The Effect of QE and Regulation on the Structure of the Financial System*

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Abstract

Insurance companies' ownership share of European government bonds fell by 10 percentage points between 2015 and 2024, despite policy and regulatory forces that should have increased their bond demand. We resolve this puzzle using confidential EIOPA supervisory data on euro area life insurers. The existing literature emphasizes that quantitative easing and regulation increase demand for long-term bonds via portfolio rebalancing. We show that, over longer horizons, this portfolio rebalancing channel is quantitatively dominated by a considerably stronger force: changes in the size and composition of insurers' balance sheets. Low long-term rates reduced household demand for guaranteed products, while Solvency II induced insurers to shift toward unit-linked contracts. Together, these forces contracted insurers' general-account liabilities and their demand for government bonds. Liability flows account for the majority of the time-series and cross-sectional variation in insurers' bond purchases. Our findings show that monetary policy and regulation reshape the structure of the financial system in the long term not primarily by shifting how intermediaries allocate their portfolios, but by changing how households allocate capital across intermediaries.

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1. Introduction

Insurance companies are among the largest investors in bond markets. They absorb a substantial share of long-term fixed-income issuance and, given the nature of their liabilities, typically hold these assets to maturity. As a result, they are often viewed as a stable source of demand, anchoring government bond markets - particularly in the Euro area.

Over the past decade, however, this role has changed dramatically. Despite a prolonged period of low interest rates and regulatory reforms that should have increased insurers' demand for long-term bonds, insurers' holdings of government debt have declined sharply. Between 2015 and 2024, their share of outstanding government bonds fell by almost 40 percent. This decline stands in stark contrast to the predictions of standard portfolio-based explanations.

This paper helps to resolve this puzzle. We show that while portfolio rebalancing operates at high frequency, the dominant force shaping insurers' bond demand is the slow-moving evolution of their liabilities. Monetary policy and regulation not only affect how insurers allocate their portfolios, but, when persistent, reshape the size and composition of their balance sheets. The central object of the paper is the decomposition of insurers' bond demand into portfolio weights and balance sheet size. Our main result is that policy can affect these two margins in opposite directions, but the balance sheet channel dominates in the data.

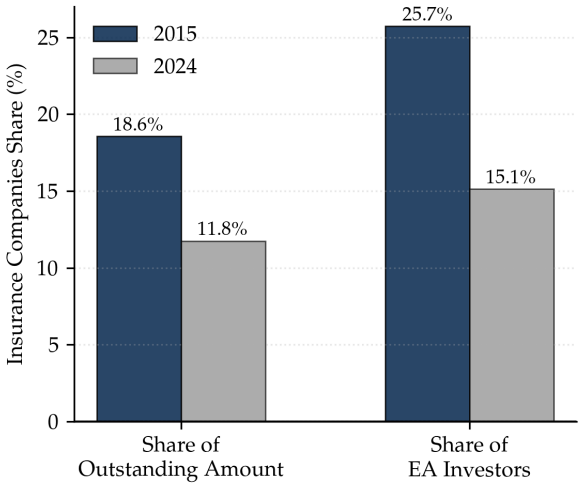
We leverage novel regulatory data covering the universe of European insurance companies and document several new facts. First, insurers' share of long-term bond holdings declines markedly between 2015 and 2024. Second, this decline is driven by a contraction in household demand for long-term guaranteed insurance products, which reduces flows into the insurance sector. Third, using both aggregate and micro data, we argue that these flows are tightly related to the slope of the yield curve, indicating that low long-term rates—driven by QE—reduce the attractiveness of guaranteed products. We also argue this effect is amplified by Solvency II, which increases the capital requirements associated with guarantees. Fourth, insurers shift their product mix toward unit-linked contracts, which are predominantly invested in equities, further reducing bond demand. Finally, we quantify the relative importance of portfolio rebalancing and balance sheet adjustments, and show that liability-driven flows account for the bulk of the variation in insurers' bond demand.

To organize our discussion, it is convenient to decompose investor demand for bonds (in dollars) as the product of portfolio weights and assets under management:

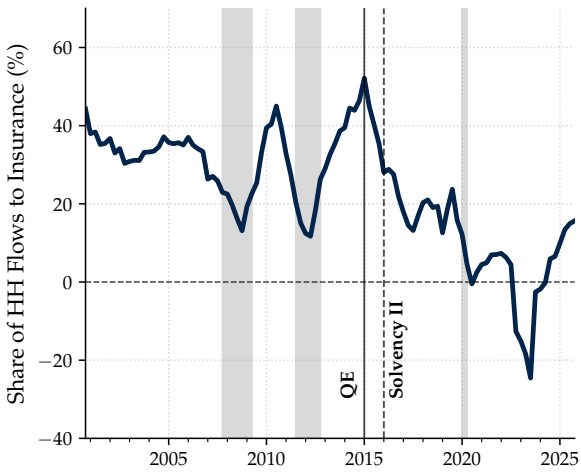
$$\text{Bond Demand}_t \;=\; w_{b,t} \;\cdot\; A_t. \tag{1}$$

Figure 1: The Evolution of the European Insurance Sector

(a) Insurers' Ownership share in EU Bonds



(b) Households Flows Into Insurance Sector



Note: Panel (a) plots the share of insurance companies in the total outstanding amount of bonds, as well as their share relative to the total holdings of Euro area investors. Panel (b) plots the share of households financial flows into insurance companies using data from the ECB QSA.

A large literature studies how interest rates and regulation affect insurers' portfolio choices, that is, $w_{b,t}$. A decline in interest rates due to QE increases the duration of liabilities relative to assets, prompting insurers to increase their allocation to long-term bonds (Domanski et al., 2017; Koijen et al., 2017). The adoption of Solvency II reinforces this effect, as mark-to-market valuations of liabilities and risk-based capital requirements incentivize insurers to hold more government bonds to hedge liability risk and economize on regulatory capital (Jansen, 2023). Both forces predict an increase in bond portfolio weights, $\Delta w_{b,t} > 0$, a pattern that is indeed observed in the data in the short run, as documented by the studies above.[1]

Yet when we look at insurers' total bond demand over the past decade, we observe the opposite. As shown in Panel a of Figure 1, between 2015 and 2024, insurers' share of outstanding government bonds fell from 18.6 to 11.8 percent—a decline of almost 40 percent relative to their initial share. When measured relative to all Euro area investors, the drop is even more pronounced, from 25.7 to 15.1 percent. These figures mark a structural retreat of the largest long-term investors from the sovereign bond market.

This paper argues that the resolution lies in the second component of the decomposition, namely assets under management, A_t. Over the longer run, the balance sheet itself adjusts. As shown in Panel (b) of Figure 1, household inflows into the life-insurance sector,

[1]Moreover, a decline in interest rates may improve insurers' capital positions, relaxing risk-based constraints and allowing a reallocation toward riskier securities within the bond portfolio (Li, 2024).

measured as a share of total flows into financial assets (a proxy for household portfolio reallocation), declined sharply following the introduction of QE and Solvency II. The share was approximately 30% prior to QE. Over the period 2015–2023, when interest rates increased again, the average share was less than 10%. If the share of flows had remained at its pre-QE level, the insurance sector would have received an additional cumulative amount of nearly €1.7 trillion. We plot flows rather than portfolio shares because flows capture reallocation decisions more immediately, whereas portfolio shares adjust only gradually given the large existing stock of household assets. The figure shows that, following the introduction of QE and Solvency II, households strongly reduced their net purchases of insurance products.

To interpret these facts, we develop a simple model of insurance companies that formalizes the decomposition in equation (1). Bond demand is the product of portfolio weights and assets under management, and the key insight of the model is that these two margins respond differently to interest rates and regulation. The empirical analysis stands on its own, and the model serves to organize and sharpen the interpretation of the results.

The model builds on Koijen and Yogo (2015, 2022b) and captures two defining features of life insurers. First, insurers offer long-term guaranteed contracts (profit-participation, PP), whose attractiveness depends on the level of long-term interest rates and on regulatory capital requirements. Second, insurers can alternatively offer unit-linked (UL) products, which transfer investment risk to households and generate fee income without creating balance sheet exposure. As a result, insurers' liabilities—and hence the size of their balance sheet—are endogenously determined by household demand across these products.

The model delivers three predictions that map onto the two components of the decomposition. First, a decline in long-term interest rates or tighter regulation increases the portfolio weight on safe bonds $w_{b,t}$, as insurers shift toward assets that economize on regulatory capital. Second, the same forces reduce inflows into guaranteed products: lower guarantee rates and higher fees make these contracts less attractive to households, contracting assets under management A_t. Third, low rates and regulation trigger a reallocation from guaranteed to unit-linked contracts, further shrinking the general account. Portfolio rebalancing and balance sheet adjustments therefore operate in opposite directions; the net effect on bond demand is an empirical question.

Motivated by these predictions, we present a set of empirical findings using both aggregate flow-of-funds data and confidential EIOPA supervisory data covering the universe of European insurers. Our goal is not to fully disentangle the effect of QE from regulation, but to show that their joint effect operates primarily through liabilities rather than portfolio reallocation. We begin by showing that insurance inflows are strongly positively related to the slope of the yield curve. A one-percentage-point reduction in the slope is associated

with a 12-percentage-point decline in the share of household financial flows directed toward insurance ($R^2 = 45\%$).

While drawing a causal link between rates and slow-moving insurance flows is inherently difficult, we provide three pieces of evidence beyond their high aggregate correlation that point to a causal role of interest rates: (i) monetary policy shocks shift flows in the predicted direction across maturities, (ii) cross-sectional heterogeneity aligns with exposure to guaranteed products, and (iii) the 2022–2023 episode of surrender-induced outflows provides a sharp, out-of-sample validation. Using monetary policy shocks of different maturities, we find that short-rate shocks reduce inflows, while long-rate shocks increase them, with a monotonic pattern across maturities, consistent with the model predictions. In the cross-section, insurers with greater exposure to profit-participation contracts exhibit significantly stronger flow sensitivity to slope changes: the interaction between the instrumented slope and the pre-QE exposure to profit-participation contracts is significant and economically large, implying that the mechanism operates precisely through the guaranteed-return channel. The sharp increase in policy surrenders during the 2022–2023 tightening episode - rising by 49% between 2020 and 2023 - provides complementary evidence, concentrated in countries where outstanding policies carried low guaranteed rates written during the QE period.

We then let the equity market speak on how interest rates affect insurers. Combining market data with regulatory net asset values (NAV), we show that interest rates primarily affect insurers stock valuations through franchise value - the present value of future underwriting profits - rather than through balance sheet revaluation. Interest rates alone explain only about 6% of the variation in insurer-level NAV (median R^2), indicating a small duration gap. By contrast, insurer stock returns respond strongly to long-term rates (coefficient of 4.8, significant at the 1% level), and this sensitivity emerges only after QE. The implied franchise value response—constructed as the difference between stock returns and NAV growth—carries a coefficient of 4.5 to 5.8, confirming that the equity market prices interest rate changes through future business rather than the existing balance sheet.

Our framework implies that, as low rates and regulation raise the cost of providing guarantees, insurers increase fees on profit-participation products and shift their offerings toward unit-linked contracts, while households substitute away from guaranteed products in response. In line with this, we document a reallocation from guaranteed to unit-linked products, with UL assets rising from 18% to about 35% of total assets since 2016. Using confidential data, we show that UL separate accounts are predominantly invested in equities (approximately 51% equity exposure), so this shift further reduces the bond-relevant balance sheet.

Finally, we quantify the pass-through from flows to bond demand. Using insurer-level

data, we estimate that each euro of net premiums translates into approximately €0.70 of bond purchases, indicating near-proportional scaling of bond holdings with inflows. By contrast, variation in net equity - central to the rebalancing channel emphasized in the literature - has negligible economic effects: the spread in bond flows between the top and bottom deciles of the net premium distribution is 7.5% of assets, compared with less than 1% for net equity. Aggregate flow-of-funds data confirm a tight and stable relationship between insurance inflows and bond purchases, with a pass-through of about 0.7 and an R^2 of 75%. Overall, changes in assets A_t dominate portfolio rebalancing effects $w_{b,t}$ in driving the large shift in insurers' presence in the government bond demand.

Using a sufficient-statistic framework, we estimate that the post-2015 reallocation of household wealth away from the insurance sector - a cumulative shortfall of nearly €2 trillion relative to pre-QE allocations - raised long-term yields by 40 to 100 basis points. These results imply that QE affects bond markets not only through portfolio rebalancing but also through slow-moving balance sheet channels that QT can reverse only gradually.

1.1 Related Literature

Our paper contributes to the literature studying the asset demand of intermediaries. A large body of work studies insurers' demand for bonds and the effects of unconventional monetary policies such as QE (Domanski et al., 2017; Koijen et al., 2017; Bretscher et al., 2022; Breckenfelder and De Falco, 2023; Jansen et al., 2024). Relatedly, Jansen (2023) analyzes the role of regulation and Solvency II in shaping insurers' bond demand. Other channels—such as tightening of constraints (Ellul et al., 2015; Sen, 2023; Becker et al., 2022), reaching for yield (Becker and Ivashina, 2015), and risk-bearing capacity (Li, 2024)—have also been studied in the context of insurers' portfolio choices. Other papers have studied the portfolio rebalancing effects of QE (examples in the Euro area are Albertazzi et al. (2021); Koijen et al. (2021); Corell et al. (2025)). The focus of this literature has primarily been on the within-portfolio asset allocation decision, that is, portfolio rebalancing across asset classes, taking the size of intermediaries' balance sheets as given. In contrast, we show that persistent changes in regulation and monetary policy also affect the size of intermediaries' balance sheets, and that these quantity effects can dominate portfolio rebalancing in the long run. Taken together, our results highlight an important distinction across horizons. At short horizons, balance sheets are approximately fixed, making portfolio rebalancing the primary channel through which policy affects asset demand. At longer horizons, however, household allocation decisions reshape the balance sheet size of different intermediaries, each with distinct portfolio habitats. These shifts in the structure of the financial system become the dominant driver of aggregate asset demand in the long run.

Our paper studies both the liability channel and portfolio rebalancing across asset classes and maturities. We show that, in economic terms, rebalancing activity is dominated by trading driven by liability flows, which are ultimately determined by households. While liability-driven trading has been used to construct exogenous bond demand shocks (Mota and Siani, 2023; Kubitza, 2025) to identify bond market elasticities, we argue that these flows are large, volatile, and exhibit persistent trends. As a result, they constitute the primary driver of insurers' bond demand, both in the cross-section and in the aggregate time series. Because the insurance sector is a major participant in government bond markets (Greenwood and Vissing-Jorgensen, 2018) and its presence can contribute to making bonds safer (Coppola, 2025), changes in the size of the sector have first-order asset pricing implications. We show that a prolonged period of low long-term interest rates, together with permanent regulatory changes, persistently contracted the sector, reducing a key source of stable demand for long-term government bonds. The contraction of the sector was further amplified during the 2022–2023 tightening episode, when rising short-term rates triggered a wave of policy surrenders. Extending the analysis of Grochola et al. (2023b) for Germany to all European countries, we show that surrender activity was concentrated in countries where outstanding policies carried low guaranteed rates written during the QE period, most notably Italy and France.

Our findings also relate to an emerging literature that endogenizes the wealth distribution of financial intermediaries. Darmouni et al. (2022) show how fund flows can increase fragility in corporate bond markets, while Fang and Xiao (2025) study the effects of monetary policy on flows across intermediaries. We contribute by emphasizing the long-run effects of QE on insurers through a liability-driven channel. This liability channel is also studied in contemporaneous work by Li and Wenning (2025) for the U.S., who document sizable contractions in the supply of long-duration life insurance products and in the overall life insurance market. While they emphasize a duration-based mechanism, we focus on a demand-driven flow channel: when long-term rates are low, guaranteed returns become less attractive relative to alternative assets, leading households to reduce their demand for insurance products. By focusing on insurers' liability flows, we also link the literature studying the asset side of insurers' balance sheets to the literature studying the liability side, i.e., the products offered by insurance companies to households (Koijen and Yogo, 2015, 2016, 2022b; Hombert and Lyonnet, 2022). Jiang and Sun (2024) provide complementary evidence for the United States, documenting changes in investor composition and showing that different investor groups adjust their portfolios at different speeds. They also study the QT episode and argue that shifts in investor composition make demand more elastic, thereby attenuating the effects of QT on yields. While our evidence on investor composition is consistent with

these findings, our paper points to a different implication for bond yields: the contraction of the insurance sector reduces a key source of inelastic demand for long-term bonds, which can *increase* bond yields during the QT phase.

Our stock market-based evidence on how interest rates affect insurers contributes to a large number of papers that estimate the sensitivity of insurers' stock returns to interest rates and other market factors (Hartley et al., 2016; Koijen and Yogo, 2022a,b). In particular, Grochola et al. (2023a); Grochola (2026) provide a detailed analysis of the sensitivity of European insurers' stock returns to interest rates and other market risk factors. In this paper, we take a different approach and compare the sensitivity of stock returns to that of net asset values (NAV), in order to shed light on how markets price insurers' franchise value.

Last, our paper contributes to the literature documenting the evolution of the life-insurance market using newly available regulatory data. While Du et al. (2023) employ EIOPA data to study international portfolio frictions—focusing on the *cross-sectional* allocation of insurance portfolios across countries—our analysis emphasizes the *time-series* dynamics of insurers' assets and their connection to the liability side of their balance sheets. Barbu et al. (2025) show that regulatory changes have pushed insurers toward offering unit-linked products. Barbu (2023) highlights insurers' incentives to encourage customers holding high-guarantee contracts to switch into products with less favorable guarantees. Our paper studies the implications of these shifts for bond demand. In particular, we show that the transition toward unit-linked products leads to a reduction in bond demand in favor of equities.

2. Model

We build on Koijen and Yogo (2015) and Koijen and Yogo (2022b), adapting their liability valuation framework to study how interest rates and regulation jointly shape insurers' product mix and, through it, their demand for long-term bonds.

The model formalizes the decomposition introduced in equation (1). Bond demand $w_{b,t} \cdot A_t$ has two components: the portfolio weight $w_{b,t}$ - the share of general account assets invested in safe bonds - and the level of general account assets A_t, which evolves endogenously with household demand for profit-participation contracts Q_t^{PP}. The propositions below deliver predictions for both components. A key finding is that the two can move in opposite directions: forces that compress Q_t^{PP} - and hence contract A_t - simultaneously push insurers toward safer portfolios (higher $w_{b,t}$), so the net effect on bond demand depends on which channel dominates.

2.1 Environment

Time is discrete, indexed by t. The short-term interest rate i_t and the long-term interest rate y_t are exogenous. We define the term spread as:

$$s_t = y_t - i_t \tag{2}$$

Assets The insurer's general account can invest in two assets: a safe asset with expected return y_t and a risky asset with expected return $y_t + \mu$, where $\mu > 0$ is a constant spread. We can think about the two assets in terms of factor exposure. The safe bond has only interest rate risk, while the risky asset has credit risk or equity risk exposure but earns a risk premium. Let $w_{b,t}$ denote the share invested in safe bonds. The portfolio expected return is:

$$y_t^S(w_{b,t}) = y_t + (1 - w_{b,t})\mu \tag{3}$$

We assume that there is a stochastic discount factor $M_{t,t+s}$ that prices payoffs s periods ahead.

Profit Participation (PP) A profit-participation contract is issued at time t and matures at $t + \tau$. The policyholder pays a one-off premium of 1 (normalized) plus a lump-sum fee f_t^{PP}. The insurer invests the proceeds in its general account and earns a stochastic gross portfolio return $R_{t,t+\tau}^S$ over $[t, t + \tau]$. The contract guarantees the policyholder a minimum gross return $(1 + g_t)^\tau$, where

$$g_t = \phi \cdot y_t, \qquad \phi \in (0, 1), \tag{4}$$

is set as a fraction of the prevailing long-term yield, reflecting regulatory caps on guarantee rates that we assume bind. If the portfolio return exceeds the guarantee, the policyholder receives a share $\delta \in (0, 1)$ of the surplus. The policyholder's payoff at $t + \tau$ per unit of premium is:

$$L_{t+\tau} = (1 + g_t)^\tau + \delta \cdot \max\left(R_{t,t+\tau}^S - (1 + g_t)^\tau,\, 0\right). \tag{5}$$

This is the guarantee floor plus δ call options on the portfolio return struck at $(1 + g_t)^\tau$.

