after the crisis, where S_t is normalized to \$100,000. I find that neglecting accumulated living benefits would understate the value of the life annuity under the contract by up to \$40,000 for the most generous policies (e.g. policies issued in 2007Q4). Collectively, the evidence from disciplinary actions suggests that consumer confusion about the value of accumulated benefits provides the most plausible explanation for questionable exchanges.

H. Insurers Incentives: Risk Management

I next turn to the reasons why insurance companies might incentivise exchanges in the first place. Profit motives seem to be important. As discussed in Section III, insurers target their largest and most generous policies, as those provide the largest economic benefit. Risk management concerns seem equally important. Variable annuities expose insurers to aggregate market risk. Losses on variable annuities have forced insurers in the past to seek government assistance, issue equity at discounts, or undertake costly actions to avoid raising external capital (sell policies below actuarially fair values (Koijen and Yogo (2015)), distort hedging decisions (Sen (2019)), potentially resort to fire sales (Ellul et al. (2020))). By removing the riskiest exposures, exchanges can help prevent such actions in the future.

I provide two pieces of evidence that risk management concerns are active. First, conditional

on contract generosity, contract and consumer characteristics that I have shown to correlate with demand, as well as insurer characteristics that proxy for risk bearing capacity, such as size, rating, ownership or use of reinsurance, companies that applied to, companies that benefited from government financial assistance and more generally companies that were forced to raise equity during the last financial crisis had higher replacement intensities in 2018 (Table DIV). This suggests that conditional on their current risk bearing capacity, companies with a history of getting financially constrained exchange more, probably because they have a tighter risk management. Second, conditional on contract generosity to proxy for profit motives, companies that experienced larger maximum cumulative stock price declines during first quarter of 2020, a period characterised by large declines in both the SP500 and interest rates in the midst of the Covid Pandemic, had higher replacement intensities in 2018 (and 2019, 2020) (Figure 11). This suggests that companies exchange more when they are more exposed to aggregate risk.

I. Insurers Incentives: Reputational Costs

If exchanges are on average disadvantageous to consumers, then incentivizing these transactions may create reputational costs for insurers. I test this hypothesis in the cross-section by showing that insurance companies with lower reputational costs have higher replacement intensities on average, and in particular among the most questionable exchanges. To capture variation in reputational costs across firms, I exploit two important developments in the variable annuity market over the last decade. First, to reduce risk exposures from minimum return guarantees, several large insurance companies have stopped selling variable annuities after the financial crisis (Koijen and Yogo (2020)). At the same time, insurers have sold more than $100 billion in legacy variable annuity assets to non-traditional insurers, mostly private equity firms (Foley-Fisher et al. (2020)). I argue that companies no longer selling variable annuities and companies acquired by private equity firms face lower reputational costs. The intuition is as follows: If companies worry that exploiting today hurts tomorrow's profits by lowering demand for variable annuities and close substitutes (which is consistent with survey evidence, see Shu et al. (2018)), then not selling variable annuities or similar products relaxes the constraint on exploitation (Kahneman et al. (1986)). Given that the set of contracts no longer selling and those sold to private equity firms somewhat overlaps, I describe the analysis on private equity ownership first, with the understanding that all results go through when looking at active/inactive insurers.

I identify 102 variable annuity contracts from 9 insurance subsidiaries which were acquired by

private equity firms or consortia involving private equity firms between 2010 and 2018. Examples of variable annuity writers acquired by private equity firms are Voya, Talcott Resolution, Aviva, Security Benefit or Sun Life (currently Delaware Life)(see Appendix E for full list). 7 of these companies were still owned by their initial acquirer in 2018. One company, Equitrust Life - has been resold to another private equity firm in the meantime. Another company, Union Security, has not been acquired, but its contract administration is outsourced to another insurance company owned by a consortium of private equity firms. I construct a dummy PE set to 1 whenever the insurer is owned or managed by a private equity firm or consortium involving private equity firms and test whether contracts managed by private equity firms have higher replacement intensities, controlling for contract and company characteristics (Table VII). I find that variable annuity contracts managed by private equity firms have higher replacement intensities than contracts that are not (+1.18%). The results are not explained by differences in contract generosity between the two groups.

Next, I split the sample into contracts selling guaranteed living benefits between 2004-2008 (the most generous contracts in my sample) and contracts not selling guaranteed living benefits during that period. I find that the differences in replacement intensities between PE and non-PE owned contracts originate within the most generous contracts. PE owners replace more, and do so exactly where replacements are most questionable.

I then look at how exiting the variable annuity market interacts with private equity ownership. There are broadly three categories of insurers. First, there are small traditional insurers with limited exposure to variable annuities, that have exited the market after the crisis but still operate important insurance businesses (fixed annuities, life insurance). Examples are State Farm, Farm Bureau, Mutual of Omaha or Symetra. Their replacement intensities are somewhat higher than those of active variable annuity writers, but not statistically significant. Then there are companies who have been taken over by private equity consortia, but still write variable annuities (Security Benefit, Delaware Life). Replacement intensities are even higher (+ 1,2%) and significantly so. Finally, there are companies who have been taken over by private equity consortia and also stopped selling variable annuities (Talcott Resolution, Voya). These companies replace the most (+2,3%) and significantly so.

The results control for a large set of contract and company characteristics, including the entity originating the exchange (insurer vs broker), the clientele (retail vs group, qualified vs non-qualified), fees, number of investment options, living and death benefits as well as issue-year fixed effects. To ensure that the higher replacement intensity does not capture expectations of higher default risk

in private equity owned insurers, I control for the insurance company AM Best rating. While I find that private equity owned firms are indeed 2.18 notches riskier in 2018 (Table DV), variable annuity contracts managed by private equity firms have higher replacements intensities, even after controlling for default risk.

VI. A Model of Exchanges

A large number of policyholders appear to forgo tens of thousands of dollars in variable annuity benefits to exchange their existing policies. None of several key rational explanations is able to explain the results, suggesting that consumers make mistakes. Evidence from disciplinary actions connects consumer mistakes to brokers omissions and misrepresentations, while the characteristic most commonly omitted, accumulated living benefits, explains both consumers demand coefficients and is quantitatively large enough to match the present value losses in the data. Insurance companies can benefit from exploiting consumer mistakes in terms of both economic profits and relaxing financial constraints. I find that insurance companies actively incentivise consumer mistakes through discretionary brokerage compensation, but restrict themselves to exploiting only gradually, and only the largest and most generous contracts at a time, suggesting an important role for exploitation or reputational costs. Exchanges do respond to variation in proxies for reputational costs.

In the rest of the paper, I build and estimate a structural model of consumer exploitation in the variable annuity market that captures the main features of the data. Insurance companies trade-off the economic profits from exchanges and benefits from relaxing financial constraints against the reputational costs of misselling when deciding the amount to exchange. I use the model to pin down the share of exploitable consumers in the market and the reputational costs faced by firms, compute the value transferred from unsophisticated households to the insurance sector, and evaluate the effectiveness of policies aimed at reducing exploitation by reducing its marginal benefit or increasing its marginal cost. Since parts of the model will require an overview of the insurance company's balance sheet, I begin with a stylised single contract version below.

Variable Annuity Accounting

In the valuation section, I have shown that when an insurer exchanges a variable annuity, it pays the policyholder the account value S (normalized to 1 for simplicity) and writes off the present value

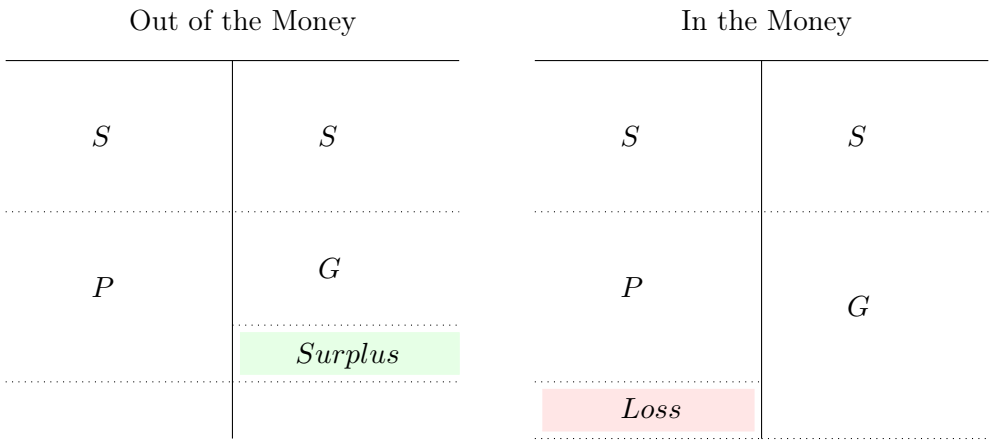
of variable annuity benefits V_{GLWB} for an economic profit (ignoring the sale of a new policy):

$$\hat{V}_{GLWB} = V_{GLWB} - 1 \tag{15}$$

To understand how this transaction affects the insurer balance sheet, I consider the following accounting identity:

$$V_{GLWB} \equiv 1 + G - P \tag{16}$$

which says that the value of a variable annuity must equal the account value ($= 1$) plus the fair value of the guarantees G minus the present value of fees levied on the account value to pay for these guarantees P. So when an insurer issues a variable annuity, it records an account value $S = 1$ as a separate account item both on the asset and the liability sides, a general account asset P and a general account economic reserve G. When the policy out of the money, $P > G$ and the insurer records a frictionless present value surplus:



Conversely, when an insurer exchanges a variable annuity, it releases the separate account, removes any variable annuity reserves and renounces any right to the present value of future fees. When the policy is in the money, $G > P$, and exchanges result in positive economic profits (ignoring again the potential sale of a new policy) $\hat{V}_{GLWB} > 0$.

Exchange Structure

Insurance companies make (direct and undifferentiated) exchange offers to existing policyholders (I introduce brokers in Appendix B9). A variable annuity exchange allows customers to sell back their old policies for the account value and use that account value to purchase any new policy (from the same or different insurer) at market prices.

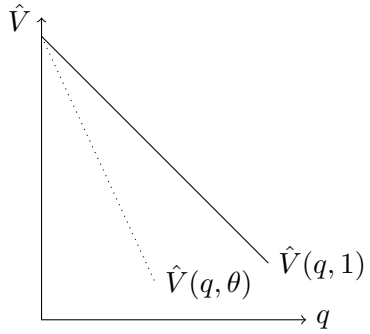
Consumer Types

I start with a very stylised representation of demand. The firm faces two types of existing policyholders. There is a share $1-\theta$ of attentive costumers. When making exchange decisions, these costumers pay attention to all characteristics in the old policy and the new policy and understand the terms of the exchange. For simplicity, attentive customers always reject the exchange offer for valuations seen in the data.[6] Then there is a share $\theta > 0$ of inattentive consumers. One way to think about them, given the evidence from disciplinary actions, is these consumers neglect one or several key characteristics of the contract (e.g. accumulated living benefits) and that results in underestimating the value of their existing policy to an extent large enough that they exchange. Inattentive consumers always accept the exchange offer.

Demand Side

For every contract i and firm j, the demand for exchanges is given by the subset of policies in force in the hands of inattentive consumers. Specifically, I will think of a contract as a continuum of contract vintages – groups of policies sold at the same point in time. For each vintage, there is an average benefit from exploitation $\hat{V}$, which I will call the exploitable value. All else equal, policies issued in 2007 will be more generous, and hence more profitable to exploit than policies issued in 2010. I rank these vintages from the most to least generous, and define what is essentially an inverse demand schedule $\hat{V}(q,\theta)$ that maps shares exploited q into exploitable values $\hat{V}$ for any degree of consumer inattention θ. I assume the inverse demand function is continuous, continuously differentiable, and strictly decreasing in q for any θ. When $\theta = 1$, $\hat{V}(q,1)$ is the exploitable value for the q^{th} most generous unit in force. When $\theta < 1$, $\hat{V}(q,\theta)$ returns the exploitable value of the q^{th} most generous unit in the hands of inattentive policyholders. I do not make any assumptions about the distribution of inattentive customers at this point, apart from noting that θ will govern the slope of the inverse demand curve. A lower degree of consumer inattention shrinks the set of policies which are exploitable at any exploitable value level $\hat{V}$, and steepens the inverse demand curve, as shown graphically below:

[6] In reality, there will be a small demand for exchanges even for the most generous policies for reasons discussed in Section IV. I will try to identify and control for this rational component in replacements in the estimation section.



Supply Side

On the supply side, the insurer is a monopolist on its demand curve, meaning only it can make offers to its existing customers.[7] For every vintage, the insurer decides to exploit (extend an offer) or not taking the degree of consumer inattention and exploitable value as given.[8] For every policy that accepts the offer, which happens at rate θ, the insurer extracts its respective exploitable value $\hat{V}$.

Balance Sheet

Having defined the exploitable value curve $\hat{V}(q,\theta)$, also let $P(q,\theta)$ and $G(q,\theta)$ denote the associated present value of fees and reserves such that:

$$\hat{V}(q,\theta) = G(q,\theta) - P(q,\theta) \qquad \forall q,\theta \tag{17}$$

To understand how exchanges affect the insurer's balance sheet, I write down the general account assets and liabilities by integrating over the present value of fees and reserves of all policies in force for a contract i and a firm j, where policies are ranked from the most to least generous, assuming without loss of generality that each contract has total mass (contract value) 1 (so q denotes both

[7] One way to think about this is customers are locked-in, and only their current company can make them an exchange offer. In practice, however, most exchanges are initiated by brokers, and most brokers work with multiple companies. This means that a company can pay a broker to steal customers from another company. The new company earns a markup on the new policy, pays any costs associated with exchanging the customer, while the old company earns $\hat{V}$. I will shut down this channel by making markups on the new policies zero. (though what is needed is that the costs of exploitation exceed markups on new policies, which is consistent with the data). Hence, in equilibrium, no insurer would have an incentive to exploit the policies of other insurers even if it could, as the exploiter will bear all the costs and the original owner will reap all the benefits.

[8] This reflects the way insurers make exchange offers in practice. Around 33% of the aggregate exchange volume in 2018 came from Investment Company Act Rule 11-a2 offers, direct (mail) offers where insurers set eligibility up to the policy year and benefit type (see Figure D16 for an example). However, the remainder are initiated by brokers, so insurers need to incentivise brokers to exploit the right policies, and there is a concern that they might not be able to do that perfectly. In Appendix B8, I show that the model parameters can still be identified when incentives are not perfectly aligned, while in Appendix B10, I provide robustness by showing that re-estimating the model on the subset of exchanges originating from Rule 11-a2 offers returns similar results.

quantities and contract shares):

$$A_{ij} = \int_0^1 P_{ij}(q,1)dq \tag{18}$$

$$L_{ij} = \int_0^1 G_{ij}(q,1)dq \tag{19}$$

Assume that the firm exploits share q_{ij}. It removes variable annuity reserves associated with the most generous q_{ij} policies owned by inattentive consumers and renounces the right to the present value of future fees associated with the most generous q_{ij} policies owned by inattentive consumers, leaving the policies in the hands of attentive consumers unchanged:

$$A_{ij} = \int_0^1 P_{ij}(q,1)dq - \int_0^{q_{ij}} P_{ij}(q,\theta)dq \tag{20}$$

$$L_{ij} = \int_0^1 G_{ij}(q,1)dq - \int_0^{q_{ij}} G_{ij}(q,\theta)dq \tag{21}$$

and records an economic profit:

$$\int_0^{q_{ij}} \hat{V}_{ij}(q,\theta)dq = \int_0^{q_{ij}} G_{ij}(q,\theta)dq - \int_0^{q_{ij}} P_{ij}(q,\theta)dq \tag{22}$$

Equation (22) says that the economic profit from lapsation must equal the gross reserves minus the fees, and is the correspondent of equation (16) in a continuum of policies case. Finally, the firm records a statutory capital:

$$K_j = \sum_i \Big[A_{ij} - (1+\phi)L_{ij} \Big] \tag{23}$$

where $\phi > 0$ is an exogenous parameter. For instance, under US Actuarial Guideline 43, the insurer is required to post additional statutory reserves and subtract those reserves when reporting capital for regulatory purposes. ϕ would represent the amount of required statutory reserves in excess of market value reserves. Alternatively, the insurer might voluntarily decide to set additional reserves for internal risk management purposes. ϕ would then capture the tightness of the value at risk constraint.

Financial, Reputational and Product Market Frictions

Low statutory capital could lead to a rating downgrade or regulatory action, which has adverse consequences in both retail and capital markets. I model financial constraints through a cost function and assume it is continuous, twice continuously differentiable, strictly decreasing, and

strictly convex in statutory capital:

$$C_j = C(K_j) \qquad s.t \qquad \frac{\partial C_j}{\partial K_j} < 0 \qquad \frac{\partial^2 C_j}{\partial K_j^2} > 0 \tag{24}$$

The cost is decreasing as higher statutory capital reduces the probability of a rating downgrade or regulatory action, and convex, as building up statutory capital has diminishing returns. The shape of the cost function has been validated by several empirical studies (see Koijen and Yogo (2015), among others). Implicit in this formulation are financial frictions that make funding statutory capital costly.

Moreover, I assume that exploiting inattentive consumers carries reputational costs $B_j > 0$ (broadly defined). The costs can be borne directly by the insurer (fines for failure to supervise its salesforce, loss of future profits associated with bad image) or indirectly by the salesforce and charged back to the insurer as brokerage compensation. I model reputational costs as a function of firm-level exploitation intensity that is continuous, twice continuously differentiable, strictly increasing, and strictly convex:

$$B_j = B\left(\sum_i q_{ij}\right) \qquad s.t \qquad \frac{\partial B_j}{\partial q_{ij}} > 0 \qquad \frac{\partial^2 B_j}{\partial q_{ij}^2} > 0 \tag{25}$$

Reputational costs are convex to capture the (intuitive) idea that one cannot exploit indefinitely no matter how large (but finite) the marginal benefit from exploitation might be. Firms caught exploiting on a large scale tend to go out of business.

To close the model, I assume that insurers make zero profits on new policies. This says that a market where most players are exiting (as was the variable annuity market after the crisis) cannot be very profitable, and implies that the economic profits extracted from exchanging variable annuities must come exclusively from lapsing existing policies. That is, the total economic profit from exploiting quantity q_{ij} remains:

$$\int_0^{q_{ij}} \hat{V}_{ij}(q,\theta)dq$$

The Firm Problem

The firm chooses the exploitation intensity q_{ij} to maximize economic profits from exploitation subject to the inverse demand curve for exchanges, financial and reputational constraints:

$$\max_{qij} \left\{ \int_0^{q_{ij}} \hat{V}_{ij}(q,\theta)dq - B_j - C_j \right\} \tag{26}$$

The notion that firms choose the amount of exploitation to maximise profits is in the spirit of Becker (1968). Egan et al. (2019) show that the average financial advisory firm (which is the type of firm employed by insurers to exchange variable annuities) is approximately profit maximizing when deciding how many bad advisers to retain and implicitly what amount to exploit. I am extrapolating this notion to the level of the overall insurance company. Given the regularity conditions on $\hat{V}(\cdot)$, $B(\cdot)$ and $C(\cdot)$, the maximization problem is guaranteed to have a global maximum at q^*_{ij}. The first order condition with respect to q_{ij} is:

$$\hat{V}_{ij}(q_{ij},\theta) + c_j\left[\hat{V}_{ij}(q_{ij},\theta) + \phi G_{ij}(q_{ij},\theta)\right] - (1+c_j)b_j = 0 \tag{27}$$

where $b = {}^{\partial B}/_{\partial q}$ from equation (25) and $c = -{}^{\partial C}/_{\partial K}$ from equation (24). Equation (27) says that the marginal benefit from exploitation, which is composed of two terms: the profit from buying back the old policy at the account value and any associated benefit from relaxing financial constraints (arising from both economic profits $\hat{V}_{ij}$ and removing reserves G_{ij}) must equal the marginal cost – the reputational cost and its impact on financial constraints. It is useful to decompose the gross option value G_{ij} into a net option value $\hat{V}_{ij}$ and the present value fee P_{ij}:

$$G_{ij}(q_{ij},\theta) = \hat{V}_{ij}(q_{ij},\theta) + P_{ij}(q_{ij},\theta) \tag{28}$$

so the first order condition becomes:

$$\hat{V}_{ij}(q_{ij},\theta)\big(1 + c_j(1+\phi)\big) + c_j\phi P_{ij}(q_{ij},\theta) = (1+c_j)b_j \tag{29}$$

I do not observe P_{ij}. However, given that the present value of future fees is much smaller than the present value of future benefits by definition of the variable annuity being deeply in the money $P_{ij} << G_{ij}$, the second term $c_j\phi P_{ij}$ will be one order of magnitude smaller than the rest, so I will ignore it. The optimality condition in the exchange market becomes:

$$\hat{V}_{ij}(q^*_{ij},\theta) = \frac{1+c_j}{1+c_j(1+\phi)}b_j = \frac{b_j}{\lambda_j} \tag{30}$$

The LHS is the exploitable value of contract i from firm j assuming a share θ of consumers is exploitable and a quantity q^*_{ij} has already been exploited, and varies at the contract level. The RHS is the ratio of reputational costs b to the cost of financial constraints (summarised in λ) for firm j and varies at the firm level. Because the denominator is never smaller than 1, the RHS is also a

lower bound on the firm-level marginal cost of exploitation. As the reputational cost operates at the firm level and not the contract level, another way to read the optimality condition is that insurers set exploitation intensities across contracts to equalise the contract-specific marginal benefits from exploitation with the firm level reputational cost.

Qualitative Predictions

The model matches all the main patterns in the data. At the contract level, within the same insurance company, the model predicts that contracts with a higher share of policies above that firm's reputational cost (more generous contracts) will have higher exploitation intensities. Second, for the same contract across firms, companies which that are more financially constrained (see the estimation section) will have higher exploitation intensities. Third, for the same contract across firms, companies which are have lower reputational costs (private-equity owned insurers) will have higher exploitation intensities. Finally, if one thinks of stricter intermediary standards of care as making exploitation more expensive (higher b_j), then stricter intermediary standards of care result in lower exploitation intensities.

VII. Estimation

In this section, I take the optimality condition in the exchange market in equation (30) to the data to estimate the degree of consumer inattention θ, the firm level reputational costs b_j and the cost of financial constraints λ_j. The estimation proceeds in three stages, shown below:

First Stage

For every contract i of firm j, I use within-contract variation in the issue time profile of life annuity benefits to pin down the contract-specific marginal benefit curve $\hat{V}_{ij}(q_{ij})$ under the assumption of full inattention ($\theta = 1$). Specifically, let $\hat{V}_{ijt}$ denote the average excess life annuity value per dollar of account value for policies issued at time t in contract i and firm j, and let $q_{ijt} \in [0, 1]$ denote the

contract value share for all policies in ij at least as generous as $\hat{V}_{ijt}$.[9] Let:

$$\hat{V}_{ijt} = \alpha_{ij} + \beta_{ij} q_{ijt} + \epsilon_{ijt} \tag{31}$$

I estimate equation (31) at the contract issue quarter level for 946 variable annuity contracts (each contract has on average 22 issue quarters) in 2018 and store the point estimates $\hat{\alpha}_{ij}$ and $\hat{\beta}_{ij}$. $\hat{\alpha}_{ij}$ is a contract-specific intercept which measures the marginal exploitation benefit on the first (most generous) unit exploited and $\hat{\beta}_{ij} \leq 0$ is a contract-specific slope parameter that measures how the marginal exploitation benefit falls with the amount exploited q_{ij} when all consumers are inattentive. I define the marginal benefit curve (assuming full inattention) as the predicted value:

$$\hat{V}_{ij}(q_{ij}, 1) = \hat{\alpha}_{ij} + \hat{\beta}_{ij} q_{ij} \quad \forall q_{ij} \in [0, 1]. \tag{32}$$

The linearity assumption in equation (32) is not particularly restrictive. Given that most variation in the generosity of legacy variable annuities seems to come from variation in life annuity values (I make this point clear in Appendix A3), one alternative would be to fit the observed within-contract distribution of life annuity values very tightly. I have done that in Appendix B11 to show that the main parameters (the degree of consumer inattention, reputational cost and financial constraints) are very similar.

I now introduce partial inattention. Specifically, I assume that within contract, inattentive customers are uniformly distributed across the generosity spectrum. This says that for any given contract, which is a collection of policies having the same contract characteristics but perhaps written at different points in time, customers having bought policies in 2004 are on average as inattentive as those who bought policies in 2008. Under this assumption, a partial degree of inattention $\theta_{ij} < 1$ shrinks the distribution of exploitable values proportionally, as for every exploitable value level $\hat{V}$,

[9] Specifically, for every contract i of firm j, I see when the contract was active, the amount sold each quarter, and use estimates of average cumulative surrender and mortality rates for contracts issued in the same quarter, having the same benefits and the same moneyness from LIMRA to get an estimate of the contract value still in force in 2018 at the issue quarter level. q_{ijt} is cumulative contract value (still in force as of 2018) over all quarters at least as generous as t, divided by total 2018 contract value in force in ij. Similarly, for every contract i of firm j, I use the contract benefit characteristics to construct the average life annuity value that an individual, having purchased a variable annuity in issue quarter t, would obtain if she exercised immediately at age 60 (which is representative of the age of exchange buyers) in 2018. For a policy issued in quarter t and evaluated in 2018, $\hat{V}_{ijt}$ is:

$$\hat{V}_{ijt,2018}(n) = \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} w^{X_{t,2018}/S_{2018}}}{Y^{s}_{2018,2018+s}} - 1$$

where S_{2018} is the account value in 2018, $X_{t,2018}$ is the benefit base for a contract issued in quarter t and evaluated in 2018, π_n the one-year survival probability at age n, w the annual withdrawal rate under the contract and Y is the gross discount rate. The text drops the subscripts denoting the age $n = 60$ and the current period 2018 for simplicity.

there are fewer consumers to exploit, or equivalently steepens the slope of the marginal benefit curve. The marginal benefit curve under inattention level θ_{ij} becomes:

$$\hat{V}_{ij}(q_{ij}, \theta_{ij}) = \hat{\alpha}_{ij} + \frac{1}{\theta_{ij}} \hat{\beta}_{ij} q_{ij} \quad \forall q_{ij} \in [0, 1]. \tag{33}$$

Second Stage

Second, I use within-firm (across contracts) variation in contract generosity ($\hat{\alpha}_{ij}$, $\hat{\beta}_{ij}$) and data on actual exploited intensities q^*_{ij} to pin down the degree of consumer inattention θ and the ratio of reputational costs to financial constraints b_j/λ_j, under the additional assumption that consumer inattention is constant across contracts and firms ($\theta_{ij} = \theta$), to be relaxed later on:

$$\hat{\alpha}_{ij} + \frac{1}{\theta} \hat{\beta}_{ij} q^*_{ij} - b_j/\lambda_j = u_{ij} \tag{34}$$

Equation (34) is the correspondent of the optimality condition in equation (30) in the data. The first two terms capture the marginal economic benefit from exploitation, expressed as the marginal curve in equation (33) evaluated at the actual exploitation intensity q^*_{ij}, the third term is an insurer fixed effect that captures the ratio of reputational costs to financial constraints, and u_{ij} is a structural error that captures any reason why the optimality condition in (30) (the marginal benefits get equalised at the firm-level marginal cost) might not hold exactly in the data.

To proxy for exploitation intensities q^*_{ij}, I use 2018 contract-level replacement intensities, defined as contract value replaced over contract value in force. However, that implicitly assumes that all exchanges are evidence of consumer exploitation. I relax this assumption in appendix B12, where I identify the rational component in replacements under the assumption that, within contracts with otherwise similar characteristics (default, tax, liquidity), replacement intensity should not increase with contract generosity. Under this assumption, the replacement intensity in similar but deeply out-of-the-money policies captures the rational replacement rate and any excess is evidence of exploitation. I reestimate the model using this excess replacement as q^*_{ij} and results are unchanged.

Third Stage

Finally, I use across-firm variation in characteristics to tease out reputational costs b_j from financial constraints λ_j. Specifically, I parameterise the ratio of reputational costs to financial constraints (the insurer fixed effect in equation (34)) as an exponential linear function of insurer characteristics

X_j:

$$b_j/\lambda_j = \exp(\gamma X_j) + \xi_j \tag{35}$$

and partition the vector X_j into characteristics that plausibly correlate with financial constraints $X_{\lambda j}$ and characteristics that correlate with reputational costs X_{bj}. Specifically, I parameterize financial constraints as an exponential linear function of insurer characteristics:

$$\lambda_j = \exp(\lambda_0 + \lambda X_{\lambda j}) \tag{36}$$

where λ_0 is the shadow cost of capital for unconstrained companies (approximately 0) and $X_{\lambda j}$ are company characteristics that past literature has shown to capture financial constraints, normalized such that $X_{\lambda j} = 0$ is unconstrained. I have considered the AM Best financial strength rating (the lower the rating, the more financially constrained), whether the company uses shadow reinsurance (Koijen and Yogo (2016)), whether the company applied to or benefited from government financial assistance and more generally whether it was forced to raise equity during the last financial crisis (Koijen and Yogo (2015)), whether the company was willing to pay existing customers a bonus to lapse their generous policies, and both level and the change in variable annuity reserves around the financial crisis (the bigger the shock in reserves during the crisis, the more financially constrained, see Koijen and Yogo (2020)).