Unit-Linked (UL) In addition to PP, the insurer may offer UL contracts. These are investment products in which the insurer invests fully on behalf of the policyholder. The policyholder bears all market risk, and the insurer earns a fixed fee f_t^{UL} per unit sold. There is no minimum return guarantee.

Liability Valuation The insurer's net liability value per new PP contract is the present value of what the insurer owes beyond what the portfolio delivers:

$$V_{t,t} = P_{t,t} - (1-\delta) \cdot C_{t,t}, \tag{6}$$

where

$$P_{t,t} = \mathbb{E}_t\big[M_{t,t+\tau} \cdot \max\big((1+g_t)^\tau - R^S_{t,t+\tau},\, 0\big)\big] \tag{7}$$

is the put value - the cost of the guarantee - and

$$C_{t,t} = \mathbb{E}_t\big[M_{t,t+\tau} \cdot \max\big(R^S_{t,t+\tau} - (1+g_t)^\tau,\, 0\big)\big] \tag{8}$$

is the call value - the profit participation. The insurer retains a fraction $(1-\delta)$ of the upside, which offsets the cost of the guarantee.

Standard option pricing implies three properties of $V_{t,t}$ that drive the model's main results. First, $\partial V_{t,t}/\partial y_t < 0$: when yields are high, the portfolio return comfortably exceeds the guarantee floor - the put is out of the money and the insurer retains valuable calls; as yields fall, the put moves into the money and $V_{t,t}$ rises. Second, $\partial^2 V_{t,t}/\partial y_t^2 > 0$: this relationship is convex, so that low-rate environments amplify the effect of any further rate decline on guarantee costs. Third, $V_{t,t}$ depends on the portfolio allocation: a higher risky share $(1-w_{b,t})$ raises both the put and call values, with the net effect on $V_{t,t}$ pinned down by the insurer's asset allocation condition in equilibrium.

2.2 Household Demand

There is a unit mass of insurance customers in each period. Households first decide whether to purchase a PP contract, buy UL, or exit the insurance sector altogether. We model demand using a multinomial logit, with bank deposits (yielding the short-term rate i_t) as the outside option.

Demand for PP and UL contracts is:

$$Q^{PP}_t = Q^{PP}(f^{PP}_t, f^{UL}_t, y_t, i_t), \qquad Q^{UL}_t = Q^{UL}(f^{PP}_t, f^{UL}_t, y_t, i_t).$$

PP demand is decreasing in f^{PP}_t, weakly increasing in f^{UL}_t, increasing in y_t, and decreasing in i_t; UL demand has symmetric cross-price properties.[2] The key determinant of PP demand is therefore the slope of the yield curve: since $g_t = \phi \cdot y_t$, a steeper curve simultaneously

[2]For PP: $\partial Q^{PP}/\partial f^{PP}_t < 0$, $\partial Q^{PP}/\partial f^{UL}_t \geq 0$, $\partial Q^{PP}/\partial y_t > 0$, $\partial Q^{PP}/\partial i_t < 0$. For UL: $\partial Q^{UL}/\partial f^{PP}_t \geq 0$, $\partial Q^{UL}/\partial f^{UL}_t < 0$; the signs of $\partial Q^{UL}/\partial y_t$ and $\partial Q^{UL}/\partial i_t$ are set to zero in the baseline.

raises the guaranteed return and lowers the attractiveness of the outside option. Under the small-share approximation—consistent with PP and UL each representing a modest fraction of household savings—the logit delivers constant semi-elasticities, which we exploit to obtain closed-form comparative statics for our Propositions.

2.3 Balance Sheet

The insurer's balance sheet has two accounts. The separate UL account evolves as:

$$B_t = R_{B,t}\, B_{t-1} + Q_t^{UL} \tag{9}$$

where $R_{B,t}$ is the gross return on the risky asset. The general account backs PP liabilities and insurer equity. Policyholders pay a lump sum invested in the general account portfolio, so assets evolve as:

$$A_t = R_t^S\, A_{t-1} + (1 + f_t^{PP})Q_t^{PP} + f_t^{UL}\, Q_t^{UL} \tag{10}$$

where $E_{t-1}\left[R_t^S\right] = y_{t-1} + (1 - w_{t-1})\mu$ is the expected return on the general account portfolio. The UL fee $f_t^{UL} \cdot Q_t^{UL}$ accrues to the insurer with no corresponding liability. Equation (10) connects directly to the decomposition in equation (1): A_t is the balance-sheet component of bond demand, and its stock grows with PP inflows Q_t^{PP}. A decline in new PP business therefore contracts A_t, reducing bond demand $w_{b,t} \cdot A_t$ independently of any change in the portfolio weight $w_{b,t}$.

Liabilities have two components. The first, L_t^{PP}, is the policyholder's claim on the portfolio:

$$L_t^{PP} = R_{A,t}\, L_{t-1}^{PP} + Q_t^{PP} \tag{11}$$

where $R_{A,t}$ is the return credited to existing policyholders, which embeds legacy guarantee rates and lapsation and is taken as given by the insurer. New contracts enter at face value.

The second component, L_t^G, is the market-consistent value of existing minimum return guarantees net of the participation offset:

$$L_t^G = \frac{V_{t-1,t}}{V_{t-1,t-1}}\, L_{t-1}^G + V_{t,t}\, Q_t^{PP} \tag{12}$$

The existing guarantee stock is revalued each period by the ratio $V_{t-1,t}/V_{t-1,t-1}$—the change in the market-consistent option value of the legacy book—and new contracts contribute $V_{t,t}$ per unit of new business.

2.4 Regulation

We define statutory capital as equity minus required capital. Required capital has two components, reflecting the two sources of risk on the insurer's balance sheet under Solvency II.

First, the minimum return guarantee exposes the insurer to interest rate risk. This generates a capital charge proportional to the minimum return guarantee liability L_t^G, with risk weight $\phi_1 > 0$, which is present regardless of portfolio allocation.

Second, the risky asset share $(1-w_{b,t})$ exposes the insurer to spread risk on assets backing L_t^{PP}. This generates a capital charge proportional to $(1-w_{b,t})L_t^{PP}$, with risk weight $\phi_2 > 0$. The safe asset carries no spread risk charge, so an insurer fully invested in safe bonds faces only the first component.

Statutory capital is therefore:

$$K_t = \underbrace{A_t - (L_t^{PP} + L_t^G)}_{\text{equity}} - \underbrace{\phi_1 \, L_t^G + \phi_2 \, (1 - w_{b,t}) \, L_t^{PP}}_{\text{required capital}} \tag{13}$$

The risk weights ϕ_1 and ϕ_2 are exogenous regulatory parameters; an increase in either represents a tightening of regulation. Low statutory capital can trigger a rating downgrade or regulatory action, and equity issuance is costly due to financial frictions. We model these costs through a cost function $C_t = C(K_t)$, which is continuous, twice continuously differentiable, strictly decreasing, and strictly convex. In other words, the marginal cost of capital $c_t = -\partial C/\partial K_t > 0$ increases as the stock of regulatory capital falls, reflecting the convexity of $C(\cdot)$.

2.5 Insurer's Problem

The insurer optimises over the pricing and allocation of *new* contracts each period, taking the existing book of business as given. The return on legacy statutory capital, $R_{K,t}$, is determined by realised returns on the existing asset portfolio and the mark-to-market evolution of legacy guarantee liabilities - both of which embed inherited guarantee rates, lapsation, and past allocation decisions that are outside the insurer's current control.[3]

The insurer therefore chooses fees f_t^{PP}, f_t^{UL} and safe asset share $w_{b,t} \in [0,1]$ to maximise

[3]We abstract from the effect of current decisions on future capital K_{t+1}, following Koijen and Yogo (2022b); this retains the key within-period trade-off between profitability and capital costs without requiring a fully dynamic solution.

current-period profits from new business, net of the cost of financial frictions:

$$J_t = \underbrace{(f_t^{PP} - V_{t,t})\, Q_t^{PP}}_{\text{PP net margin}} + \underbrace{f_t^{UL}\, Q_t^{UL}}_{\text{UL fee income}} - \underbrace{C(K_t)}_{\text{friction cost}} \tag{14}$$

The first term is the net margin on new PP business: the fee collected minus the market-consistent cost of the guarantee liability being issued. The second term is pure fee income on UL, with no corresponding liability. Statutory capital reflects the legacy book plus the contribution of new business:

$$K_t = R_{K,t}\, K_{t-1} + \left(f_t^{PP} - (1+\phi_1)\, V_{t,t} - \phi_2\,(1 - w_{b,t})\right) Q_t^{PP} + f_t^{UL}\, Q_t^{UL} \tag{15}$$

New PP business contributes the fee net of the regulation-inflated guarantee cost $(1+\phi_1)V_{t,t}$ and the spread risk charge $\phi_2(1-w_{b,t})$; UL contributes fee income with no capital deduction.

2.6 Propositions

We now study the implications of low long-term rates and changes in regulation for PP inflows - and hence total assets A_t - and for the portfolio weight $w_{b,t}$. Together, these results characterise how each force in the decomposition (1) responds to the policy environment. For the moment we set demand cross-elasticities to zero to simplify the proofs; we allow for cross-elasticities in Proposition 3.

Proposition 1 (Effect of Long-Term Rates on Portfolio Weights and Inflows)**.** *An increase in the long-term rate y_t, holding i_t fixed (i.e. a steepening of the yield curve), has the following equilibrium effects:*

1. *$dw_{b,t}/dy_t < 0$: the insurer reduces its safe bond share, tilting toward the risky asset;*

2. *$dQ_t^{PP}/dy_t > 0$: PP new business rises through two reinforcing channels:*

$$\frac{dQ_t^{PP}}{dy_t} = \underbrace{\varepsilon_{PP}^{y}\, Q_t^{PP}}_{\textit{direct channel}} + \underbrace{\varepsilon_{PP}^{f^{PP}}\, Q_t^{PP} \left(-\frac{df_t^{PP}}{dy_t}\right)}_{\textit{indirect channel}} > 0; \tag{16}$$

where $\varepsilon_{PP}^{y} = \partial log(Q_t^{PP})/\partial y_t$ and $\varepsilon_{PP}^{f^{PP}} = -\partial log(Q_t^{PP})/\partial f_t^{PP}$.

The direct channel operates through the guaranteed rate $g_t = \phi \cdot y_t$: a rise in y_t mechanically increases guarantees, making PP more attractive relative to deposits. The indirect

channel reflects a supply-side response: lower regulatory costs reduce the fee f_t^{PP}, further stimulating demand. Both channels reinforce each other.

The proposition highlights the central tension in the decomposition (1). A decline in y_t raises $w_{b,t}$, as insurers shift toward safe bonds to reduce capital charges on risky assets, consistent with Domanski et al. (2017). At the same time, it contracts A_t by reducing the attractiveness of PP through lower guarantees and higher fees.

The net effect on bond demand $w_{b,t} \cdot A_t$ depends on which margin dominates. As we show empirically in Sections 4–6, the A_t channel is quantitatively dominant.

Proposition 2 (Effect of Regulatory Capital Requirements)**.** *A tightening of either the interest rate risk capital requirement ϕ_1 or the spread risk capital requirement ϕ_2 has the following equilibrium effects:*

1. *$\partial w_{b,t}/\partial \phi_2 > 0$: a tighter spread risk requirement unambiguously increases the allocation to safe bonds;*

2. *$dQ_t^{PP}/d\phi_j < 0$ for $j \in \{1, 2\}$: PP new business falls due to the increase in fee:*

$$\frac{dQ_t^{PP}}{d\phi_j} = \underbrace{-\varepsilon_{PP}^{f^{PP}} \, Q_t^{PP} \, \frac{df_t^{PP}}{d\phi_j}}_{\text{indirect channel}} < 0 \tag{17}$$

where $\varepsilon_{PP}^{f^{PP}} = -\partial log(Q_t^{PP})/\partial f_t^{PP}$.

The increase in regulatory cost increases demand for long-term safe bonds consistent with Jansen (2023). Regulation affects Q_t^{PP} exclusively through equilibrium pricing, by inducing a higher fee. This also generates a natural interaction with the interest rate environment: when rates are low, the guarantee is deep in the money and $V_{t,t}$ is large, amplifying the effect of any regulatory tightening on fees and hence on new business. Solvency II was implemented in 2016, precisely when $V_{t,t}$ was at its peak - the two forces therefore did not simply add, they amplified each other.

As with Proposition 1, the net effect on bond demand $w_{b,t} \cdot A_t$ reflects two opposing forces: regulation raises $w_{b,t}$ but contracts A_t through lower PP inflows. The empirical sections quantify which dominates.

Proposition 3 (Reallocation toward Unit-Linked Products)**.** *Suppose cross-price demand elasticities satisfy $\varepsilon_{UL}^{f^{PP}} \equiv \partial log(Q_t^{UL})/\partial f^{PP} > 0$ but are small, so that profit participation*

and unit-linked contracts are substitutes. Then both a decline in the long-term rate y_t and a tightening of regulatory capital requirements ϕ_j, $j \in \{1, 2\}$, increase the flow of new business into unit-linked contracts.

The proposition completes the model's account of the PP to UL transition. Propositions 1 and 2 establish that low rates and tighter regulation each reduce PP new business. Proposition 3 shows that both forces simultaneously increase UL new business.

The implications for bond demand of Proposition 3 depends on how assets backing UL contracts are backed. Using confidential data we are the first to shed light on this channel in Section 5, by showing that the allocation is mostly in equity, thereby reducing bond demand.

3. Data

In this section, we describe the data construction and document key facts about the insurance sector and household portfolio allocation. We proceed in three steps. First, using aggregate flow-of-funds data, we show that flows into insurance companies are quantitatively large, both relative to insurers' balance sheets and as a share of aggregate household portfolios. Second, we document a sharp decline in inflows between 2015 and 2023, followed by a rebound in 2024. Third, we show that life insurance products—once the second-largest financial asset for households—have declined in importance over the past decade, alongside a reallocation toward equities and mutual funds.

We then describe the confidential regulatory data from EIOPA, which we use to construct net premium flows and to document key features of insurers' balance sheets, including their main assets and liabilities. Finally, we describe the financial variables used in the analysis.

Aggregate Data: QSA We use euro area flow-of-funds data from the ECB's Quarterly Sector Accounts (QSA), which provide detailed information on household balance sheets, including both positions and transactions across financial instruments.

The data cover a broad set of assets, including deposits and currency, bonds, loans, equities, mutual fund shares, pension entitlements, life insurance policies, and other financial claims. Several features of household portfolios are worth highlighting. Deposits remain the dominant asset class, accounting for approximately 32% of financial wealth, a share that has remained stable since 2014. At that time, life insurance policies represented the second-largest asset category (24%), followed by equities (20%) and mutual funds (8%). Over time, however, this composition has shifted. By 2024, the share of life insurance declined to 19%, while equities and mutual funds increased to 25% and 11%, respectively. Overall, these patterns point to a gradual reallocation of household portfolios away from insurance

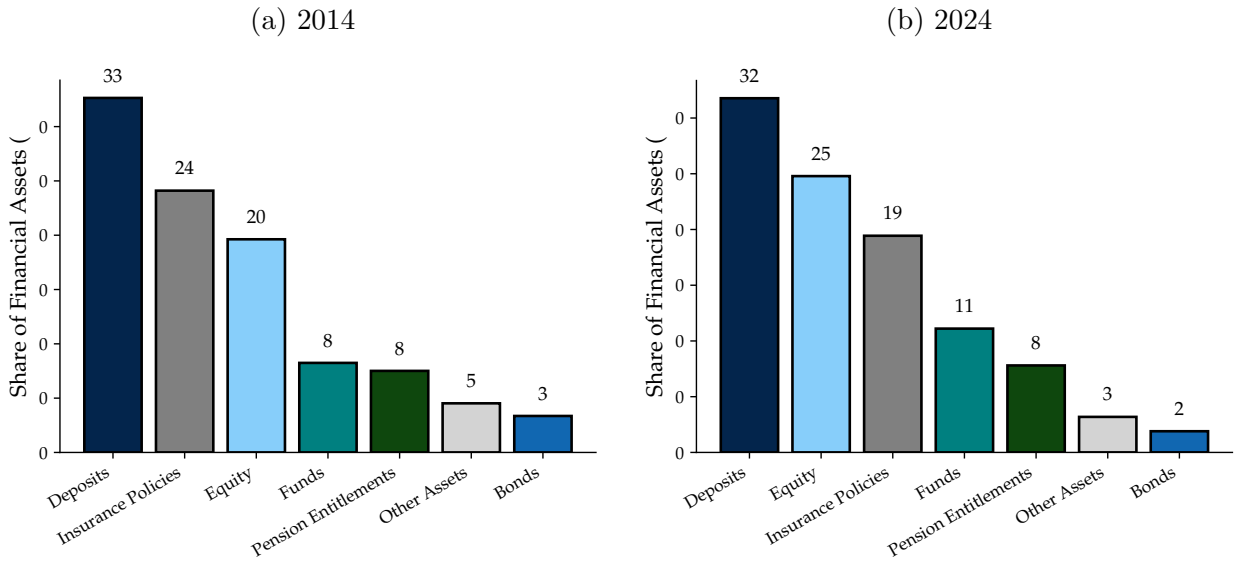
products and toward market-based investments. Figure 2 illustrates this evolution.

Aggregate Inflows into the Insurance Sector A key advantage of the flow-of-funds data is that they separately report transactions, allowing us to measure flows from households into the insurance sector. These inflows combine two components: underwriting flows and capital flows. Underwriting flows—referred to as *net premiums*—are defined as premiums minus claims and expenses. When net premiums are positive, insurers accumulate resources that can be invested in financial assets; when claims exceed premiums, insurers must draw down reserves or liquidate assets. In addition, insurers may receive capital inflows through external financing, such as equity or debt issuance.

At the quarterly frequency, flows are highly volatile and display strong seasonality. To address this, we smooth all series using a four-quarter rolling average, $\bar{F}_t = \frac{1}{4}\sum_{k=0}^{3} F_{t-k}$, where F_t denotes net flows in quarter t. This transformation reduces seasonality and attenuates valuation effects, yielding a measure that closely tracks year-over-year changes in household allocations to insurance.

To quantify the importance of insurance within household portfolio decisions, we construct a normalized measure defined as the ratio of flows into insurance to total household financial flows. Conceptually, this corresponds to a portfolio allocation problem in which households distribute new savings across available assets. Panel b) of Figure 1 shows that, on average over 2001–2014, approximately 31% of household financial flows were directed toward insurance—roughly one third of total flows. In contrast, during the low long-term interest rate period from 2015 to 2023, this share declined sharply to 13%.

Figure 2: Households Portfolio Shares

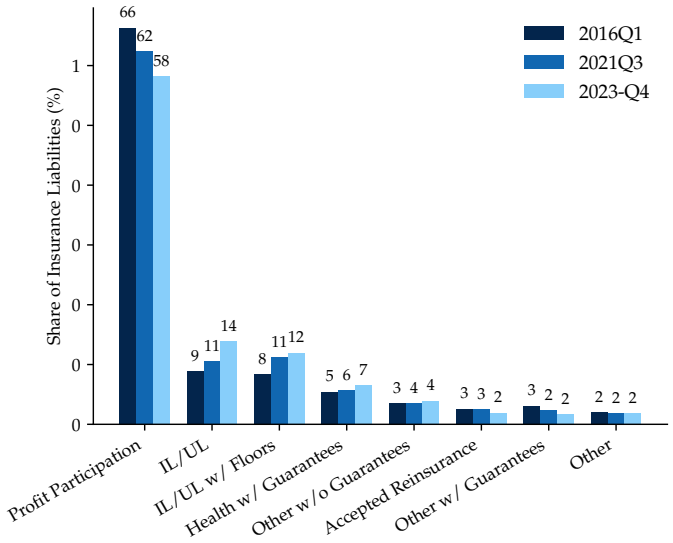


EIOPA We complement the aggregate evidence with confidential regulatory data from EIOPA, providing insurer-level information on net premiums, balance sheets, asset holdings, and trading flows. The data begin in 2016, coinciding with the implementation of Solvency II, which establishes harmonized valuation standards and risk-based capital requirements. Insurers are classified as life, non-life, composite, or reinsurance undertakings. A central object in our empirical analysis is flows into the insurance sector at the insurer level. We construct these flows using regulatory data on premiums, claims, and capital positions. Because changes in capital reflect both issuance and valuation effects (which cannot be disentangled), our baseline measure focuses on net premiums, measured net of reinsurance transactions. The magnitude of these flows is economically large. The interquartile range of net premiums is approximately 3% of assets, and inflows or outflows of up to 10% of assets are not uncommon, highlighting that underwriting flows represent a major source of balance sheet variation. Figure K.1 plots the distribution of net premiums scaled by total assets, aggregated annually across life and composite insurers.

Balance Sheet We next describe the structure of euro area insurers' balance sheets. Table K1 reports aggregate positions. At the end of 2024, total assets amounted to €8.7 trillion, down from €9.1 trillion in 2021 but still above the €7.8 trillion recorded in 2016. The decline since 2021 primarily reflects valuation losses following the increase in interest rates. On the asset side, index-linked (IL) and unit-linked (UL) products represent the largest category, reaching €1.8 trillion in 2024 (21% of total assets), a 77% increase relative to 2016. Government bonds are the second-largest component (€1.6 trillion), although their value has declined from €2 trillion in 2016. Corporate bond holdings amount to €1.3 trillion, also declining over the period. Collective investment undertakings (CIUs) have grown substantially, increasing by 84% to €1.25 trillion. Participations remain sizable at over €1 trillion, while other asset classes—such as loans, equities, cash, and property—play a smaller but non-negligible role in portfolio diversification. Appendix Table K2 provides a country-level breakdown.

Technical Provisions On the liability side, the dominant component is technical provisions (TP), which capture insurers' obligations to policyholders. Under Solvency II, TP are defined as the sum of a best estimate—corresponding to the discounted value of expected future cash flows—and a risk margin, computed using a cost-of-capital approach. Life insurance technical provisions excluding UL declined from €4.6 trillion in 2021 to €3.8 trillion in 2024. In contrast, UL technical provisions increased to €1.8 trillion, mirroring the expansion on the asset side. Non-life technical provisions amount to approximately €0.8 trillion, while other liabilities remain stable at around €0.9 trillion.

Figure 3: Shares of Insurance Liabilities by Product Type



Note: The figure reports the contract value of technical provisions by policy type, expressed as a share of total technical provisions. Source: EIOPA.

Figure 3 illustrates the evolution of life insurance liabilities by product type. Contracts with profit participation remain the largest category, accounting for more than half of total liabilities throughout the sample. However, their share has declined from roughly two thirds in 2016 to just under 60% in 2023. At the same time, IL/UL products have grown steadily. Contracts without guarantees increased from 9% to nearly 14%, while those with guarantees rose from about 8% to 12%.

These patterns point to a structural shift in the industry: traditional guaranteed products remain dominant but are gradually losing importance, while UL/IL products are gaining prominence as insurers transfer more investment risk to policyholders. Appendix Table K3 shows that countries with historically risk-based regulatory frameworks, such as the Netherlands and Ireland, have a larger share in UL products.

Financial Markets Data We use a comprehensive set of financial market data. As a measure of short-term interest rates, we use the 3-month interbank rate from FRED. To capture the term structure, we collect sovereign yield curves for all euro area countries from Bloomberg. Unless otherwise specified, we define the *slope* as the difference between the 10-year German government bond yield and the 3-month short-term rate. We also use estimates of the term premium for the German yield curve from Adrian et al. (2013) and Favero and Fernandez-Fuertes (2023). The slope and the term premium are plotted in Figure K.12. Both series were positive—around 1.5%—until 2014, after which they declined markedly.

Sovereign Risk and Credit Risk Factor We account for sovereign and credit risk. For sovereign risk we construct the spread between the average yield of Spanish and Italian bonds minus the yield on German bonds. In the baseline specification, we use the 10-year yields. For credit spreads, we use either the ICE BofA Euro High Yield Index Option-Adjusted Spread or the iBoxx BBB OAS spread.

Monetary Policy Shocks To construct shocks to the yield curve, we exploit high-frequency monetary policy surprises measured at different maturities. In the paper, we report results using the full term structure of monetary policy shocks. We denote by Δi_t^n the monetary policy surprise to the n-year OIS rate, measured in a narrow window around ECB policy announcements, following Altavilla et al. (2019); Leombroni et al. (2021).

It is also useful to define a *slope monetary policy shock*. We construct this shock using the surprise to the 10-year rate, Δi_t^{10y}, and the corresponding surprise to the 3-month OIS rate, Δi_t^{3m}, both measured around policy announcements. The slope shock is defined as:

$$\Delta s_t \equiv \Delta i_t^{10y} - \Delta i_t^{3m}.$$

This construction isolates innovations that affect the long end of the yield curve relative to the short end. For example, shocks associated with forward guidance or quantitative easing, which disproportionately affect long-term rates, generate variation in Δs_t.

Because our regressions are estimated at the quarterly frequency, we aggregate these high-frequency shocks by summing them within each quarter: $\Delta s_q = \sum_{t \in q} \left(\Delta i_t^{10y} - \Delta i_t^{3m} \right)$. To account for the slow-moving nature of flows, we further smooth the quarterly series using a four-quarter rolling average: $\bar{s}_q = \frac{1}{4} \sum_{k=0}^{3} \Delta s_{q-k}$. We use $\bar{s}_q$ as an instrument for the slope of the yield curve.

4. The Effects of Interest Rates on Flows

This section provides empirical evidence for the model's predictions about how interest rates affect the balance-sheet component A_t of the decomposition (1). Proposition 1 predicts that a steeper yield curve increases PP demand Q_t^{PP} and hence inflows into the general account, expanding A_t. We then also provide evidence of the franchise value channel—whereby the stock market capitalizes future inflows—is the market's assessment of the present value of Q_t^{PP} over the insurer's lifetime.

We now present a number of facts that discipline the quantitative importance of the different channels identified by our framework. First, interest rates are strongly *positively* related to flows into insurance companies. Second, the stock market places a positive value

on interest rate increases for insurance companies, reflecting a franchise value effect rather than a negative duration gap.

Taken together, these facts indicate that households' allocation to insurance products is far more important for insurers' long-run presence in the bond market, while conditional portfolio rebalancing within insurance companies may play a stronger role in the short run.

4.1 Insurance Flows and Interest Rates

Aggregate Evidence The model presented in Section 2 highlights how different factors affect inflows into insurance companies. Proposition 1 predicts that the slope of the yield curve $s_t = y_t - i_t$ is the key determinant of household demand for PP products: a steeper curve raises the guaranteed rate $g_t = \phi \cdot y_t$ relative to the outside option i_t, increasing Q_t^{PP} through both a direct demand channel and an indirect supply channel (lower fees). In this section, we document a tight empirical relationship between flows and the slope of interest rates.

Figure 4 plots inflows into insurance companies over time (dark blue line, left axis) together with the slope of interest rates (light blue line, right axis). The figure shows a strong positive correlation between the two series (0.67) and highlights a clear downward trend in the slope of the yield curve from 2014 to 2024, reaching negative levels during this period.

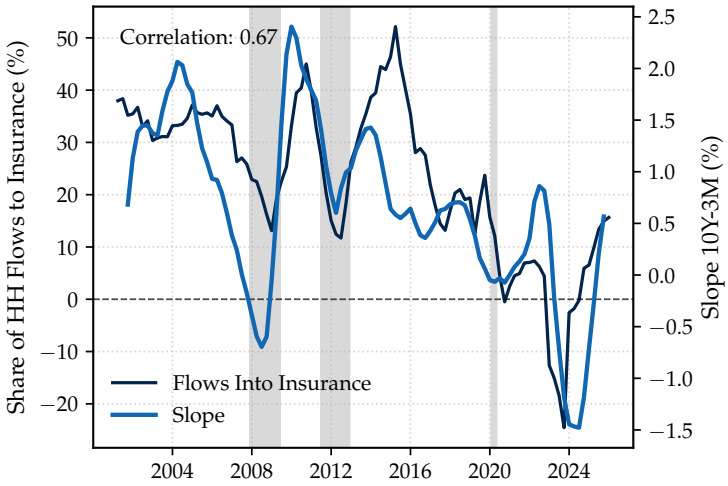
A simple linear regression of the share of household flows directed toward insurance on the slope of the yield curve over the full sample yields a coefficient of 0.12 (Newey–West standard error of 0.014, t-statistic 8.6). This estimate implies that a one–percentage-point reduction in the slope is associated with a 12–percentage-point decline in flows to insurance, measured as a share of total household financial flows. The R^2 of the regression is 45%, indicating a strong relationship between flows and the slope of the yield curve.

Inflows are measured as the share of total household financial flows that are directed toward insurance companies, which makes the series less sensitive to aggregate macroeconomic fluctuations in savings. This normalization allows us to focus on portfolio allocation decisions rather than changes in overall saving.

Importantly, inflows are not similarly correlated with the *level* of interest rates. Consistent with the model, it is the slope of the yield curve—rather than the level—that appears to be the key driver of household allocation decisions. In particular, a flatter or inverted yield curve reduces the attractiveness of insurance products relative to alternative investments, leading households to reallocate away from them.

Finally, a key finding is that inflows rebounded in 2024, alongside the recovery in the slope of interest rates. This pattern is difficult to reconcile with explanations based solely

Figure 4: Inflows and Interest Rate Slope



Note: The figure plots inflows into the insurance sector as a share of household financial flows (left axis), together with the slope of interest rates (right axis). Inflows into insurance are measured as the ratio of total inflows into the insurance sector—comprising net premiums and capital flows—to total household flows into financial assets, using data from the QSA. The slope is defined as the difference between the German 10-year government bond yield and the 3-month rate. Both series are smoothed using four-quarter rolling averages. The sample runs from Q1 2001 to Q3 2025.

on regulation. In particular, the main regulatory change occurred in 2016, yet flows had already declined in 2015, prior to its implementation, and recovered in 2024 in the absence of any new regulatory reforms. This timing suggests that movements in the term structure of interest rates, rather than regulatory changes alone, play a central role in driving flows into insurance products. The rebound in 2024 is consistent with Proposition 1: as y_t recovers, g_t rises and the PP fee falls, restoring demand Q_t^{PP}. By contrast, Proposition 2 predicts a permanent level shift from regulation, which cannot explain the recovery.

Instrumented Yields and Insurance Flows Along the Curve A potential confounding factor is a sudden change in the macroeconomic environment. One concern is that QE may simply have been a response to a crisis, with the crisis itself (rather than QE) deteriorating trust and driving outflows from the financial sector. Relatedly, low rates may proxy for periods of heightened economic uncertainty, during which households shift toward more liquid savings vehicles at the expense of long-term insurance products.[4]

[4]This explanation appears unlikely. For instance, the sovereign debt crisis of 2010–2012 did not generate outflows of comparable magnitude. Moreover, the QE episode occurred during a relatively calm period. Euro area GDP growth averaged about 2 percent (above its long-run average), unemployment was declining and already below its historical mean, and inflation remained subdued but stable. Thus, QE was implemented in a relatively tranquil environment—outside of a crisis or inflation shock that could otherwise account for a shift in household saving behavior.

To address some of these concerns and to better understand the role of interest rates for the inflows into insurance companies we use high-frequency monetary policy shocks across the yield curve. We then use the difference between the monetary policy shocks to the 10-year and 1-year rates, which captures unexpected changes in the slope of the yield curve, the *slope monetary policy shock*. Since forward guidance and QE were introduced only in the post–global financial crisis period, we restrict the analysis to the post-crisis sample.

We use our constructed monetary policy shocks to examine the direct effects of shocks at different maturities of the yield curve on insurance inflows. To this end, we estimate a series of univariate regressions, each using a monetary policy shock at a specific maturity as the regressor. Figure 5 plots the estimated coefficients across maturities on the x-axis, with the corresponding beta coefficients and confidence intervals on the y-axis.

A positive shock to the 3-month OIS rate reduces insurance inflows significantly, with an estimated coefficient of about –1.2. More broadly, shocks at maturities below two years have negative effects on insurance flows. At longer maturities, the coefficients turn positive and become statistically different from zero starting around the seven-year maturity. The effect at the ten-year maturity is approximately 0.7, and it grows larger at the twenty-year maturity. These estimates suggest a monotonic relationship: short-term rate shocks *reduce* inflows into insurance companies, whereas long-term rate shocks *increase* them. Very long-maturity shocks are likely to be driven by QE announcements. Consistent with this interpretation, we do not in fact observe such shocks in the pre-crisis period and we restrict the sample to post 2010.[5]

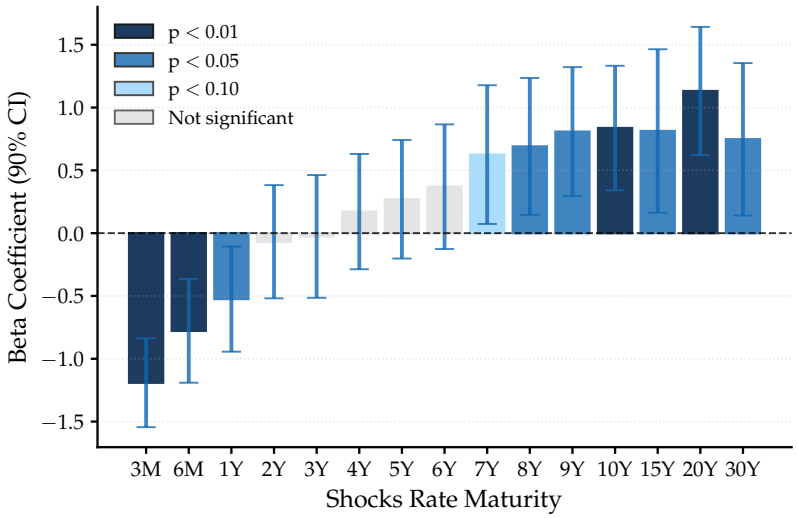
This pattern maps directly onto the model: an increase in i_t (the outside option) reduces PP demand, while an increase in y_t raises the guaranteed rate g_t and attracts inflows—exactly the opposing signs predicted by $\partial Q^{PP}/\partial i_t < 0$ and $\partial Q^{PP}/\partial y_t > 0$.

Additional Evidence from Micro Data We now turn to the cross-section of insurers and exploit the granularity of our micro data. Here, we take advantage of cross-sectional differences in insurers' exposure to interest rate changes, stemming from heterogeneity in their lines of business and product mixes. To do so, we interact interest rate changes over the period 2017–2024 with the product composition each insurer offered in 2016, which is plausibly exogenous to subsequent unexpected changes in interest rates.

Our framework suggests that a potentially important reason for the decline in insurance

[5]In the sample 2010 to 2021, the shocks to short-term interest rates and long-term rates happened in different periods. The ECB lowered short-term rates during the sovereign debt crisis, then in 2013 it started to lower medium-term rates using forward guidance and later it deployed the quantitative easing programme. When we extend the sample to include 2022, the estimates remain broadly unchanged, although the results become noisier. The slope monetary policy shock—which is the main focus of this paper, defined as the difference between the 10-year and 1-year shocks—remains virtually identical across all sample periods.

Figure 5: Insurance Inflows and Monetary Policy Shocks



Note: This figure plots the estimated coefficients and 90% confidence intervals from regressions of insurance net inflows—as a share of total household flows—on monetary policy shocks identified using high-frequency changes around ECB announcements. Estimates are shown for interest rate shocks with maturities ranging from 3 months to 30 years. We use OIS rates for short-term rates and German bund yields for longer-term rates. Newey–West standard errors.

inflows is that the minimum guaranteed returns on policies have become less attractive to households. In the model, the guaranteed rate $g_t = \phi \cdot y_t$ is the key object driving PP demand. Insurers with a higher share of PP liabilities are more exposed to this channel, so Proposition 1 predicts a stronger flow response to interest rate changes for PP-intensive firms. Insurance companies with a higher share of profit-participation liabilities should therefore exhibit greater sensitivity of flows to changes in interest rates. To test this hypothesis, we interact the slope of the yield curve with the share of profit-participation policies in 2016 (the first year of our sample) for each insurer i. Formally, we estimate:

$$np_{i,t} = \alpha_i + \alpha_t + \beta_1 \big(\text{Slope}_t \times PP_{i,2016}\big) + \beta_3 PP_{i,2016} + \varepsilon_{i,t}, \tag{18}$$

where $np_{i,t}$ denotes annualized net premiums (scaled by lagged assets) for insurer i at time t; Slope_t is the slope of the yield curve; and $PP_{i,2016}$ is the insurer-specific share of profit-participation contracts in 2016.[6] We use both the slope of the yield curve and its instru-

[6]We construct net premiums accruing to life insurance policies that are not Unit-linked, and therefore include a guaranteed component. We also compute total net premiums, which aggregate Unit-linked, non–Unit-linked, and non-life premiums. Following the approach used earlier, we construct annualized flows as the rolling sum of the previous four quarters, yielding a quarterly time series of annual flows. This procedure is necessary because net premiums exhibit strong seasonality; without this adjustment, any estimation would be dominated by short-term noise.

Table I: The Cross-Section of Insurance Flows and the Slope of the Yield Curve

	Non UL				Total	
	(1)	(2)	(3)	(4)	(5)	(6)
Slope	0.265**					
	(0.0843)					
Slope Monetary Shock		1.380*	-2.166**	-0.985***	-4.329*	-0.502
		(0.617)	(0.914)	(0.242)	(2.169)	(0.800)
PP (2016) × Slope Monetary Shock			2.734**		5.807*	
			(0.856)		(2.794)	
Life × Slope Monetary Shock				3.004***		3.345
				(0.622)		(3.583)
Insurance FE	✓	✓	✓	✓	✓	✓
Year FE			✓	✓	✓	✓
N	21338	21338	7364	21338	3735	12900
R^2	0.646	0.645	0.570	0.652	0.616	0.628

Note: Panel regressions of annualized net premiums (scaled by lagged assets) on the slope of the yield curve and its instrumented counterpart based on monetary policy shocks. Columns (1)–(4) use non–Unit-linked (Non UL) flows; Columns (5)–(6) use total flows. All regressions include insurer fixed effects and, where indicated, time fixed effects. Standard errors (in parentheses) are double-clustered at the insurer and time levels. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

mented counterpart based on monetary policy shocks. Insurer fixed effects control for time-invariant differences across firms (such as business models or product structures) while time fixed effects absorb aggregate shocks that may otherwise confound the estimates. In an alternative specification, we replace $PP_{i,2016}$ with a dummy indicating whether an insurer is a pure life insurer, expecting that composite insurers may be better able to retain clients through cross-selling and thus display lower sensitivity of inflows to interest rate movements.

Table I reports the results. Columns (1)–(4) focus on flows into non–Unit-linked (Non UL) policies—those that typically include guarantees—while Columns (5)–(6) report results for total flows, including Unit-linked and non-life business.

In Column (1), the coefficient on the slope is positive and statistically significant (0.27), indicating that a steeper yield curve is associated with stronger inflows into guaranteed products. A 1-percentage-point increase in the term-structure spread translates into a rise in net inflows of about 0.27 percentage points of total assets. This finding is consistent with the idea that a higher term premium makes life-insurance policies more attractive relative to short-term or liquid alternatives.

When the slope is instrumented with monetary policy shocks (Column 2), the coefficient increases substantially to 1.38, indicating that exogenous, policy-induced steepenings of the yield curve have an even larger effect on inflows—about 1.38 percent of assets for each 1-

percentage-point increase in the slope. This stronger effect likely reflects the causal response of household saving decisions to unexpected policy shifts, rather than contemporaneous correlations with other macroeconomic variables.

Columns (3) and (4) introduce heterogeneous effects based on insurers' product mixes. The interaction between the instrumented slope and the share of profit-participation contracts in 2016 is positive and significant (2.73), implying that insurers with a larger share of profit-participation liabilities are substantially more sensitive to changes in long-term rates. In fact, for companies with no profit participation, the effects are negative. Similarly, the interaction between the instrumented slope and the life-insurer dummy is positive and highly significant (3.00), indicating that pure life insurers experience stronger flow responses to interest rate changes than composite insurers. Both effects are economically large and statistically robust, reinforcing the interpretation that product structure and specialization amplify sensitivity to monetary policy.