Second, I also parameterize reputational costs as an exponential linear function of insurer characteristics:

$$b_j = \exp\left(b_0 + b_1 PE_j + b_2 Q_j\right) \tag{37}$$

where b_0 is the reputational cost on the first unit exploited for non-PE firms, b_1 captures the extra reputational cost on the first unit for PE firms and b_2 captures the shape of the marginal reputational cost curve, which depends on total amount exploited Q_j (as in equation (25)) and which can be evaluated separately for PE and non-PE owned firms. The coefficient on total quantity exploited will turn out to be positive, which I interpret this as evidence that reputational costs are convex. And so the ratio becomes:

$$b_j/\lambda_j = \exp(b_0 + b_1 PE_j + b_2 Q_j - \lambda_0 + \lambda X_{\lambda j}) + \xi_j \tag{38}$$

I combine the second and third stages to estimate:

$$\hat{\alpha}_{ij} + \frac{1}{\theta}\hat{\beta}_{ij}q^*_{ij} - \exp(b_0 + b_1 PE_j + b_2 Q_j - \lambda_0 - \lambda X_{\lambda j}) = u_{ij} + \xi_j \tag{39}$$

Note that since I cannot separately identify the intercept on the reputational costs b_0 from that on financial constraints λ_0, I will assign the difference $b_0 - \lambda_0$ to reputational costs, with the understanding that it measures the reputational cost on the first unit exploited for traditional insurers, net of the cost of financial constraints for the highest rated, least constrained company (arguably close to 0). I estimate equation (39) on contract level data from 946 variable annuity contracts across 33 insurance groups in 2018 to solve for $\{\theta,\, b_0 - \lambda_0,\, b_1,\, b_2,\, \lambda\}$.

Extensions

I consider three extensions to make the model more realistic. First, I allow residual characteristics to enter the marginal benefit curve. Specifically, I parameterise the residual characteristics to enter the $\hat{V}_{ij}(\cdot)$ additively (shift the valuation up and down for all issue quarters and consumer inattention levels θ):

$$\hat{V}_{ij}(q_{ij}, \theta) = \hat{\alpha}_{ij} + \frac{1}{\theta}\hat{\beta}_{ij}q_{ij} + \delta_0 + \delta'\mathbf{x}_{ij} \tag{40}$$

where δ_0 captures the value of residual characteristics common to all policies (e.g. the value of a standard death benefit), while δ captures variation in the value of residual characteristics coming from observable contract characteristics. The vector $\mathbf{x}_{ij}$ includes contract characteristics that plausibly shift the exploitable value curve for any life annuity value (summarised by $\hat{\alpha}$ and $\hat{\beta}$). I consider the type of standard death benefit (a guaranteed minimum death benefit is more valuable than a residual death benefit), whether the contract offers a positive guaranteed rate of return on the account value going forward, and the contract fee (the higher the fee, the lower the present value of residual benefits, all else equal).

Second, I allow for the degree of consumer inattention to vary across contract characteristics. Specifically, let:

$$\theta_{ij} = \theta_0 \exp\left(\theta_1' \mathbf{x}_{ij}\right)$$

where $\mathbf{x}_{ij}$ is a vector of contract characteristics demeaned such that θ_0 captures the degree of consumer inattention at the average contract characteristics while θ_1 captures the slope of θ with

respect to each contract characteristic:

$$\frac{\partial \theta_{ij}/\partial x_{ij}^k}{\theta_{ij}} = \theta_1^k$$

As contract characteristics, I look at the contract fee, both because it is a key characteristic for valuation (the higher the fee, the lower the value of residual contractual benefits, the lower the incentive to exchange) and because it subsumes brokers incentives (the higher the fee, the higher the brokerage commission).

Finally I allow for corner solutions. The optimality condition in equation (31) becomes a (weak) inequality when the exploitation intensity q_{ij}^* drops to zero. $q_{ij}^* = 0$ might indicate that the marginal cost equals the marginal benefit (interior solution) or more likely that the marginal cost on the very first unit exploited exceeds the marginal benefit, so the insurer optimally exploits zero (corner solution). Ignoring corner solutions underestimates the marginal cost, as $MB \leq MC$. To accomodate corner solutions, I introduce a slackness variable $\omega_{ij} \geq 0$ such that:

$$\hat{V}_{ij}(q_{ij}^*, \theta_{ij}) + \omega_i j = \frac{b_j}{\lambda_j} \quad \forall ij$$

and parameterize it as :

$$\omega_{ij} = \omega \mathbb{1}(q_{ij}^* = 0) \tag{41}$$

where $\mathbb{1}(q_{ij}^* = 0)$ is a dummy variable set to one whenever $q_{ij}^* = 0$ and the coefficient ω measures to average slackness of the inequality constraint at the corners. I will estimate this coefficient with $\omega \geq 0$ as a test of the model. The estimation equation becomes:

$$\hat{\alpha}_{ij} + \frac{1}{\theta_0 \exp(\theta_1' \mathbf{x}_{ij})} \hat{\beta}_{ij} q_{ij}^* + \delta_0 + \delta' \mathbf{x}_{ij} + \omega \mathbb{1}(q_{ij}^* = 0) - \exp(b_0 + b_1 PE_j + b_2 Q_j - \lambda_0 - \lambda X_{\lambda j}) = u_{ij} + \xi_j \tag{42}$$

As before, I estimate equation (42) on contract level data from 946 variable annuity contracts across 33 insurance groups in 2018 to solve for $\{\theta_0,\ \theta_1,\ \delta,\ \omega,\ b_0 - \lambda_0,\ \mathbf{b},\ \lambda\}$. Note that δ_0, the value of residual characteristics common to all policies, is not separately identified. This means that what I will identify as reputational costs will also be net of the value of the most basic residual benefit (typically a residual account value death benefit).

Finally, note that the quantity exploited q_{ij}^* (and hence also Q_j) is endogenous in the model. The insurer chooses q_{ij} to equalize the contract level marginal benefit at the firm marginal cost.

This means that coefficients are identified under the following exogeneity assumption:

$$\mathbb{E}[u_{ij} + \xi_j | q^*_{ij}, \hat{\beta}_{ij}, PE_j, X_{\lambda_j}] = 0$$

which I interpret as the insurer not being able to condition exploitation intensities q^*_{ij} on characteristics other than what I have included in the estimation (the relative generosity of its life annuity benefits (which is summarised by $\hat{\alpha}_{ij}$, $\hat{\beta}_{ij}$), the fee, the rollup rate, the death benefit, characteristics driving financial constraints and reputational costs) - which seems consistent with data on exchange offers (see Figure D17).

The coefficient estimates are available in Table VIII. The average degree of consumer inattention θ_0 is 0.203, with a standard error of 0.018, indicating that 20% of existing policyholders ignore important contract characteristics. The degree of consumer inattention increases with contract fee and commission, potentially because high fee contracts or contracts paying high brokerage commissions and may cater to more naive customers (Table IX)

Traditional insurers pay an estimated 11.079 cents per dollar (SE 1.699) on the first unit exploited as reputational costs, compared to only $7,292$ (SE 1.141) for PE-controlled companies. Reputational costs increase exponentially with the amount exploited (Figure 12), which confirms the assumption in equation (25). The average cost of financial constraints λ is 1.27, meaning that insurers derive 27 cents per dollar in benefits from relaxing financial constraints for every dollar in economic profits from exchanges, and is in line with existing estimates for the US variable annuity market (Koijen and Yogo (2020) find that λ was 1.52 in 2008:4).

All other (incidental) parameters also have reasonable values. The slackness variable ω is 6.660 (SE 1.029), meaning that I would underestimate marginal costs by about 6.6 cents per dollar on average by ignoring corner solutions. The coefficient on the guaranteed minimum death benefit is 1.834 (SE 0.874), which implies that having a standard death benefit which guarantees the return of premium or a potentially positive rate of return adds on average $1,834 in value for every $100,000 in account value net of fees, relative to a standard death benefit paying only the residual account value. The coefficient on the rollup dummy is 0.836 (SE 1.244) saying that a policy continuing to pay a minimum return guarantee on the account value going forward is worth $836 more than one that does not. Finally, the coefficient on the fee is negative and large (-4.422, SE 1.646), suggesting that high fee contracts (such as where you get a bonus upfront in exchange for higher fees over the life of a contract) are substantially less valuable than their lower fee counterparts.

Application I. Insurer Surplus

I use the estimated model to compute the aggregate present value transferred from inattentive households to the insurance sector, the aggregate reputational costs paid by insurers and the aggregate insurer surplus from 1035 exchanges in 2018. The Present Value Transfer (PVT) captures the present value lost by inattentive households through 1035 exchanges, or equivalently, the aggregate economic profit made by insurers from exploiting inattentive consumers, before financial constraints and exploitation costs:

$$PVT = \sum_{ij} \int_0^{qij^*} \hat{V}_{ij}(q, \theta^*) dq \tag{43}$$

To compute aggregate reputational costs, I take the marginal reputational cost curve and integrate over amount exploited Q_j to find the total reputational cost per firm, then aggregate across all firms in the insurance sector:

$$B = \sum_j \int_0^{Q_j} \exp(b_0 + b_1 PE_j + b_2 Q) dQ \quad \forall j \tag{44}$$

I then define insurer surplus as transfers from households minus extraction (reputational) costs, adjusted for the cost of financial constraints, aggregated across all firms in the insurance sector:

$$\mathbb{V} = \sum_j \left[\big(1 + c_j(1+\phi)\big) \sum_i \int_0^{qij^*} \hat{V}_{ij}(q, \theta^*) dq - \big(1 + c_j\big) \int_0^{Q_j} \exp(b_0 + b_1 PE_j + b_2 Q) dQ \right] \tag{45}$$

I find that insurers extracted an aggregated \$1.62 billion in present value from inattentive customers in 2018. This figure varies from \$1.56Bn to \$1.66Bn once I account for uncertainty in θ at the 95^{th} confidence level. Of that, \$1.42Bn came from life annuity benefits and \$0.20Bn from forgone residual benefits. Insurers pay \$1.22Bn in aggregate reputational costs, get \$0.40Bn in economic surplus, and an additional \$0.72Bn in net benefit from relaxing financial constraints, for a total surplus of \$1.12Bn.

Application II. Solvency

By removing large amounts of costly legacy policies over the last decade, insurers have strengthened their capital position and ultimately improved solvency. In this subsection, I examine under plausible assumptions what would happen to insurers surplus, ratings, and expected loss to policyholders if they would have kept those hundreds of billions of legacy variable annuities on their books. The

full details of this counterfactual exercise are available in Appendix B2.

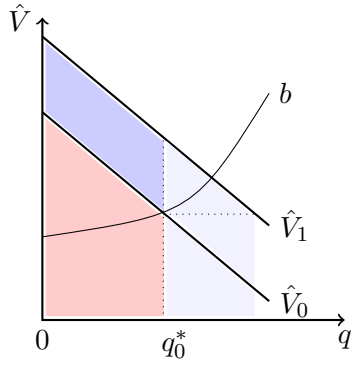
I begin by thinking of the life insurance sector as a representative company. This company has an average rating, an average surplus, earns the average economic profit from exchanges, pays the average reputational cost and records the average surplus per dollar exchanged. Between 2010 and 2018, there were $410Bn in variable annuity exchanges. Assuming the contracts exchanged were similar in characteristics with those exchanged in 2018, they would have resulted in a surplus of 7.13c per dollar exploited, which amounts to $29.24Bn in cumulative surplus. This representative company had surplus of $310Bn in 2018 (aggregate US life and health surplus), which means that a no-exchange scenario would have reduced surplus by 9.43%. Given this representative company had an AM Best rating of $A \to A+$, which is equivalent to a risk-based capital (RBC) ratio of 150%, a drop of 10% in surplus would result in a new RBC of 135% and a 1 notch drop in ratings.

I then use historical data to map the drop in ratings to changes in expected losses to policyholders. I estimate that this drop in ratings would be associated with a 0.12 cents increase in the present value of expected losses per dollar of policyholder reserves over the next 15Y. Given there were $1.981Bn in life and health statutory reserves across variable annuity writers in 2018, this would amount to a $2.4Bn increase in present value expected loss sectorwide (from about $5.2Bn currently to $7.6Bn under the counterfactual).

As I discuss in Appendix B2, there are several arguments suggesting this $2.4Bn increase in expected loss should be a lower bound. One is that ratings and risk-based capital often do not account for some off-balance sheet liabilities, such as affiliated unauthorized (shadow) reinsurance, overstating insurers solvency. For a lower base level of solvency, the same drop in surplus has larger impact on expected loss. Koijen and Yogo (2016) estimate that accounting for shadow insurance would increase required capital by 33% or equivalently lower RBC by 1-1/1.33 = 25% (from a current 150% to 112.5%) which is equivalent to an AM Best rating of B+. A further 10% fall in surplus from a no-exchange scenario would bring RBC to 100% or an AM Best rating of B. In this case, a no-exchange scenario would result in a 0.57 cents increase in present value of expected loss per dollar of policyholder reserve, or an aggregate increase of $11.4Bn (from $18.1Bn currently to $29.5Bn under the counterfactual). To put things in perspective, that would account for 85% of the state guarantee associations 2018 annual funding capacity estimated at $13.1Bn.

Application III. 1% Fall in Interest Rates

Next, I compute the counterfactual increase in present value transfer that would occur if interest rates were 1 percentage points lower than they were in 2018. Specifically, I consider a scenario whereby the whole term structure of interest rates would shift downwards by 1 percentage point, holding contract moneyness X_t/S_t constant (this is an approximation of what happened in 2020, when interest rates went down but stock markets recovered by the end of the year). Lower interest rates increase the present value of variable annuity benefits and make contracts more profitable to exploit. Holding exploitation costs constant, contracts that were not exploitable before would become exploitable now. However, marginal exploitation cost is not constant, but plausibly increasing in the amount exploited (see eq (25)). The extent to which new contracts would be exploited depends on the shape of the marginal cost curve b:



I provide a lower bound under which no new contract would be exploited (the reputational cost binds), an upper bound under which marginal exploitation costs are (locally) flat, such that all contracts whose exchange value would exceed the original marginal exploitation cost $b(q_0^*)$ would be exploited, and a best estimate, where the amount exploited grows to equalize the new marginal benefit with new marginal cost as predicted from equation (37). I find that present value transfers would increase by \$0.56 billion under the lower bound (dark blue area), by \$5.19 billion under an upper bound (dark blue + light blue area) and by \$2.26 billion under a best estimate where exploitation amount rises to equalize the marginal benefit curve ($\hat{V}_1$) with the marginal cost curve (b) (see Appendix B3 for derivations). I find that exploited quantities have not increased in 2020, which either means that either $b(q)$ is vertical (unlikely) or more plausibly point to the effect of the pandemic and lockdown on consumer demand for exchanges and the ability of brokers to persuade customers.

Application IV. Effectiveness of Fiduciary Duty

Fourth, I use the model to assess the effectiveness of fiduciary duty. First, I compute the aggregate distribution of exploitable values for the set of contracts domiciled in New York State offering guaranteed living benefits at any point between 2004-2008. The average replacement intensity reported for these contracts in 2018 was 6.3%. The counterfactual replacement intensity that would prevail if fiduciary duty were imposed was structurally estimated to be 4% lower at 2.3% (see Section V E). The policy was only active over the second half of 2019 so the effect can be considered a lower bound. Holding fixed the empirical distribution of exploitable values and the estimated degree of consumer inattention, I compute the change in reputational costs that would rationalize the drop in replacement intensities resulting from the imposition of the NY Fiduciary Duty (see Appendix B4 for full derivations). I find that reputational costs increased on aggregate by 8 cents per dollar. That is, the cost of exploiting a $100,000 policy have risen on average by $8,000 as a result of fiduciary duty. The rise in the cost of exploitation, or equivalently stated, the fall in exploitation effectiveness might provide one explanation why several large insurance companies (AIG, MetLife) have recently decided to spin off their brokerage subsidiaries in expectation of a nationwide fiduciary rule.

I then compute the counterfactual drop in present value transferred from inattentive households to the insurance sector that would have occured had a nationwide fiduciary rule been imposed in 2018 (as the US Department of Labor originally intended before its rule was vacated in court in June 2018). Specifically, I compute the marginal benefit on the last exploited unit implied by the estimated model at the contract level in 2018 ($\hat{V}_{ij}(q^*, \theta^*)$), add a constant 8 cents per dollar, and recompute the new present value transfer (using eq. (42)) assuming only contracts that were generous enough ($\hat{V} \geq \hat{V}(q^*, \theta^*) + 8$) would be exploited. I estimate that the DOL Fiduciary rule would have decreased the aggregate present value transfers by 78% nationwide (from $1.62 billion to $0.35 billion) in 2018 alone.

Application V. Risk Adjustment

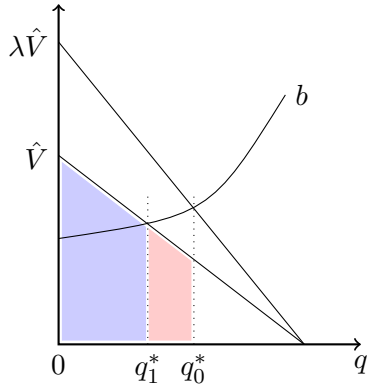
I then examine what would happen to consumer exploitation if I would relax financial constraints. To ensure insurers are able to honour their obligations to policyholders in bad states of the world, regulators require that insurers hold statutory reserves in excess of the present expected value of

liabilities. Funding these reserves is costly, resulting in:

$$\lambda = \frac{1 + c_j(1+\phi)}{1 + c_j} > 1$$

Governments have a wide array of tools they could use to relax financial constraints: from relaxing insurers VaR constraints ($\phi \downarrow$), raising the statutory discount rate on liabilities ($\phi \downarrow$), tolerating shadow insurance ($\phi \downarrow$), postponing regulatory action for each solvency level ($c_j \downarrow$), to subsidizing insurers cost of funding in the equity markets ($c_j \downarrow$) and even outright recapitalising the companies ($c_j \downarrow$). In what follows, I examine what would happen to consumer exploitation if we made the cost of financial frictions $\lambda = 1$ for all insurers.

In the model, a lower λ reduces the marginal benefit from each dollar exploited by rotating the MB curve inwards around its x-intercept (see below). That reduces the amount exploited for every reputational cost level, which in terms reduces the marginal reputational cost by moving leftward along the reputational cost curve. The new exploited quantity q_1^* is such that the two effects cancel out.



The estimation is in Appendix B5. I find that the amount exploited would fall by 40% and value extracted by 35% by removing financial constraints. This suggests that profit motives alone could explain 3/5 of exploitation in 2018, with benefits from relaxing financial constraints explaining the remainder 2/5.

Application VI. Screening

If some customers only pay attention to salient features of the contract (fees, rollup rates, withdrawal rates) but overlook the details (that guarantees only accrue to the benefit base, not the account value, that withdrawal rates may drop once the account value is exhausted rather than stay fixed for life), then an insurance company can screen consumers ex-ante by designing a contract that

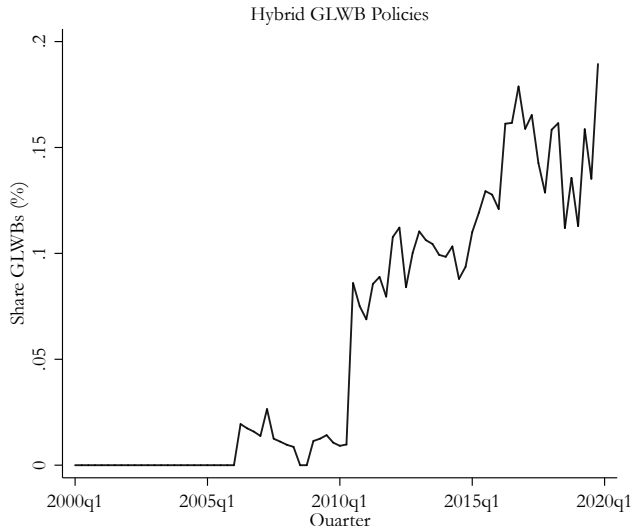
exploits consumers along those less visible features (Heidhues and Kőszegi (2017)). For instance, the insurance company could write a contract that has low fees, high rollup rates and high guarantees, but insert limits on guarantees and withdrawals that bind in bad states of the world. This would make ex-post exploitation through exchanges unnecessary.

So why have companies not screened consumers ex-ante? I use insights from the structural model to tackle this question. The model predicts that that a company would exploit a policy only when the benefits from exploitation (the economic profit from cancelling existing benefits and the benefit from relaxing financial constraints) exceed the reputational costs:

$$\frac{1+c_j(1+\phi)}{1+c_j}\hat{V}_{ij} \geq b_j \tag{46}$$

where $\hat{V}_{ij} = G_{ij} - P_{ij}$. If consumers are sensitive to fees (Koijen and Yogo (2020) shows that the price elasticity of demand is 2.8 times higher for variable annuities than for index funds), then the value of guarantees represents an upper bound on how much insurers can gain from consumer exploitation. When the guarantees were first issued before the financial crisis, they were deeply out of the money and hence not very valuable. During the financial crisis and subsequent period of low interest rates, insurers suffered a large adverse shock to the valuation of existing liabilities (average statutory reserves increased about six-fold) and a correspondingly large adverse shock to risk-based capital, to the extent to which the increased valuation in existing liabilities was not perfectly hedged (see Sen (2019), Koijen and Yogo (2020) and Appendix 1 of this paper for evidence on imperfect hedging). So both V_{ij} and c_j went up after the crisis. Moreover, many insurers stopped selling variable annuities, or sold variable annuity subsidiaries to private equity firms, which lowered reputational costs ($b_j \downarrow$). This means that there are policies that were not exploitable before the financial crisis, but became exploitable ex-post.

At the same time, there is suggestive evidence that companies have started screening customers in the primary markets as well. Since the financial crisis, there has been a growth in hybrid GLWB policies, which promise relatively high withdrawal rates for a relatively high fee, but with a catch. The high withdrawal rates are only as long as there is money in the account. Once the account is depleted, hybrid policies switch to a conservative withdrawal rate ($2-3\%$) for the remainder of one's life. Hybrid GLWBs may cater to a normative demand from consumers to withdraw more in the early years of retirement and less towards the end-of-life. But is also likely that hybrid GLWBs may be used by insurance companies to screen naive policyholders which are less likely to read the



small print.[10] The figure shows the growth in hybrid GLWB after the crisis. In 2018, around 20% of all contracts offered hybrid GLWBs, but 2/3 or variable annuity exchanges coming out of GLWB policies went into hybdrid GLWBs.

External Validity and Conclusions

The trade-offs discussed in this model apply to any consumer financial market where financial intermediaries bear significant aggregate risk over long horizons, consumers are sensitive to fees but not all product characteristics and there are gaps in consumer protections.

The UK defined benefit pensions market seems one example. In 2015, the UK implemented the Pension Freedoms – a reform allowing existing policyholders to transfer funds from their defined benefit pension plans into defined contribution plans as long as they sought financial advice. In the 5 years following its implementation, brokers exchanged £91 billion across 224,000 defined benefit plan members for an average of £406,421 per member. Advice was mandatory and 80% of it was on a contingent fee basis (no transfer, no fee), providing brokers strong incentives to recommend exchanges. In many cases, the defined benefit plan sponsors encouraged exchanges by paying bonuses and waiving brokerage transfer fees for employees who exchanged. In some cases, the brokerage firms providing advice were appointed and compensated by the plan sponsors. The UK Financial Conduct Authority conducted a random sample and found that only about half of the exchanges were suitable when considering the old product in isolation, and only about a third

[10]The fact that hybrid GLWB availability declined nationwide when the US Department of Labor announced their fiduciary rule, and rebounded when the rule was vacated except in NY State, where the rule was kept, further supports this hypothesis.

when accounting for the recommended product. Exchanges dropped when the contingent fee model was banned in 2020 (Financial Conduct Authority (2021)).

The US long term care insurance market seems another example. In the 1980s and 1990s in the US, insurance companies sold long term care insurance policies based on mortality and health spending assumptions that turned out to be overly optimistic ex-post (Liu and Liu (2019)). In a long-term care policy, the holder must make annual payments throughout the life of the policy to maintain coverage. While insurers could reprice policies with regulatory approval by raising the annual premium for the same benefits or lowering the benefits for the same premium, only proposals to raise premiums are being reviewed by regulators. The NAIC (2009) has shown that insurers submit premium hike proposals that are approved by regulators and then use those hikes to persuade consumers to accept benefit reductions that are not actuarially fair.

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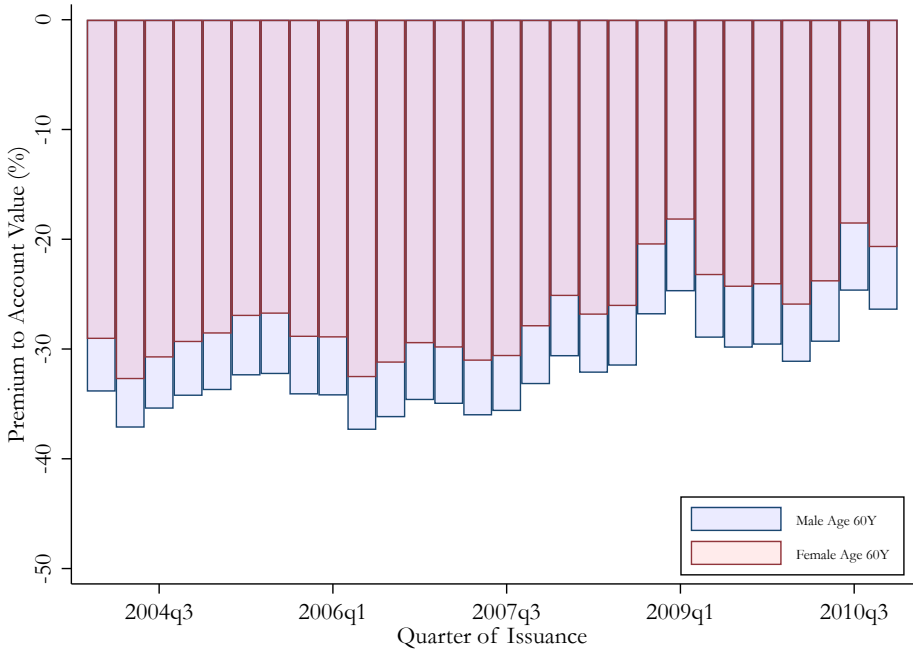
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Figure 1: **GLWB Implied Life Annuity Value at Issuance vs Replacement**

The top chart plots the present value of the life annuity implied by a guaranteed lifetime withdrawal benefit paying a 5% withdrawal rate for life for an individual aged 60Y at the time of issuance, for different issuance quarters over the period 2004Q1-2009Q4. Both Males and Females are shown. The bottom chart plots the same present value of the life annuity implied by a guaranteed lifetime withdrawal benefit paying a 5% withdrawal rate for life for an individual aged 60Y issued in 2007Q4, but now evaluated as of different replacements dates betwen 2010 and 2018. The present value is averaged across Males and Females. The present values are quoted as premiums (discounts) per dollar of account value.



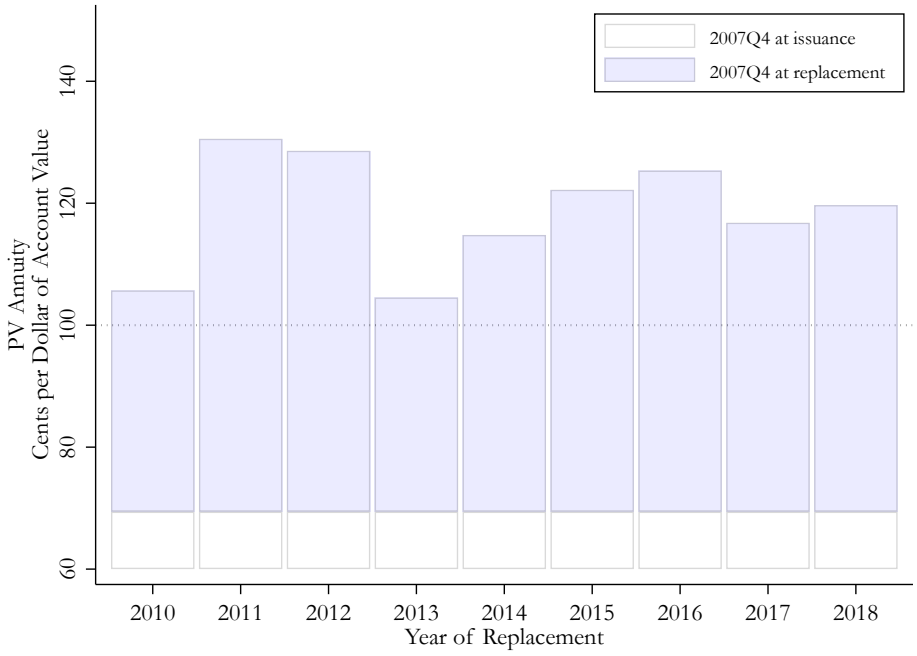
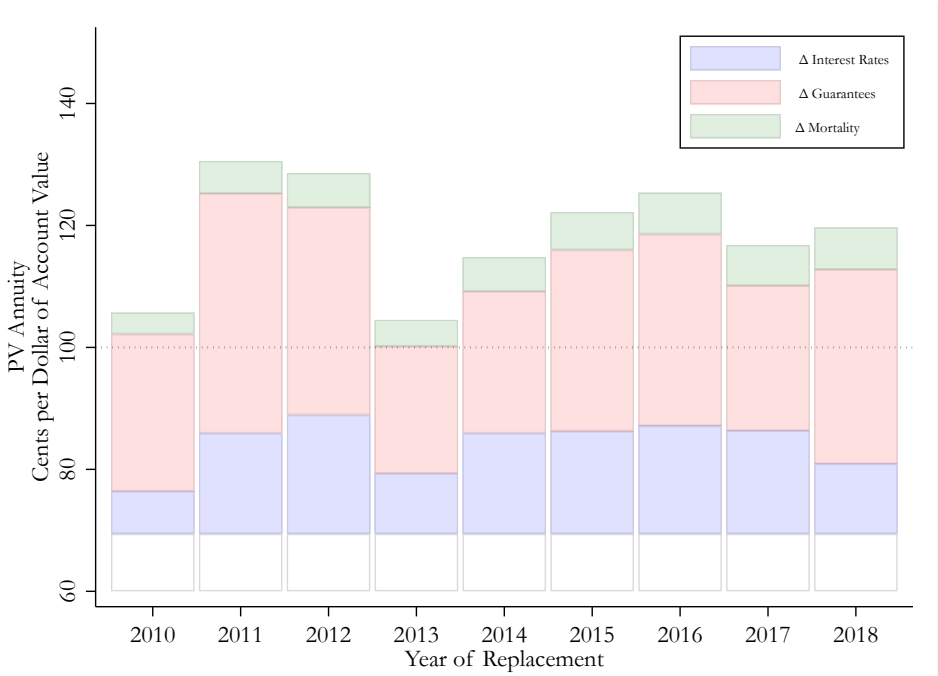


Figure 2: **GLWB Present Value Decomposition**

This chart decomposes the change in the value of the life annuity embedded in a GLWB variable annuity, between issue date in 2007Q4 and various replacement dates after the financial crisis, into three components: (1) changes in the term structure of discount rates (2) changes in ratio of the benefit base to contract value (capturing the effect of minimum return guarantees) and (3) changes in mortality assumptions. The valuation assumes a hypothetical individual aged 60Y who is able to exercise a 5% withdrawal rate GLWB immediately. For discount rates, I use quarterly averaged continuously compounded treasury yield curve from Gurkaynak Sack and Wright (2007). For mortality rates, I use the US Society of Actuaries Individual Life Annuity 2000 Mortality Basic Tables for 2007Q4, and the 2012 Mortality Basic Tables (with yearly adjustments before and after 2012 based on SOA Mortality Improvement Projection Tables) for the replacement dates. For benefit bases, I use the average benefit base to contract value for GLWB policies issued during 2007Q4 from LIMRA 2010-2018 experience studies.



Specifically, let t denote the issuance date before the financial crisis and t' the various valuation dates after the crisis. Let S_t be the account value at time t, $X_{t,t'}$ the benefit base for a contract issued at time t and evaluated at time t', $\pi_n(t)$ the one-year survival probability at age n as of time t, and w the fixed annual withdrawal rate under the contract. Then the value of the life annuity embedded in variable annuity issued at time t and evaluated at time t' (per dollar of t' account value) is:

$$LB_{t,t'}(n) = \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l}(t) w X_{t,t}/S_t}{Y^s_{t,t+s}} + \left[\sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l}(t) w X_{t,t}/S_t}{Y^s_{t't'+s}} - \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l}(t) w X_{t,t}/S_t}{Y^s_{t,t+s}} \right]$$
$$+ \left[\sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l}(t) w X_{t,t'}/S'_t}{Y^s_{t't'+s}} - \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l}(t) w X_{t,t}/S_t}{Y^s_{t't'+s}} \right]$$
$$+ \left[\sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l}(t') w X_{t,t'}/S'_t}{Y^s_{t't'+s}} - \sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l}(t) w X_{t,t'}/S'_t}{Y^s_{t't'+s}} \right]$$

where the first term is the value of the life annuity at issuance, and the subsequent 3 terms measure the contribution of changes in interest rates, changes in benefit base to account value and changes in mortality assumptions, respectively. The chart evaluates this equation for $t = 2007Q4$, $t' \in \{2010..2018\}$, $n = 60$ and Y as the gross treasury yield.

Figure 3: **1035 Exchange History**

This chart plots a history of variable annuity replacements from 3 different sources. Starting with 2014, LIMRA collects data on variable annuity replacement premiums at the aggregate US level. Since 2011, NAIC collects state-level data on the share of variable annuity replacement contracts in newly issued contracts. Two states: Illinois and Wisconsin, collect these data since 2006. I weight the state-specific series by US state-level variable annuity sales data from Morningtstar Annuity Intelligence. As average replacement premiums are considerably larger than new premiums (SEC data suggests the average replacement premium was 205.9k while the average new premium was 93,4k in 2018) I adjust the NAIC numbers up by a conservative factor of 1.5. Third, I add aggregate SEC 1035 exchanges starting with 2018.

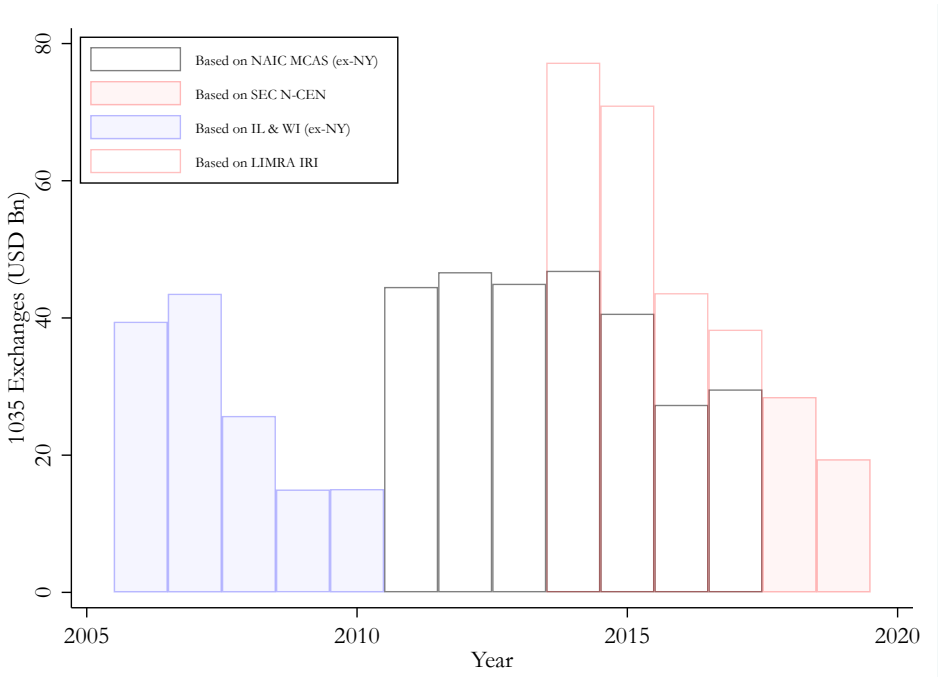


Figure 4: **Variable Annuity Contract Value by Generosity over Time**

The red line plots the aggregate variable annuity account value for all variable annuity contracts selling guaranteed living benefits during the period 2004-2008 and closed to new sales by 2011Q4. The blue line plots the aggregate variable annuity account value for all variable annuity contracts which also closed to new sales by 2011Q4 but did not sell guaranteed living benefits during 2004-2008. The dashed black line plots the evolution of aggregate account value for all vaeriable annuity contracts available in Morningstar Annuity Intelligence. All series normalised to their 2011Q4 levels. The dotted red line, provided for reference, charts the evolution of account value for a hypothetical portfolio of variable annuities invested 30% in cash (securities earning the Fed Funds rate) and 70% in the S&P500, charging a 4% annualised quarterly fee as percentage of account value, withdrawing at a 5% anualised rate (applied quarterly) as percentage of the account value and facing an annualised mortality rate equal to the one year mortality probability at age 60Y from the US Society of Actuaries 2012 Basic Mortality Table.

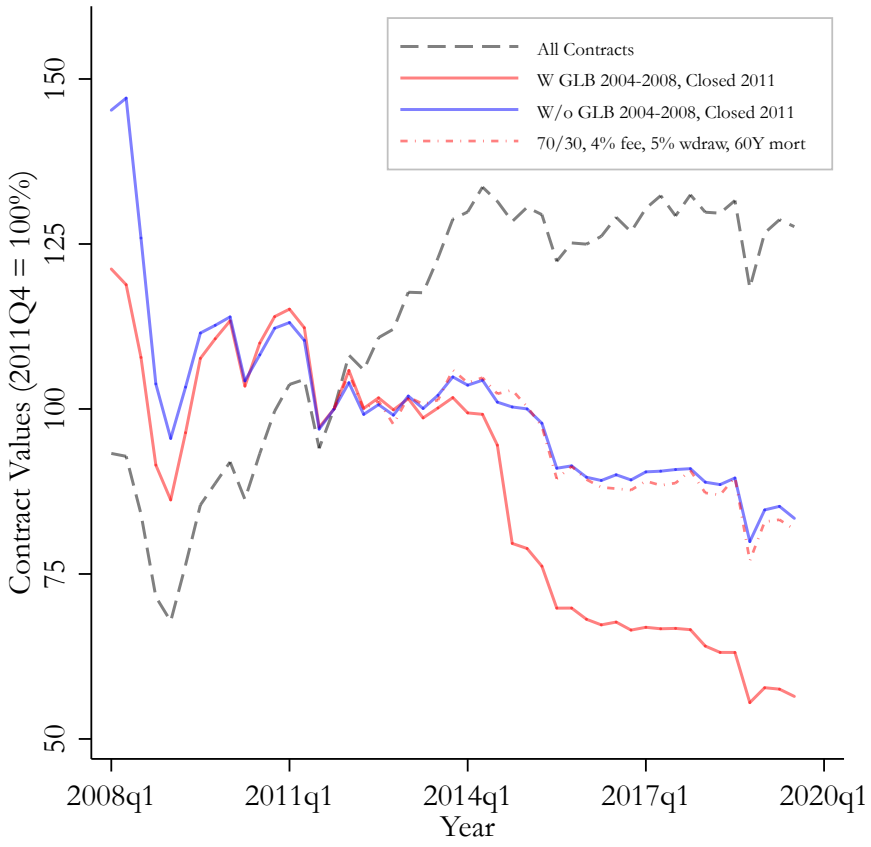


Figure 5: **Variable Annuity Replacement by Contract Generosity 2018**

This chart plots a binscatter of variable annuity contract replacement intensity versus the average contract withdrawal rates (% of account value) in 2018. Variable annuity replacement intensities defined as the amount exchanged (1035 outflows) as percentage of beginning-of-period separate account assets. The binscatter is formed by sorting the data on contract average withdrawal rates and then grouping it into 15 equally sized bins.

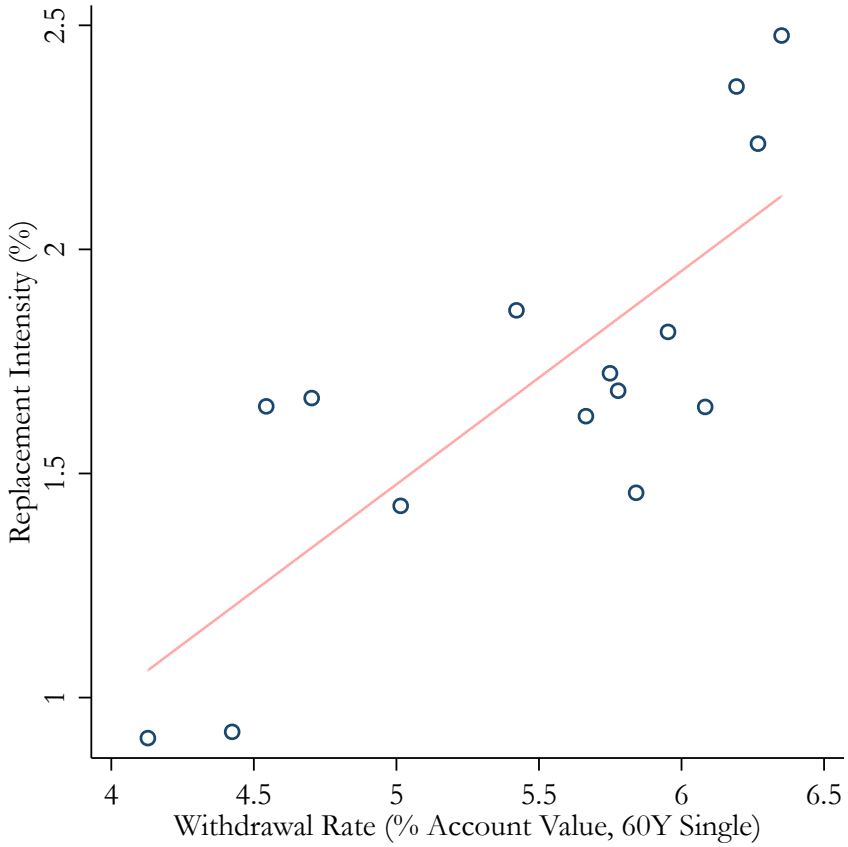


Figure 6: **1035 Parent Allocation**

This chart plots the distribution of variable annuity replacements across parent insurance companies for 2018. The data on variable annuity replacements comes from SEC N-CEN filings. The data on the identity of the parent company comes from Monrningstar Annuity Intelligence. Data sorted by 1035 Outflows.

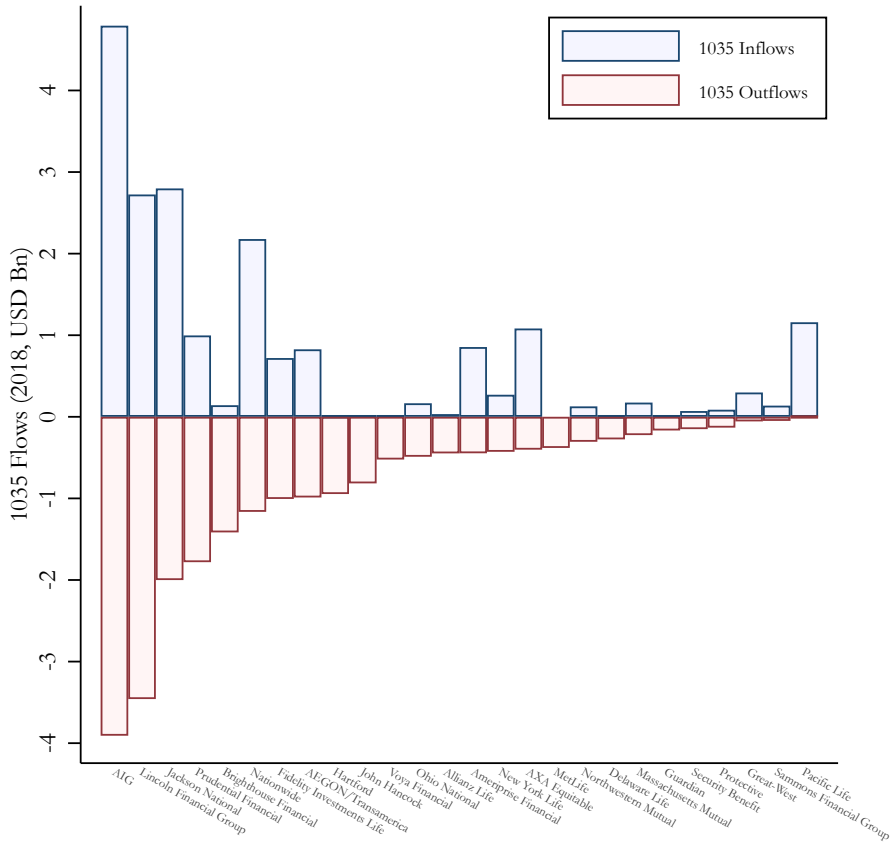


Figure 7: **Variable Annuity Replacement by Contract Size**

This chart plots a binscatter of variable annuity replacement intensity at a contract level against the average amount being replaced in US dollars (left panel) and average amount being replaced as percentage of average contract value in force for the subset of variable annuity contracts with non-qualified money exchanged in 2018 and 2019. The binscatter includes parent × year fixed effects to control for time-series (trends) and cross-sectional (cross-parent variation in default risk) variation in replacement intensity unrelated to the amount exchanged. To control for outliers, the x-variable is winsorized at the 95th percentile in the top panel and 90th percentile in the right panel. The data on variable annuity replacements comes from SEC N-CEN filings. The data on the identity of the parent company comes from Monrningstar Annuity Intelligence.

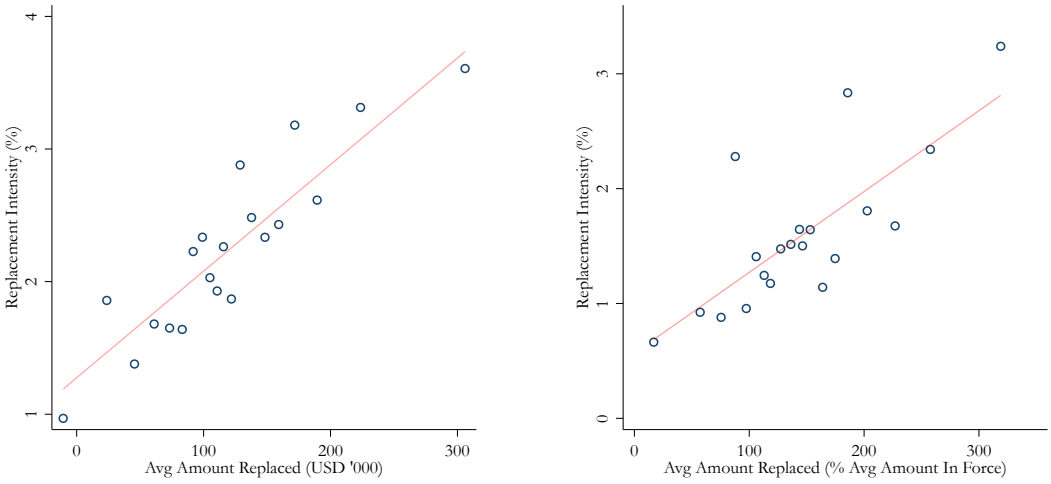


Figure 8: **Robustness: Annuity Exchange Offers**

This chart plots a binscatter of variable annuity contract replacement intensity in 2018 versus the average contract withdrawal rates (% of account value) in 2017. The sample excludes all variable annuity contracts subject to variable annuity buyback offers during 2017 or 2018. The binscatter is formed by sorting the data on contract average withdrawal rates and then grouping it into 15 equally sized bins.

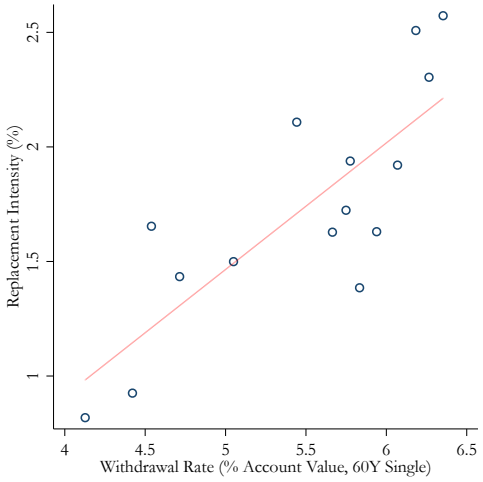


Figure 9: **Brokerage Compensation Structure**

This chart plots the time-series evolution of total aggregate variable annuity brokerage compensation, broken down into upfront commissions and additional compensation, over the period 2001-2018. Total brokerage compensation based on N3/4(A) registration filings and 485POS post-ammendment filings from 389 variable annuity separate accounts. Aggregate upfront commissions computed as the product of variable annuity upfront commission rates from SEC Edgar filings and variable annuity annual sales from Morningstar Annuity Intelligence.

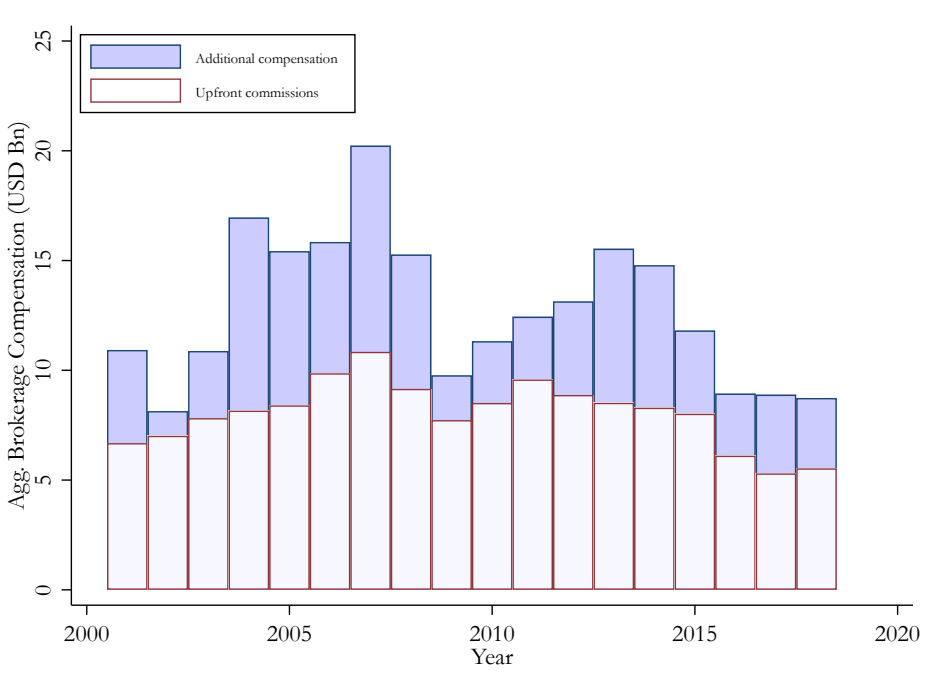


Figure 10: **Additional Compensation, Assets and Exchanges**

This chart plots the time-series evolution of aggregate variable annuity servicing compensation against variable annuity assets (top panel) and variable annuity 1035 exchanges (bottom panel). In the top panel, assets and servicing compensation are normalized to 100 at the beginning of the sample for comparability. Servicing compensation from N3/4(A) registration filings and 485POS post-ammendment filings from 389 variable annuity separate accounts. Variable annuity assets from Morningstar Annuity Intelligence. Variable annuity 1035 exchanges from NAIC MCAS filings, LIMRA and SEC NCEN filings.

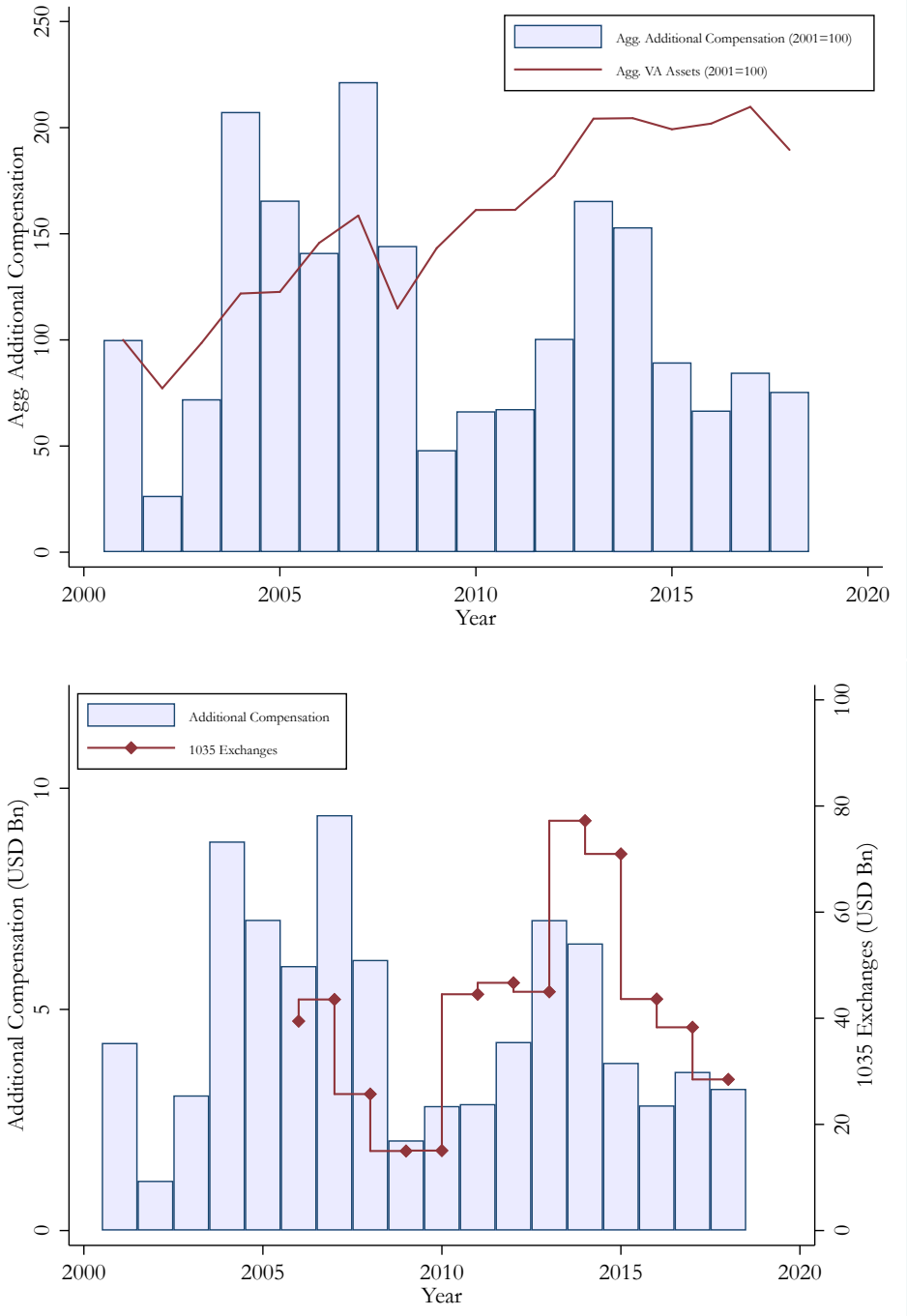


Figure 11: **Variable Annuity Replacements and Financial Constraints**

This chart plots variable annuity replacement intensities in 2018 against 2020Q1 stock price drawdowns for publicly listed variable annuity writers in the United States. The variable annuity replacement intensity is defined as the amount exchanged (1035 outflows) as percentage of beginning-of-period separate account assets. The drawdown is defined as the maximum cumulative percentage stock price decline over the period January 2 to March 31, 2020. Data on variable annuity replacements from SEC N-CEN filings. Data on stock prices from Factset.

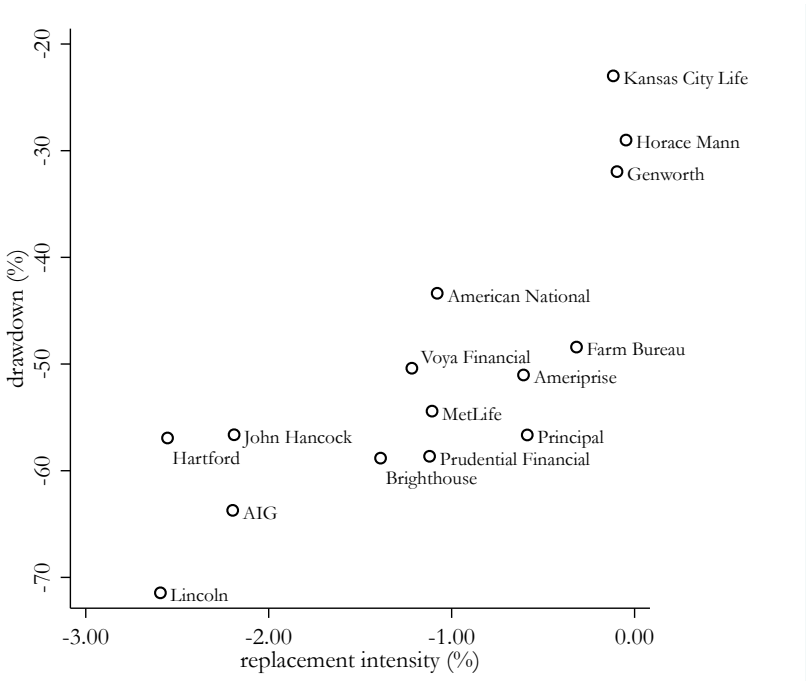


Table I: **Variable Annuity Assets, Sales and Exchanges in 2018**

This table reports summary statistics on variable annuity assets, premiums and exchanges as of end-2018. Variable annuity 1035 exchanges broken down into inflows and outflows. 1035 outflows further broken down by channel: exchanges originating in contracts where the insurer launches an SEC-registered variable annuity exchange offer (Registered Offer), exchanges originating in contracts where the insurer launches a registration exempt exchange offer under SEC Rule 11a2 (11a2 Exempt Offer), and exchanges initiated exclusively by brokers or direct solicitation of customers (Brokered). Amounts denote the value of mutual funds. The last two columns report the share of variable annuity assets in each category for which a guaranteed living benefit (GLB) or a guaranteed lifetime withdrawal benefit (GLWB) was available. Data on variable annuity assets, premiums and exchanges from insurance companies separate accounts SEC N-CEN filings. Data on benefit availability from Morningstar Annuity Intelligence. Datasets merged by contract name.