In Columns (5)–(6), we extend the analysis to total flows, which also include Unit-linked and non-life business. The results remain qualitatively similar. The interaction between the instrumented slope and the share of profit-participation liabilities remains positive and significant (5.81), confirming that insurers with a higher share of guaranteed contracts are more sensitive to interest rate movements. The coefficient on the interaction between the instrumented slope and the life-insurer dummy (3.35) is similar in magnitude to that in Column (4), though less precisely estimated due to the smaller sample size and greater heterogeneity in total flows.

Overall, the estimates indicate that life insurers with higher exposure to profit-participation liabilities and a pure life focus exhibit the strongest flow responses to changes in the yield curve. These findings are consistent with the mechanism proposed earlier: when the yield curve steepens or long-term rates rise, the relative attractiveness of guaranteed policies increases, driving larger inflows into the insurance sector.

It is useful to emphasize that these flows primarily reflect the subscription of new policies by households (or the lack thereof), rather than active trading of existing positions. In this sense, the tight relationship we document does not contradict the well-established evidence that households adjust their financial decisions only gradually. A large literature documents substantial inattention and portfolio inertia across many settings (e.g., Agnew et al., 2003; Brunnermeier and Nagel, 2008; Andersen et al., 2014).[7] An important exception is the 2022–2023 period. During this time, the rapid tightening of interest rates by the ECB reduced the slope of the yield curve by about 2.5 percentage points, with short-term rates exceeding

[7]Further evidence includes passive acceptance of default retirement allocations (Choi et al., 2003) and limited portfolio rebalancing or financial sophistication (Calvet et al., 2009).

long-term rates by roughly 1.5%. This salient shift triggered a more active response from households, including the surrender of existing insurance policies, which we examine next.

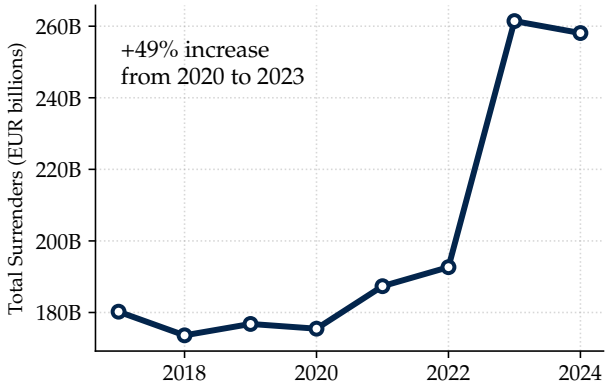
Surrenders as Corroborating Evidence The evidence above shows that flows into insurance products respond to the slope of interest rates primarily through the extensive margin: households subscribe to fewer new policies when guaranteed returns are unattractive. A natural concern is that this relationship reflects slow-moving structural forces—demographic trends, changing household preferences, or industry consolidation—rather than a direct response to interest rates. The surrender episode of 2022–2023 addresses this concern directly. When the ECB tightened policy rapidly and the slope of the yield curve fell by approximately 2.5 percentage points, turning sharply negative, households responded actively by surrendering existing contracts. This reveals that the same sensitivity to interest rates that operates gradually through new subscriptions can, when rate movements are salient enough, also manifest through existing positions—confirming that the mechanism is genuinely rate-driven rather than structural.

Using data from EIOPA, which allow us to observe surrenders directly, we document a substantial increase in policy exits. As shown in Figure 6, overall surrenders rose by 49% between 2020 and their peak in 2023, and remained elevated in 2024.

The cross-country pattern reported in Table K8 provides additional identification. Surrenders were not uniformly distributed across the Euro area: Germany and the Netherlands recorded no increase and in some cases a decline, while Italy, France, and Luxembourg experienced sharp rises. This heterogeneity is informative. Countries where surrenders rose most sharply are precisely those where the stock of outstanding policies carried low guaranteed rates written during the QE period—making the gap between the guaranteed rate and the newly available deposit rate most salient to policyholders. By contrast, countries where surrender activity was muted tend to have different distribution channels or product structures that insulate policyholders from this comparison. The cross-country pattern therefore mirrors the cross-sectional heterogeneity in our main flow regressions: sensitivity to interest rates is strongest where exposure to guaranteed-rate products is highest. During 2022–2023, countries experiencing large increases in surrenders were also net sellers of government bonds, illustrating the direct link from household behavior to bond market outcomes.

Overall, the surrender episode corroborates the main identification in two ways. First, it confirms that the interest rate sensitivity we estimate in the cross-section of insurers is not a statistical artifact of slow-moving trends: when rates moved sharply, households responded sharply. Second, the cross-country pattern replicates the same heterogeneity as our main regressions—insurers with greater exposure to guaranteed-rate products, and house-

Figure 6: Surrenders in the Euro Area



Note: Amount of policy surrenders for life insurance companies in the Euro area. Data are sourced from EIOPA and available from 2018 to 2024.

holds facing a more salient rate-guarantee gap, responded more strongly. Taken together, the evidence points to an important underlying mechanism: the attractiveness of guaranteed returns relative to outside options drives household allocation to the insurance sector, whether operating gradually through new subscriptions or abruptly through surrenders.

4.2 Interest Rates and Franchise Value

There are two distinct channels through which interest rates affect insurers. The first is a duration channel: insurers hold long-duration liabilities, and under negative duration gaps, falling rates reduce net asset value (Hartley et al., 2016; Koijen and Yogo, 2022a,b; Li, 2024). The second is a franchise value channel: low rates compress underwriting margins by limiting insurers' ability to offer attractive guarantees relative to households' outside options, reducing the value of future business. As Koijen and Yogo (2022a) acknowledge, existing data have not allowed researchers to disentangle these two channels. We make progress on this distinction by letting the stock market speak: we combine market valuations of insurance companies with granular regulatory data on the market value of liabilities from EIOPA filings. Institutional evidence already suggests that duration mismatch is limited, with asset and liability durations both around twelve years (EIOPA, 2019).

The franchise value channel is closely related to Drechsler et al. (2017), adapted to the insurance sector. When the yield curve is steep, insurers can offer guarantees at positive margins, attracting inflows that expand future balance sheets A_t and, through them, future bond demand. When the slope is low, these margins compress, reducing the profitability of new business. In terms of the model, franchise value is the present discounted value of future per-customer surpluses Π_t. Proposition 1 shows that Π_t rises with y_t—both because

the guarantee cost $V_{t,t}$ falls and because lower fees attract more customers—so a steeper yield curve raises franchise value. This yields a sharp empirical implication: if the flow channel dominates, interest rate changes should primarily affect equity valuations through franchise value rather than through the existing balance sheet (NAV). Under a duration-based view, the opposite should hold.

Indeed we show that the dominant channel through which interest rates affect insurers is not duration mismatch, but rather a *flow-based* channel operating through future business. We provide three pieces of evidence. First, the sensitivity of insurer stock returns to interest rates emerges only after QE and the introduction of Solvency II. Second, insurers' net asset values exhibit limited exposure to interest rates, consistent with a small duration gap. Third, the response of equity valuations to interest rates is driven primarily by changes in franchise value—that is, the present value of future underwriting profits.

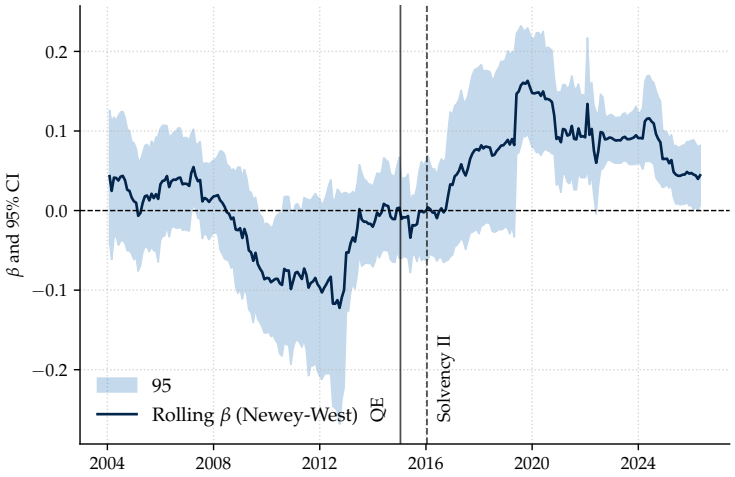
Time-Varying Stock Return Sensitivity to Rates. We begin by estimating regressions similar to Hartley et al. (2016); Koijen and Yogo (2022a,b), regressing insurance stock returns on changes in the 10-year rate while controlling for market returns, sovereign spreads, and credit spreads.

Figure 7 plots the resulting sensitivity using the Euro Stoxx 600 Insurance Index. Prior to 2012, insurer stock returns exhibit little sensitivity to interest rates. This changes markedly after 2015, following the introduction of QE and Solvency II, when stock returns become strongly sensitive to long-term rates. Several features of the data suggest this reflects a profitability channel rather than duration mismatch. First, during the global financial crisis and the sovereign debt crisis (2010–2014), both short- and long-term rates declined substantially, yet stock return sensitivity remained limited. Second, sensitivity emerges only once the slope of the yield curve declines persistently, suggesting that the relevant object is the spread between long-term returns and households' outside options. Third, the sensitivity disappears after 2022 when the slope recovers, even though the regulatory environment remains unchanged. This reversal implies that regulation alone cannot account for the time variation.

To more directly disentangle the balance sheet and franchise value channels, we exploit the granularity of EIOPA regulatory filings, which report the market value of both assets and liabilities separately. This allows us to construct NAV directly and distinguish it from total equity, which bundles current net asset value together with the market's valuation of future business.

Insurers' NAV, Stock Returns and Franchise Value. To decompose the equity return sensitivity into its balance sheet and franchise value components, we use mark-to-

Figure 7: Insurance Stock Market Sensitivity to Interest Rates



Note: The figure plots the rolling sensitivity of insurance stock returns to changes in long-term interest rates. The coefficient is estimated from rolling regressions of insurance sector returns on changes in the German 10-year government bond yield, controlling for market returns, sovereign spreads, and credit spreads. We use monthly data. Each regression is estimated over a 48-month window. Standard errors are computed using Newey–West corrections. The shaded area represents the 95% confidence interval. Vertical lines indicate the start of the ECB's quantitative easing (QE) program in January 2015 and the implementation of Solvency II in 2016.

market net asset values from EIOPA Solvency II filings, which capture the difference between market-consistent assets and liabilities including derivative hedges and the volatility adjustment. We measure all variables at the year-on-year frequency to eliminate seasonality and smooth through the slow adjustment of illiquid positions. We define franchise value as the difference between equity market returns and NAV growth, capturing what the stock market prices beyond the regulatory balance sheet: the present value of future underwriting profits. We regress each of the three outcomes on year-on-year changes in interest rates, progressively adding short-term rates, sovereign spreads, and credit spreads as controls. In all specifications we control for aggregate market returns.

Table II reports the results. Columns (1)–(3) show the relationship between NAV and long-term rates. The key finding is that once short-term rates are controlled for, the long-rate coefficient becomes small and insignificant, suggesting that the pure duration gap effect on the existing balance sheet is limited. Without this control, the univariate specification yields a negative coefficient (-1.86, significant at the 1% level), which is the wrong sign for a duration mismatch channel: if insurers held longer-duration liabilities than assets, rising rates should *increase* NAV. This somewhat counterintuitive result is driven by the 2022–2023 tightening episode, during which short- and long-term rates rose sharply together. As documented in the previous section, the rapid increase in short-term rates triggered

substantial outflows from guarantee products as households surrendered policies to reinvest in higher-yielding alternatives, directly compressing NAV independently of any duration effect.[8] Once this short-rate channel is controlled for, the relationship between NAV and long-term rates vanishes entirely.

Columns (4)–(6) turn to stock returns, the object typically estimated in the literature when granular balance sheet data is unavailable. In sharp contrast to NAV, insurer stock returns are strongly positively associated with rising long-term rates (coefficient approximately 4.7–4.8, significant at the 1% level across all specifications). The coefficient on short-rate changes is negative (-2.1 to -2.6), indicating that what matters is not the level of rates but the slope of the yield curve. A steepening yield curve is associated with significantly higher equity valuations, consistent with a franchise value channel: a steeper curve widens the spread between long-term portfolio returns and households' outside options, allowing insurers to offer more attractive guarantees, expand future business, and increase the present value of expected underwriting profits. Columns (7)–(9) report the implied franchise value response, constructed as the difference between stock returns and NAV growth. The coefficient on Δ 10Y Rate is 5.5–5.8 (significant at the 5% level), confirming that the positive equity response to rising long-term rates is entirely driven by franchise value rather than balance sheet revaluation.[9]

Taken together, the results in Table II provide direct evidence that the franchise value channel dominates insurer interest rate exposure. If the duration gap were the primary mechanism, rising rates would produce NAV gains that flow through to stock returns. Instead, NAV does not show a positive response to long-term rates, yet stock prices rise strongly. The forward-looking stock market thus prices interest rate changes primarily through their effect on the attractiveness of guarantee products and the resulting household demand, with duration mismatch playing a limited role. This evidence confirms the model's central prediction: interest rates affect insurers primarily through future inflows Q_t^{PP} (Proposition 1), which drive A_t and hence bond demand, rather than through the existing balance sheet.

Evidence from Micro Data. We now use individual insurer data to ask how much of the variation in net asset values is actually explained by interest rates. The aggregate regressions above impose a common coefficient across all insurers, potentially concealing important heterogeneity. If the duration gap were the dominant mechanism, interest rates should be a powerful predictor of NAV changes at the insurer level. We estimate the regression separately

[8] Consistent with this interpretation, the period saw significant stress in the sector, including the case of the Italian insurer Eurovita, which entered special administration.

[9] By construction, the franchise value and NAV coefficients sum to the stock return coefficients. We report the decomposition separately for ease of interpretation.

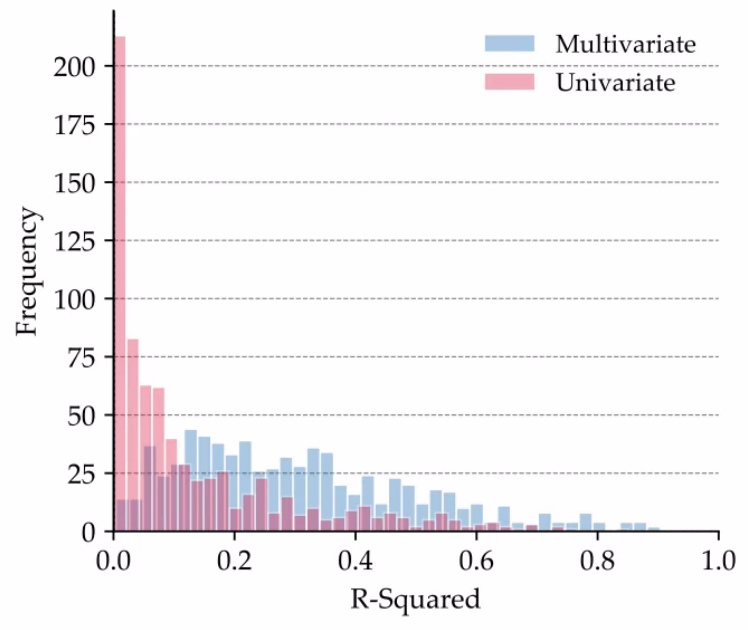
Table II: Rate Sensitivity of NAV, Stock Market, and Franchise Value

	NAV			Stock Market			Franchise Value		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ 10Y Rate	−1.86***	−0.83	−0.95	2.68**	4.71***	4.81***	4.54***	5.53**	5.76**
	(0.60)	(0.94)	(1.48)	(1.16)	(1.71)	(1.36)	(1.25)	(2.51)	(2.78)
Δ 3M Rate		−1.07	−1.12		−2.09	−2.59**		−1.02	−1.47
		(1.20)	(1.38)		(1.81)	(1.30)		(2.93)	(2.62)
Δ Sov. Spread			−0.99			−3.65***			−2.66
			(2.37)			(1.24)			(3.29)
Δ Credit			−0.97			−6.44***			−5.47*
			(2.29)			(1.20)			(2.96)
Market	0.18**	0.19***	0.10	1.17***	1.19***	0.48***	0.98***	0.99***	0.38
	(0.08)	(0.07)	(0.25)	(0.08)	(0.10)	(0.17)	(0.13)	(0.16)	(0.36)
R^2	0.17	0.20	0.20	0.73	0.74	0.81	0.47	0.48	0.52
N	33	33	33	33	33	33	33	33	33

Note: The table reports regressions of changes in net asset value (NAV), insurance stock returns, and franchise value on interest rate changes and control variables. Franchise value is defined as the difference between insurance stock returns and NAV growth. All dependent variables are measured as year-on-year percentage changes. Interest rates are measured as changes in the German 10-year government bond yield and the 3-month rate. Sovereign spreads are defined as the difference between German and Italian 10-year yields, and credit spreads correspond to changes in high-yield spreads. All regressions include market returns as a control. Columns (1)–(3) report results for NAV, columns (4)–(6) for insurance stock returns, and columns (7)–(9) for franchise value. Specifications progressively add controls for short-term rates, sovereign spreads, and credit spreads. Standard errors are Newey–West (HAC) with 12 lags. The sample runs from 2016-Q3 to 2025-Q3.

for each insurer, first using only interest rates and then adding sovereign and credit spreads as controls. The distribution of R^2 values is shown in Figure 8. Interest rates alone explain only a small fraction of the variation in insurers' net asset values, with a median R^2 of around 6%. In many cases, the R^2 is close to zero, providing direct cross-sectional confirmation that duration mismatch is not a first-order driver of balance sheet fluctuations. Including credit spreads greatly increases explanatory power to nearly 30%, consistent with Koijen and Yogo (2023), who show that insurers are effectively levered to credit spreads. However, credit spread movements tend to be temporary and, while they have a large impact on NAV in the short run, are unlikely to determine its long-run trajectory. This distinction between short- and long-run variation is central to our argument. Credit spreads drive short-run NAV fluctuations, but their effects are transitory. Interest rates, by contrast, are highly persistent. Their dominant effect on insurers operates not through short-run balance sheet revaluation but through the contraction of household flows into the sector documented in the previous section, which drives long-run bond demand and is capitalized by the stock

Figure 8: R-squared of Regressing NAV on Long-Term Rates



Note: The figure reports the results from a set of regressions at the individual insurer level of year-on-year changes in NAV on changes in interest rates, sovereign spreads, and credit spreads. The figure plots the distribution of R^2 for the univariate (interest rates only) and multivariate regressions (interest rates, sovereign spreads, and credit spreads). The data are quarterly and span the period from Q1 2016 to Q4 2024.

market as franchise value.

5. The Rise of Unit-Linked Products

This section documents the empirical counterpart of Proposition 3: the reallocation from participating (PP) to unit-linked (UL) products. In the model, both a decline in interest rates (y_t) and a tightening of regulation (ϕ_j) raise PP fees and divert households toward UL. Because UL assets are held in separate accounts that are predominantly invested in equities, this shift reduces the bond-relevant balance sheet A_t and rotates the aggregate portfolio away from bonds, amplifying the decline in $w_{b,t} \cdot A_t$ beyond what the contraction in PP demand alone delivers. Additionally, **?** highlight that, unlike PP contracts, which embed a guaranteed return that mutual funds cannot replicate, UL products are economically equivalent to tax-advantaged mutual funds with an insurance label. This exposes insurers to direct competition from asset managers, potentially reducing total flows into the insurance sector rather than merely reallocating them across product lines. In our framework, this competition channel amplifies the decline in A_t beyond what PP-to-UL substitution alone delivers: some households who would have purchased PP contracts exit the insurance sector entirely,

further contracting the bond-relevant balance sheet. As noted by the Chair of EIOPA, "the low interest rate environment precipitated a shift out of traditional life insurance products towards unit-linked ones."[10]

Evidence on the shift toward UL. Figure 9a shows that the share of insurers' assets invested in unit-linked products has increased steadily since 2016, rising from 18% to about 35%. This mirrors the pattern documented by **?** in the UK, where the ratio of unit-linked to traditional underwriting quadrupled from 1.5 in 2002 to 6 in 2014. Our Euro area evidence extends this finding to a broader set of countries and a later period, confirming that the shift is not confined to a single regulatory environment.

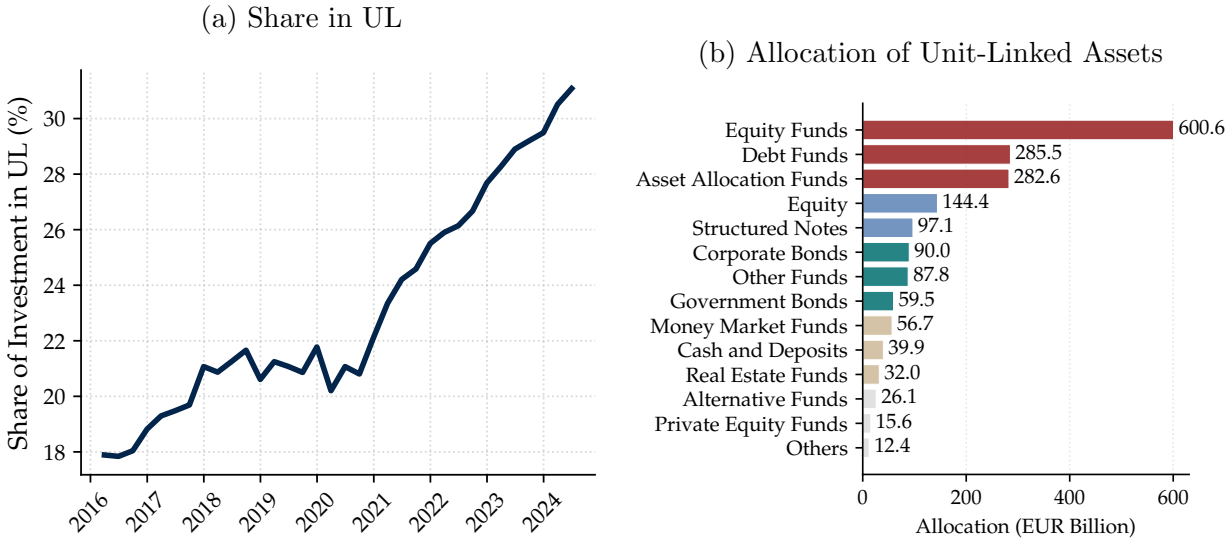
Composition of UL portfolios. To assess the implications for bond demand, we examine the asset allocation of UL portfolios using regulatory data. Figure 9b shows that, in 2024, UL assets (totaling €1.83 trillion) are heavily tilted toward equities. The largest component is €600 billion invested in equity funds, followed by €144.4 billion in direct equity holdings and €282 billion in asset-allocation funds. Assuming a 60/40 split within the latter implies an additional €169.2 billion in equity exposure. Including €16 billion in private equity, total equity exposure amounts to approximately €930 billion, or about 51% of UL assets. This allocation contrasts sharply with insurers' traditional balance sheets (excluding UL), which remain predominantly invested in bonds.

Interest Rates versus Regulation The combination of weaker inflows into guarantee products and the shift toward unit-linked contracts reduces the effective balance sheet A_t and reallocates assets away from bonds at the aggregate level. Because UL growth substitutes for PP demand rather than supplementing it, this transformation implies a persistent decline in insurers' bond demand, making a return to the pre-QE equilibrium unlikely.

Of course, our analysis cannot determine which force (interest rates versus regulation) matters more. The two channels are complementary and mutually reinforcing. Low interest rates erode the profitability of guarantees (Proposition 1), while risk-based capital regulation raises their cost even when they remain profitable (Proposition 2). Each force would likely have produced a significant shift on its own: Barbu et al. (2025) show that the UK's adoption of risk-based regulation triggered a sharp decline in traditional insurance even before the low-rate environment fully materialized, suggesting that regulation alone can be an important driver in shifting the business model of insurance companies and thereby contracting their bond demand. Quantitatively disentangling the relative importance of interest rates versus regulation is an important question that we leave to future research. What we can establish

[10] Petra Hielkema, Chair of EIOPA, speech entitled *"Navigating low rates, the pandemic and inflation – shifting patterns in life insurance"*.

Figure 9: Unit-Linked Products



Note: Panel (a) plots the share of assets in Unit-linked products for Euro area insurance companies. Panel (b) plots their allocation in Euro billions.

is that both forces operate primarily through the same margin: they reduce household inflows into guarantee-bearing contracts, shrinking the bond-relevant balance sheet A_t. This liability-side channel, driven by household allocation decisions, is quantitatively far more important for insurers' declining bond market presence than the portfolio rebalancing effects that have been the focus of the prior literature.

6. Flow-Induced Bond Demand

The previous sections establish that interest rates drive inflows (Proposition 1) and that the PP to UL shift contracts the bond-relevant balance sheet A_t (Proposition 3). We now ask how directly these flows translate into bond demand: If insurers allocated new inflows in the same proportions as their existing portfolio, the pass-through would be one-for-one. In practice, however, new premiums need not mirror the existing allocation: insurers may temporarily park inflows in cash as a liquidity buffer, direct them toward equities or alternative assets, or adjust portfolio weights in response to changing market conditions. We estimate a pass-through of approximately €0.70 per euro of net premiums confirming that the bulk of new inflows reaches the bond market. This is the key link in the chain: because insurers invest incoming premiums on profit participation products predominantly in bonds, then the contraction in these flows maps almost one-for-one into a contraction in bond demand. We show that this is indeed the case, and that liability-driven flows dwarf portfolio rebalancing

as a driver of insurers' bond purchases.

6.1 Flows versus Portfolio Rebalancing

Insurers trade for two main reasons: portfolio rebalancing on the asset side and liability-driven flows. Portfolio rebalancing reflects shifts across asset classes that leave the overall size of the balance sheet unchanged. By contrast, liability flows arise from premiums received, claims paid, and investment income, and they expand or contract the balance sheet depending on whether they are positive or negative. When inflows occur, insurers can either hold the additional resources in cash or allocate them to securities such as bonds. Thus, while rebalancing changes the composition of the portfolio, liability flows directly affect its scale. In terms of the decomposition (1), rebalancing operates through $w_{b,t}$ while liability flows operate through A_t.

The existing literature has primarily emphasized the rebalancing channel, documenting how regulatory capital constraints shape insurers' cross-sectional portfolio allocations. When constraints tighten (Ellul et al., 2011; Becker et al., 2022) or when increases in equity value make them less binding (Li, 2024), the resulting change in the "optimal" allocation generates bond trading. By contrast, the role of liability flows in driving insurers' bond purchases has received much less attention.[11] Importantly, Mota and Siani (2023) and Kubitza (2025) construct flow-induced trading by insurance companies as demand shocks for corporate bonds. While Kubitza (2025) focus on flows from paid insurance premiums only for non-life insurance companies, Mota and Siani (2023) use flows from operating income. We show that, economically, flows from operating income are considerably smaller than flows from net premiums, which are the key driver of insurance companies' bond demand, both in the cross-section of insurers and in the aggregate time series.

6.2 Net-Premium Induced Trading

Despite the magnitude of capital in- and outflows, these may simply be absorbed by insurers' cash positions without necessarily affecting their security portfolios. To test this, we examine to what extent insurers adjust their aggregate bond holdings (corporate and government) in response to net premium flows. We refer to this adjustment as net-premium-induced trading. Specifically, we estimate the following pooled regression over all insurers and quarters from 2016 to 2024:

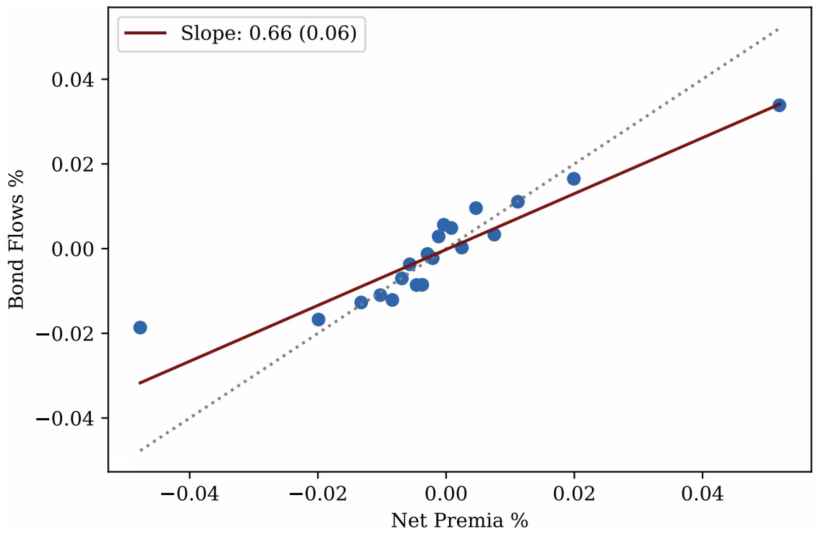
$$\Delta q^B_{i,t} = \alpha + \beta\, np_{i,t} + \epsilon_{i,t}, \tag{19}$$

[11] There is, however, a large literature on mutual funds' trading in response to flows. Lou (2012) find that equity mutual funds scale their equity positions by 0.62% for every 1% inflow. Similarly, Chaudhary et al. (2023) report a passthrough of 0.59 for corporate bond mutual funds.

where $\Delta q^B_{i,t}$ denotes bond purchases relative to lagged bond holdings, and $np_{i,t}$ is net premiums relative to lagged total assets.[12]

If insurers reinvest net premiums proportionally across their existing portfolio—keeping the relative weights of bonds, cash, and other asset classes constant—the scaling coefficient β should equal one. In that case, a 1% net premium relative to total assets translates into a 1% increase in bond holdings. By contrast, if inflows are parked as cash buffers, or if outflows are financed by drawing down cash rather than selling bonds, we would expect $\beta = 0$. Figure 10 reports the estimated coefficient.

Figure 10: Net Premium-Induced Bond Trading



Note: We regress percentage changes in bond holdings $\Delta q^B_{i,t}$ on net premiums $np_{i,t}$ at the quarterly horizon over the panel of insurer-quarter observations via WLS, weighting by lagged bond holdings to reduce the influence of outliers. Standard errors of the partial scaling coefficients (in parentheses) are clustered by quarter. Source: EIOPA Regulatory Filings.

On average, a net premium of 1% of assets is associated with a 0.7% increase in bond holdings. Rather than absorbing flows into cash, insurers scale their bond positions almost one-for-one with inflows and redemptions. In Appendix Figure K.2, we split the sample into net-premium inflows and outflows and find significant downscaling of bond holdings when net premiums are negative and upscaling when they are positive.

The combination of large net premiums and near-proportional portfolio adjustments underscores the importance of net premiums for understanding insurers' role in bond markets. Next, we assess the economic importance of net premiums relative to equity capital in driving insurance companies' bond holdings.

[12]Formally, $\Delta q^B_{i,t} = \frac{F^B_{i,t}}{A^B_{i,t-1}}$, where $F^B_{i,t} = \sum_{n \in \text{CB,GB}} \Delta Q_{i,t}(n) P_{t-1}(n)$ are dollar flows into corporate and government bonds and $A^B_{i,t} = \sum_{n \in \text{CB,GB}} Q_{i,t}(n) P_t(n)$ are total holdings in corporate and government bonds.

6.3 Economic Importance of Net Premiums versus Net Equity

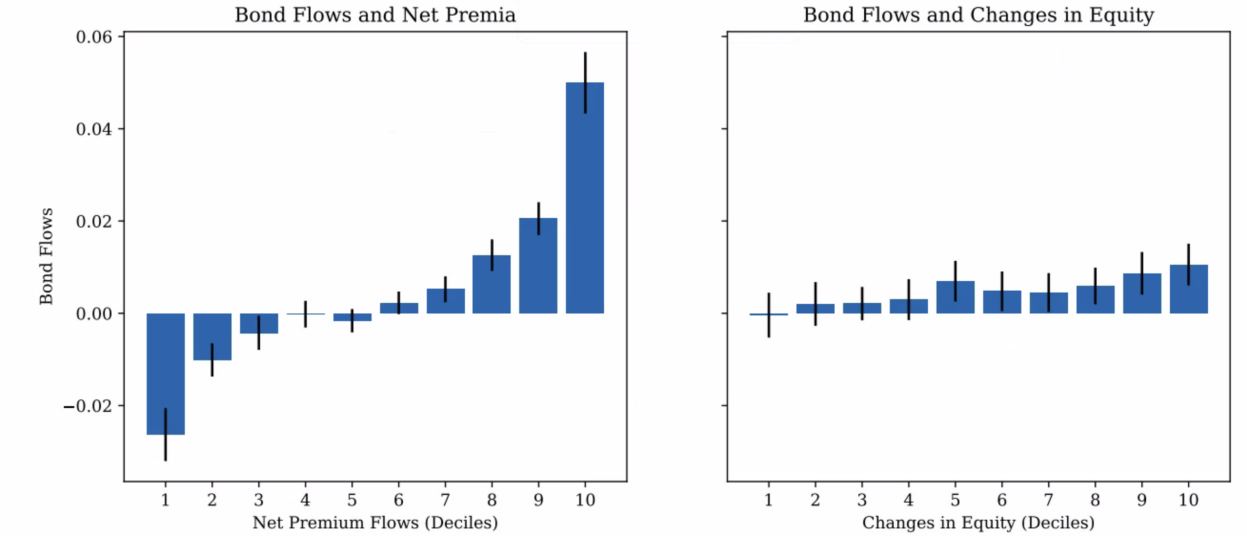
To highlight the *economic* importance of net premiums in driving insurance companies' bond demand, we benchmark the impact of net premiums against that of net equity, which has received considerable attention in the literature (see, e.g., Sen (2023); Haddad et al. (2024)). As for net premiums, we compute net equity flows as $ne_{i,t} = \frac{\Delta NAV_{i,t}}{A_{i,t-1}}$. Net equity flows capture changes in leverage arising from shifts in net equity, holding total assets constant. Since quarterly changes in net equity are small, and to give net equity the best chance of explaining bond rebalancing, we aggregate both net premiums and net equity flows to the annual horizon.

Simple Double Sort We sort all insurance companies into deciles based on their past annual net premiums $np_{i,t}$ and net equity flows $ne_{i,t}$. Note that net premiums may mechanically increase net equity due to accounting conventions. Therefore, we first sort based on net premiums and then, within each net premiums bucket, sort insurers into deciles by net equity flows. This is conceptually similar to orthogonalizing net equity changes with respect to net premiums. For each decile, we compute the average bond flow.[13] Figure 11 reports the results. The economic importance of net equity for explaining bond purchases is negligible compared to net premiums. Across deciles, the difference in bond flows between the top and bottom of the net premium distribution is 7.5% of total assets, whereas for changes in net equity it is less than 1%.

Regression Results The double sorting is only chosen for visual exposition. Table III reports ordinary regressions of annual bond flows on annual net premiums and annual changes in net equity. A one standard deviation higher inflow from net premiums leads to 1.67% additional bond flows. This dwarfs the economic importance of net equity: a one standard deviation net equity flow leads to a mere 0.2% higher bond flows. Furthermore, net premiums explain a large fraction (15%) of the variation in total bond flows, while the incremental explanatory power of net equity on top of net premiums is virtually zero. The relative importance of net premiums holds across different bond subgroups such as corporate bonds, government bonds, long-term bonds, and low-rated bonds. For example, net premiums are eight times more important for explaining government bond flows, and seven times more important for explaining flows to high-risk bonds than changes in net equity.

[13] We scale by total assets, which allows interpreting the coefficient as a dollar allocation relative to total assets. This is more robust than $\Delta q^B_{i,t}$, as it avoids dividing by potentially small previous bond holdings, but does not yield an interpretable scaling coefficient as in Figure 10. Using $\Delta q^B_{i,t}$ delivers noisier but qualitatively equivalent results.

Figure 11: Bond Flow Drivers: Net Premiums versus Net Equity



Note: We sort insurance companies into deciles by annual net premiums (left panel) and changes in net equity (right panel), and plot average annual bond flows relative to total assets, $F^B_{i,t}/A_{i,t}$, by decile. Changes in net equity are orthogonalized with respect to net premiums. Source: EIOPA Regulatory Filings.

Table III: Bond Flow Drivers: Net Premiums versus Net Equity

	All Bonds		Bonds by Subgroup			
	(1)	(2)	Corp.	Gov. Bonds	Long-Term	Low-Rated
Constant	0.57***	0.53***	0.28***	0.24**	0.29**	1.85***
	(0.11)	(0.13)	(0.09)	(0.10)	(0.12)	(0.18)
$\Delta NAV_{i,t}$		0.32***	0.21***	0.12*	0.20**	0.10
		(0.09)	(0.04)	(0.07)	(0.09)	(0.06)
Net Premium$_{i,t}$	1.67***	1.62***	0.69***	0.92***	0.96***	0.67***
	(0.09)	(0.08)	(0.09)	(0.05)	(0.08)	(0.08)
N	4006	4006	4006	4006	3709	3815
R^2	0.15	0.15	0.07	0.08	0.10	0.05

Note: We estimate pooled regressions at the insurer-year level of annual bond flows on annual net premiums and annual net equity (relative to total assets). Net premiums and changes in net equity are standardized. The first two columns use total flows into all bonds; the remaining columns use flows into subgroups. Long-maturity bonds are bonds with maturities greater than eight years. Low-rated bonds are those rated below BBB. Standard errors are clustered by year. * p<0.10, ** p<0.05, *** p<0.01.

6.4 Portfolio Rebalancing Based on Net Equity and Net Premiums

The previous subsections show that liability flows (A_t channel) are the dominant driver of total bond demand. We now examine the portfolio weight channel ($w_{b,t}$). Proposition 1

predicts $dw_{b,t}/dy_t < 0$ (lower rates push toward safe bonds) and Proposition 2 predicts $\partial w_{b,t}/\partial \phi_2 > 0$ (tighter regulation pushes toward safe bonds). Both operate through rebalancing conditional on the balance sheet. We show that while these rebalancing effects are statistically detectable, they are economically small relative to the A_t channel.

Net premiums are the primary driver of total bond demand and are economically more important than variations in net equity. We now examine how net premiums and changes in net equity shape insurers' cross-sectional portfolio choices across different segments of the bond market. In particular, we focus on two key dimensions of bond demand: credit rating and maturity.

Let $A^L_{i,t}$ denote insurer i's holdings of long-term bonds—defined as securities with maturities greater than eight years—and let $A^R_{i,t}$ denote holdings of risky bonds, defined as those with credit ratings of BBB or lower. We scale these positions by total bond holdings $A^B_{i,t}$ to obtain the corresponding portfolio weights $w^L_{i,t} = \frac{A^L_{i,t}}{A^B_{i,t}}$ and $w^R_{i,t} = \frac{A^R_{i,t}}{A^B_{i,t}}$

To isolate active portfolio rebalancing, we compare observed flows into each bond category with the flows that would occur mechanically if insurers simply expanded their portfolios in proportion to existing weights. Formally, we define active rebalancing as

$$\Delta a^k_{i,t} = \frac{F^k_{i,t} - w^k_{i,t-1} F^B_{i,t}}{A_{i,t-1}},$$

where $k \in \{L, R\}$; $F^L_{i,t}$ denotes flows into long-term bonds, $F^R_{i,t}$ denotes flows into risky bonds, and total flows satisfy $F^B_{i,t} = F^L_{i,t} + F^R_{i,t}$. This decomposition allows us to distinguish between passive expansion of existing positions—driven by the size of net premiums—and active changes in the composition of bond portfolios along maturity and credit-risk dimensions. For example, $\Delta a^L_{i,t}$ is flows toward long-term bonds in excess of proportionally scaling existing bond weights. We regress the cross-section of rebalancing toward long maturity $\Delta a^L_{i,t}$ and low credit rating $\Delta a^R_{i,t}$ respectively onto net premiums and changes in net equity. We study active rebalancing from 1 quarter up to 3 years via Fama–MacBeth regressions.