	Tot Amount ($Bn)	# Policies	Amt/Policy ($)	has GLB (%)	has GLWB (%)
In Force	1575.54	18,049,460	87,290	83.19	73.81
Premiums	109.55	1,172,767	93,417	81.38	70.43
1035 Inflows	20.19	98,052	205,872	76.31	69.30
1035 Outflows	23.18	160,349	144,565	83.71	75.11
Registered Offer	1.15	5,446	210,672	99.97	91.34
11a2 Exempt Offer	8.30	27,614	300,548	86.50	83.47
Brokered	13.73	127,289	107,898	82.15	70.44

Data Structure

This second table illustrates the structure of the data. An insurance group (parent) can have one or multiple life insurance subsidiaries (companies), which can have one or several separate accounts (legal and reporting entities holding the variable annuity assets). Each variable annuity separate account (SA) can have one or multiple variable annuity contracts (collection of policies with similar characteristics) which contains many individual policies. Data available at the contract level.

	# Policies	# Contracts	# SA	#Subsidiaries	# Groups
In Force	18,049,460	2491	431	104	60

Table II: **Variable Annuity Demographics**

Variable annuity sales demographics based on a survey of 602 new buyers and 346 replacement buyers aged 40-85, who had purchased variable annuities through a financial advisor in the three years prior to December 2017. Source: LIMRA Secured Retirement Institute Deferred Annuities Survey, 2019. Variable annuity ownership demographics will be soon available from the 2016 Survey of Consumer Finances. Data collection is in progress.

	New Buyers	Replacement Buyers
Age	63.51	62.50
Male	54%	50%
Marital Status		
Coupled	74%	69%
Single	8%	13%
Divorced	12%	11%
Widowed	6%	7%
Work Status		
Full-time	35%	39%
Part-Time	12%	23%
Household Financial Assets		
Under $100k	14%	22%
$100k-$500k	31%	35%
Over $500k	55%	43%
Household Annual Income		
Under $50k	19%	29%
$50k-$100k	39%	32%
Over $100k	42%	39%
Risk Tolerance		
No Risk	4%	9%
Little Risk	28%	34%
Moderate Risk	64%	54%
Substantial Risk	4%	3%
Advisor Relationship		
Engaged	44%	56%
Familiar	36%	22%
First-time	20%	22%
Main Reason for Purchase		
Broker Recommend.	10%	37%

Table III: **Variable Annuity Replacement and Contract Generosity**

This table shows estimates on the relationship between variable annuity replacement intensity and contract generosity for all US variable annuity contracts with Guaranteed Lifetime Withdrawal Benefits in 2018. The dependent variable is the replacement intensity, defined as the percentage of 1035 net outflows in beginning-of-period assets. The independent variable is the contract average effective withdrawal rate in the year prior to replacement. To compute it, I multiply for each GLWB benefit x quarter combination, the contractual withdrawal rate at the time of issuance times the benefit base to contract value in the the year prior to replacement. I take the maximum effective withhdrawal rate across benefits in a given quarter, then average the quarterly effective rates at the contract level using quarterly contract sales. The omitted category for the death benefit fixed effects is the residual account value death benefit. ROP stands for return of premium death benefit. HAV stands for highest anniversary value. The omitted category for the share class fixed effects is the B share. *t*-stats clustered at insurance-group level. ***,**, and * indicate statistical significance at the 1%, 5% and, 10% level, respectively.

Replacement Intensity	(1)	(2)	(3)	(4)
Rate 60Y Single	0.437**	0.415***	0.687***	0.398**
	(2.34)	(4.43)	(2.94)	(1.97)
Rule 11a-2	0.432*	0.248*	1.773***	1.795**
	(1.22)	(1.70)	(3.25)	(2.57)
Retail	0.756*	0.763	1.257***	1.050**
	(1.98)	(0.24)	(3.28)	(2.62)
Non-Qualified	0.194	0.287*	0.204	0.169
	(1.36)	(1.79)	(1.31)	(0.98)
AM Best Rating	-0.101	-0.034	-0.244	-0.297
	(-0.55)	(-0.36)	(-0.84)	(-0.91)
M&E Charge	0.185	0.311	0.240	0.289
	(0.36)	(1.05)	(0.50)	(0.62)
No Subaccounts	-0.004	-0.005***	-0.004	-0.003
	(-0.80)	(-2.81)	(-0.78)	(-0.56)
Death Benefit Type				
ROP	0.250	0.201	0.341	0.324
	(0.68)	(0.89)	(0.83)	(0.77)
HAV	0.830*	0.861***	0.766	0.815*
	(1.77)	(2.90)	(1.42)	(1.90)
Share Class				
A	-0.441*	0.262	-0.823**	-0.865**
	(-1.75)	(0.71)	(-2.67)	(-2.71)
C	-0.499	-0.779***	-0.417	-0.545
	(-1.55)	(-3.01)	(-1.25)	(-1.65)
L	-0.140	-0.148	-0.271	-0.352
	(-0.56)	(-0.84)	(-1.17)	(-1.60)
O	-1.108***	-0.931**	-0.815	-0.428
	(-3.59)	(-2.30)	(-1.63)	(-1.01)
X	0.289	0.051	0.212	0.016
	(0.83)	(0.23)	(0.63)	(0.06)
Insurer Group FE	No	No	Yes	Yes
Issue Year FE	No	No	No	Yes
Asset Weighted	No	Yes	No	No
N	721	720	721	721
R2	0.060	0.123	0.175	0.213

Table IV: **Variable Annuity Replacement and Brokerage Compensation**

This table shows estimates on the relationship between variable annuity replacement intensity and brokerage compensation. The sample is all US variable annuity contracts in 2018. The dependent variable is the contract-level replacement intensity, defined as the percentage of 1035 net outflows in beginning-of-period assets. Compensation stands for the total discretionary brokerage compensation paid at the separate account level, normalized as percentage of begginning of period separate account assets. The 6th column (Inactive) looks at the subset of contracts belonging to insurance companies no longer selling variable annuities in 2018. The last column aggregates the data at the separate account level. The controls are the contract type (retail vs group), tax status (qualified vs non-qualified), the company's AM Best Rating, the number of subaccounts, the mortality and expense charge, the share class and the type of standard death benefit. *t*-stats clustered at the separate account level, except for (3) and (4) where they are clustered at distributor level. ***,**, and * indicate statistical significance at the 1%, 5% and, 10% level, respectively.

						Inactive	SA level
Replacement Intensity	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Compensation	1.148**	0.979***	1.156**	0.866***	0.615*	3.088***	0.922***
	(2.44)	(2.97)	(2.56)	(3.27)	(1.75)	(3.55)	(2.90)
Comp # Rule 11a-2					1.467***		
					(3.13)		
Issue Year FE	No	Yes	No	No	Yes	Yes	No
Distributor State FE	No	No	Yes	No	No	No	No
Distributor FE	No	No	No	Yes	No	No	No
Controls	No	Yes	Yes	Yes	Yes	Yes	No
N	795	795	725	725	795	84	61
R2	0.019	0.109	0.104	0.131	0.119	0.189	0.125

Table V: **Changes in Brokerage Compensation DID**

This table shows difference-in-differences estimates on the effect of changes in brokerage compensation on variable annuity replacement intensity. To identify changes in brokerage compensation, I exploit Ohio National's Sep 2018 announcement to unilaterally terminate all servicing agreements for all inforce non-group variable annuities sold through independent channels. For all Ohio National contracts, I identify variations of the same contract which differ only in terms of the period active and jurisdiction. For each contract variant, I define the replacement intensity as the percentage share of 1035 outflows in beginning of period assets, and define the treatment intensity as the share of historical sales coming from independent distribution channels (that is, all channels except career agents and direct sales). I regress the replacement intensity at a contract variant level on treatment intensity and a treatment x post interaction. Buyout is a dummy set to 1 whenever the a contract variant was subject to a buyout offer. The NY x Post interaction captures the effect of fiduciary duty. To control for differences in average replacement intensity across contract pairs, I add contract pair fixed effects. Columns I-III cover all contract variants. Column IV covers the subset of contract variants offering GMIBs. Column V repeats Column III incorporating 2020 into the post period. *t*-stats reported in parantheses. ***,**, and * indicate statistical significance at the 1%, 5% and, 10% level, respectively.

				GMIB Only	Including 2020
Replacement Intensity	(1)	(2)	(3)	(4)	(5)
Treatment	-2.624*	-0.944	-1.984	-1.799	-2.890
	(-1.69)	(-0.74)	(-0.74)	(-0.64)	(-1.12)
Post	-2.986	-3.337**	-3.404**	-3.486*	-3.583**
	(-1.46)	(-2.03)	(-2.11)	(-2.04)	(-2.34)
Treatment x Post	3.637	4.362**	4.499**	4.623**	4.061**
	(1.65)	(2.43)	(2.54)	(2.31)	(2.42)
Buyout		2.084***	1.829***	2.209***	1.067**
		(5.07)	(3.78)	(3.81)	(2.41)
NY x Post		-0.962*	-1.143*	-0.839	-0.529
		(-1.72)	(-1.85)	(-0.99)	(-1.00)
Cons	3.987***	1.849	2.871	2.438	3.916
	(2.75)	(1.51)	(1.15)	(0.95)	(1.63)
Pair FE	No	No	Yes	Yes	Yes
No Pairs			9	7	9
N	62	62	62	42	91
R2	0.063	0.429	0.530	0.580	0.324

Table VI: **Intermediary Standards of Care DID**

This table shows difference-in-differences estimates on the relationship between intermediary standards of care and variable annuity replacement intensity. I identify contracts issued by the same parent insurance company which are identical up to their name, observable contract characteristics and benefit availability, only that one contract is authorised for sale in the New York State, while the other is authorised for sale in the rest of the US except the New York State. To identify the effect of brokerage standards of care on 1035 exchanges, I exploit the imposition of NY Best Interest Regulation 187 in August 2019, regulation raising variable annuity brokers to fiduciary duty. Speficially, I define the replacement intensity as the percentage share of 1035 outflows in beginning of period assets and regress the replacement intensity at a contract level on a NY dummy, a 2019 dummy (post), and the interaction between the two. To control for differences in average replacement intensity across pairs of contracts, I add contract pair fixed effects. Within contract pair, the 2019 dummy captures differences in the replacement intensity between 2018 and 2019 for all contracts (NY and non-NY). The NY dummy measures differences in the replacement intensity between NY and non-NY contracts for both years. The interaction effect is the coefficient of interest. Within a pair of otherwise identical (on observables) contracts, it measures the incremental effect of selling in NY in 2019 and is intended to capture the effect of Regulation 187. Column 6 extends the post period to include 2020. Results weighted by pre-period pair assets, except column 7 where they are equal weighted. *t*-stats reported in parantheses. ***,**, and * indicate statistical significance at the 1%, 5% and, 10% level, respectively.

				GLBs 2004-2008	no GLBs 2004-2008	Including 2020	Equal Weighted
Replacement Intensity	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NY	-1.139***		0.114	-0.057	0.119	0.497	0.848*
	(-3.07)		(0.23)	(-0.05)	(0.43)	(1.12)	(1.87)
Post		-1.876***	-0.643	-0.974	-0.253	-0.960**	-0.544*
		(-5.19)	(-1.29)	(-0.86)	(-0.97)	(-2.52)	(-1.70)
NY # Post			-2.516***	-3.953**	-0.477	-2.505***	-1.025*
			(-3.53)	(-2.52)	(-1.23)	(-4.61)	(-1.94)
Cons	3.955***	4.331***	4.275***	6.339***	1.892***	4.090***	2.016***
	(15.38)	(17.01)	(12.10)	(7.91)	(10.24)	-13.15	(7.61)
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1045	1045	1045	378	535	1562	1274
R2	0.012	0.033	0.060	0.094	0.024	0.075	0.016

Table VII: **Variable Annuity Replacement and Reputational Costs**

This table shows estimates on the relationship between variable annuity replacement intensity and proxies for reputational costs. The sample is all US variable annuity contracts in 2018. PE is a dummy variable set to 1 whenever the firm is owned or managed by a private equity firm or consortium involving private equity. Inactive is a dummy variable set to 1 whenever the insurance group no longer sells variable annuities. The dependent variable is the replacement intensity, defined as the percentage of 1035 net outflows in beginning-of-period assets. The controls are the contract type (retail vs group), tax status (qualified vs non-qualified), the company's AM Best Rating, the number of subaccounts, the mortality and expense charge, the share class, type of standard death benefit and where it offers guaranteed living benefits, the age 60 effective withdrawal rate. *t*-stats clustered at the insurance group level. ***,**, and * indicate statistical significance at the 1%, 5% and, 10% level, respectively.

			no GLBs 2004-2008		GLBs 2004-2008		GLWB	
Replacement Intensity	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inactive	0.773**		0.298		1.470***			
	(1.97)		(0.88)		(3.49)			
PE		1.181***		0.599		1.830***		
		(3.67)		(1.49)		(6.31)		
PE # Inactive								
0×1							0.081	0.396
							(0.23)	(0.93)
1×0							1.339***	1.128
							(4.46)	(1.24)
1×1							2.220***	2.431***
							(7.28)	(7.43)
Issue Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1743	1743	1001	1001	732	732	732	723
R2	0.076	0.084	0.085	0.086	0.106	0.126	0.128	0.125

Table VIII: **Structural Model: Estimated Coefficients**

This table reports estimates from the structural model of variable annuity exchanges estimated in equation (42). GMDB is a dummy set to 1 whenever the contract offers a guaranteed minimum death benefit as standard (for no extra fee). has rollup is a dummy set to 1 whenever the contract offers a positive minimum return guarantee on the account value. fee is a categorical variable taking the value -1 for a fee-only contract (share class I, low fee, no commissions), 1 for a bonus contract (share class X, high fee, high commission) and 0 for all remaining share classes (average fee, average commission). The coefficient θ_1 on the slope of the degree of consumer inattention is with respect to the fee. Coefficients on residual characteristics and the slackness variable reported in cents per dollar. Coefficients on reputational costs and financial constraints in log(cents per dollar) - e.g. $exp(b_0)$ is in cents per dollar. The structural model is estimated on 2018 contract level data using a two-step generalized method of moments. Robust standard errors computed using the delta method.

Coefficient	Mean	Robust SE
Degree of Consumer Inattention		
θ_0	0.203***	[0.018]
θ_1	0.142	[0.233]
Coeff. on Residual Characteristics (δ)		
GMDB	1.834**	[0.874]
has rollup	0.836	[1.244]
fee	-4.422***	[1.646]
Slackness Variable		
ω	6.660***	[1.029]
Reputational Costs		
b_0	2.405***	[0.153]
b_1	-0.418***	[0.099]
b_2	0.246***	[0.074]
Financial Constraints		
λ_1	0.140***	[0.025]
Obs	946	

Table IX: **Structural Model: Predicted Values**

This table reports predicted values from the structural model of variable annuity exchanges estimated in equation (42), as follows: the top panel reports the degree of consumer inattention evaluated at contracts of different share class (fee), the mid panel reports the reputational cost on the first dollar exploited for traditional vs PE owned insurers, while the bottom panel reports the shadow cost of capital for the average company. The expressions used to arive at these estimates is provided. Robust standard errors computed using the delta method.

	Degree of Consumer Inattention		
Evaluated at:	Fee-Based VA (low fee, no commission)	Avg Fee VA	Bonus VA (high fee, high commission)
Expression:	$\theta_0 \exp(\theta_1 x\|_{x=-1})$	$\theta_0 \exp(\theta_1 x\|_{x=0})$	$\theta_0 \exp(\theta_1 x\|_{x=1})$
Point Estimate:	0.176***	0.203***	0.234***
Robust SE:	[0.045]	[0.018]	[0.056]

	Reputational Cost on First Dollar Exploited	
Evaluated at:	Traditional insurers	PE-owned insurers
Expression:	$\exp(b_0)$	$\exp(b_0 + b_1)$
Point Estimate:	11.079***	7.292***
Robust SE:	[1.699]	[1.141]

	Shadow Cost of Capital
Evaluated at:	Average rated company
Expression:	$\exp(\lambda_1 \overline{X_j})$
Point Estimate:	1.269***
Robust SE:	[0.053]

Figure 12: **Model-Implied Reputational Cost Curve**

This chart plots the model implied reputational cost curve for traditional insurance companies. The chart is produced by taking the estimated coefficients from the structural model estimated in equation (42), and use them to evaluate firm-level reputational costs at various levels of total amount exploited (here ranging from $\$0 - 3Bn$) using equation (37): $b_{j(Q=Q_j)} = \exp(b_0 + b_2 Q|_{Q=Q_j})$ The blue dots plot the point estimates. The dark and light grey areas denote 68% and 95% confidence bands around the point estimates. Point estimates computed using the delta method. Confidence intervals computed by evaluating equation (37) at each respective coefficient percentile. For reference, the average traditional insurer exploited \$0.72Bn in 2018, resulting in marginal reputational cost of 13.31 cents per dollar exploited.

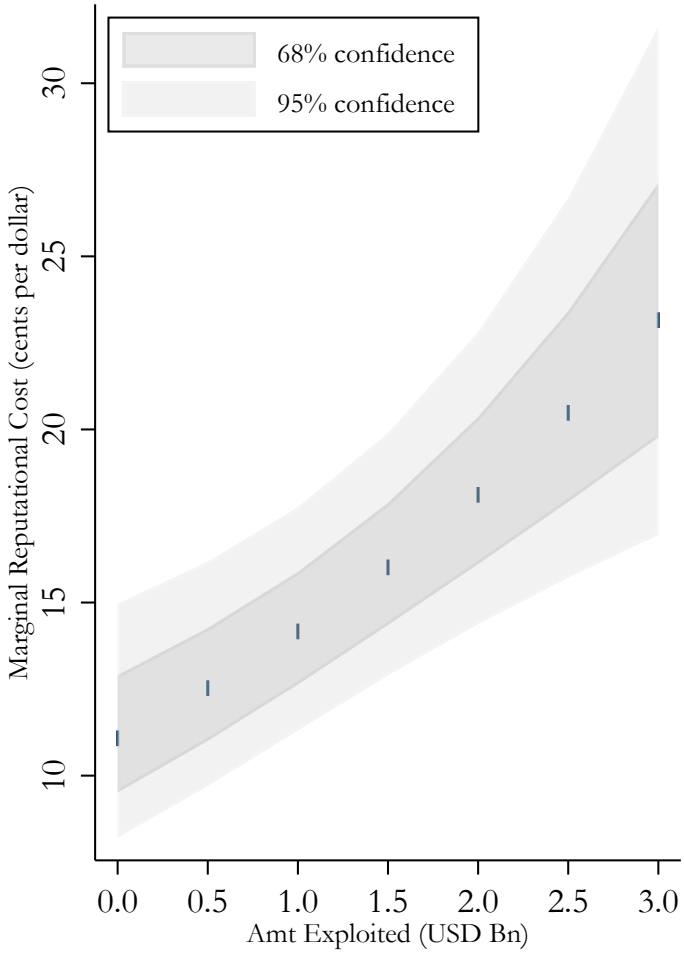


Table X: **Model Implied Shadow Cost of Capital**

This table reports the model-implied shadow cost of statutory capital c_j, defined as the partial derivative of the regulatory cost function with respect to statutory capital from equation (24), and interpreted as the marginal benefit of one extra unit of statutory capital, for various company AM Best financial strength ratings in 2018. For implementation details, see Appendix B1. Shadow cost for A++ rating normalized to 0.

Shadow Cost of Capital		
AM Best Rating	Mean	Robust SE
A++	0.000	[0.000]
A+	0.167	[0.037]
A	0.444	[0.129]
A-	0.988	[0.423]
B++	2.504	[2.015]
Avg Company	0.345	[0.092]

Appendix A: Valuation Appendix

A1. Raising the Lower Bound: Distribution Costs

I have so far assumed that the insurance company can manufacture and sell a variable annuity at no cost. In that case, the zero-profit condition for the insurance company required that the present value sum of the benefits under the variable annuity contract (the marginal cost from the point of view of the insurer) cannot exceed the premium (the price of the contract which also equals the initial account value). That is: $1 - V^{new}_{GLWB_t(n)} \geq 0$. However, 98% of variable annuities are sold through brokers. Brokerage services induce significant distribution costs in terms of upfront brokerage fees and commissions (which I can measure in the data). Assume that a new policy can only be sold at a distribution cost $C_t > 0$. Further assume, as it is in practice, that the cost is initially borne by the insurance company, which will subsequently pass it on to consumers as fees on the account value. To satisfy the insurance company participation constraint:

$$(1 - V^{new}_{GLWB_t(n)}) \geq C_t \tag{47}$$

which says that new policies must be sold at a premium high enough to compensate for distribution costs. Defining the insurance sector as the insurance company and the broker, I can redefine equation (8):

$$(V^{old}_{GLWB_t(n)} - 1) + (1 - V^{new}_{GLWB_t(n)})$$

as value the insurance sector as a whole extracts from from the customer, whereby a portion C_t is distributed to insurance brokers, while the remainder stays with the insurance company. Brokers therefore introduce a wedge between the value lost by consumers $-(V^{old}_{GLWB_t(n)} - V^{new}_{GLWB_t(n)})$ and the value gained by insurance companies $(V^{old}_{GLWB_t(n)} - V^{new}_{GLWB_t(n)}) - C_t$. Equation (10) then becomes:

$$(V^{old}_{GLWB_t(n)} - V^{new}_{GLWB_t(n)}) > \left(\sum_{s=1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} w_{e_t}}{Y^s_{t,t+s}} - 1 \right) + C_t \tag{48}$$

The RHS of equation (48) can be estimated in the data and gives a (strictly higher) lower bound on the value gained by the insurance sector as a whole from variable annuity exchanges, or alternatively, a lower bound on the present value that consumers are willing to give up, or transfer, to the insurance sector to exchange their variable annuities.

A2. Deferred GLWB

I have so far assumed that the living benefit is exercisable immediately. Often, however, policyholders may only exercise the living benefit conditional on reaching a certain age (e.g. 60). To allow for this possibility, suppose instead that the guaranteed lifetime withdrawal benefit can only be exercised after a waiting period

of length $k > 0$. The policyholder still has the right to a residual death benefit equal to the account value after withdrawals and fees at any point during the contract, and may still postpone the exercise of the living benefit beyond $t + k$, but she may not exercise the living benefit before $t + k$. During the waiting period, the benefit base will grow at preset rollup rate $g \geq 0$ (or higher, if for instance the account value exceeds the benefit base). The value of a variable annuity with a guaranteed living withdrawal benefit with waiting period k for an individual of age n at time t can be decomposed into:

$$V_{GLWB_{t(n,k)}} = V_{LB_{t(n,k)}} + V_{DB_{t(n,k)}} + V_{W_{t(n,k)}} \tag{49}$$

where the subscripts have changed to indicate that the variable annuity value also depends on the waiting period k. As before, the value of the residual death benefit V_{DB} and the option value of waiting V_W are strictly positive, even though the the latter can only be exercised starting at some later date $t + k$. The value of the living benefit is at least as great as the value of the smallest deferred lifetime annuity payable starting with $t + k$:

$$V_{LB_t(n)} \geq \sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+k+l} w^{X^{LB}_{t+k}/S_t}}{Y^s_{t,t+s}} \tag{50}$$

where X^{LB}_{t+k} denotes the smallest possible $t + k$ benefit base, which is known with certainty as of time t as $X^{LB}_{t+k} = (1+g)^k X_t$. Therefore, the RHS of equation (50) provides a lower bound on the value of the deferred GLWB variable annuity, which can again be estimated in the data given n, g, k, w and time t estimates of mortality and discount rates.

A3. Lower Bound Validation

Consider the following accounting identity:

$$V_{GLWB_{t(n)}} \equiv 1 + G_{t(n)} - PV_{t(n)(fees)} \tag{51}$$

which says that the value of variable annuity benefits for an individual aged n at time t ($V_{GLWB_{t(n)}}$) must equal the account value plus the fair value of the guarantees $G_{t(n)}$ minus the present value of fees levied on the account value to pay for these guarantees (where I have normalised the account value to 1 such that everything is per unit of account value). I can decompose the value of the variable annuity into the value of the life annuity benefits and the value of any residual benefits under the contract:

$$V_{GLWB_{t(n)}} = V^{LB}_{GLWB_{t(n)}} + V^{r}_{GLWB_{t(n)}} \tag{52}$$

and similarly decompose the fair value of the guarantees $G_t(n)$ into the statutory value of guarantees $\hat{G}_t(n)$ (which is a conservative estimate of the value of guarantees that insurance companies post on their balance sheets for statutory purposes) and the difference between the fair (economic) and statutory values $G_t(n)^e =$

$G_t(n) - \hat{G}_t(n)$:

$$G_t(n) = \hat{G}_t(n) + G_t(n)^e \tag{53}$$

Replacing equations (52) and (53) into the accounting identity and applying first differences:

$$\Delta V^{LB}_{GLWB_t(n)} + \Delta V^{r}_{GLWB_t(n)} \equiv \Delta \hat{G}_t(n) - \Delta G_t(n)^e - \Delta PV_{t(n)(fees)} \tag{54}$$

which says that variation in the value of variable annuity benefits (LHS) should be reflected either in variation in statutory reserves, variation in the conservativeness of statutory vs economic reserves, or variation in contract and benefit fees. Provided that most of the variation in the value of variable annuities comes from variation in the life annuity component, and there is relatively little variation in fees and the conservativeness of statutory valuation from year to year, then:

$$\Delta V^{LB}_{GLWB_t(n)} \approx \Delta \hat{G}_t(n) \tag{55}$$

This suggests that I can validate my lower bound valuation by looking at a measure of statutory reserves. Equation (55) holds before hedging. To the extent to which insurance companies use hedging programs to smooth out the true volatility in statutory reserves, then the equation becomes:

$$\Delta V^{LB}_{GLWB_t(n)} \approx \beta \Delta \hat{G}_t(n) \tag{56}$$

where the RHS measures the change in statutory reserves after hedging (but before reinsurance) and $\beta \leq 1$ measures the effectiveness of hedging programs. In Figure D6 in the appendix, I take equation (56) to the data by comparing the implied lower bound on the value of variable annuities issued at various times prior to the financial crisis against the aggregate variable annuity statutory valuation ratio from insurance companies' NAIC filings. I find that the statutory valuation ratios indeed closely match the dynamics of $V^{LB}_{GLWB_t(n)}$ in the time series.

A4. Guaranteed vs Actual Returns

In the valuation section, I have argued that the main driver behind the rise in GLWB valuations after the crisis has been guaranteed returns exceeding the returns on the mutual funds net of fees. I investigate whether this has been due to generous guarantees in absolute terms or low actual returns (high fees). Figure D4 plots the joint evolution of benefit base and account values for a set of representative contracts issued before the financial crisis to confirm that the two series have substantially diverged after the crisis. First, guarantees have been very generous (7%+ per annum). Second, account values have considerably underperformed the S&P500 and even a 60:40 stock-bond allocation after the crisis, suggesting an important role for past fees. In Figure D5, I quantify the contribution of fees driving down the return on the mutual funds versus guarantees exceeding the gross return on the mutual funds in driving this gap. I show that both have played

a role. While variable annuity fees are high (3-4% per anuum), 10 years after the crisis, the benefit base still exceeded the gross cumulative return on the mutual funds, pointing to overly generous guarantees.

A5. Insurers Profits

The fact that insurers charge high fees prior to option exercise leaves open the possibility that insurers make fewer losses over the life of the policy than what the post-exercise transfers to policyholders would suggest. While this paper cannot give a definitive answer, I show how one can think about insurers profits in this setting. I find that insurers do overall lose money from holding on legacy variable annuity policies, and the loss is likely comparable to the post-exercise transfers to policyholders. Specifically, let the insurer's profits over the life of a variable annuity policy be:

$$\Pi_t = \Pi_{t-k,t} + \Pi_{t,\infty} \tag{57}$$

where the first term is the cumulative profit from time of issue $t-k$ to the time where the option is exercised t, the second term is the cumulative profit from exercise date t to the eventual death of the policyholder, both per dollar of time t account value. The pre-exercise profits are pre-exercise cumulative fees minus pre-exercise cumulative payments to intermediaries (e.g. asset management fees, brokers commissions):

$$\Pi_{t-k,t} = P_{t-k,t} - C_{t-k,t} \tag{58}$$

After exercise, the insurer must pay the policyholder the present value of variable annuity benefits V_{GLWB_t} and pay intermediaries the present value of fees and commissions $C_{t,\infty}$. It funds these payments through transfers from the residual account value, and when the account value is exhausted, with transfers from past fees levied (surplus extracted) on the account value. Since the sum of the residual account value and the fees levied on the account value equal the value of the mutual fund S_{t+k}, $\forall k \geq 0$, whose present value at t is 1 by no arbitrage, it turns that the present value funding available to pay policyholders and intermediaries is 1. So insurers profits after exercise are:

$$\Pi_{t,\infty} = 1 - V_{GLWB_t} - C_{t,\infty} \tag{59}$$

So the condition for positive insurer profits over the life of the policy is:

$$\Pi_t = P_{t-k,t} - C_{t-k,t} + 1 - V_{GLWB_t} - C_{t,\infty} \geq 0 \tag{60}$$

which collapses to:

$$P_{t-k,t} - C_{t-k,\infty} \geq V_{GLWB_t} - 1 \tag{61}$$

and says that fees collected prior to exercise must be enough to cover servicing costs over the life of the policy plus any excess present value of policyholder benefits (estimated at up to 30 cents per dollar). Since $P_{t-k,t}$ is just a part of the total fees, it says that variable annuity markups must well exceed 30 cents per dollar, which seems implausible. Conversely, the condition for insurers losses not to exceed 30 cents per dollar is:

$$P_{t-k,t} - C_{t-k,\infty} \geq 0 \tag{62}$$

that is, fees collected prior to exercise must be enough to cover servicing costs over the life of the policy, which may or may not be true (variable annuities typically lose money in the early years of the policy as fees recover large distribution cost - this is why insurers charge early surrender penalties - and become profitable later on).

A6. Lower Bound on Insurers Losses

In Appendix A5, I have argued that insurance companies likely lose money on legacy variable annuities even after accounting for past fees. I now provide a lower bound on insurers losses. In Figure D5, I show that the funds available to pay for policyholder benefits, which are the sum of two components: policyholder account values and past fees collected by insurance companies, can at most cover the benefit base. Since the insurance company converts the benefit base into a joint life annuity at a 5% annual withdrawal rate, which was approximately actuarially fair, it turns these funds can at most cover the life annuity portion of the contract. In the language of equation (60):

$$1 + P_{t-k,t} \leq V^{LB}_{GLWB_t} \tag{63}$$

The insurer must still pay fees and commissions to intermediaries to sell and service the contract and cover any residual benefits to policyholders. Since there is no other source of funds within the contract, these amounts provide a lower bound on insurers losses:

$$-\Pi_t \geq [V_{GLWB_t} - V^{LB}_{GLWB_t}] + C_{t-k,\infty} \tag{64}$$

Appendix B: Model Appendix

B1. Shadow Cost of Capital

The model pins down λ, which is the marginal benefit of relaxing financial constraints. λ measures the effect of financial frictions on the profitability of exchanges, and is specific to variable annuity exchanges as it depends on the way variable annuity exchange profits enter the statutory balance sheet. Readers might be more interested in the shadow cost of statutory capital c_j, which captures of the shape of the regulatory

cost curve for potentially any company facing a risk based capital constraint. From equation (30):

$$c_j = \frac{\lambda_j - 1}{\phi - \lambda_j - 1} \tag{65}$$

which says that the shadow cost of statutory capital depends on the marginal cost of financial frictions λ and the regulatory risk weight ϕ. $1 + \phi$ is the ratio of statutory reserves to market value reserves, (i.e. $\hat{G}/G$ from equation (53)) which is not directly observed. I follow Koijen and Yogo (2020) to back out a lower bound estimate on ϕ which gives me an upper bound on c_j since $c_j/\phi < 0$. Specifically:

$$\phi = \frac{\hat{G}}{G} - 1 \geq \frac{\hat{G}_{C-3PhaseII}}{\hat{G}_{AG43}} - 1 \tag{66}$$

which says the ratio of statutory reserves under C-3 Phase II regulatory standard to statutory reserves under Actuarial Guideline 43 provides a lower bound on ϕ. The C-3 Phase II regulatory standard defines statutory reserves for a variable annuity as its 90th percentile conditional tail probability, which is an average of the 10% worst capital deficiencies (approximately 96% value at risk) from a set of stress scenarios provided by the regulator. The Actuarial Guideline 43 is a less conservative regulatory standard that defines statutory reserves as the an average of the 30% worst deficiencies (approximately 87% value at risk) and is closer to the market value of guarantees (which is (roughly) an average across all deficiencies).

I obtain estimates of statutory reserves for a policy 10Y old, individual aged 60, benefit base to contract value 112.5%, which is representative of the average policy in force in 2018, from Milliman (Junus and Wang, 2011, p20). I get:

$$\phi = \geq \frac{11\%}{5.4\%} - 1 = 1.04$$

and combine this estimate with equation (65) to compute the shadow costs of capital in Table X.

B2. Solvency

I start with a simple framework explaining how variable annuity exchanges affect insurers risk based capital. As before, let L denote general account liabilities (e.g. option value of guarantees), ϕ the regulatory risk weight on liabilities and denote with $\mathbb{V}$ insurer surplus. An insurer risk-based capital (RBC) ratio is defined as surplus over required capital:

$$RBC = \frac{\mathbb{V}}{\phi L} \tag{67}$$

A variable annuity exchange affects risk-based capital both through surplus and required capital. Since exchanges are profitable and/or relax financial constraints, they increase surplus ($\mathbb{V}$ goes up) increasing RBC. Second, since generous policies exchange into less generous ones, required capital goes down, as both the option value of guarantees and the risk charge typically go down, further increasing RBC. I focus on the effect of exchanges on RBC via surplus holding required capital constant, with the understanding that the resulting effect constitutes a lower bound.

To compute the effect of exchanges on surplus, I start with insurers actual surplus from life insurance companies annual NAIC 2018 filings. I use total adjusted capital (TAC), which is the numerator in the statutory risk based capital (RBC) ratio. I then compute the counterfactual surplus absent exchanges as the statutory surplus minus the cumulative surplus from exchanges, and from there, compute the counterfactual RBC ratio as the new counterfactual surplus over required capital.

I then map RBC ratios to ratings using the mapping provided by A.M. Best Company. To map AM Best ratings to expected losses for policyholders, I follow several steps. First, for every rating, AM Best provides a term structure of cumulative impairment rates up to 15Y out. A.M. Best Company designates an insurer as financially impaired upon the first regulatory action that restricts its activity (e.g. liquidation, supervision, rehabilitation, receivership, conservatorship, suspension, license revocation). The term structure of impairment rates is based on actual impairment experience over the sample of rated insurance companies over 1977-2018. I extract marginal impairment rates by first differencing the cumulative rates.

An impaired insurer could subsequently default on policyholder claims. A default occurs when a state regulator liquidates an insolvent insurer, and guaranty associations step in to provide coverage to policyholders. I follow Koijen and Yogo (2016) who estimate the probability of default conditional on impairment to 0.22 and the loss given default to 0.25 based on historical data.

I then compute the expected loss per unit of policyholder reserve for each of the next 15 years as the product of the probability of impairment conditional on rating ($\Pr(m_s|\text{rating})$) times the probability of default conditional on impairment times the loss given default, and define present value of expected loss as the present value sum of annual expected losses, discounted at the gross risk free rates from Gürkaynak et al. (2007):

$$\sum_s \frac{Pr(m_s|\text{rating}) \times 0.22 \times 0.25}{Y^s_{t,t+s}} \tag{68}$$

B3. 1% Fall in Interest Rates

In text, I have argued one can derive three estimates of the present value transfer from a counterfactual 1pp fall in interest rates: a lower bound, where the value extracted per dollar exploited goes up, but the amount exploited stays constant, an upper bound, where the value extracted per dollar exploited goes up, and all contracts whose marginal benefit exceed the old marginal cost get exploited (flat reputational cost curve), and a best estimate, where the value extracted per dollar exploited goes up, the amount exploited goes up, but then also the reputational costs go up, hence the new amount exploited is set to equalize the new MC and MB. I hereby lay out each of these estimates:

LOWER BOUND: no new contract would be exploited ($q^{new}_{ij} = q^{old}_{ij} = q_{ij}, \forall i, j$). That is:

$$\Delta PVT^{LB} = \sum_{i,j} \int_0^{q^*_{ij}} \hat{V}^{new}_{ij}(q, \theta^*) - \sum_{i,j} \int_0^{q^*_{ij}} \hat{V}^{old}_{ij}(q, \theta^*) \tag{69}$$

where the first term is the PVT under the counterfactual, the second term is the actual estimated PVT for 2018 from equation (43), and each integral is computed by first discretizing contract value at issue quarter level, evaluating the present value transfer at each issue quarter, then aggregating across issue quarters, contracts and firms as before. Since the amount exploited q_{ij} is assumed constant, ΔPVT comes entirely from differences in the valuation of currently exploited contracts.

Upper bound: all contracts whose new exchange value exceeds the original marginal exploitation cost $b(Q_j^{old})$ would get exploited. Specifically, for every contract i and firm j, I recover the model-implied marginal benefit $\hat{V}_{ij}^{old}(q_{ij}^{*old}, \theta^*)$ and compute the counterfactual exploitation intensity that, when used to evaluate the new MB curve, returns the original MB:

$$q_{ij}^{*new} \quad s.t. \quad \hat{V}_{ij}^{new}(q_{ij}^{*new}, \theta^*) = \hat{V}_{ij}^{old}(q_{ij}^{*old}, \theta^*) \quad \forall i, j$$

and define the increase in present value transfer as:

$$\Delta PVT^{UB} = \sum_{i,j} \int_0^{q_{ij}^{*new}} \hat{V}_{ij}^{new}(q, \theta^*) - \sum_{i,j} \int_0^{q_{ij}^{*old}} \hat{V}_{ij}^{old}(q, \theta^*) \tag{70}$$

Now, ΔPVT originates from both existing contracts becoming more valuable (intensive margin) and new contracts becoming exploitable (extensive margin), but risks overestimating the extensive margin as the reputational costs are assumed to stay fixed.

Best Estimate: the new exploitation intensity q_{ij}^{*new} is set such that the new (and higher) marginal benefit equals the new (and higher) marginal cost as predicted by the reputational cost curve in equation (37). Specifically, let $m \geq 1$ be a scaling factor that scales all contract exploitation proportionally:

$$m \quad s.t. \quad q_{ij}^{new} = m q_{ij}^{old} \quad \forall i, j$$

$$Q_j^{new} = m Q_j^{old} \quad \forall j$$

I estimate $m \geq 1$ that best fits the optimality condition in equation (42), evaluated at the new exploitable value curve $\hat{V}_{ij}^{new}(\cdot)$ and previously estimated parameters:

$$\hat{V}_{ij}^{new}\left(\frac{m q_{ij}^{*old}}{\theta_0^* \exp(\theta_1^* \mathbf{x}_{ij})}, 1\right) + \delta^* \mathbf{x}_{ij} + \omega^* \mathbb{1}(q_{ij}^* = 0) = \exp(b_0^* + b_1^* PE_j + b_2^* m Q_j^{*old} - \lambda_1^* rating_j) \tag{71}$$

where the stars denote previosuly estimated parameters and $\hat{V}_{ij}^{new}(q, \theta)$ is obtained by fitting the new (counterfactual) distribution of exploitable values under 1pp lower interest rates following equations (31) -(33) in text. I estimate equation (71) using non-linear GMM and find $m = 1.99$ (SE=0.079). The change in present

value transfer becomes:

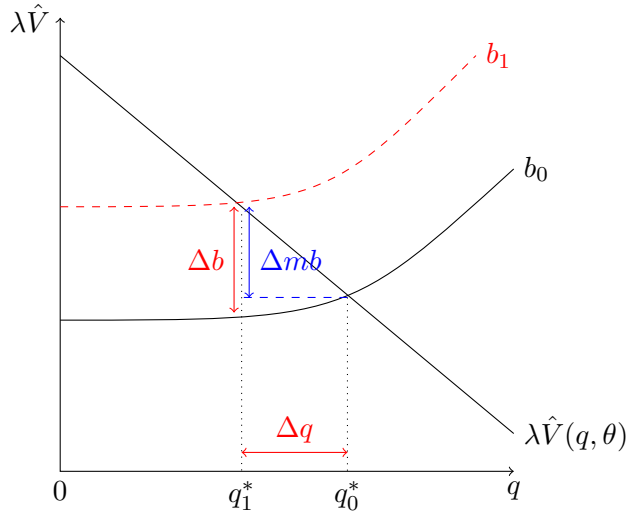
$$\Delta PVT^{BE} = \sum_{i,j} \int_0^{mq_{ij}^{*old}} \hat{V}_{ij}^{new}(q, \theta^*) - \sum_{i,j} \int_0^{q_{ij}^{*old}} \hat{V}_{ij}^{old}(q, \theta^*) \tag{72}$$

B4. Cost Shock from Fiduciary Standard

I have argued that stricter intermediary standards of care imply an upward shift in reputational cost per unit of account value being exploited (b). If I knew the marginal benefit curve $\lambda\hat{V}(q, \theta)$ and the change in replacement intensity Δq, then I could compute the dollar shift in the reputational cost curve Δb which is needed to satisfy the new equilibrium in the exchange market. Specifically, in equilibrium, the marginal cost must equal the marginal benefit at all times. This means that the total change in marginal benefit associated with the fiduciary standard must equal the shift in marginal reputational costs (Δb) plus the change in reputational costs as you move along the cost curve to the new equilibrium. Writing the reputational cost curve as a Taylor series expansion, the equality becomes:

$$\lambda\hat{V}(q^* + \Delta q) - \lambda\hat{V}(q^*) = \Delta b + \frac{\partial b(q)}{\partial q}\Delta q + \frac{\partial^2 b(q)}{\partial q^2}\frac{\Delta q^2}{2} + ... \tag{73}$$

If the movement along the cost curve (the Taylor Series terms) is small relative to the size of the cost shift (as I will show below), then the total change in the marginal benefit provides a sensible first order approximation of the reputational cost shock (and a lower bound given that b is upward sloping). I proceed in two steps. I first compute the change in marginal benefit as a lower bound on Δb. I then discuss what would happen to my estimate of Δb if I were to incorporate the movement along the curve under plausible assumptions.



Change in Marginal Benefit: I have estimated Δq in the data using a difference in differences identification strategy and structurally estimated the inverse demand function $\hat{V}(q, \theta)$ and the cost of financial constraints λ. I construct the change in marginal benefit by evaluating the marginal benefit function at the

pre and post fiduciary duty exploitation intensities, under the conservative assumption that financial constraints do not change. Reestimating financial constraints would only further increase Δmb as firms become more financially constrained when they can exploit less. I find $\lambda\hat{V}(q^* + \Delta q) - \lambda\hat{V}(q^*) = 8.05c$ per dollar exploited.

Movement along the Curve: Second, I compute the movement along the curve under plausible assumptions. In 2018, the average traditional insurer exploited \$0.72Bn and the average private equity owned insurer \$0.25Bn in variable annuity assets nationwide. The fiduciary duty imposed in NY State in the latter half of 2019 resulted in an estimated 3\$.09Bn drop in exchanges. Given there were at least 17 parent insurance companies operating variable annuities in NY State, that would result in a \$0.18Bn average drop per company. I then evaluate the reputational cost function at the average traditional and PE owned insurer before and after the 0.18Bn drop in exploitation and take the difference. The movement along the curve for the average traditional insurer is:

$$\exp(b_0^* + b_2^*\overline{Q}_j^{pre}) - \exp(b_0^* + b_2^*\overline{Q}_j^{post}) = 0.46c$$

The movement along the curve for the average PE owned insurer is:

$$\exp(b_0^* + b_1^* + b_2^*\overline{Q}_j^{pre}) - \exp(b_0^* + b_1^* + b_2^*\overline{Q}_j^{post}) = 0.27c$$

where the $\overline{Q}_j$s represent the average amounts exploited pre or post as described.

B5. Risk Adjustment

I first solve for the exploitation intensities q_{ij} that would prevail in the absence of financial constraints. As mentioned in text, a lower λ reduces the marginal benefit from each dollar exploited by rotating the MB curve inwards around its x-intercept. That reduces the amount exploited for every reputational cost level, which in terms reduces the marginal reputational cost by moving leftward along the reputational cost curve. The shock to q_{ij} needed to equate the new marginal benefit and marginal cost would primarily depend on the size of the shock in λ, which in the model is a function of ratings. Let $m_r \geq 1$ be a (rating specific) scaling factor that scales all contract exploitation proportionally for all contracts rated r:

$$m_r \quad s.t. \quad q_{ij}^{new} = m_r q_{ij} \quad \forall i, j$$

$$Q_j^{new} = m_r Q_j \quad \forall j$$

The goal is to find $m_r \leq 1$ that best fits the optimality condition in equation (42) when I restrict $\text{rating}_j = 0$, holding fixed all previously estimated parameters:

$$\hat{V}_{ij}^{LB}\left(\frac{m_r q_{ij}^*}{\theta_0^* \exp(\theta_1^* \mathbf{x}_{ij})}, 1\right) + \delta^* \mathbf{x}_{ij} + \omega^* \mathbb{1}(q_{ij}^* = 0) = \exp(b_0^* + b_1^* PE_j + b_2^* m_r Q_j^* - \lambda_1^* \mathbf{0}) \quad \forall r \tag{74}$$

Ideally, I would estimate m_r for each rating bucket separately. However, there are relatively few contracts belonging to companies rated A or below, so I split the sample into contracts rated AAA AA, and bundle the remainder under A and below. I estimate m_r using non-linear GMM and find $m_{AA} = 0.63$ (SE= 0.05) and $m_{A-} = 0.50$ (SE= 0.14) ($m_{AAA} = 1$ by construction since $\lambda = 1$). To compute the drop in aggregate amount exploited from removing financial constraints, I store the drop in amounts exploited at the contract level and aggregate across all contracts and firms:

$$\Delta Q_{(\lambda)} = \sum_{i,j} \big(1 - m_r\big) q_{ij}^* \tag{75}$$

To compute the drop in aggregate value extracted from removing financial constraints, I store for each contract the area under the curve corresponding to the $(1 - m_r)$ share of policies no longer exploited, and aggregate across all contracts and firms:

$$\Delta PV_{(\lambda)} = \sum_{i,j} \int_{m_r q_{ij}^*}^{q_{ij}^*} \hat{V}_{ij}(q, \theta^*) \tag{76}$$

B6. Underpricing

I have so far assumed that insurers do not price new variable annuity policies below marginal cost. However, a large class of hidden price models (Gabaix and Laibson (2006), Heidhues and Kőszegi (2018)) would predict that competition should force insurance companies to return all surplus from 1035 exchanges to consumers via lower variable annuity prices in the primary market. In this subsection, I examine the effect of underpricing in the primary market on consumer surplus. In Section VII, I have estimated that the average policyholder lost 10.90 cents per dollar in present value of benefits from exchanges in 2018 ($1.68Bn lost divided by $15.4Bn in GLWB contracts exchanged). At the same time, insurers recorded 7.13 cents per dollar in surplus. Now assume insurers would return this surplus to policyholders. Given that the SEC does not allow insurers to price discriminate consumers based on origin (new vs exchange customers), this surplus would be split between exchange buyers and first time buyers. That would result in 1.1 cents per dollars per policyholder, assuming the surplus is split equally across the 100.2Bn in 2018 sales. So an exchange customer would still lose 9.8 cents per dollar net on average, a new customer would gain 1.1 cents per dollar and the insurer would break even.

B7. Indentifying Reputational Costs through Quantity Variation

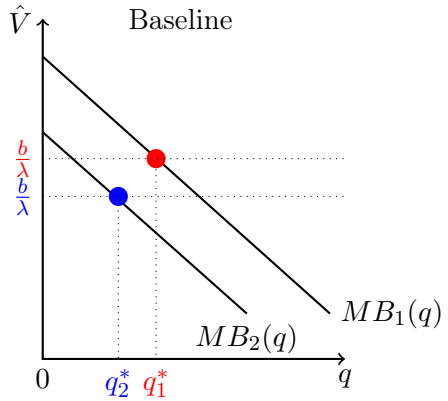
In separating financial constraints from reputational costs, I have assumed that any variation in total quantity exploited captures variation in reputational costs rather than financial constraints. To see this, imagine the average firm exchanges \$1Bn. The regulator would likely launch an investigation, disseminate its findings with the public and keep the firm under scrutiny for additional misconduct. The marginal reputational cost from exploiting another policy has increased considerably ($b_j \uparrow$). This explains why no company exchanges more than \$3Bn in any single year in the data. At the same time, the firm would record \$71Mn in surplus (7.1 cents per dollar). This is a small portion of the average insurer surplus (\$3.3Bn in 2018) and hence unlikely to change the shadow cost of capital unless the company was very financially constrained to begin with. For the average company:

$$\frac{\partial b}{\partial Q} >> \frac{\partial c}{\partial Q}$$

B8. Relaxing Within-Contract Discrimination

In the model, insurers have the ability to discriminate existing customers across infinitely many vintages, and use this ability to exclude low value customers (from newer vintages) from their offers. This assumption is important in identifying the degree of consumer inattention and the reputational cost. In this section, I relax the discrimination assumption and provide minimal conditions under which the two parameters are still identified.

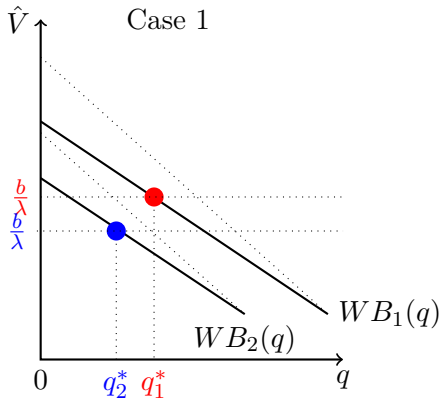
Consider a contract as a continuum of policies of different generosities. In the model, offering exchanges is the same as sampling without replacement. Each round, the insurer samples out of the most generous vintage with probability one. The expected benefit per sampling is the generosity on the most generous remaining unit, which goes down with each sampling (shown by the marginal benefit MB curve below).



To fix inuition, imagine there are two contracts (1) and (2). (1) is more generous than (2) as $\hat{V}_1(q) > \hat{V}_2(q)$ $\forall q$. (1) gets exploited more than (2) as $q_1^* > q_2^*$, but not enough to equalise marginal benefits (this is representative of the data). Assume I introduce smart investors (make $\theta < 1$). A lower θ steepens the marginal benefit curves for both contracts as for any exploitable value level, there is less mass of consumers

to be exploited. So the question I am asking is how much do I have to steepen the marginal benefit curves (lower θ) such that, when evaluated at their respective exploitation intensities q^*, the marginal benefits equal, and the equalised marginal benefits pin down the marginal cost b/λ.

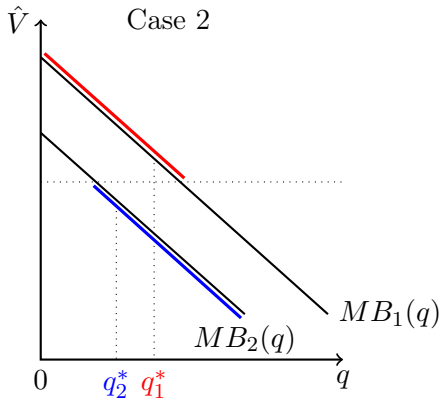
Imagine instead insurers cannot sample the highest value vintage with probability 1, but sample with positive probability across the generosity spectrum. Further assume the sampling probability increases in generosity, At each sampling, the expected benefit is a weighted average of all policies generosities, weighted by their sampling probability. But because it is more likely to sample from high than low generosity at each round, and sample without replacement, expected benefit per sampling goes down with q (as shown by the weighted benefit WB curve below).



For same two contracts (1) and (2) depicted above (now plotting the flatter WB rather than MB curves), there will be a $\theta \in [0, 1)$ that equalises the expected benefits. And the equalised expected benefits pin down the marginal cost. So as long as the sampling probability increases in generosity, the model mechanism goes through: given a distribution of contract generosity in force $\hat{V}$, variation in q across contracts pins down both θ and the MC.

Third, assume insurers can only discriminate between broad groups of customers. For simplicity, assume insurers condition exchanges on a single contract characteristic, common across all contracts, that can only identify 2 groups of existing customers: high value customers and low value customers. The insurer will work sequentially: exploit out of high value customers across contracts until the high value group is exhausted, then move to low value customers. Since the insurer cannot discriminate within groups, it will randomise and extract the average group benefit at each draw (which may vary across contracts if there is different distribution of generosity within group). Optimality requires that the average benefit belongs to same group across contracts.

Consider the same two contracts (1) and (2), such that, for $\theta = 1$, $\hat{V}_1(q_1^*)$ belongs to high value group and $\hat{V}_2(q_2^*)$ belongs to low value group. Assume we lower θ. There will be a range $[\theta_l, \theta_h]$ for which the average marginal benefit across all contracts will lie in the same value interval. We have moved from a point to a (single or disjoint) set identification of θ (and hence the MC). So as long as there are at least 2 existing customers for which the probability of being offered an exchange differs, and this probability is higher for



the more generous policy owner than for the less generous one, the model is informative about the degree of consumer inattention and firms reputational costs.

Finally, consider an alternative model where insurers cannot discriminate within-contracts, but can discriminate across contracts. Since it cannot discriminate within contract, the insurer will randomize and extract the average benefit. Across contracts, the insurer will work sequentially: exploit out of the high value contract until is exhausted, then move to low value contract. The share exploited in the high value contract pins down θ, while the average benefit in the low value contract pins down the (common) reputational cost.

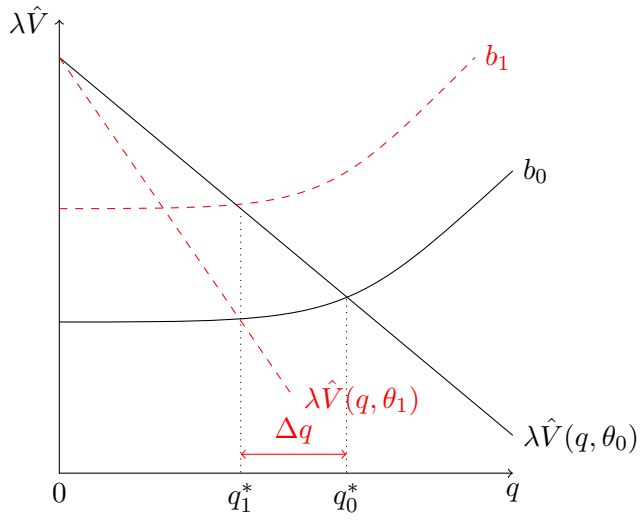
B9. Introducing Brokers

In the model, insurance companies make direct exchange offers to their existing customers. One way to think about this is brokers are just a pass-through, whose incentives are perfectly aligned (e.g. via compensation) with that of the insurance companies. In this section, I explain how the interpretation of model parameters changes when one introduces brokers explicitly, what counterfactuals change, and what happens when brokers incentives are misaligned.

Suppose I follow Robles-Garcia (2019) and Egan et al. (2020) and model brokers as maximizing the joint indirect utility of the broker and the consumer, written as a weighted average of the indirect utility of the consumer (plausibly decreasing in the exploitable value $\hat{V}$) and that of the broker (plausibly increasing in the exploitable value $\hat{V}$ through compensation). If brokers place no weight on consumers interests, then all unsophisticated customers exchange and the inattention parameter θ indeed captures the degree of consumer inattention. If a subset of brokers place consumers interests above their own, then these consumers would not exchange and the inattention parameter θ would capture the joint effect of the degree of consumer inattention and the share of brokers placing consumer interests first.

This has implications for the way we think about fiduciary duty in the model. Currently, a stricter selling standard increases the marginal exploitation cost on all units exploited leaving the degree of consumer inattention θ unchanged (as consumers do not become smarter). If one thinks instead of stricter selling standards as increasing the share of brokers that place consumer interests first, then the 'inattention' parameter θ would fall, which then requires a smaller shift in reputational costs to rationalize the same drop

in exploited quantities (the limit cases where the same drop in exploited quantities can be rationalized by either an increase in reputational costs or a drop in the degree of consumer inattention alone are shown in red below). This means that ignoring brokers underestimates the drop in the value extracted from consumers as a result of fiduciary duty (as the area under the $V(\cdot, \theta_0)$ curve is greater than the area under $V(\cdot, \theta_1)$ curve).



Finally, I consider the case where the broker is willing to exploit customers but the insurer is unable to incentivize brokers to exchange the right policies (misaligned incentives). This would result in one of the two cases shown in Appendix B8.

B10. Robustness to Model Misspecification: Incentive Alignment

The model assumes that the insurer will exploit across vintages in decreasing order of generosity. I have provided some evidence that this seems a plausible characterisation of insurer initiated exchange offers. Where brokers initiate the exchanges, there is a concern that the insurer will not be able to perfectly align incentives, so that brokers will not always pick the most generous vintages first. The model is potentially misspecified. To evaluate the impact of incentive alignment on estimated parameters, I reestimate the restricted model $\hat{V}_{ij}^{LB}(q_{ij}^*/\theta, 1) + \epsilon_{ij} = b/\lambda$ for the sample of insurer initiated exchanges (model most likely well-specified), full sample and sample of broker initiated exchanges (model most likely misspecified). I report the resulting degree of consumer inattention and the ratio of reputational costs to financial constraints:

	Insurer Initiated	Broker Initiated	Full Sample
θ	0.250***	0.180***	0.192***
	[0.049]	[0.019]	[0.017]
b/λ	10.542***	7.470***	8.065***
	[1.010]	[0.385]	[0.391]
N	174	772	946

B11. Robustness: Nonlinear Marginal Benefit Curve

In the main text, for each contract i and firm j, I have taken the distribution of life annuity benefits across issue quarters, ranked them from the most to the least generous, and fitted a linear regression to get an estimate of the marginal benefit curve from exchanges. In this section, I will fit this distribution particularly tightly. The figure below shows the distribution of the life annuity benefits from a variable annuity contract in 2018. Each dot represents one issue quarter. The y-coordinate is the excess annuity value averaged across all policies issued in that quarter ($\hat{V}_{ijt}$). The x-coordinate is the cumulative account value share in policies issued in quarters as or more generous than itself (q_{ijt}). I am fitting cubic spline of the form:

$$\hat{V}_{ijt} = \alpha_{ij} + \beta_{1ij} q_{ij} + \beta_{2ij} q_{ij}^2 + \sum_{k=0}^{K} \beta_{k+3ij} \big(\max\{0, q_{ij} - t_k\} \big)^3 + \epsilon_{ijt} \tag{77}$$

where α_{ij} is the excess life annuity value on the most generous contract policy quarter, coefficients $\{\beta_{1ij}..\beta_{K+3ij}\}$ measure how the life annuity value falls as you go down the generosity spectrum, and t_k denote the end-points of the spline intervals, chosen to fit the left end of the curve (where most of the action will happen) particularly tightly. And so the marginal benefit curve assuming full inattention is:

$$\hat{V}_{ij}(q_{ij}, 1) = \hat{\alpha}_{ij} + \hat{\beta}_{1ij} q_{ij} + \hat{\beta}_{2ij} q_{ij}^2 + \sum_{k=0}^{K} \hat{\beta}_{k+3ij} \big(\max\{0, q_{ij} - t_k\} \big)^3 \tag{78}$$

To introduce partial inattention, I am exploiting the following proposition:

Proposition 1: *Assume inattentive customers are uniformly distributed within contract. A partial degree of inattention $\theta < 1$ shrinks the distribution of exploitable values by a factor θ, as for every exploitable value $\hat{V}$, there are fewer consumers to exploit, or equivalently expands the share exploited q by a factor of $1/\theta$, holding the distribution of exploitable values fixed, such that:*

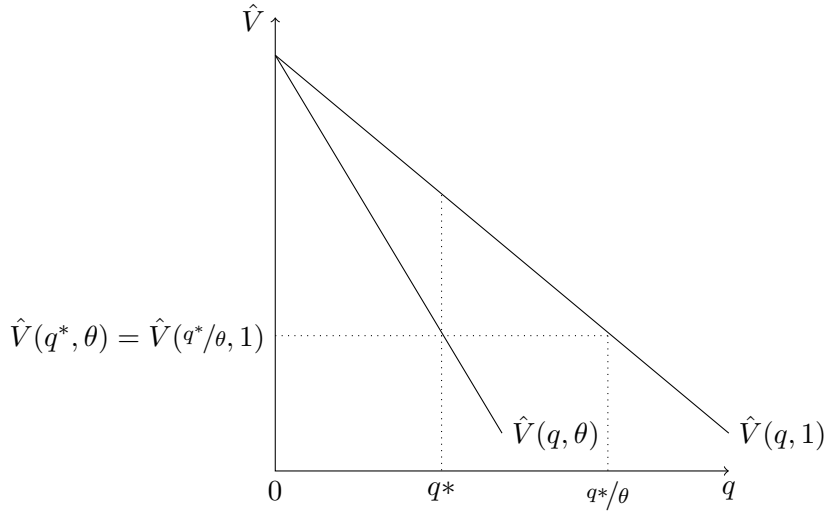
$$\hat{V}(q, \theta) = \hat{V}(q/\theta, 1) \tag{79}$$

which holds true for any strictly monotonic function $\hat{V}(\cdot)$ (this follows directly from the definition of the slope and the fact that $\hat{V}(0, \theta) = \hat{V}(0, 1)$).