Table IV reports the estimated rebalancing for high-risk bonds (with lower credit ratings). Increases in net equity lead to a significant active rebalancing toward riskier bonds. This echoes the findings in Ellul et al. (2011) and Li (2024). Improvements in net equity alleviate potential risk-based capital constraints and lead to higher allocations to riskier bonds. However, despite their statistical significance, the economic magnitudes are extremely small. A one standard deviation increase in net equity increases the weight to high-risk bonds (within the total bond portfolio) by 0.22% over a three-year horizon.

Table V reports the estimates for the demand for long-maturity bonds. Net premium

Table IV: Demand for Lower-Rated Bonds

	Rebalancing to Lower-Rated Bonds			
	1Q	4Q	8Q	12Q
$\Delta NAV_{i,t}$	-0.01	0.02	0.09*	0.22***
	(0.01)	(0.03)	(0.05)	(0.07)
Net Premium$_{i,t}$	-0.01	0.00	-0.05	−0.19**
	(0.01)	(0.03)	(0.05)	(0.08)
Avg. R^2	0.01	0.01	0.01	0.01
Avg. N	435	418	398	377

Note: We estimate the portfolio rebalancing toward lower-rated bonds versus investment-grade bonds via Fama–MacBeth regressions of $\Delta a^{R}_{i,t}$ onto net premiums and changes in net equity. We scale both net premiums and changes in equity by total lagged assets and estimate the rebalancing regression over 1, 4, 8, and 12 quarter horizon changes. * p<0.10, ** p<0.05, *** p<0.01.

inflows lead to significant active rebalancing toward longer-maturity bonds. While we cannot decompose the underwritten premiums by their maturity (e.g., selling life policies to older versus younger people), we suspect that this relationship points to the mechanical effect of new policies being of longer maturity than expiring or surrendered policies. We also find that increases in net equity lead to a significant active rebalancing toward shorter-maturity bonds. However, despite the statistical significance of the rebalancing activity, the economic magnitudes are small. For example, a one standard deviation higher net premium leads an insurer to increase the weight on long-term bonds by 0.60% over a three-year horizon.

Table V: Demand for Long Maturity

	Rebalancing to Long-Term Bonds			
	1Q	4Q	8Q	12Q
$\Delta NAV_{i,t}$	0.00	−0.06*	−0.13**	−0.31***
	(0.01)	(0.03)	(0.06)	(0.09)
Net Premium$_{i,t}$	0.03**	0.23***	0.40***	0.60***
	(0.02)	(0.06)	(0.10)	(0.13)
Avg. R^2	0.01	0.02	0.02	0.01
Avg. N	447	430	410	390

Note: We estimate the portfolio rebalancing toward long versus short maturity bonds via Fama–MacBeth regressions of $\Delta a^{L}_{i,t}$ onto net premiums and changes in net equity. We scale both net premiums and changes in equity by total lagged assets and estimate the rebalancing regression over 1, 4, 8, and 12 quarter horizon changes. * p<0.10, ** p<0.05, *** p<0.01.

Appendix Tables K5 and K4 repeat the portfolio rebalancing results on credit rating and maturity choice for alternative specifications. We use dummy variables equal to 1 for the

top decile of insurers with the highest net premiums and net equity changes as opposed to the raw net premiums and net equity changes. The qualitative patterns are unchanged and the economic importance of net equity for the cross-sectional portfolio choice remains small.

Overall, the portfolio rebalancing results confirm that the channel emphasized by the existing literature—net equity relaxing capital constraints and shifting portfolio composition—is statistically present but economically negligible. A one standard deviation improvement in net equity shifts the weight toward risky bonds by 0.22% and toward long-maturity bonds by 0.60% over a three-year horizon. These magnitudes are an order of magnitude smaller than the effect of net premiums on total bond demand. The rebalancing channel affects the *composition* of bond portfolios at the margin; it does not move the *scale*. The scale is determined by flows. Returning to the decomposition (1): changes in $w_{b,t}$ (portfolio rebalancing) are economically small, while changes in A_t (driven by net premiums) are large. The decline in insurers' bond market share documented in Figure 1 is therefore overwhelmingly a balance-sheet phenomenon, not a portfolio-weight phenomenon.

6.5 Evidence from Aggregate Data

Our micro data on insurer-level holdings and net premiums are available from 2016 onward. However, aggregate statistics are available from the Euro area flow-of-funds accounts since the inception of the euro. We link liability flows and bond flows (net purchases, controlling for valuation effects) at the aggregate level using these flow-of-funds statistics. For both liabilities and bonds, we focus on transactions.[14]

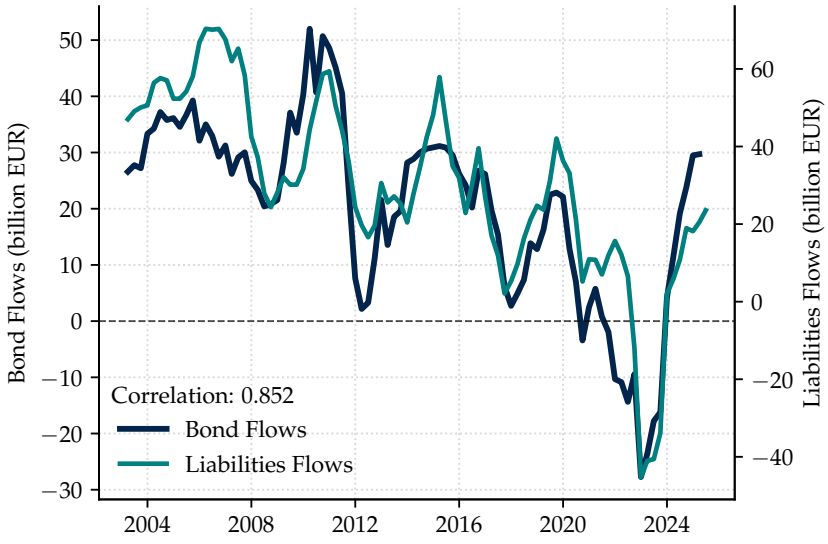
Figure 12 illustrates that bond purchases closely mirror insurance liability flows. Both series are constructed at a quarterly frequency using a rolling annual average. Insurance bond flows (in blue, left y-axis) move almost one-for-one with liability flows (in teal, right y-axis), with a correlation of about 85%. A simple univariate regression explains roughly 73% of the time-series variation in bond purchases through liability flows. The estimated pass-through coefficient is slightly below unity—around 0.85—and declines to about 0.7 in the post-2009 period, remarkably close to our cross-sectional estimates (which were estimated over the period 2016–2025). Overall, these results highlight the dominant role of liability flows in shaping insurers' bond demand and the stability of the pass-through mechanism over time.

Although insurers have historically been net buyers of bonds—never selling on net be-

[14] In the flow of funds, these appear under life insurance and pension entitlements. Conceptually, they are closely related to *net premium flows*—premiums and contributions received net of benefits and claims paid—but in this exercise we use a broader measure of inflows that also includes other financing flows such as equity issuance and bond issuances. Appendix I.1 provides further detail on their construction and mapping to ESA 2010 accounts.

tween 2000 and 2022—their purchases exhibit substantial time-series variation. The sharp increase in short-term rates in 2022–2023 triggered a further decline in flows into insurers, driven in part by policy surrenders. As a result, insurers became net sellers of bonds during this period. This pattern challenges the duration-hedging channel, which would instead predict increased demand for long-duration bonds when interest rates rise.

Figure 12: Net Premium and Bond Flows over Time



Note: This figure plots insurance bond flows (blue, left y-axis) and insurance liability inflows (black, right y-axis) over time, both measured as transactions from Euro area flow-of-funds data.

Taken together, the evidence in this section establishes a tight and stable link between household flows into the insurance sector and insurers' bond purchases. Every euro of net premiums translates into approximately €0.70 of bond demand, a pass-through that is stable across the micro cross-section and the aggregate time series spanning two decades. Because liability flows are an order of magnitude more important than portfolio rebalancing in explaining bond demand, the contraction in flows documented in Section 4 translates directly into the structural retreat of insurers from sovereign bond markets shown in Figure 1. We next examine the implications for bond yields.

7. Asset Pricing Implications

The previous sections established that household flows into the insurance sector contracted sharply after 2015 and that declining interest rates and regulation are an important driver of this shift. In equilibrium, however, these flows are not lost: they are reallocated to, for example, mutual funds or bank deposits. Whether this reallocation matters for bond markets

depends on whether insurance companies differ meaningfully from other investors in their exposure to long-duration assets.

We address this question in two steps. First, in Section 7.1, we provide a simple back-of-the-envelope calculation that translates the observed decline in insurance flows into an approximate effect on long-term bond yields. The goal is not to pin down the general equilibrium price impact precisely but rather to establish that the magnitudes are economically significant. Second, in Section 7.2, we discuss what this reallocation implies for equilibrium models of the bond market that feature intermediaries with preferred habitats, such as pension funds and insurance companies.

7.1 Back-of-the-Envelope Calculation: Effect on Bond Yields

To estimate the asset pricing implications of contracted insurance flows, we build on the insights of Koijen and Yogo (2019) and Gabaix and Koijen (2021) that provide a simple mapping from changes in investor demand to asset prices. The mechanism is simple: households reallocate savings across intermediaries that differ in their portfolio exposures. Because insurance companies hold far more long-term bonds than the mutual funds and banks absorbing the redirected flows, the reallocation generates a net reduction in demand for duration, even though aggregate flows sum to zero. The resulting price impact is governed by the demand elasticity of the remaining long-term bond investors.

We formalize this idea using a simple sufficient-statistic representation that maps flows into price changes. We provide a brief summary here and refer to Appendix G for details. The equilibrium price impact of flows into the insurance sector can be written as:

$$\Delta p_t^B = \frac{1}{\zeta} \times \frac{F_{\text{Ins},t}}{w_{b,t}} \times \Psi_t, \tag{20}$$

where $\frac{F_{\text{Ins},t}}{w_{b,t}}$ denotes flows into insurance relative to household wealth, Ψ_t captures insurers' excess exposure to long-term bonds relative to other investors, and $\frac{1}{\zeta}$ is the price multiplier. This expression highlights that the effect of flows on equilibrium yields depends on three sufficient statistics: the magnitude of flows, the degree of market segmentation, and the elasticity of demand for long-term bonds.

We now quantify these objects. First, we measure flows into the insurance sector. Relative to a counterfactual in which households maintain their pre-QE allocation to insurance products, we estimate a cumulative shortfall of €1.7 trillion between 2015 and 2025. With total household wealth of approximately €30 trillion, this corresponds to a net reallocation of about -5.6% of wealth away from the insurance sector. These flows are economically large,

particularly relative to the stock of long-term bonds, which constitutes insurers' primary asset class. Second, we quantify differences in portfolio exposures across intermediaries. Insurance companies allocate about 31% of their assets to long-term bonds, compared with 16% for other investors (see Appendix Figure G.1) . This implies a market segmentation measure of $\Psi \approx 0.84$. As a result, when one euro flows out of the insurance sector and is reallocated to other intermediaries, approximately 15 cents are withdrawn from long-term bonds in equilibrium. This reflects a structural difference in maturity preferences across investor sectors. Third, we adopt a conservative estimate of the price multiplier, $\frac{1}{\zeta} \approx 1$, consistent with Chaudhary et al. (2024) and related studies. This value reflects the relatively low elasticity of demand for long-duration bonds, particularly at maturities where close substitutes are limited.

Combining these estimates yields:

$$\Delta p^B \approx 1 \times (-5.6\%) \times 0.84 \approx -4.7\%.$$

For a 10-year bond, this corresponds to an increase in yields of approximately 50 basis points. Across alternative calibrations—varying flows, segmentation, and elasticities—the implied effect ranges between 40 and 100 basis points (see Appendix Table G2).

The key insight is that reallocations of household savings across intermediaries have first-order effects on asset prices when intermediaries differ in their portfolio composition. In our setting, the contraction of the insurance sector reduces the presence of a key preferred-habitat investor in long-term bond markets. As a result, equilibrium demand for duration declines and yields increase. This framework provides a simple way to translate the observed decline in insurance flows into economically meaningful effects on the term premium.

7.2 Implications for Models of the Bond Market

Segmented-market models of the term structure, such as Vayanos and Vila (2021) and Jansen et al. (2024), treat investor habitats as fixed: each sector has a stable demand for a particular maturity segment, and equilibrium yields are determined by the interaction of these demands with arbitrageur capital. Our findings suggest that this assumption is a useful approximation at short horizons but becomes increasingly restrictive at longer ones: At short horizons, the relevant margin is portfolio rebalancing. Monetary policy and regulation shift intermediaries' portfolio weights w_t, and the resulting demand changes are well captured by models with fixed habitats. At longer horizons, however, the habitats themselves evolve. As household flows shift away from insurers toward mutual funds and banks, the sector that generates the strongest demand for long-duration bonds shrinks, while sectors with weaker duration

preferences expand. The aggregate demand curve for long-term bonds does not merely shift along existing habitats; the habitats themselves contract and expand.

This distinction has direct implications for the analysis of QE and QT. Standard models predict that QE compresses term premia by absorbing duration from preferred-habitat investors, and that QT reverses this effect symmetrically. Our results suggest an additional, slower-moving channel: QE depresses long-term rates, which in turn reduces household flows into insurance, gradually shrinking the preferred-habitat sector that generates demand for duration. QT can in principle reverse this process, but the adjustment is slow because insurance contracts are long-term, rigid, and costly to unwind. The implication is that the effects of QE on term premia are partially persistent, even after the central bank's balance sheet is normalized. Jiang and Sun (2024) study the implications of slow-moving capital across intermediaries but do not take into account that different sectors have different propensity to buy long-term bonds. In Appendix H, we sketch an extension of Vayanos and Vila (2021) that incorporates both features.

8. Conclusion

This paper shows that understanding bond demand requires going beyond portfolio rebalancing and accounting for slow-moving balance sheet adjustments. While existing work emphasizes how monetary policy and regulation affect portfolio weights, we show that their dominant effect operates through changes in assets under management. In the context of the European insurance sector, persistently low long-term interest rates and tighter regulation reduced the attractiveness of guaranteed products, leading to a sustained stagnation in household inflows and a reallocation toward unit-linked contracts. As a result, insurers' bond-relevant balance sheets failed to keep pace with the growing supply of government and corporate bonds, steadily eroding insurers' ownership share and their role as a marginal buyer in European bond markets.

Quantitatively, liability-driven flows account for the bulk of the variation in insurers' bond demand, and their decline implies a sizable upward pressure on long-term yields. These findings highlight a novel transmission channel of monetary policy: by reshaping the liability structure of intermediaries, QE alters aggregate asset demand in a persistent manner. Importantly, these effects unfold slowly due to the long-term and rigid nature of insurance contracts.

More broadly, our results suggest that models of asset pricing and policy transmission should incorporate the joint dynamics of portfolio allocation and balance sheet size. Policies such as QT may therefore have delayed and asymmetric effects, as rebuilding intermediary

balance sheets takes time.

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A. Data

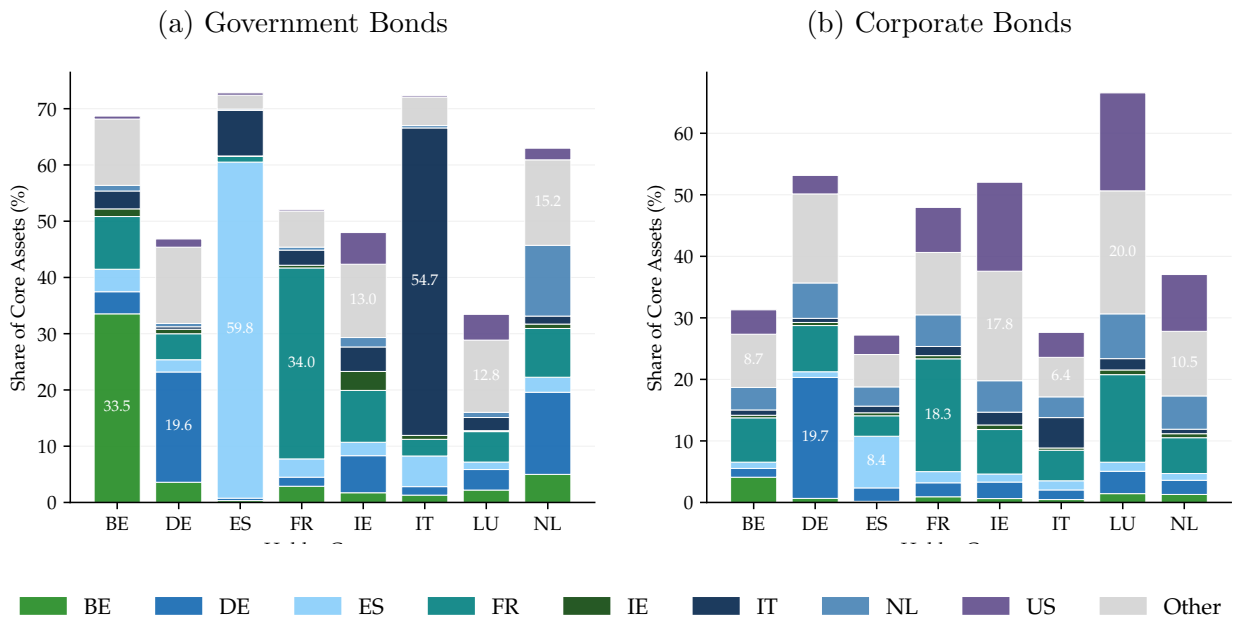
A.1 Government and Corporate Bond Holdings

Figure A.1a illustrates the distribution of insurers' government bond holdings across countries. The x-axis shows the country of the holder, while the y-axis refers to the country of issuance. Each cell reports the share of core assets (government bonds, corporate bonds, and CIUs) invested in a given issuer by insurers from a given country.

The figure highlights a clear domestic concentration. French insurers hold about 34% of their core assets in French government bonds, with additional exposures to Belgium, Italy, and Spain. German insurers allocate around 20% to German government bonds, while also investing in Austria and the Netherlands. Italian insurers show the highest domestic concentration, with more than 54% of their portfolios in Italian government debt. Spanish insurers display a similar pattern, with nearly 60% invested in Spanish government bonds. Overall, the figure documents strong home bias across the four largest markets.

Figure A.1b shows insurers' corporate bond holdings. Domestic concentration is less pronounced than for sovereign debt. French insurers invest about 18% in French corporate bonds, with additional exposures to Germany, Belgium, and Luxembourg. German insurers allocate around 20% to German issuers, while Italian and Spanish insurers hold only 5% and 8% in domestic corporate bonds, respectively, with substantial cross-border positions in France, Germany, and the U.S.

Figure A.1: Holdings by Issuer Country



Note: The figure shows t

A.2 CIUs

Table A1 reports the distribution of insurers' CIU investments across fund categories and insurer types as of 2021Q3. The table distinguishes between Composite, Life (unit-linked and non-unit-linked), Non-Life, and Reinsurance portfolios, and presents the share of total CIU assets allocated to each fund type. This breakdown provides a clear view of how different business models shape investment strategies.

Debt Funds emerge as the dominant allocation across most insurer types. Their importance is particularly striking for Life Non UL portfolios, where more than half of all investment funds assets are invested in Debt Funds, underlining the conservative nature of traditional life insurance business. Non-Life and Reinsurance portfolios also allocate substantial shares to Debt Funds, at 44% and 40% respectively, reflecting the preference for stable and predictable returns.

By contrast, Equity Funds play a less prominent role overall, but they are central in unit-linked business. For both Composite UL and Life UL portfolios, Equity Funds account for roughly 40% of CIU assets. This highlights the higher risk and return orientation of UL products compared to non-unit-linked business, where allocations to equities remain modest.

Table A1: CIU Subcategory Shares by Insurer Type

SubCategory	Composite		Life		Non-Life	Reinsurance
	Non UL	UL	Non UL	UL		
Debt Funds	27.3	17.8	51.1	21.6	44.1	39.7
Equity Funds	16.3	41.5	12.6	40.1	11.5	20.3
Other	4.5	8.8	10.3	6.0	15.0	12.8
Real Estate Funds	13.7	5.5	9.1	2.7	10.6	5.1
Money Market Funds	15.0	2.9	6.5	2.8	5.1	3.7
Asset Allocation Funds	11.8	22.6	4.4	23.6	8.4	10.6
Private Equity Funds	5.0	0.1	2.9	0.6	2.5	4.1
Infrastructure Funds	4.1	0.0	1.9	0.1	1.6	1.6
Alternative Funds	2.4	0.8	1.2	2.6	1.3	2.2

B. The Correlation Between Long-term Rates and Spreads

In section 4.2, we emphasized that understanding the correlation between interest rates and spreads is crucial for interpreting the relationship between rates and insurers' equity. Historically, in many credit markets—such as U.S. corporate bonds—interest rates and credit spreads have been negatively correlated: higher rates typically coincided with stronger growth and lower credit risk. This negative correlation acted as a natural hedge, dampening the impact of rate increases on insurers' and banks' equity values (De Marzo et al., 2024).

In the euro area, sovereign spreads and interest rates also used to move inversely. However, the ECB's unconventional monetary policies reshaped these dynamics (Haddad et al., 2024). Quantitative Easing simultaneously reduced long-term rates and compressed sovereign spreads, while Quantitative Tightening raised both, thereby generating a positive correlation.[15] Figure B.1a shows that the correlation between long-term OIS rates (50-year) and sovereign spreads (10-year) flipped from about -0.6 before QE to $+0.6$ after its launch. The correlation subsequently declined toward zero but surged again to around $+0.6$ when the ECB began tightening.

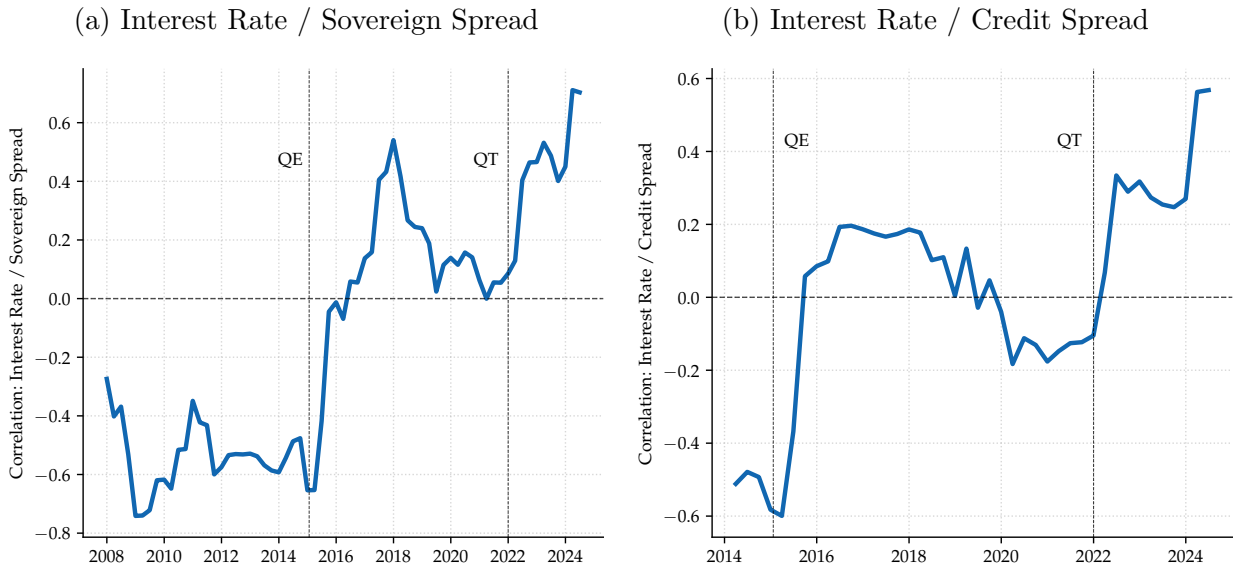
A similar, though less pronounced, pattern is evident for corporate credit spreads. Figure B.1b shows that correlations rose in 2016, declined thereafter, and then spiked again in 2022 with the onset of rate hikes and QT.

This shift matters directly for insurers' solvency. In 2023, insurers were net sellers

[15] See Krishnamurthy et al. (2018).

of bonds precisely when both rates and spreads were rising, compounding balance-sheet pressures. The events of 2022 highlighted these vulnerabilities starkly: the ECB's policy normalization—raising short-term rates and ending QE—triggered a wave of surrenders as policyholders sought higher-yielding products, while sovereign spreads widened sharply. Eurovita, an Italian life insurer, failed after rising rates depressed the value of its sovereign bond portfolio just as mass surrenders forced asset sales.[16]

Figure B.1: Correlation between Interest Rates and Spreads



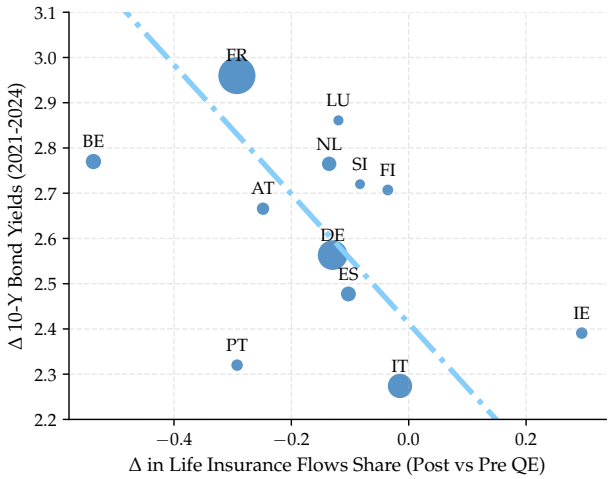
Note: Rolling 5-year correlations between long-term interest rates (OIS) and spreads. Panel (a): sovereign spreads (Italy/Spain vs. Bunds). Panel (b): corporate bond spreads.

C. The Effects of Insurance Flows on Government Bond Yield

The start of quantitative tightening (QT) and the tightening of monetary policy led to a sharp rise in long-term bond yields. In June 2022, the ECB announced the end of its QE program. By July, however, it was forced to intervene again through the Transmission Protection Instrument (TPI) as bond yields rose rapidly. Figure K.14 plots the rise in 10-year bond yields for different countries from 2021 to 2024. We also plot the shares of flows going to insurers in the period 2015-2021 compared to 2001-2014. The figure shows a negative pattern: countries that saw larger reduction in their flows into insurance sector were also

[16] According to Fitch, Eurovita "ran into trouble when rising interest rates reduced the value of its government bond holdings and prompted customers to redeem their savings contracts to reinvest into higher-yielding products."

Figure C.1: QT Effects



Note: Figure K.14 relates changes in household flows and bond yields across countries: the x-axis reports the change in household flows into life insurance—pre-QE versus post-QE—as a share of total household financial flows, while the y-axis shows the change in 10-year government bond yields between the end of 2021, when the ECB began communicating about quantitative tightening (QT), and 2024.

those with larger increase in yields. In Appendix C we show that using data from 2000 to 2025, countries that experience higher inflows into the insurance sectors, they see a relative reduction in bond yields.

We study the effects of flows into insurance companies on country government bond yields. Country exhibit home bias in government bond holdings and hence inflows into insurance companies should reduce the government bond yields. We run the regression

$$\Delta y_{i,t} = \gamma_i + \gamma_t + \beta \Delta \frac{Flows_{i,t}}{Asset_{i,t-1}} + \varepsilon_{i,t} \tag{21}$$

where $\Delta Flows_{i,t}$ is the change in flow into insurance scaled by the total assets. The standard deviation of the scaled flow measure is 1.5%. The standard deviation of the $\Delta y_{i,t}$ is 1.3%. implies that a one standard deviation increase in flows reduce the bond yields by approximately 25 basis points. The effects are robust when we include time and country fixed effects. The time fixed effect is particulary useful as it controls for aggregate variation that in fact is important in driving the results. However, even if we control for the time fixed effects the results remain statistically significant.

Table C1: Effects on Bond Yields

Panel A: *Dependent Variable: Δ 10-Year Government Bond Yield*						
	Sample: 2000-2025			Sample: 2009-2025		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Insurance Flows	-0.244***	-0.249***	-0.104**	-0.293***	-0.294***	-0.127*
	(0.072)	(0.073)	(0.051)	(0.096)	(0.098)	(0.068)
Observations	1,258	1,258	1,258	854	854	854
R-squared	0.046	0.046	0.419	0.050	0.050	0.391
Entity FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes

Panel B: *Dependent Variable: 10-Year Government Bond Yield*				
	Sample: 2000-2025		Sample: 2009-2025	
	(1)	(2)	(3)	(4)
Insurance Flows (Level)	-0.211*	-0.242**	-0.338**	-0.252*
	(0.122)	(0.113)	(0.170)	(0.137)
Observations	1,314	1,314	910	910
R-squared	0.497	0.677	0.434	0.710
Entity FE	No	Yes	No	Yes
Time FE	Yes	Yes	Yes	Yes

D. Model Appendix

D.1 First-Order Conditions

Optimal PP Fee

Differentiating (14) with respect to f_t^{PP}:

$$\frac{\partial J_t}{\partial f_t^{PP}} = \underbrace{Q_t^{PP} + (f_t^{PP} - V_{t,t})\frac{\partial Q_t^{PP}}{\partial f_t^{PP}} + f_t^{UL}\frac{\partial Q_t^{UL}}{\partial f_t^{PP}}}_{\text{direct profit}} + c_t\frac{\partial K_t}{\partial f_t^{PP}} \tag{22}$$

where the effect on statutory capital is:

$$\frac{\partial K_t}{\partial f_t^{PP}} = Q_t^{PP} + \left(f_t^{PP} - (1+\phi_1)V_{t,t} - \phi_2\alpha_t\right)\frac{\partial Q_t^{PP}}{\partial f_t^{PP}} + f_t^{UL}\frac{\partial Q_t^{UL}}{\partial f_t^{PP}} \tag{23}$$

The capital channel has the same structure as the direct profit channel, with two differences. First, the guarantee cost is inflated from $V_{t,t}$ to $(1+\phi_1)V_{t,t}$, reflecting the regulatory capital charge on MRG liabilities. Second, each additional PP customer absorbs spread risk capital $\phi_2\alpha_t$. Importantly, the cross-demand term $f_t^{UL}\,\partial Q_t^{UL}/\partial f_t^{PP}$ appears in both channels: raising f_t^{PP} diverts some customers toward UL, generating fee income f_t^{UL} per diverted customer with no associated guarantee cost.

Re-arranging and setting the first-order condition $\partial J_t/\partial f_t^{PP} = 0$, it becomes:

$$Q_t^{PP} + f_t^{UL}\frac{\partial Q_t^{UL}}{\partial f_t^{PP}} = \underbrace{(\Pi_t)}_{\text{per-customer surplus}}\left(-\frac{\partial Q_t^{PP}}{\partial f_t^{PP}}\right) \tag{24}$$

where the **per-customer surplus** Π_t is:

$$\Pi_t = f_t^{PP} - \lambda_t V_{t,t} - \frac{c_t}{1+c_t}\phi_2\alpha_t$$

The left-hand side is the marginal benefit of raising the price. Firstly, you get the extra fee on the new PP participants. Second, by raising the price, you partly rebalance households to unit-linked business for you which you make a profit. The right-hand side is the marginal cost of raising the price. The first bracket is the profits per unit PP - the fee net of the regulation-adjusted cost of the guarantee and the regulatory cost of the risky share. The second bracket is the lost demand for PP.

The shadow cost of capital λ_t captures the key mechanism through which regulation affects the insurer's pricing. When regulatory capital requirements tighten (ϕ_1 increases)

or the insurer is poorly capitalised (c_t is high), λ_t rises, making guarantees more expensive relative to their actuarial value. This is the direct analogue of the shadow cost of capital in Koijen and Yogo (2022, equation 14).

Finally, re-arranging to derive the optimal price in line with Koijen and Yogo (2022), we have that:

$$f_t^{PP} = \underbrace{\frac{1}{\epsilon_{PP}^{f^P}}}_{\text{mark-up}} + \underbrace{\left(\lambda_t V_{t,t} + \frac{\phi_2 \alpha_t c_t}{1+c_t}\right)}_{\text{marginal cost}} + \underbrace{f_t^{UL} \frac{\epsilon_{UL}^{f^P}}{\epsilon_{PP}^{f^P}} \frac{Q_t^{UL}}{Q_t^{PP}}}_{\text{cross-demand effect}} \tag{25}$$

where the **shadow cost of capital** is:

$$\lambda_t = \frac{1 + c_t(1+\phi_1)}{1+c_t} > 1 \tag{26}$$

and $\epsilon_{PP}^{f^P} = -\partial log(Q^{PP})/\partial f^{PP}$ and $\epsilon_{UL}^{f^P} = -\partial log(Q^{UL})/\partial f^{PP}$.

Optimal UL Fee

Differentiating (14) with respect to f_t^{UL}:

$$\frac{\partial J_t}{\partial f_t^{UL}} = \underbrace{Q_t^{UL} + (f_t^{PP} - V_{t,t}) \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} + f_t^{UL} \frac{\partial Q_t^{UL}}{\partial f_t^{UL}}}_{\text{direct profit}} + c_t \frac{\partial K_t}{\partial f_t^{UL}} \tag{27}$$

where the effect on statutory capital is:

$$\frac{\partial K_t}{\partial f_t^{UL}} = \left(f_t^{PP} - (1+\phi_1)V_{t,t} - \phi_2 \alpha_t\right) \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} + Q_t^{UL} + f_t^{UL} \frac{\partial Q_t^{UL}}{\partial f_t^{UL}} \tag{28}$$

Collecting terms and setting $\partial J_t / \partial f_t^{UL} = 0$, dividing through by $(1 + c_t)$:

$$Q_t^{UL} + f_t^{UL} \frac{\partial Q_t^{UL}}{\partial f_t^{UL}} = -\Pi_t \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} \tag{29}$$

Re-arranging using $\varepsilon_{UL}^{f^{UL}} \equiv -\partial \log Q_t^{UL} / \partial f_t^{UL} > 0$ and $\varepsilon_{PP}^{f^{UL}} \equiv -\partial \log Q_t^{PP} / \partial f_t^{UL} < 0$:

$$f_t^{UL} = \frac{1}{\varepsilon_{UL}^{f^{UL}}} + \Pi_t \frac{\varepsilon_{PP}^{f^{UL}}}{\varepsilon_{UL}^{f^{UL}}} \frac{Q_t^{PP}}{Q_t^{UL}} \tag{30}$$

The first term is the standard inverse-elasticity markup. The second term is the cross-demand correction: since $\varepsilon_{PP}^{f^{UL}} < 0$, raising f_t^{UL} diverts customers toward PP, compressing the UL markup. Unlike the PP pricing equation, there is no $\lambda_t V_{t,t}$ term: UL carries no guarantee cost and no capital charge.

Optimal Risky Asset Share

Differentiating (14) with respect to α_t, and noting that demand depends only on fees and interest rates but not directly on α_t:

$$\frac{\partial J_t}{\partial \alpha_t} = \underbrace{-\frac{\partial V_{t,t}}{\partial \alpha_t} Q_t^{PP}}_{\text{direct profit}} + c_t \frac{\partial K_t}{\partial \alpha_t} \tag{31}$$

where the effect on statutory capital is:

$$\frac{\partial K_t}{\partial \alpha_t} = -(1+\phi_1)\frac{\partial V_{t,t}}{\partial \alpha_t} Q_t^{PP} - \phi_2 Q_t^{PP} \tag{32}$$

Collecting terms and dividing through by $(1 + c_t)$, the first-order condition $\partial J_t / \partial \alpha_t = 0$ becomes:

$$\lambda_t \frac{\partial V_{t,t}}{\partial \alpha_t} + \frac{c_t}{1+c_t}\phi_2 = 0 \tag{33}$$

where λ_t is defined as in (26). The insurer increases α_t until the marginal benefit of reducing net liabilities—through a more valuable participation component that dominates the worsening MRG cost, so that $\partial V_{t,t}/\partial \alpha_t < 0$—is exactly offset by the spread risk capital charge ϕ_2. In the absence of regulation ($\phi_2 = 0$), the insurer sets α_t such that $\partial V_{t,t}/\partial \alpha_t = 0$: the point where the participation benefit and the MRG cost exactly cancel. A tighter spread risk requirement (higher ϕ_2) or a more capital-constrained insurer (higher c_t, and therefore higher λ_t) pushes the optimal α_t downward.

D.2 Setup of Comparative Statics

It is important to firstly state the three first-order conditions defining the equilibrium values of $(f_t^{PP}, f_t^{UL}, \alpha_t)$:

$$F_t \equiv Q_t^{PP} + \Pi_t \frac{\partial Q_t^{PP}}{\partial f_t^{PP}} + f_t^{UL} \frac{\partial Q_t^{UL}}{\partial f_t^{PP}} = 0 \tag{34}$$

$$G_t \equiv Q_t^{UL} + \Pi_t \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} + f_t^{UL} \frac{\partial Q_t^{UL}}{\partial f_t^{UL}} = 0 \tag{35}$$

$$H_t \equiv \lambda_t \frac{\partial V_{t,t}}{\partial \alpha_t} + \frac{c_t}{1+c_t}\phi_2 = 0 \tag{36}$$

where $\Pi_t = f_t^{PP} - \lambda_t V_{t,t} - \frac{c_t}{1+c_t}\phi_2 \alpha_t$ is the per-customer surplus. Ideally, in order to do comparative statics for changes to $x_t \in \{y_t, \phi_1, \phi_2\}$, we would totally differentiate each of the three equations, obtaining a system of 3 equations and 3 unknowns of $(\frac{df_t^{PP}}{dx_t}, \frac{df_t^{UL}}{dx_t}, \frac{d\alpha_t}{dx_t})$. However, this becomes far too cumbersome, regardless of the assumptions that we make. As a result, we split up the problem. First, we assess the effects on fees, holding the portfolio share fixed, and vice versa.

D.2.1 Partial Equilibrium Effects on Fees

When assessing the equilibrium effects on fees, we totally differentiate (34) and (35) holding the portfolio share α_t constant. This yields a 2×2 linear system in $(df_t^{PP}/dx_t,\ df_t^{UL}/dx_t)$:

$$\underbrace{\begin{pmatrix} F_{f^{PP}} & F_{f^{UL}} \\ G_{f^{PP}} & G_{f^{UL}} \end{pmatrix}}_{\mathbf{J}} \begin{pmatrix} df_t^{PP}/dx_t \\ df_t^{UL}/dx_t \end{pmatrix} = - \begin{pmatrix} F_x \\ G_x \end{pmatrix} \tag{37}$$

where the left-hand side terms are:

$$F_{f^{PP}} = \left(1 + \frac{\partial \Pi_t}{\partial f_t^{PP}}\right) \frac{\partial Q_t^{PP}}{\partial f_t^{PP}} + \Pi_t \frac{\partial^2 Q_t^{PP}}{\partial (f_t^{PP})^2} + f_t^{UL} \frac{\partial^2 Q_t^{UL}}{\partial (f_t^{PP})^2} < 0 \tag{38}$$

$$F_{f^{UL}} = \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} + \frac{\partial \Pi_t}{\partial f_t^{UL}} \frac{\partial Q_t^{PP}}{\partial f_t^{PP}} + \Pi_t \frac{\partial^2 Q_t^{PP}}{\partial f_t^{PP} \partial f_t^{UL}} + \frac{\partial Q_t^{UL}}{\partial f_t^{PP}} + f_t^{UL} \frac{\partial^2 Q_t^{UL}}{\partial f_t^{PP} \partial f_t^{UL}} \tag{39}$$

$$G_{f^{PP}} = \frac{\partial Q_t^{UL}}{\partial f_t^{PP}} + \frac{\partial \Pi_t}{\partial f_t^{PP}} \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} + \Pi_t \frac{\partial^2 Q_t^{PP}}{\partial f_t^{UL} \partial f_t^{PP}} + f_t^{UL} \frac{\partial^2 Q_t^{UL}}{\partial f_t^{UL} \partial f_t^{PP}} \tag{40}$$

$$G_{f^{UL}} = 2\frac{\partial Q_t^{UL}}{\partial f_t^{UL}} + \frac{\partial \Pi_t}{\partial f_t^{UL}} \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} + \Pi_t \frac{\partial^2 Q_t^{PP}}{\partial (f_t^{UL})^2} + f_t^{UL} \frac{\partial^2 Q_t^{UL}}{\partial (f_t^{UL})^2} < 0 \tag{41}$$

where the partial derivatives of the per-customer surplus with respect to the fees are:

$$\frac{\partial \Pi_t}{\partial f_t^{PP}} = 1 - \frac{C''(K_t)(\phi_1 V_{t,t} + \phi_2 \alpha_t)^2}{(1+c_t)^3} \frac{\partial Q_t^{PP}}{\partial f_t^{PP}} > 1 \tag{42}$$

$$\frac{\partial \Pi_t}{\partial f_t^{UL}} = -\frac{C''(K_t)(\phi_1 V_{t,t} + \phi_2 \alpha_t)^2}{(1+c_t)^3} \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} < 0 \tag{43}$$

The term $C''(K_t)(\phi_1 V_{t,t} + \phi_2 \alpha_t)^2/(1+c_t)^3$ is common to both expressions and captures the regulatory capital feedback: it is proportional to the convexity of the cost function and the squared regulatory wedge $(\phi_1 V_{t,t} + \phi_2 \alpha_t)^2$. When regulation is absent ($\phi_1 = \phi_2 = 0$), this term vanishes, $\partial \Pi_t / \partial f_t^{PP} = 1$, and $\partial \Pi_t / \partial f_t^{UL} = 0$: the per-customer surplus moves one-for-one with the PP fee and is independent of the UL fee, as one would expect without capital constraints.