This is very useful, because I can hold the distribution of exploitable values in force (which I will observe) fixed and just vary the amount exploited by $1/\theta$ to capture the varying degree of consumer inattention, as shown in the figure below:

In my case, this says that I can derive the exploitable value curve associated with any consumer inattention $\theta < 1$ by taking equation (14) and evaluating it at q/θ instead of q. Specifically:

$$\hat{V}_{ij}(q_{ij}, \theta) = \hat{\alpha}_{ij} + \hat{\beta}_{1ij} \frac{q_{ij}}{\theta_{ij}} + \hat{\beta}_{2ij} \left(\frac{q_{ij}}{\theta_{ij}} \right)^2 + \sum_{k=0}^{K} \hat{\beta}_{k+3ij} \left(\max \left\{ 0, \frac{q_{ij}}{\theta_{ij}} - t_k \right\} \right)^3 \tag{80}$$



I then estimate the second stage cross-sectional regression in equation (4) in terms by plugging in the linear marginal benefit curve from equation (3) and then the non-linear marginal benefit curve in equation (16), under the assumption that inattention is constant across contracts, as before. The table below shows the results, to suggests that both the estimated degree of consumer inattention and the ratio of reputational costs to financial constraints are not very sensitive to the functional form of $\hat{V}(q, \theta)$.

	Linear MB	Cubic Spline MB
θ	0.192***	[0.284]*
	[0.017]	[0.151]
b/λ	8.065***	9.359***
	[0.391]	[0.978]
N	946	946

B12. Robustness: Rational Component in Replacement

In the main text, I have used contract level data on replacement intensities from 2018 to proxy for the share exploited q^*_{ij}. However, not all replacements are evidence of consumer exploitation. Even in the most generous contracts, policyholders may be forced to replace their contracts if they face liquidity constraints (partial exchange), receive adverse health and mortality shocks, go through a divorce or inheritance. To proxy for the rational component in replacements, I take the average replacement intensity for otherwise similar, but deeply out of the money policies. The assumption is that insurance companies have no incentive to exploit these policies (and may even have an incentive to keep consumers from replacing to avoid losing the present value of future profits), so all replacements should reflect normative consumer preferences. To capture any heterogeneity in consumer demand for replacements, I split out of the money policies by firm and product characteristics that plausibly correlate with consumer demand. I look at proxies of default (AM Best Rating), liquidity (share class), tax status (qualified vs non-qualified) but no demographics (as I

have shown that the demographics of replacements does not reflect that of contracts in force). I compute replacement intensities separately for policies with different tax, risk and liquidity characteristics, and then extrapolate this rational component to similar policies across the generosity spectrum. My assumption is that conditional on tax, risk and liquidity characteristics, the replacement intensity should not increase with generosity, and is what identifies consumer inattention from preferences in the estimation.

Specifically, since generous policies written before the financial crisis tend to be more liquid than the average out of the money policy (mainly because they are older so their surrender charge periods have ended), I only look at out of the money policies which are liquid (share classes A, C, I). I find there is no replacement whatsoever in policies funded with qualified money (where there is no tax benefit of partial exchanges). For policies with non-qualified money, replacement activity correlates with ratings (0.8% in policies rated A- or above, 2.5% in policies rated B+ or below). I take these values (0% for qualified money, 0.8% for highly rated non-qualified money, 2.5% for lower rated non-qualified money) as my estimates of rational replacement intensities and assume they stay constant across the generosity spectrum (the other plausible assumption, whereby rational replacements actually go down as policies become more generous, as agents seek cheaper alternatives, returned essentially identical estimates). I then compute the exploitation intensity q^* as total replacement intensity q minus rational replacement intensity q_r.[11]

B13. Robustness: Alternative Estimates of Consumer Inattention

I validate the structurally estimated degree of consumer inattention in the variable annuity market by comparing it with alternative data and survey-based measures of consumer inattention.

Estimating the Naive Share from the Data: With the benefit of foresight, I can stand in 2010 and know that over the next decade, 25% of the contract-holders will be willing to exchange their variable annuities at relatively disadvantageous terms. So I might conclude that 40% of the existing policyholders was a plausible estimate for the number of customers that could potentially be exploited in 2010 (it could be less, as some policyholders have exchanged for rational reasons, but it could be more, if one would assume that insurance companies have not exhausted all exploitable customers yet).

Estimating the Naive Share from Survey Evidence: Alternatively, one can look at survey evidence to gauge the ability of consumers to make informed decisions regarding their variable annuity exchange.

[11] More formally, a rational component in replacements moves both the the exploited quantity and exploitable value curve such that only proactive consumer exploitation is being captured. The exploited quantity shifts left by the amount rationally exchanged, as shown in text. The exploitable value curve shrinks such that the overall amount replaceable shifts left by the same amount. However, the second effect is tiny. In the limit case where rational replacements are evenly distributed across the generosity spectrum, the shrinkage can be captured through the share q under Assumption 1. That is $V(q, 1, q_r) = V(\frac{q-q_r}{1-q_r}, 1, 0)$. If I also assume rational replacements are proportionally allocated to attentive and inattentive consumers, so it does not affect the share of inattentive consumers, but shrinks the distribution proportionally, then this holds for any degree of consumer inattention θ. That is: $V(q, \theta, q_r) = V(\frac{q-q_r}{1-q_r}, \theta, 0)$. In the other limit case where rational replacements happen only in the least generous contracts, the effect is nil.

For instance, the 2017 LIMRA Secured Retirement Institute Survey on Deferred Annuities reports that 37% of variable annuity owners would replace their existing variable annuity if their financial adviser would recommend it. This underscores the notion that trust is an important element in the customer-broker relationship, and suggest brokers can play an important role in exchanges. Given the share of exploitable consumers in a variable annuity contract likely goes down over time as exploitation proceeds, this could provide a lower bound on the share of exploitable consumers in the same contracts in earlier years.

Appendix C: Demand Appendix

C1. Partial 1035 Exchanges

There is one possibility under which 1035 exchanges can be done for tax reasons. For non-qualified owners (individuals who made variable annuity contributions from post-tax dollars), partial 1035 exchanges are essentially tax-advantaged withdrawals. Assume you have $100 in premiums and $20 in earnings in your account value. Under the US Tax Code, you first tax out of earnings and then out of contributions. So if you withdraw $20, it is all considered earnings and you pay tax. Now assume you move $20 to a newly established variable annuity in a partial 1035 exchange. Under the US Tax Code, those $20 become 84% contributions and 16% earnings (so earnings contribution rate is transferred pro-rata). In 180 days, you can withdraw the $20 and pay taxes on just 16% x $20 = $3.2 instead of the full $20. You will eventually still pay taxes on the remaining $16.8, but the tax bill moves to the future. Partial 1035 exchanges reduce the present value of the tax bill by deferring some of the taxes on earnings to the future, while leaving the undiscounted tax bill unchanged. Most importantly in the case of liquidity constraints, partial 1035 exchanges can provide immediate tax relief, postponing taxes to the future and essentially granting taxpayers a zero-interest loan on the unpaid tax bill.

Similarly, when a non-qualified owner wants to borrow from the account value or use it as collateral, IRS regards it as a taxable event. US Tax code section 72(e)(4)(A) notes that any type of pledge or assignment of variable annuity assets triggers a taxable event. This implies that customers can use partial 1035 exchanges in non-qualified annuities not only as tax-advantaged withdrawals, but also a tax-advantaged way to use a portion of the annuity account value as collateral for personal or business loans.

Hypothesis 1: If tax reasons drive 1035 exchanges, then one should see higher replacement intensities in contracts with higher share of non-qualified sales. To test it, I collect the share of sales going into qualified and non-qualified accounts at a contract level from Morningstar. For those contracts where sales data is not available, I set the qualified share to 0 where the contract accepts only qualified money, and to 1 where the contract accepts only non-qualified money. Then I regress replacement intensity on non-qualified money, with time and parent company fixed effects to control for time series and cross-sectional variation in replacement rates. I find that replacement intensity is indeed higher for contracts with higher share of non-qualified sales.

Hypothesis 2: If partial exchanges drive 1035 exchanges in non-qualified contracts, then one should

see higher replacement intensities in contracts with lower average amounts exchanged. This is because the tax advantage is greatest when the amount exchanged is lower than the earnings component of the contract (which for most policies is under 30-50% of account value). When the amount exchanged approaches the account value, the net benefit is actually negative, as the tax benefits approach zero and one also pays the broker (I simulate the net benefit for a representative contract in Figure D3). I find the opposite: it is larger amounts (both in absolute terms and normalized by average contract value) that tend to be exchanged the most (see Figure 7).

This suggests that cross-sectional variation in replacement rates cannot be explained by tax, collateral or liquidity considerations related to partial 1035 exchanges. By contrast, the fact that the largest generous contracts are predominantly exchanged would be the most effective way to exploit consumers from the insurer's perspective.

Appendix D: Other Tables and Figures

Figure D1: **The Lifetime Cost of Living Benefits**

I exploit the accounting of guaranteed lifetime withdrawal benefit fees to compute a holding period cost of living benefits. The fees for lifetime withdrawal benefits are normally stated as a percentage share of the account value and are settled through the redemption of units. This means that, given the initial number of units and the fee rate, one can compute exactly the attrition in account units due to benefit fees at any point in time (assuming no intermediary premiums, redemptions or withdrawals). Note that a subset of benefits state GLWB fees as percentage of the greater between the account value and the benefit base. For those benefits, my cost measure represents a lower bound. This figure plots the average 20Y holding period cost of a single-life GLWB as percentage of account value, by quarter of issue.

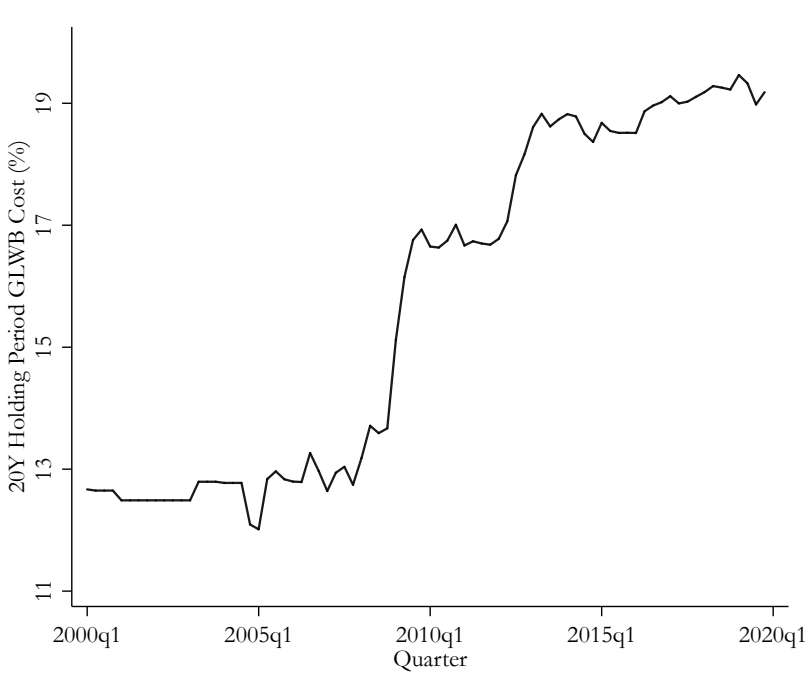


Figure D2: **Historical GLWB Characteristics**

The figure plots the time series evolution of annual fees (top left) and contractual withdrawal rates (top right) averaged across all guaranteed lifetime withdrawal benefits available for sale in a given quarter. Data from Morningstar Annuity Intelligence.

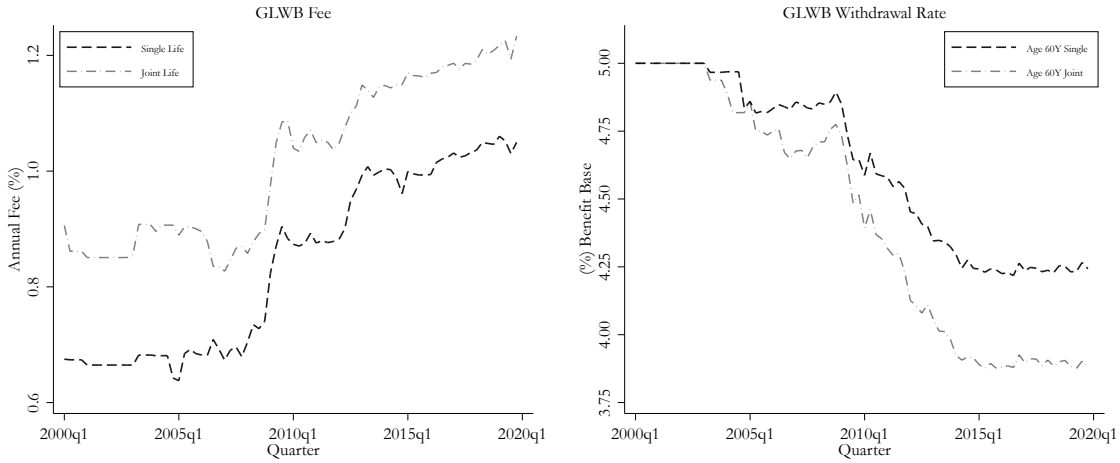


Figure D3: **Relative Benefit of Partial 1035 Exchanges**

This chart plots the relative contemporaneous benefit, in cents per dollar exchanged, of a partial 1035 exchange relative to a withdrawal for a representative non-qualified variable annuity policy with 2/3 of the account value in contributions, 1/3 of the account value in earnings, an average income tax rate of 30% and brokerage commission rate of 6%, for various shares of account value exchanged/withdrawn.

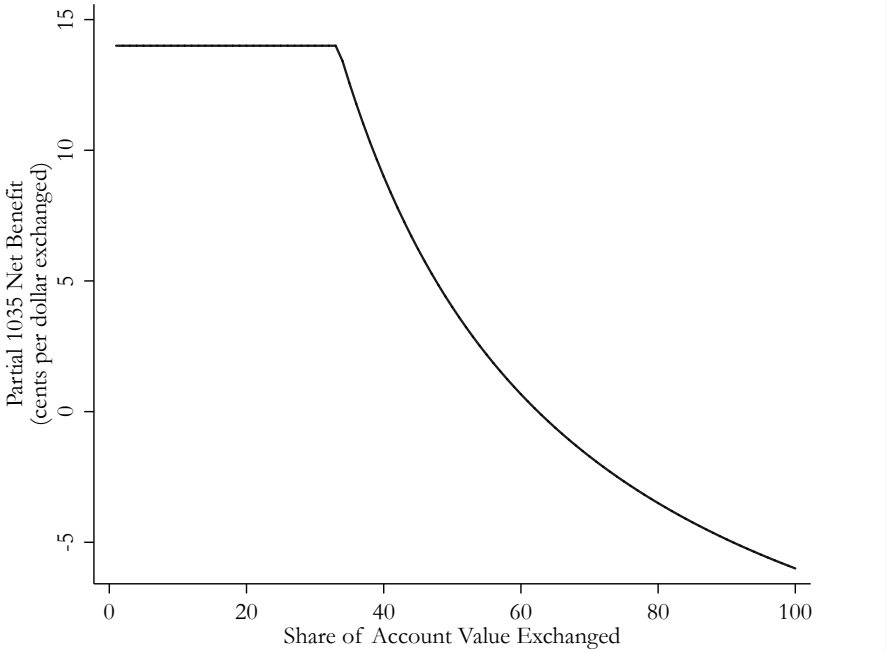


Figure D4: **Benefit Base vs Account Value Evolution over Time**

This chart plots the evolution of benefit base (blue) and account value (red) for a set of representative variable annuity contracts with guaranteed lifetime withdrawal benefits issued in 2007. The account value is computed as the initial investment (normalised to 100) compounded at the actual return on the separate account, net of fees. The benefit base is computed as the initial investment (normalised to 100) compounded at the annual contractual rollup rate (7-7.25% per annum).

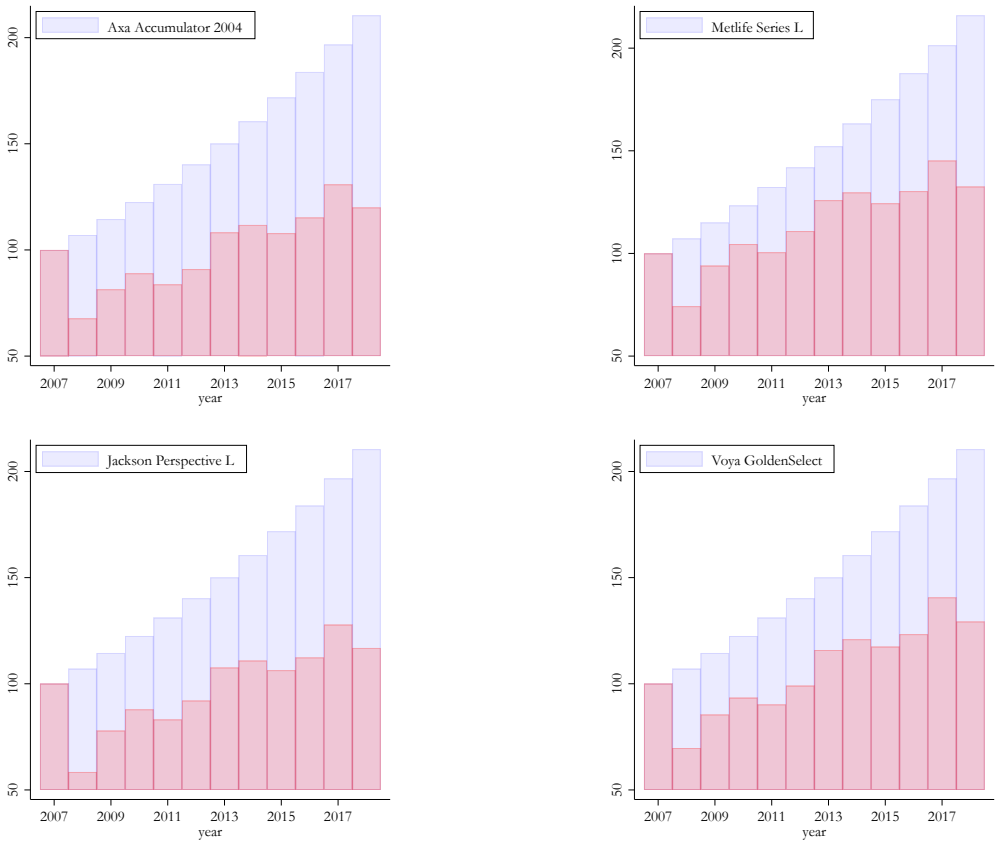


Figure D5: **High Fees vs Overly-Generous Guarantees**

This chart decomposes the wedge between the benefit base and the account value from Figure D4 into two components: fees driving down the return on the mutual funds (red) and guarantees exceeding the gross return on the mutual funds (blue), for a set of representative variable annuity contracts with guaranteed lifetime withdrawal benefits issued in 2007. Fees computed as the difference between the gross return and the net return on the mutual funds, cumulated over time. Guarantees computed as the difference between the guaranteed return and the gross return on the mutual funds, cumulated over time.

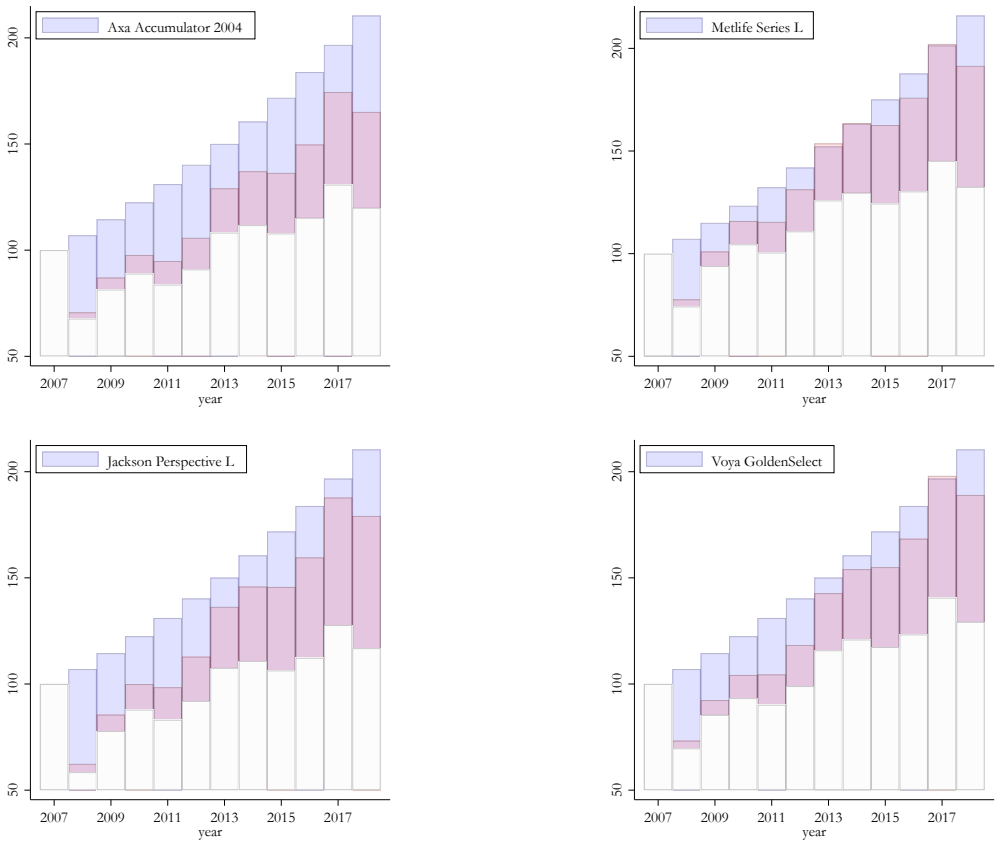
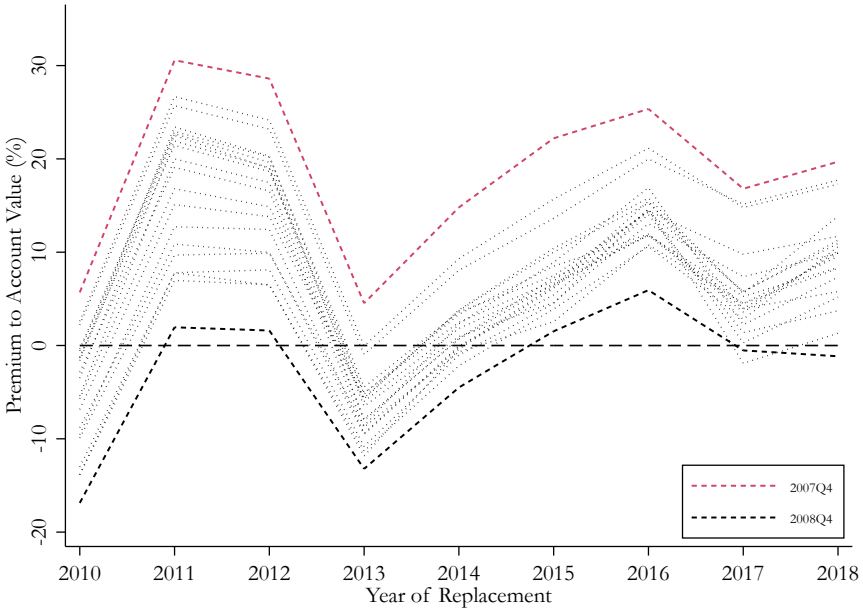


Figure D6: **GLWB Valuation vs NAIC Statutory Valuation**

This figures compares the evolution of the implied lower bound on the value of GLWB variable annuities issued at different quarters between 2004Q1-2008Q4 against the aggregate variable annuity statutory valuation ratio, defined as aggregate variable annuity gross reserves (before reinsurance but after hedging) over aggregate account values, from NAIC Interrogatory 9.2. Lower bound assuming an individual aged 60Y exercising a 5% withdrawal rate GLWB immediately.



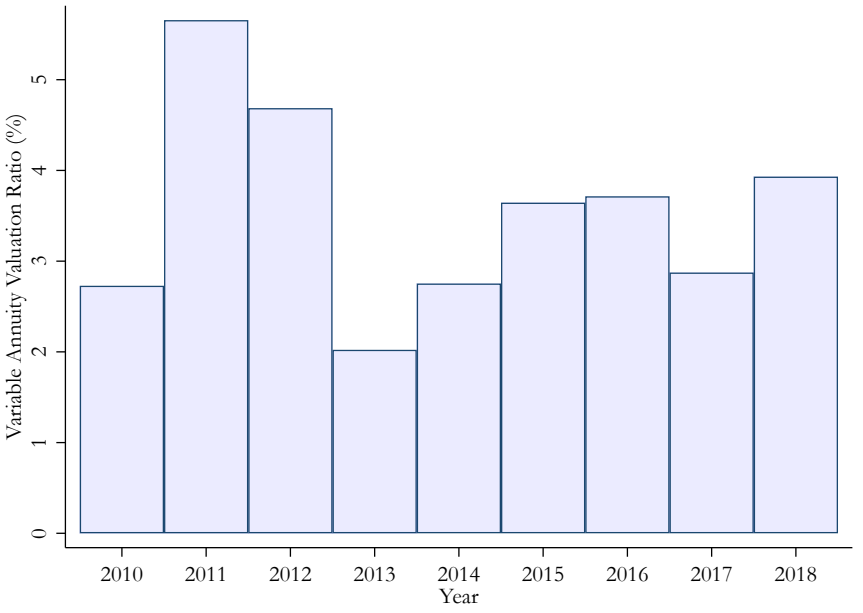
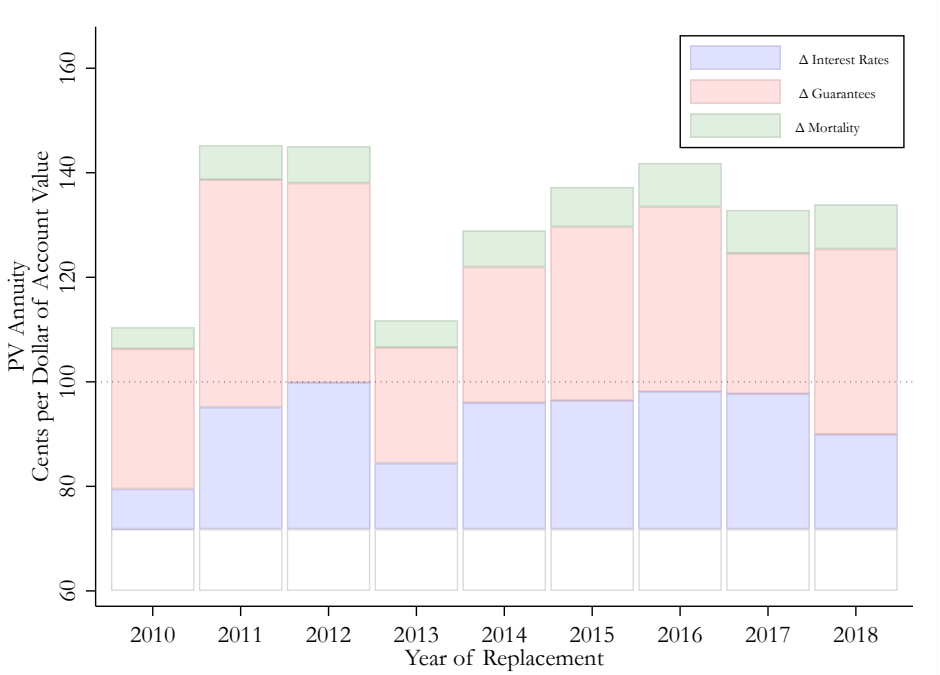


Figure D7: **5Y Waiting Period GLWB Present Value Decomposition**

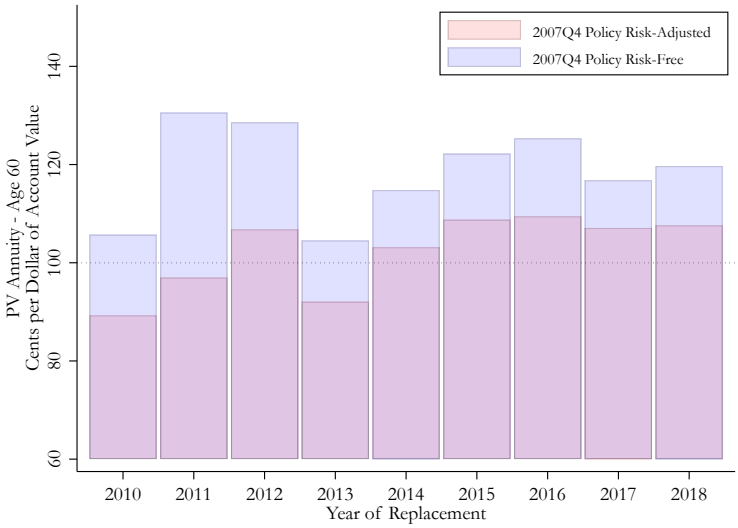
This chart decomposes the growth in the implied lower bound on the value of a GLWB variable annuity originally issued in 2007Q4 into three components: (1) changes in the term structure of interest rates (used to discount the annuity cashflows) (2) changes in ratio of the benefit base to contract value (capturing the effect of minimum return guarantees) and (3) changes in US Society of Actuaries individual life annuity mortality assumptions. The valuation assumes a hypothetical individual aged 55Y who is able to exercise a 6% rollup 5% withdrawal rate GLWB in 5Y. For discount rates, I use quarterly averaged continuously compounded treasury yield curve from Gurkaynak Sack and Wright (2007). For mortality rates, I use the 2000 Mortality Basic Tables for the issuance date and the 2012 Mortality Basic Tables (with yearly adjustments before and after 2012 based on SOA Mortality Improvement Projection Tables) for the replacement dates. For benefit bases, I use the average benefit base to contract value for GLWB policies issued during 2007Q4 from LIMRA 2010-2018 experience studies.



$$LB'_t = \sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+k+l} \times w^{X_{t+k}/St}}{Y^s_{t,t+s}} +$$
$$\left[\sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} \times w^{X_{t+k}/St}}{Y^s_{t',t'+s}} - \sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} \times w^{X_{t+k}/St}}{Y^s_{t,t+s}} \right] +$$
$$\left[\sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+l} \times w^{X_{t'+k}/St'}}{Y^s_{t',t'+s}} - \sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+k+l} \times w^{X_{t+k}/St}}{Y^s_{t',t'+s}} \right] +$$
$$\left[\sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi'_{n+k+l} \times w^{X_{t'+k}/St'}}{Y^s_{t',t'+s}} - \sum_{s=k+1}^{\infty} \frac{\prod_{l=0}^{s} \pi_{n+k+l} \times w^{X_{t'+k}/St'}}{Y^s_{t',t'+s}} \right]$$

Figure D8: **GLWB Valuation Robustness: Risk Adjustment**

I This first figure compares the value of life annuity embedded in a GLWB variable annuity discounted at risk-free rate (blue) with a more conservative estimate adjusting for default risk (red). To compute the adjustment, I extract a history of CDS spreads on senior unsecured debt for the largest US variable annuity writers (Aegon, AIG, Allianz, Hartford, Lincoln, Metlife, ING, Prudential) for 1Y, 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 20Y and 30Y maturities from Refinitiv. I linearly interpolate the spreads at annual maturities to create a term structure of CDS spreads, then aggregate at the industry level by weighting by variable annuity sales. I then recompute the life annuity value by adding the maturity specific CDS spread to the treasury discount rate. This provides a conservative estimate, as policyholders are senior to debtholders, annuity benefits are secured by separate account assets, and there are explicit or implicit state and federal government guarantees protecting policyholders but not debtholders. Valuation assuming an individual aged 60Y exercising a 2007Q4-issued 5% withdrawal rate GLWB at various points after the financial crisis.



II This second figure plots the implied lower bound shift from the US Treasury discount curve required to make a policyholder indifferent (in a present value sense) between the lifetime annuity implied by a GLWB variable annuity and the underlying account value. The valuation assumes a GLWB variable annuity originally issued in 2007Q4 paying a 5% withdrawal rate for life for an individual aged 60Y at the time of replacement.

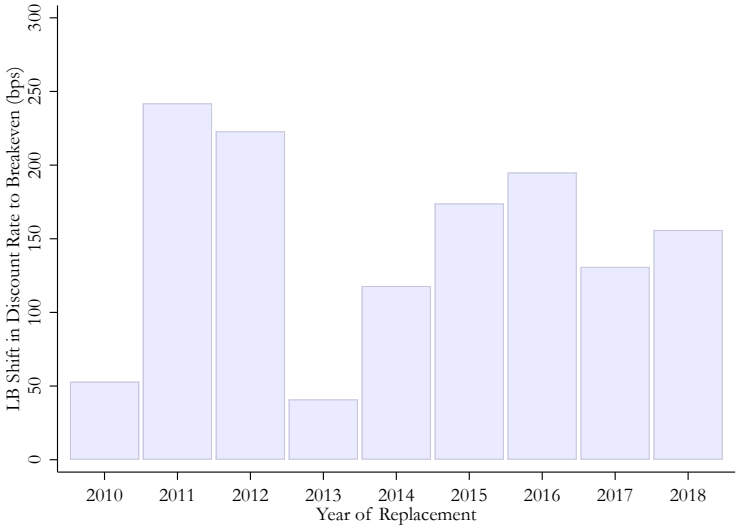


Figure D9: **Hartford VA Statutory Valuation vs Share Buybacks**

This chart plots variable annuity statutory valution ratios (top panel) and share buyback volume (bottom panel) for Hartford Financial Services Group Inc. The variable annuity statutory valution ratio is defined as gross variable annuity statutory reserves over variable annuity account value and comes from NAIC Interrogatory 9.2. The data on stock buybacks comes from Factset. The red dots denote Hartford Financial variable annuity subsidiary Talcott Resolution's annual extraordinary dividends to the holding company. These dividends are pooled at the holding company level and partly used for share repurchases. The dividends are approved by the insurance regulator where the subsidiary is domiciled, in this case Connecticut.

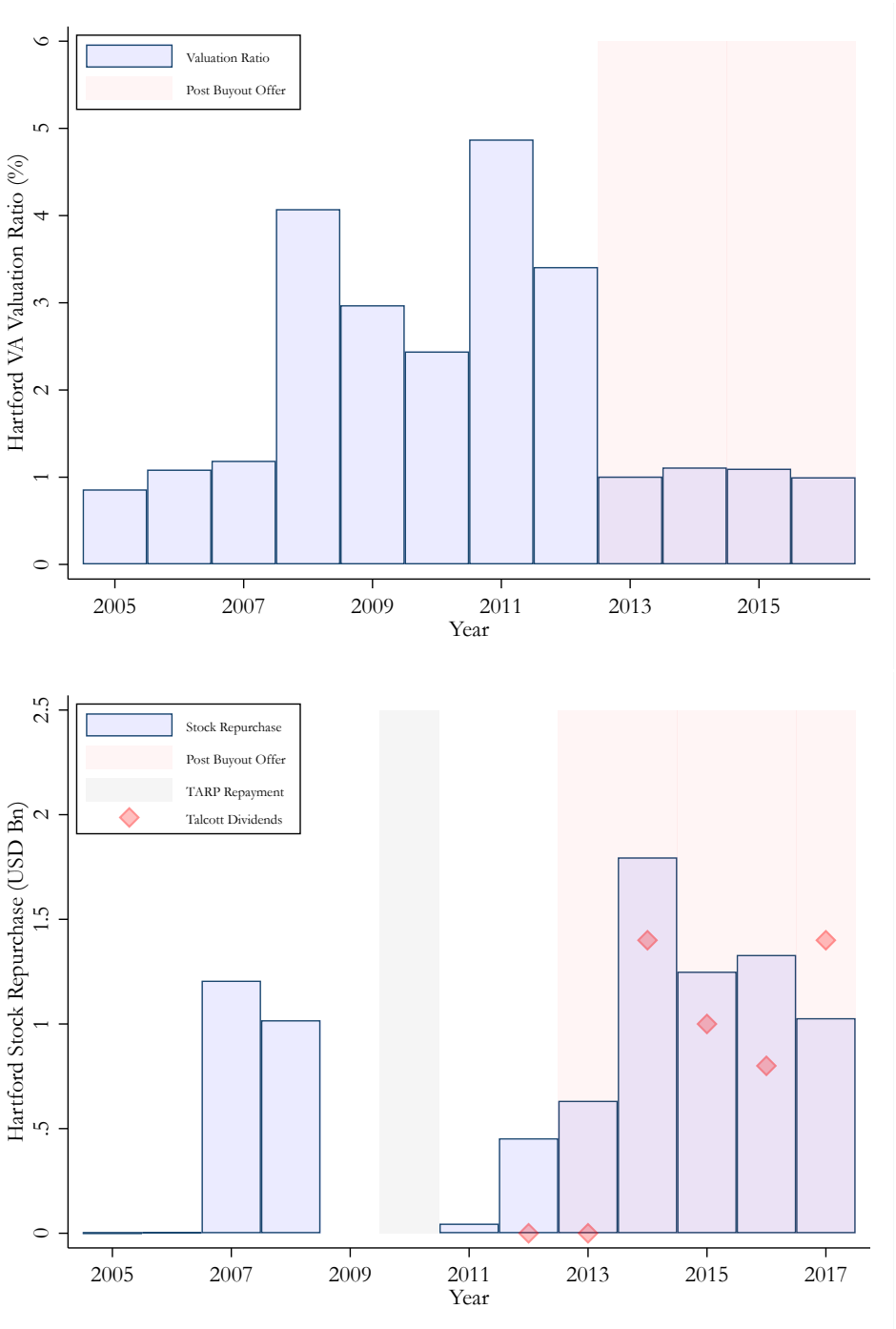


Table DI: **Brokerage Compensation vs Misconduct: Evidence from FINRA**

FINRA requires all firms and individuals registered to sell securities or provide investment advice to disclose information on arbitrations, regulatory actions, judicial proceedings at firm level, and additionally customer complaints, bankruptcy filings and criminal investigations at the individual level. This table shows the incidence of firm and broker-level disclosures for all brokerage firms, the subset of brokerage firms selling and servicing variable life insurance or annuities ("Offer VA") and within these firms, the subset of firms which are reported to have received discretionary brokerage compensation in insurance companies variable annuity filings with the SEC. I report total disclosures as well as disclosures involving the term "variable annuit(ies)", which I extract from the disclosures' textual description. For firm variable annuity related disclosures, I also report the average final sanction awarded in court, by a regulator or an arbitrator when applicable. Broker-level disclosures aggregated at the broker × firm employment spell level. Standard errors clustered at brokerage firm level. Data on brokerage firms receiving discretionary variable annuity compensation from SEC 485POS and N3/4(A) filings. Data on brokerage firms and affiliated brokers disclosure records from FINRA's BrokerCheck. The datasets merged by brokerage firm name.

			of which: Receiving Discretionary Compensation			
	All firms	Offer VA	Yes	No	Diff (Y-N)	|T-stat|
			Firm-Level Disclosures			
Have Disclosures (%)	38.63	61.05	80.18	53.32	26.86	14.59
Disclosures/Year (×100)	14.45	28.98	71.57	11.69	59.89	5.30
Have VA Disclosures (%)		12.02	29.47	4.96	24.951	14.24
Avg VA Sanction per Firm ($)		220,384	261,704	121,041	140,663	3.07
# Brokerage Firms	11,135	2,663	767	1,896		
			Broker-Level Disclosures			
Have Disclosures (%)	20.23	23.00	23.39	20.86	2.53	1.59
Disclosures/Year (×100)	3.00	3.48	3.59	2.90	0.69	2.75
Complaints/Year (×100)	1.40	1.70	1.80	1.18	0.62	3.29
Brokers × Firms	1,633,893	1,243,737	1,052,121	191,616		

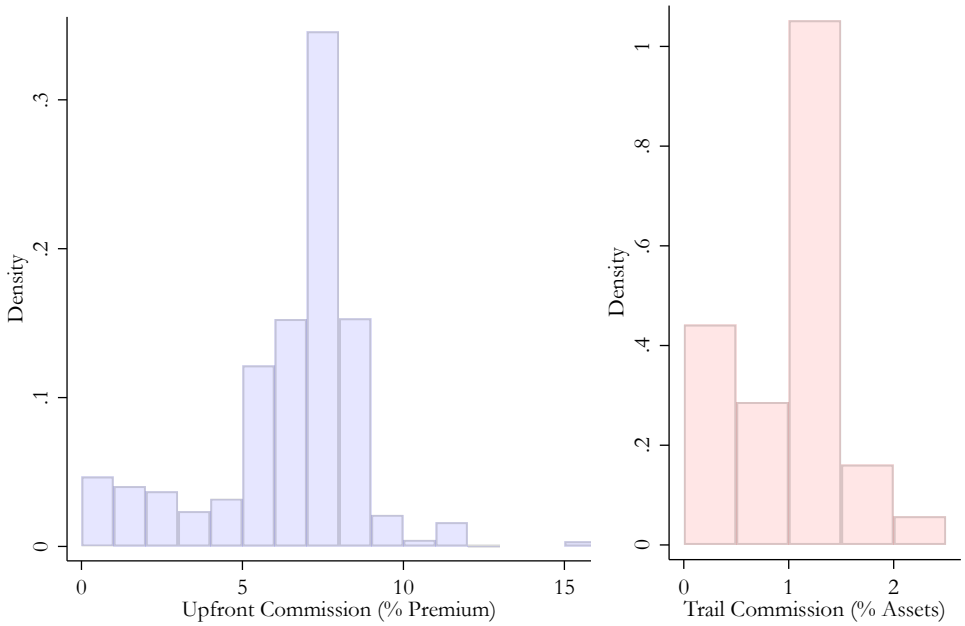
Table DII: **Brokers Omissions and Misrepresentations: Evidence from FINRA**

This table shows conclusions from FINRA investigations into variable annuity exchange practices carried at four brokerage firms: Metlife Securities Incorporated, Fifth Third Securities, Transamerica Financial Advisors and UnionBanc Investment Services. The table reports the period under investigation, the number of variable annuity exchanges investigated (sample size), the amount exchanged and associated broker commission, and the share containing at least one material ommission and misrepresentation in general, and relating to the value of accumulated living benefits or accumulated death benefits in particular. The last column shows the percentage of variable annuity exchange applications that were ultimately approved by the brokerage firms' compliance divisions. Fields with − mean the data was not reported. Data from FINRA Disciplinary Actions Online.

					% Omissions and Misrepresentations			
	Period	Sample Size	Amount Xchanged	Comm. Earned	Total	Living Benefit	Death Benefit	Approved
Metlife Securities Inc	2009-2014	35,500	$3,000m	$152m	72%	52%	21%	99,8%
Fifth Third Securities	2013-2015	1,431	$165.7m	$8.52m	77%	−	−	92%
Transamerica Advisors	2010-2016	51,000	−	$591m	50%+	52%	31%	-
UnionBanc Investments	2016-2018	454	$51m	−	61%	61%	0%	-

Figure D10: **Distribution of Variable Annuity Commission Rates**

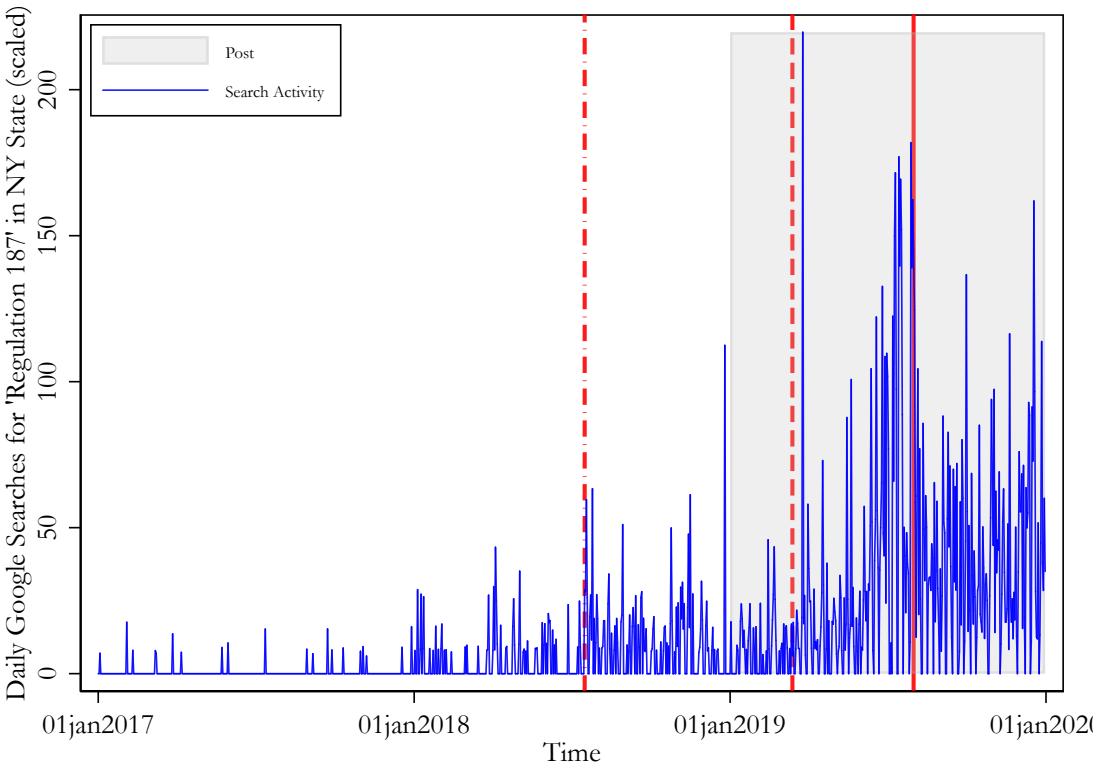
This chart plots the empirical distribution of brokerage commission rates across variable annuity contracts. When selling a contract, brokers can choose between a higher upfront commission, payable upon sale, or a lower upfront commission combined with annual trail commissions for as long as the policy is in force. The LHS chart plots the maximum offered upfront commission rate over 2025 variable annuity contracts available for sale between 2006 and 2019. The RHS chart plots the associated trail commission rates. Not all contracts offer a trail commission option. Where contracts change commissions over their lifecycle, the average commission is being reported. Data from variable annuity separate accounts N3/4(A) registration filings and 485POS post-ammendment filings available on SEC Edgar.



Together, upfront and trail commissions make up the non-discretionary component of variable annuity brokerage compensation. Brokers may also receive discretionary compensation in the form of cash bonuses, trainings, conferences, trips or entertainment. Aggregate discretionary brokerage compensation is further discussed in Figure 10

Figure D11: **Search Interest in NY Fiduciary Duty and Key Dates**

This chart plots the a time series of daily Google searches for "Regulation 187" from IPs located in New York State between 2017 and 2019. Aggregated from hourly search data extracted from Google Trends. Intervals of very low search volume in 2017 likely censored by Google (showing up as zeros). As Google Trends does not report absolute but only relative search volume, I scale the data as percentage of "fiduciary duty" searches in January 2017.



The New York Regulation 187 is the insurance regulation governing intermediaries standards of care, which was amended during this period to include fiduciary responsibilities. The vertical lines denote three events that led to the emergence of differential standards of care in NY State vs the Rest of the US: 17th Jul.2018 (dotted line), when NY Department of Financial Services revealed its first proposal for an own fiduciary rule (independent of nationwide regulatory efforts) with a clear implementation deadline for August 2019, 14th Mar.2019 (dashed line), when the US House of Representatives revealed the SEC would implement a weaker standard in the rest of the US, and 1st Aug.2019 (solid line), when changes to NY Insurance Regulation became effective. An earlier proposal, dated 27th Dec.2017, had no implementation date and was seen as harmonizing US Department of Labor's existing nationwide fiduciary proposal with state regulation rather than proposing a different standard.

Table DIII: **New York Fiduciary Duty: Base Period Balancing Test**

This table shows a balance test of matched NY and non-NY contracts along several contract, consumer and distributor characteristics for the pre-period (2018). I consider the average amount exchanged (total amount exchanged divided by number of contracts affected), the type of client (retail vs group), the tax treatment (qualified vs non-qualified money), the distribution channel (captive agents vs independent agents vs direct response), whether the insurance company has made a buyout offer, the broker servicing compensation (annual trail commission as % of account value), and the probability a broker will have a regulatory disclosure in any given year. The table shows the raw difference as well as controlling for contract pair fixed effects. The sample size varies as not all covariates were available for all contracts.

					With Pair FE		Observations		
Variable	NY	non-NY	Diff	|T-stat|	Diff	|T-stat|	Total	NY	non-NY
Replacement Intensity	2.261	2.135	0.126	0.22	0.182	0.32	596	286	310
Amount (000s$)	138.6	168.7	-30.05	2.16	-23.01	2.41	388	147	241
Sh Retail	0.947	0.968	-0.021	1.19	-0.027	1.95	512	228	284
Sh Qualified	0.479	0.437	0.041	1.89	0.013	0.87	457	189	268
Sh Captive Agent	0.049	0.084	-0.035	1.58	0.002	0.56	457	189	268
Sh Direct Response	0.006	0.016	-0.010	1.06	-0.007	1.47	457	189	268
Sh Buyout (Rule 11a2)	0.238	0.248	-0.011	0.30	-0.003	0.46	596	286	310
Trail Commission (%)	0.873	0.814	0.058	0.98	0.432	1.88	273	120	153
Disclosure Rate (%)	1.568	2.178	-0.610	37.54	-0.662	60.68	363	152	211

To compute the annual probability that a broker will have a regulatory disclosure reported in the last row, I extract all brokers disciplinary records over the period 2000-2018 and match them with brokers location information and employment histories with brokerage firms, for the subset of firms reported to service each variable annuity contract in insurance companies SEC filings, under the restriction that contracts issued in a given state are only serviced by brokers in the same state. I then compute the contract-specific disclosure rate as:

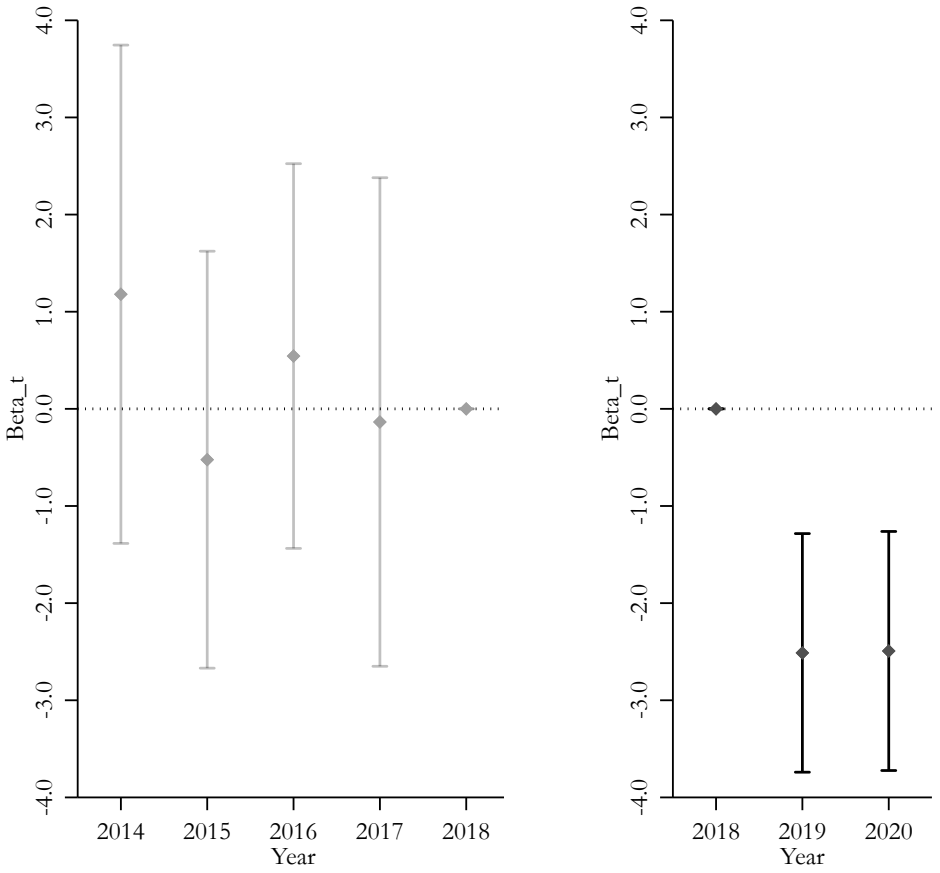
$$\text{Disclosure Rate} = \frac{\sum_j \sum_b \#\text{ disclosures while at firm}}{\sum_j \#\text{brokers} \times \text{years}} \times 100$$

where j denotes firms and b denotes brokers. The gap in disclosure rate is mostly historical. As Figure D13 shows, the incidence of variable annuity-related complaints has been fairly similar in NY State and the rest of US in the 4-5 years prior to the amendment of NY Insurance Regulation 187.

Figure D12: **Fiduciary Duty: Parallel Trends and Persistency**

This chart plots the differential replacement intensity in NY domiciled contracts relative to (otherwise identical) non-NY domiciled contracts, controlling for time and contract pair fixed effects, over two periods: prior to the implementation of NY Regulation 187 (LHS, parallel trends) and after the implementation of the regulation (RHS, persistency). Since contract-level replacement data is not available prior to 2018, the LHS chart proxies replacement intensity by redemption intensity (described below). Results based on 302 contract pairs containing 633 variable annuity contracts. The regression specification is:

$$Repint_{ijt} = \alpha_j + \alpha_t + \beta_0 NY_{ij} + \sum_{s=t-4}^{t+2} \beta_s NY_{ij} \times \mathbb{1}_{[t=s]} + \epsilon_{ijt}$$



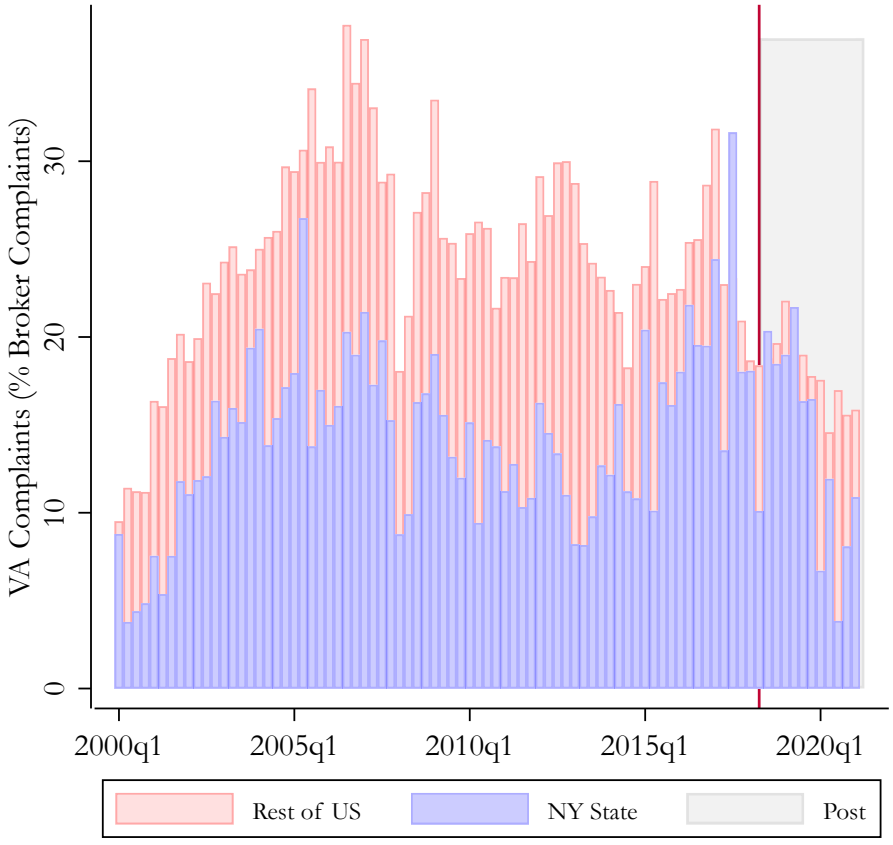
Redemption Intensity: For every contract i at time t, I collect assets and sales information from Morningstar. I do not observe contract-level returns. Instead, I collect separate account-level returns from insurance companies variable annuity filings with the SEC, and apply the return to all contracts in that separate account. The assumption is that contracts facing the same investment options also have similar asset allocations across those options resulting in similar returns. To obtain contract level redemptions, I use an accounting identity:

$$A_{i,t+1} = (1 + r_{i,t+1})A_{i,t} + S_{i,t} - R_{i,t}$$

which says that next period assets A_{t+1} are current period assets A_t compounded at the return on the mutual funds r_{t+1}, plus sales S_t minus redemptions R_t, where redemptions stand for contract outflows due to death, contractual withdrawals, surrenders and exchanges, and define the redemption intensity as redemptions in beginning of period assets. Under the assumption that neither policyholder deaths, contractual withdrawals (which are agreed at issuance) and surrenders (which are costly for the broker as she would lose commissions) are not correlated with intermediary standards of care, redemptions are just exchanges with measurement error, and proxying replacements with redemptions results in β coefficients which are unbiased, but imprecise (classical measurement error in dependent variables).

Figure D13: **Fiduciary Duty: Variable Annuity Related Complaints**

This chart plots the quarterly incidence of variable annuity-related customer complaints, as a percentage of total broker-related complaints, for brokers operating in NY State vs the rest of the US over the period 2000-2020. The red vertical line subsumes the three events marking the announcement of a differential brokerage standard in NY State vs the rest of US (which all happened in 2018 Q2): the date when DOL's nationwide fiduciary rule was brought down in court, DOL's decision not to appeal the court's decision (hence abandoning the rule), and NY Department of Financial Services subsequent decision to implement its own statewide fiduciary rule under NY Insurance Regulation 187. Based on 110,432 consumer complaints from 1,147,625 brokers from FINRA's BrokerCheck.



A key takeaway from this chart is that variable annuities are an important source (20-30%) of broker-related costumer complaints. Historically, there used to be a lower incidence of variable annuity related complaints in NY State compared to the rest of the US (as percentage of total consumer complaints). However, since 2014, variable annuity related complaints in the two regions moved in lockstep. This changed with the introduction of a fiduciary duty in NY State in the second half of 2019, which has resulted in lower variable annuity related complaints in NY State but not the rest of the US (which can be seen here with a 2 quarters lag, which is close to the average time it takes for an event to result in a written complaint submitted to the broker).

Table DIV: **Supply Side Regression**

This table looks at insurer characteristics that correlate with exchanges controlling for contract and consumer level characteristics from Table III. The dependent variable is the replacement intensity, defined as percentage of 1035 outflows in beginning of period assets. BCAR is the AM Best Capital Adequacy Ratio, a risk based capital measure defined as available capital over required capital. Affiliated Reinsurance denotes the share of life insurance reserves reinsured by affiliates, and is computed as the product of the share of life insurance reserves reinsured from NAIC Exhibit 5 and the share of reserves reinsured through affiliates from NAIC Schedule S. Affiliated Reinsurance denotes the share of life insurance reserves reinsured by affiliates, and is computed as the product of the share of life insurance reserves reinsured from NAIC Exhibit 5 and the share of reserves reinsured through affiliates from NAIC Schedule S. Shadow Reinsurance denotes the share of life insurance reserves reinsured by unauthorised affiliates, and is computed as above. PE is a dummy variable set to 1 if the company is owned or managed by a private equity firm or a consortium involving private equity firms. TARP is a dummy variable set to 1 if the company benefited from government financial assistance through the Troubled Asset Relief Program in 2009. Reserves refer to gross life insurance reserves from NAIC Exhibit 5. Adj.BCAR is risk based capital adjusted for shadow reinsurance, and is described below. Standard errors clustered at insurance group level. t-stats clustered at insurance group level. ***,**, and * indicate statistical significance at the 1%, 5% and, 10% level, respectively.

Replacement Intensity	(1)	(2)	(3)	(4)
BCAR	0.027***	0.028***	0.025***	
	(5.56)	(5.80)	(5.18)	
Affiliated Reinsurance	1.256*			
	(1.92)			
Shadow Reinsurance		1.837		
		(1.16)		
TARP			0.664**	0.743**
			(2.12)	(2.12)
log(Reserves)	0.167***	0.196***	0.141**	0.170***
	(3.52)	(3.97)	(2.48)	(2.90)
PE	2.037***	1.995***	1.437***	0.660**
	(12.84)	(11.26)	(5.14)	(2.10)
Adj.BCAR				-0.001
				(-0.29)
Controls	Yes	Yes	Yes	Yes
N	679	679	679	679
R2	0.094	0.092	0.095	0.084

Shadow Adjusted Risk Based Capital: Consider an operating company ceding exposure to an affiliated shadow reinsurer. Let r denote the share of liabilities reinsured and $1-r$ the share retained. Let E denote operating company's equity, $(1-r)L$ denote its retained liabilities, let $k>0$ be a statutory risk charge that summarises the risk profile of assets and liabilities, and define the operating company's risk based capital as:

$$BCAR = {}^{E}/_{k(1-r)L}$$

Assume we moved the reinsured liabilities back on the operating company's balance sheet. Under two assumptions: that the risk profile of retained and reinsured liabilities is the same (k is the same) and the shadow reinsurer carries no equity (see Koijen and Yogo (2016)), the adjusted risk based capital ratio is:

$$Adj.BCAR = {}^{E}/_{kL} = (1-r) \times BCAR.$$

Table DV: **Default Risk vs Consumer Exploitation in Private Equity Owned Insurers**

This first column looks at the relationship between private equity ownership and default risk in the population of insurance companies selling individual US variable annuity contracts in 2018. AM Best Rating stands for the Financial Strength Rating, computed as a weighted average of the ratings in force throughout 2018, weighted by the number of days they have been in force (1 unit = 1 rating notch, higher means higher risk, lower rating) Columns II-IV look at the relationship between replacement intensity and default risk, controlling for contract generosity, in the subset of life insurance companies owned by private equity firms in 2018 (II), not owned by private equity firms (III) and the combined sample, respectively. t-stats clustered at insurance group level. ***,**, and * indicate statistical significance at the 1%, 5% and, 10% level, respectively.

		PE Owned	Not PE Owned	Full Sample
	AM Best Rating	Replacement Intensity	Replacement Intensity	Replacement Intensity
PE	2.185***			
	(6.57)			
AM Best Rating		0.209	-0.325***	-0.060
		(0.54)	(-3.81)	(-0.33)
N	1676	107	608	715
R2	0.483	0.028	0.044	0.023

Figure D14: **NY vs non-NY Matched Product Comparison**

	American Legacy III B	**American Legacy III B NY**
	Lincoln National Life Insurance Co	Lincoln Life & Annuity Co of NY
Contract Information		
Share Class	B	B
Prospectus Date	05-01-2020	05-01-2020
Supplement Date	09-03-2020	09-03-2020
Date of Last Update	04-19-2021	04-19-2021
Inception Date	06-06-2005	06-06-2005
Closed Date	10-30-2015	10-30-2015
AM Best Rating	A+ (as of 03-26-2021)	A+ (as of 03-26-2021)
Website	www.lincolnlife.com	www.lincolnlife.com
Phone Number	(888) 868-2583	(888) 868-2583
State Availability	This contract is no longer available for new sales.	This contract is no longer available for new sales.
Surrender Schedule		
Duration (Years)	7	7
Surrender Charge Schedule (%)	7, 7, 6, 6, 5, 4, 3	7, 7, 6, 6, 5, 4, 3
Free Withdrawals	10% of the greater of current contract value or purchase payments	10% of the greater of current contract value or purchase payments
	As a percentage of purchase payments liquidated.	Waived after seventh anniversary; as a percentage of purchase payments liquidated.
Expenses and Fees		
Mortality and Expense Risk (M&E)	1.20	1.20
Administrative Charge	0.10	0.10
Distribution Charge	0.00	0.00
Total Annual Expense	1.30	1.30
Annual Policy Fee	$35	$35
Anniversary Contract Fee Waived at	$100,000	$100,000
	M&E Fee: M&E charge is based on the default death benefit (Guarantee of Principal Death Benefit). The optional Account Value Death Benefit is available for 0.05% less. Annual Policy Fee: Charged for the first 15 years. For contracts issued prior to 11/15/2010, annual policy fee is $50 and is waived if anniversary value is $50,000 or more.	M&E Fee: M&E charge is based on the default death benefit (Guarantee of Principal Death Benefit). The optional Account Value Death Benefit is available for 0.05% less. Annual Policy Fee: Charged for the first 15 years. For contracts issued prior to 11/15/2010, annual policy fee is $50 and is waived if anniversary value is $50,000 or more.
Premium Based Sales Charges		
	not applicable	*not applicable*
Contract Operation		
Controlling Life:	Hybrid (Both O & A)	Hybrid (Both O & A)
Spousal Benefits & Continuation		
Guaranteed death benefit pays at death of either spouse?	Yes	Yes
Death benefit credited at Spousal Continuation?	Yes	Yes
CDSC waived at Spousal Continuation?	No	No
Spousal Benefit and Continuation Notes		
Sample Titling for Obtaining Spousal Benefits on a Non-Qualified Contract		
Owner	Husband	Husband
Joint Owner	Wife	Wife
Annuitant	Husband or Wife	Husband or Wife
Joint Annuitant	Blank	Blank
Primary Beneficiary	Anybody	Anybody
Secondary Beneficiary	Anybody	Anybody
Notes	-	-
Issue Ages and Contributions		
Non-Qualified		
Min-Max Age	0-85	0-85
Lives	Covered Annuitant(s)	Covered Annuitant(s)
Initial	$10,000	$10,000
Subsequent	$100	$100
Qualified		
Min-Max Age	0-85	0-85
Lives	Owner	Owner
Initial	$10,000	$10,000
Subsequent	$100	$100
Notes		
Subaccount Information		
Number of Subaccounts	33	34
Subaccount Fee Range	0.55-1.22	0.55-1.22
Free Transfers Per Year	6	12
Transfer Fee	$0	$0*
Notes	Net subaccount fee range is 0.46 - 1.14%. *This limit does not apply to transfers made under the automatic transfer programs of dollar cost averaging, cross re-investment or portfolio rebalancing program.	Net subaccount fee range is 0.46 - 1.14%. *Company reserves the right to charge $50 for any transfer in excess of 12 in a contract year. This limit does not apply to transfers made under the automatic transfer programs of dollar cost averaging, cross re-investment or portfolio rebalancing program.
Plan Availability		
	Non-Qualified, Qualified	Non-Qualified, Qualified
Surrender Charge Waivers		
	Disability, Nursing Home, Terminal Illness	Disability, Nursing Home, Terminal Illness

Figure D15: **NY vs non-NY Matched Product: Subaccount and Benefit Comparison**

	American Legacy III B	**American Legacy III B NY**
	Lincoln National Life Insurance Co	Lincoln Life & Annuity Co of NY
Subaccount Summary		
Number of Subaccounts	33	34
Equity Style Distribution/Fixed-Income Style Distribution	**Equity Style Distribution** 3 13 9 Large 0 0 1 Mid 3 0 0 Small Value Blend Growth **Fixed-Income Style Distribution** 1 2 0 High 1 16 1 Med 1 0 0 Low Ltd Mod Ext	**Equity Style Distribution** 3 14 9 Large 0 0 1 Mid 3 0 0 Small Value Blend Growth **Fixed-Income Style Distribution** 1 2 0 High 1 17 1 Med 1 0 0 Low Ltd Mod Ext
Subaccount Total Expenses	Gross / Net	Gross / Net
Highest	1.22 / 1.14	1.22 / 1.14
Median	0.95 / 0.85	0.95 / 0.87
Lowest	0.55 / 0.46	0.55 / 0.46
Average	0.89 / 0.82	0.89 / 0.82
Investment Management		
Advisor(s)	Capital Research & Management Company Capital Research and Management Company Lincoln Investment Advisors Corporation	Capital Research & Management Company Capital Research and Management Company Lincoln Investment Advisors Corporation
Subadvisor(s)	Milliman Financial Risk Management LLC	Milliman Financial Risk Management LLC
Benefit Comparison		
Benefit Name	i4LIFE Advantage w/GIB (vs. 4)(Joint)	i4LIFE Advantage w/GIB (vs. 4-NY)(Joint)
Benefit Detail		
Benefit Type	Death Benefit, GMIB	Death Benefit, GMIB
Benefit Charges	**Current** 1.250% assessed daily and calculated against the account value **Maximum** 2.400%	**Current** 1.250% assessed daily and calculated against the account value **Maximum** 2.400%
Issue Ages	0 to 85 (non-qualified contracts), 59½-80 (qualified contracts). GIB may be elected up to age 95 for non-qualified contracts.	0 to 85 (non-qualified contracts), 59½-80 (qualified contracts). GIB may be elected up to age 95 for non-qualified contracts.
Benefit Based on Life(ives) of	Annuitant(s)	Annuitant(s)
When Benefit Can Be Elected	Any time, provided the benefit is still available. If i4LIFE Advantage is elected without the Guaranteed Income Benefit component, the GIB may be elected while the access period is still in effect.	Any time, provided the benefit is still available. If i4LIFE Advantage is elected without the Guaranteed Income Benefit component, the GIB may be elected while the access period is still in effect.
Benefit Description	This benefit converts the contract to an immediate variable annuity that provides periodic variable lifetime payments for the lives of two spouses. Once elected, owner has access to the account value for a specified period of time (called the "Access Period"). With the Guaranteed Income Benefit, the minimum access period is the longer of 20 years or to age 90 (may vary depending on circumstances). After the Access Period, the account value is no longer available and the payments continue for life. Payments fluctuate depending on the performance of the subaccounts. Access Period requirements vary depending on age, account type, and other benefits elected. With the i4LIFE Advantage Guarantee of Principal Death Benefit, regular income payments reduce the death benefit dollar-for-dollar. Excess withdrawals reduce the death benefit proportionately. Withdrawals for the other two death benefits reduce the death benefit proportionately. Once the access period is over, there is no death benefit. The Guaranteed Income Benefit provides a minimum payout floor for the i4LIFE variable annuitization income payments with the initial payout equal to a percentage of the account value at time of benefit election. The payout percentage is based on the age of the younger spouse at time of election as follows: 0-39 ..... 2.5% 40-54 ..... 3.0% 55-59½ ..... 3.5% 59½-64 ..... 4.0% 65-69 ..... 4.5% 70-79 ..... 5.0% 80 and up ... 5.5% On each anniversary, the guaranteed floor will automatically step-up to 75% of the current payment, if that amount is higher than the previous guaranteed floor. Also, as long as the Guaranteed Income Benefit component is elected at the same time as i4LIFE Advantage and previous living benefits existed, the benefit base values from the terminated benefits may be used to establish the initial Guaranteed Income Benefit payout if greater than the account value.	This benefit converts the contract to an immediate variable annuity that provides periodic variable lifetime payments for the lives of two spouses. Once elected, owner has access to the account value for a specified period of time (called the "Access Period"). With the Guaranteed Income Benefit, the minimum access period is the longer of 20 years or to age 90 (may vary depending on circumstances). After the Access Period, the account value is no longer available and the payments continue for life. Payments fluctuate depending on the performance of the subaccounts. Access Period requirements vary depending on age, account type, and other benefits elected. With the i4LIFE Advantage Guarantee of Principal Death Benefit, regular income payments reduce the death benefit dollar-for-dollar. Excess withdrawals reduce the death benefit proportionately. Withdrawals for the other two death benefits reduce the death benefit proportionately. Once the access period is over, there is no death benefit. The Guaranteed Income Benefit provides a minimum payout floor for the i4LIFE variable annuitization income payments with the initial payout equal to a percentage of the account value at time of benefit election. The payout percentage is based on the age of the younger spouse at time of election as follows: 0-39 ..... 2.5% 40-54 ..... 3.0% 55-59½ ..... 3.5% 59½-64 ..... 4.0% 65-69 ..... 4.5% 70-79 ..... 5.0% 80 and up ... 5.5% On each anniversary, the guaranteed floor will automatically step-up to 75% of the current payment, if that amount is higher than the previous guaranteed floor. Also, as long as the Guaranteed Income Benefit component is elected at the same time as i4LIFE Advantage and previous living benefits existed, the benefit base values from the terminated benefits may be used to establish the initial Guaranteed Income Benefit payout if greater than the account value.
Step-Up Provisions	Guaranteed floor steps-up automatically every year as described above	Guaranteed floor steps-up automatically every year as described above
Cap on Benefit Base		No cap specified
Impact of Withdrawals	Other than regular income payments, withdrawals reduce the benefit on a proportionate basis.	Other than regular income payments, withdrawals reduce the benefit on a proportionate basis
Impact of RMDs	No special treatment for RMD withdrawals.	No special treatment for RMD withdrawals
Considerations with Older Ages	-	-
Investment Restrictions	May limit how much can be invested in certain subaccounts	May limit how much can be invested in certain subaccounts
Spousal Continuation	At time of election of income payments, a single or joint life option is available. Under the joint life option, payments will continue for surviving spouse.	At time of election of income payments, a single or joint life option is available. Under the joint life option, payments will continue for surviving spouse.
Benefit Termination	If any owner or annuitant is changed for any reason other than death, the only death benefit payable for the new person will be the Account Value death benefit. Also, the Guaranteed Income Benefit component terminates if the access period is shortened. The GIB may be voluntarily terminated and if the benefit base from an existing living benefit was used to establish the initial payout, the i4LIFE Advantage may terminate. Qualified contracts may terminate i4LIFE Advantage prior to the end of the Access Period. Non-qualified contracts cannot terminate i4LIFE Advantage once elected.	If any owner or annuitant is changed for any reason other than death, the only death benefit payable for the new person will be the Account Value death benefit. Also, the Guaranteed Income Benefit component terminates if the access period is shortened. The GIB may be voluntarily terminated and if the benefit base from an existing living benefit was used to establish the initial payout, the i4LIFE Advantage may terminate. Qualified contracts may terminate i4LIFE Advantage prior to the end of the Access Period. Non-qualified contracts cannot terminate i4LIFE Advantage once elected without terminating the entire contract.
Benefit Conflicts/Availability	Cannot have in conjunction with any other benefit because once this benefit is elected, the other benefits automatically terminate. Benefit is not available for purchase as of 5/21/2012. Not available for bonus contracts issued after 6/30/09.	Cannot have in conjunction with any other benefit because once this benefit is elected, the other benefits automatically terminate. Benefit is not available for purchase as of 5/21/12, previously only available in NY. Not available for bonus contracts issued after 6/30/09.

Figure D16: **Variable Annuity Exchange Offer Example**

The Ohio National Life Insurance Company
Ohio National Variable Account A

Supplement dated December 1, 2017
to the Prospectuses dated May 1, 2017

Offer to exchange your ONcore variable annuity with a GMIB rider for an ONdex fixed indexed annuity with a GLWB rider

This supplement describes a limited time offer (the "Offer") we are making to Eligible Owners (defined below) to exchange an eligible ONcore variable annuity contract listed below (each, an "Eligible ONcore variable annuity") with an eligible Guaranteed Minimum Income Benefit ("Eligible GMIB") rider listed below for an ONdex fixed indexed annuity with a Guaranteed Lifetime Withdrawal Benefit ("GLWB") rider.

This Offer is not available in all states. For questions regarding this Offer, please contact your financial professional or us at 1.833.810.4642.

If you accept the Offer and exchange your Eligible ONcore variable annuity for an ONdex fixed indexed annuity, we will waive any surrender charges on your ONcore variable annuity and any rider charges or premium taxes that you would incur upon a surrender as part of the exchange. *Please note that you will be subject to new surrender charges under the ONdex fixed indexed annuity.*

> You are not required to accept the Offer. No action is required on your part if you do not want to accept the Offer. If you do not accept the Offer, your contract and rider benefits will continue unchanged.

The Eligible ONcore variable annuities are:

ONcore Xtra (sold before October 1, 2012)
ONcore Premier (sold before October 1, 2012)
ONcore Value (sold before October 1, 2012)
ONcore Lite
ONcore Lite II
ONcore Flex
ONcore Wrap
ONcore Ultra
ONcore Ultra II

The Eligible GMIB riders are:

(a) provided that the annuitant is 55 years old or older at the beginning of the Offer Period (defined below):

GMIB Plus with Annual Reset (2009)

(b) provided that the annuitant is 60 years old or older at the beginning of the Offer Period and the GMIB rider was issued on or after April 1, 2008:

GMIB Plus with Annual Reset
GMIB Plus with Five Year Reset
GMIB Plus with Annual Reset (2008), with or without optional investment restrictions
GMIB Plus with Annual Reset II, with or without optional investment restrictions
GMIB Plus with Five Year Reset II, with or without optional investment restrictions

Figure D17: **Enhanced Variable Annuity Buyback Offer Example**

TRANSAMERICA LIFE INSURANCE COMPANY

Supplement dated December 30, 2014

ALTERNATIVE LUMP SUM OFFER 1.2
For Eligible Owners Who Have The
FAMILY INCOME PROTECTOR, MANAGED ANNUITY PROGRAM,
MANAGED ANNUITY PROGRAM II or
GUARANTEED MINIMUM INCOME BENEFIT RIDERS

The Company suspended an offer called the Alternative Lump Sum Offer ("ALSO") on February 2, 2015. For a limited time, beginning on or about February 2, 2015, the Company is making a new Alternative Lump Sum Offer ("ALSO 1.2") available to Eligible Owners (defined below) of the Transamerica variable annuity policies listed below (each, an "Existing Policy") and an in force Family Income Protector, Managed Annuity Program, Managed Annuity Program II or Guaranteed Minimum Income Benefit rider (each, an "Eligible Rider"). In simple terms, ALSO 1.2 is an offer to buy you out of your Existing Policy in return for your full cash surrender value plus an "Enhancement Amount" (defined below).

	New Policy	**Existing Policies**
	Transamerica Freedom℠ Variable Annuity Form No.: AV864 101 165 103	***WRL Freedom® Variable Annuity Form No.: VA.02.06.88***
Annual Service Charge	$35 (waived if policy value or sum of premiums less withdrawals ≥$50,000)	$30
Mortality and Expense Risk Charge (different charges may apply after annuitization)	1.55%	1.25%
Administrative Charge	0.15%	None
Variable Investment Options Class	Service Class	Initial Class; Service Class
Guaranteed Minimum Annual Rate on the Fixed Account	2%	4%
Premium Enhancement	None	None
Standard Death Benefit [1]	Generally, the greater of: • account value; and • return of premium value. (subject to limitations)	Generally, the greater of: • account value; • return of premium value; and • anniversary value.

The following hypothetical examples illustrate how we calculate the Enhancement Amount for an Existing Policy with an Eligible Rider and then use that amount to calculate the offer amount (offer amount = cash surrender value + Enhancement Amount):

Assumptions:

Annuitization Base:	$100,000.00
Policy Value:	$60,000.00
Surrender Charge:	$0.00
Pro-Rated Rider Fee:	$150.00 (assumes 1/3 of a year @ 0.45%)
Annual Service Charge	$35.00
Cash Surrender Value:	$59,815.00
Premium Payments after September 5, 2014	$0.00

Enhancement Amount:

Enhancement Amount is equal to the greater of:

($100,000.00 x 0.90) - $59,815.00 = $30,185.00 0.10 * ($100,000.00 - $0.00) = $10,000.00

$30,185.00 > $10,000.00

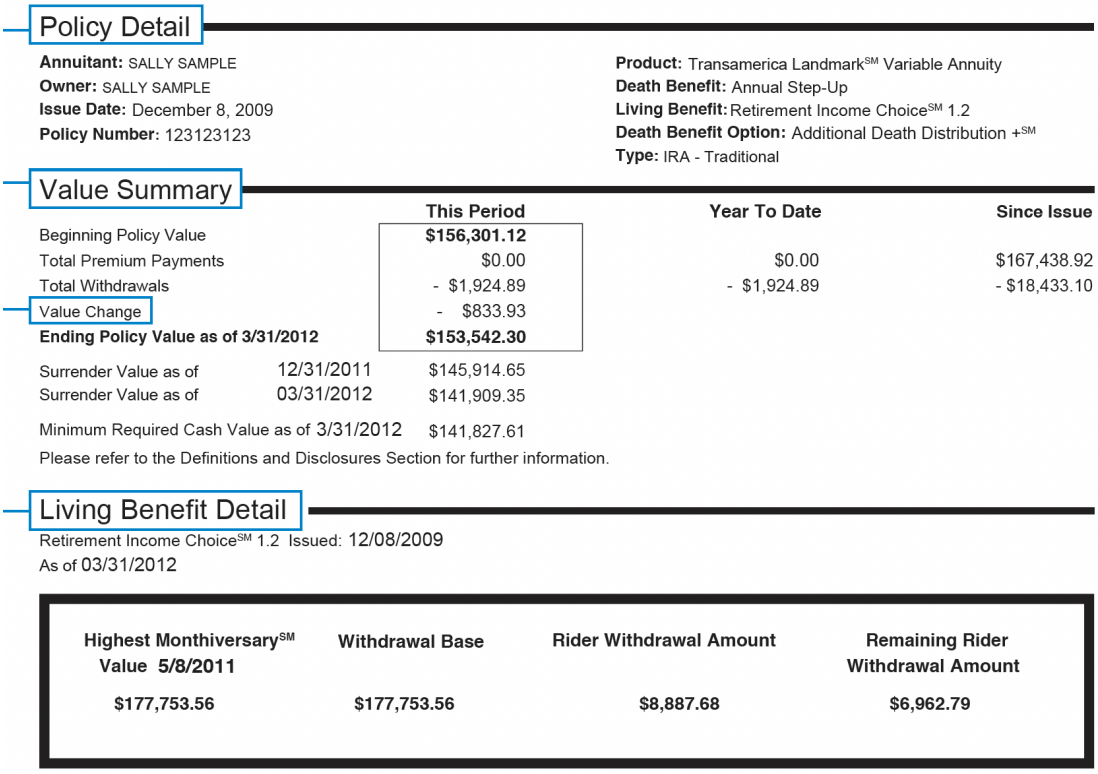
Enhancement Amount = $30,185.00

Offer Amount: $59,815.00 + $30,185.00 = $90,000.00

Offer Amount above Cash Surrender Value: $90,000.00 - $59,815.00 = $30,185.00

Offer Amount above Policy Value: $90,000.00 - $60,000.00 = $30,000.00

Figure D18: **Variable Annuity Quarterly Statement Example**



Policy Detail

Annuitant: SALLY SAMPLE
Owner: SALLY SAMPLE
Issue Date: December 8, 2009
Policy Number: 123123123

Product: Transamerica Landmark℠ Variable Annuity
Death Benefit: Annual Step-Up
Living Benefit: Retirement Income Choice℠ 1.2
Death Benefit Option: Additional Death Distribution +℠
Type: IRA - Traditional

Value Summary

	This Period	Year To Date	Since Issue
Beginning Policy Value	**$156,301.12**		
Total Premium Payments	$0.00	$0.00	$167,438.92
Total Withdrawals	- $1,924.89	- $1,924.89	- $18,433.10
Value Change	- $833.93		
Ending Policy Value as of 3/31/2012	**$153,542.30**		

Surrender Value as of	12/31/2011	$145,914.65
Surrender Value as of	03/31/2012	$141,909.35

Minimum Required Cash Value as of 3/31/2012 $141,827.61

Please refer to the Definitions and Disclosures Section for further information.

Living Benefit Detail

Retirement Income Choice℠ 1.2 Issued: 12/08/2009
As of 03/31/2012

Highest Monthiversary℠ Value 5/8/2011	Withdrawal Base	Rider Withdrawal Amount	Remaining Rider Withdrawal Amount
$177,753.56	**$177,753.56**	**$8,887.68**	**$6,962.79**

Appendix E

Private Equity Ownership List

1 In February 2010, the private equity firm Guggenheim Partners announced its intention to acquire Security Benefit Corporation. The acquisition was closed in August 2010.

2 In October 2011, the private equity firm Guggenheim Partners, through some associates, announced its intention to acquire insurer EquiTrust Life from FBL Financial Group. The acquisition was expected to be completed, subject to regulatory approval, by December 2011. Equitrust Life was resold by Guggenheim to another private firm, Magic Johnson Enterprises (MJE), in 2015.

3 In December 2012, the Canadian insurer Sun Life agreed to sell its US variable annuity subsidiary Delaware Life Insurance Company and the NY subsidiary Delaware Life Insurance Company of NY to the private equity firm Guggenheim Partners LLC. The transaction closed after it obtained regulatory approvals in August 2013.

4 In December 2012, Athene Holding, a Bermuda based insurance conglomerate backed by private equity firms, announced its intention to acquire Aviva US life and annuity operations, including Aviva Life and Annuity Company, based in Iowa, and Aviva Life and Annuity Company of New York. The companies will be reorganised into Athene Annuity & Life Assurance Company. The transaction was completed in October 2013.

5 In December 2017, Hartford Financial announced it is selling its variable annuity subsidiary Talcott Resolution to a consortium of private equity firms, including Cornell Capital LLC, Atlas Merchant Capital LLC, TRB Advisors LP, Global Atlantic Financial Group, Pine Brook and J. Safra Group. The transaction was completed in May 2018. Hartford has retained a 9.7 percent ownership interest in Talcott Resolution.

6 In December 2017, Voya Financial announced it is selling its Voya Insurance and Annuity Company to Venerable Holdings Inc. Behind Venerable stands a group of investors led by private equity firms Apollo Global Management LLC and its affiliates, Crestview Partners and Reverence Capital Partners. The transaction was completed in June 2018, and Voya retained a 9.9% stake in the firm.

7 Talcott Resolution Life Insurance Company administers the annuity contracts issued by Union Security Insurance Company. As Talcott Resolution was acquired by a consortium of private equity firms, the consortium administered the contracts.