The diagonal elements $F_{f^{PP}}$ and $G_{f^{UL}}$ are negative by own-price effects and second-order conditions. The off-diagonal elements $F_{f^{UL}}$ and $G_{f^{PP}}$ capture cross-price effects and are in general unsigned without further restrictions on demand.

The right-hand side terms of (43) are:

$$F_x = \frac{\partial Q_t^{PP}}{\partial x_t} + \frac{\partial \Pi_t}{\partial x_t} \frac{\partial Q_t^{PP}}{\partial f_t^{PP}} + \Pi_t \frac{\partial^2 Q_t^{PP}}{\partial f_t^{PP} \partial x_t} + f_t^{UL} \frac{\partial^2 Q_t^{UL}}{\partial f_t^{PP} \partial x_t} \tag{44}$$

$$G_x = \frac{\partial Q_t^{UL}}{\partial x_t} + \frac{\partial \Pi_t}{\partial x_t} \frac{\partial Q_t^{PP}}{\partial f_t^{UL}} + \Pi_t \frac{\partial^2 Q_t^{PP}}{\partial f_t^{UL} \partial x_t} + f_t^{UL} \frac{\partial^2 Q_t^{UL}}{\partial f_t^{UL} \partial x_t} \tag{45}$$

where we simply use $\frac{\partial \Pi_t}{\partial x_t}$ and not a total derivative because we are holding fees and the portfolio share fixed here.

By Cramer's rule, with $\Delta \equiv F_{f^{PP}} G_{f^{UL}} - F_{f^{UL}} G_{f^{PP}} > 0$:

$$\frac{df_t^{PP}}{dx_t} = \frac{-F_x G_{f^{UL}} + G_x F_{f^{UL}}}{\Delta} \tag{46}$$

$$\frac{df_t^{UL}}{dx_t} = \frac{-G_x F_{f^{PP}} + F_x G_{f^{PP}}}{\Delta} \tag{47}$$

D.2.2 Partial Equilibrium Effects on Portfolio Share

This part is more straightforward: we simply differentiate (36) w.r.t. x_t to get the following expression:

$$\frac{\partial \lambda_t}{\partial x_t} \frac{\partial V_{t,t}}{\partial \alpha_t} + \frac{\partial \lambda_t}{\partial c_t} \frac{\partial c_t}{\partial x_t} \frac{\partial V_{t,t}}{\partial \alpha_t} + \lambda_t \frac{\partial^2 V_{t,t}}{\partial \alpha_t \partial x_t} + \lambda_t \frac{\partial^2 V_{t,t}}{\partial \alpha_t^2} \frac{\partial \alpha_t}{\partial x_t} + \frac{\partial}{\partial x_t} \left(\frac{c_t}{1+c_t} \phi_2 \right) = 0 \tag{48}$$

where $\partial c_t/\partial x_t = -C''(K_t)\,\partial K_t/\partial y_t$. Since $C''(K_t) > 0$. Solving for $d\alpha_t/dy_t$:

$$\frac{\partial \alpha_t}{\partial x_t} = \frac{-\frac{\partial \lambda_t}{\partial x_t}\frac{\partial V_{t,t}}{\partial \alpha_t} - \frac{\partial \lambda_t}{\partial c_t}\frac{\partial c_t}{\partial x_t}\frac{\partial V_{t,t}}{\partial \alpha_t} - \lambda_t \frac{\partial^2 V_{t,t}}{\partial \alpha_t \partial x_t} - \frac{\partial}{\partial x_t}\left(\frac{c_t}{1+c_t}\phi_2\right)}{\lambda_t \frac{\partial^2 V_{t,t}}{\partial \alpha_t^2}} \tag{49}$$

The denominator is positive by the second-order condition for a maximum ($\partial^2 V_{t,t}/\partial \alpha_t^2 > 0$). As a result, the directional effect of α depends on the sign of the numerator.

D.3 Functional Form Assumption: Demand

To make the comparative statics concrete and to prepare for calibration, we impose a functional form assumption on household demand. This assumption delivers constant semi-elasticities throughout, allowing us to express the Jacobian and Cramer's rule expressions entirely in terms of a small number of structural parameters.

D.3.1 Demand Structure

We specify household demand using a multinomial logit. For each alternative $x \in \{PP, UL, D\}$, the deterministic indirect utility is:

$$v_t^x = \beta_x^y y_t - \beta_x^f f_t^x + \beta_x^{cross} f_t^{-x} \tag{50}$$

where f_t^{-x} denotes the fee on the competing insurance product and $v_t^D = 0$ normalises deposits as the outside option. The demand (or portfolio) share for each alternative is:

$$Q_t^x = \frac{\exp(v_t^x)}{\sum_{x'} \exp(v_t^{x'})} \tag{51}$$

so that $\sum_x Q_t^x = 1$ by construction.

Under the maintained assumption that insurance market shares are small—consistent with PP and UL each representing a modest fraction of total household savings—we apply the small-share approximation $Q_t^{PP}, Q_t^{UL} \approx 0$. This delivers constant semi-elasticities equal to the utility parameters, $\varepsilon_x^z \approx \beta_x^z$, for all own-price, cross-price, and long-rate semi-elasticities. The own-price semi-elasticities are positive ($\varepsilon_{PP}^{f^{PP}}, \varepsilon_{UL}^{f^{UL}} > 0$) and the cross-price semi-elasticities are positive ($\varepsilon_{PP}^{f^{UL}}, \varepsilon_{UL}^{f^{PP}} > 0$), reflecting substitutability between PP and UL. The long-rate semi-elasticity satisfies $\varepsilon_{PP}^{y} > 0$, capturing the demand channel through $g_t = \phi \cdot y_t$, while the level of ε_{UL}^{y} is set to zero.

Crucially, under constant semi-elasticities all second derivatives of demand reduce to products of first derivatives and semi-elasticities — no new objects appear. This means the

Jacobian **J** and all right-hand side vectors in the comparative statics are expressible entirely in terms of the semi-elasticities, the quantities Q_t^{PP} and Q_t^{UL}, the per-customer surplus Π_t, and f_t^{UL}. The sign conditions in the propositions therefore reduce to explicit parametric inequalities that can be verified at calibrated values.

D.3.2 Implications

Under the functional form assumptions over demand, the equilibrium conditions for the fees take the following explicit forms. Substituting logit demand

$$F_t \equiv Q_t^{PP}\left(1 - \Pi_t \varepsilon_{PP}^{f^{PP}}\right) + f_t^{UL}\varepsilon_{UL}^{f^{PP}} Q_t^{UL} = 0 \tag{52}$$

$$G_t \equiv Q_t^{UL}\left(1 - f_t^{UL}\varepsilon_{UL}^{f^{UL}}\right) + \Pi_t \varepsilon_{PP}^{f^{UL}} Q_t^{PP} = 0 \tag{53}$$

Turning to the Jacobians: defining the regulatory feedback term:

$$\Gamma_t \equiv \frac{C''(K_t)(\phi_1 V_{t,t} + \phi_2 \alpha_t)^2}{(1+c_t)^3} > 0 \tag{54}$$

the derivatives of the per-customer surplus become:

$$\frac{\partial \Pi_t}{\partial f_t^{PP}} = 1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP} > 1 \tag{55}$$

$$\frac{\partial \Pi_t}{\partial f_t^{UL}} = -\Gamma_t \varepsilon_{PP}^{f^{UL}} Q_t^{PP} < 0 \tag{56}$$

Substituting into the four Jacobian elements:

$$F_{f^{PP}} = -\left(2 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}\right)\varepsilon_{PP}^{f^{PP}} Q_t^{PP} + \Pi_t (\varepsilon_{PP}^{f^{PP}})^2 Q_t^{PP} + f_t^{UL}(\varepsilon_{UL}^{f^{PP}})^2 Q_t^{UL} \tag{57}$$

$$F_{f^{UL}} = \varepsilon_{PP}^{f^{UL}} Q_t^{PP} + \Gamma_t \varepsilon_{PP}^{f^{UL}} \varepsilon_{PP}^{f^{PP}} (Q_t^{PP})^2 - \Pi_t \varepsilon_{PP}^{f^{PP}} \varepsilon_{PP}^{f^{UL}} Q_t^{PP} + \varepsilon_{UL}^{f^{PP}} Q_t^{UL} - f_t^{UL} \varepsilon_{UL}^{f^{PP}} \varepsilon_{UL}^{f^{UL}} Q_t^{UL} \tag{58}$$

$$G_{f^{PP}} = \varepsilon_{UL}^{f^{PP}} Q_t^{UL} + \left(1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}\right)\varepsilon_{PP}^{f^{UL}} Q_t^{PP} - \Pi_t \varepsilon_{PP}^{f^{UL}} \varepsilon_{PP}^{f^{PP}} Q_t^{PP} - f_t^{UL} \varepsilon_{UL}^{f^{PP}} \varepsilon_{UL}^{f^{UL}} Q_t^{UL} \tag{59}$$

$$G_{f^{UL}} = -2\varepsilon_{UL}^{f^{UL}} Q_t^{UL} - \Gamma_t (\varepsilon_{PP}^{f^{UL}})^2 (Q_t^{PP})^2 + \Pi_t (\varepsilon_{PP}^{f^{UL}})^2 Q_t^{PP} + f_t^{UL}(\varepsilon_{UL}^{f^{UL}})^2 Q_t^{UL} \tag{60}$$

Exploiting the equilibrium conditions $F_t = 0$ and $G_t = 0$ to substitute out Π_t, the

Jacobian elements simplify to:

$$F_{f^{PP}} = -\varepsilon_{PP}^{f^{PP}} Q_t^{PP} \left(1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}\right) + f_t^{UL} \varepsilon_{UL}^{f^{PP}} Q_t^{UL} \left(\varepsilon_{PP}^{f^{PP}} + \varepsilon_{UL}^{f^{PP}}\right) \tag{61}$$

$$F_{f^{UL}} = \Gamma_t \varepsilon_{PP}^{f^{UL}} \varepsilon_{PP}^{f^{PP}} (Q_t^{PP})^2 + \varepsilon_{UL}^{f^{PP}} Q_t^{UL} \left(1 - f_t^{UL} (\varepsilon_{PP}^{f^{UL}} + \varepsilon_{UL}^{f^{UL}})\right) \tag{62}$$

$$G_{f^{PP}} = \varepsilon_{PP}^{f^{UL}} Q_t^{PP} \left(1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}\right) + Q_t^{UL} \left(\varepsilon_{UL}^{f^{PP}} + \varepsilon_{PP}^{f^{PP}} - f_t^{UL} \varepsilon_{UL}^{f^{UL}} \left(\varepsilon_{PP}^{f^{PP}} + \varepsilon_{UL}^{f^{PP}}\right)\right) \tag{63}$$

$$G_{f^{UL}} = Q_t^{UL} \left(-2\varepsilon_{UL}^{f^{UL}} - \varepsilon_{PP}^{f^{UL}} + f_t^{UL} \varepsilon_{UL}^{f^{UL}} \left(\varepsilon_{PP}^{f^{UL}} + \varepsilon_{UL}^{f^{UL}}\right)\right) - \Gamma_t (\varepsilon_{PP}^{f^{UL}})^2 (Q_t^{PP})^2 \tag{64}$$

All four elements are now expressed entirely in terms of semi-elasticities, quantities Q_t^{PP} and Q_t^{UL}, the UL fee f_t^{UL}, and the regulatory feedback term Γ_t - the per-customer surplus Π_t does not appear.

Finally, for F_x and G_x, by substituting constant semi-elasticities and exploiting $F_t = G_t = 0$, these simplify to:

$$F_x = -\frac{\partial \Pi_t}{\partial x_t} \varepsilon_{PP}^{f^{PP}} Q_t^{PP} + f_t^{UL} \varepsilon_{UL}^{f^{PP}} Q_t^{UL} \left(\varepsilon_x^{UL} - \varepsilon_x^{PP}\right) \tag{65}$$

$$G_x = \frac{\partial \Pi_t}{\partial x_t} \varepsilon_{PP}^{f^{UL}} Q_t^{PP} + Q_t^{UL} \left(1 - f_t^{UL} \varepsilon_{UL}^{f^{UL}}\right) \left(\varepsilon_x^{UL} - \varepsilon_x^{PP}\right) \tag{66}$$

D.4 Proofs of Propositions

For Propositions 1 and 2, I am going to make a simplifying assumption: the cross-partial derivatives of demand are zero. In other words:

Assumption 1: $\varepsilon_{PP}^{f^{UL}} = \varepsilon_{UL}^{f^{PP}} = 0$

This eliminates the feedback effects through the demand of the other product. When these are strong enough, it can cause the effects to flip signs.

D.4.1 Proposition 1: Effect of Long-Term Rates on Portfolio Weights and Inflows

Under Assumption 1, and applying Cramer's rule:

$$\frac{df_t^{PP}}{dy_t} = \frac{-\partial \Pi_t / \partial y_t}{1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}} < 0 \tag{67}$$

$$\frac{df_t^{UL}}{dy_t} = 0 \tag{68}$$

The UL fee is unaffected by y_t: with no cross-demand effects and the UL markup pinned by the inverse elasticity condition, there is no channel through which y_t disturbs the UL equilibrium.

The sign of $\partial f_t^{PP}/\partial y_t$ depends on the sign of $\partial \Pi_t/\partial y_t$, which we now investigate. Differentiating $\Pi_t = f_t^{PP} - \lambda_t V_{t,t} - \frac{c_t}{1+c_t}\phi_2 \alpha_t$ with respect to y_t, holding fees and portfolio shares fixed:

$$\frac{\partial \Pi_t}{\partial y_t} = -\lambda_t \frac{\partial V_{t,t}}{\partial y_t} + C''(K_t)\frac{\partial K_t}{\partial y_t} \cdot \frac{\phi_1 V_{t,t} + \phi_2 \alpha_t}{(1+c_t)^2} \tag{69}$$

The first term is positive. This captures the idea that, by lowering the value of the guarantee, it improves statutory capital by $\lambda_t > 1$. The second term is unambiguously positive because the effect on capital is positive - regulatory capital increases by lowering the value of the MRG and boosting demand for PP products, pushing down the marginal cost of capital.

For the risky asset share, from equation (49) and rearranging:

$$\frac{\partial \alpha_t}{\partial y_t} = \frac{\frac{\phi_2 C''(K_t)}{\lambda_t (1+c_t)^2}\frac{\partial K_t}{\partial y_t} - \lambda_t \frac{\partial^2 V_{t,t}}{\partial \alpha_t \partial y_t}}{\lambda_t \frac{\partial^2 V_{t,t}}{\partial \alpha_t^2}} > 0 \tag{70}$$

The denominator is positive by the second-order condition. As a result, the sign depends on the numerator. The second term is positive because $\partial^2 V_{t,t}/\partial \alpha_t \partial y_t < 0$. Intuitively, when y_t increases, it moves the MRG more out of the money, meaning that a marginal change in risky shares has less of an effect on its option value. The first term depends on the sign of $\partial K_t/\partial y_t$, which we know is positive, making the first term negative. Intuitively, a higher y_t increases capital stock in equilibrium, making it less costly to use up regulatory capital by loading more on risky assets.

Finally, combining the effects of the interest rate on fees, then the total derivative of quantities sold, given a certain portfolio share α_t:

$$\frac{dQ_t^{PP}}{dy_t}\Big|_{\Delta \alpha_t = 0} = \underbrace{\varepsilon_{PP}^{y} Q_t^{PP}}_{\text{direct channel}} + \underbrace{\frac{\partial \Pi_t/\partial y_t \cdot \varepsilon_{PP}^{f^{PP}} Q_t^{PP}}{1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}}}_{\text{indirect channel}} > 0 \tag{71}$$

In this case, both channels are unambiguously positive and reinforce each other. The direct channel operates through the mechanical rise in $g_t = \phi \cdot y_t$, making PP more attractive to households. The indirect channel operates through the fall in $\lambda_t V_{t,t}$, reducing the regulation-inflated cost of the guarantee and lowering the optimal PP fee. The supply chan-

nel is amplified by regulation: when $\phi_1 = \phi_2 = 0$, $\lambda_t = 1$ and capital is unaffected by y_t, so the capital relaxation component of $d\Pi_t/dy_t$ disappears.

$$\frac{dQ_t^{UL}}{dy_t}\Big|_{\Delta\alpha_t=0} = 0 \tag{72}$$

In this case, with no change in own fees, and no cross-demand elasticities and sensitivity to the long-term rate, the effect on Q_t^{UL} is zero.

D.4.2 Proposition 2.1: Effect of Regulatory Capital Requirements

Under the Assumption 1, and applying Cramer's rule:

$$\frac{df_t^{PP}}{d\phi_2} = \frac{-\partial\Pi_t/\partial\phi_2}{1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}} > 0 \tag{73}$$

$$\frac{df_t^{UL}}{d\phi_2} = 0 \tag{74}$$

The UL fee is unaffected by ϕ_2: with no cross-demand effects and the UL markup pinned by the inverse elasticity condition, there is no channel through which ϕ_2 disturbs the UL equilibrium. The sign of $\partial f_t^{PP}/\partial\phi_2$ depends on the sign of $\partial\Pi_t/\partial\phi_2$, which we now investigate. Differentiating $\Pi_t = f_t^{PP} - \lambda_t V_{t,t} - \frac{c_t}{1+c_t}\phi_2\alpha_t$ with respect to ϕ_2, holding fees and portfolio shares fixed, one can show that:

$$\frac{\partial\Pi_t}{\partial\phi_2} = -\frac{\alpha_t c_t}{1+c_t} - C''(K_t)\alpha_t Q_t^{PP} \cdot \frac{\phi_1 V_{t,t} + \phi_2\alpha_t}{(1+c_t)^2} < 0 \tag{75}$$

This term is unambiguously negative: higher ϕ_2 reduces profits. The first is the direct effect of increasing the regulatory cost of existing guarantees. The second is the indirect effect of the feedback effect through higher marginal regulatory costs by lowering the stock of statutory capital.

For the risky asset share, from equation (49) and rearranging, one can show that:

$$\frac{\partial\alpha_t}{\partial\phi_2} = \frac{-\left(\frac{\phi_2 C''(K_t)\alpha_t Q_t^{PP}}{\lambda_t(1+c_t)} + c_t\right)}{\lambda_t(1+c_t)\frac{\partial^2 V_{t,t}}{\partial\alpha_t^2}} < 0 \tag{76}$$

The effect is unambiguous: the risky asset share falls with ϕ_2. Intuitively, what dominates is that holding risky assets incurs a greater regulatory cost, which is strengthened by the feedback effect of lower capital.

Finally, totally differentiating the demand functions with respect to price, holding portfolio shares constant:

$$\frac{dQ_t^{PP}}{d\phi_2} = \underbrace{-\frac{\partial \Pi_t/\partial \phi_2 \cdot \varepsilon_{PP}^{f^{PP}} Q_t^{PP}}{1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}}}_{\text{supply channel}} < 0 \tag{77}$$

$$\frac{dQ_t^{UL}}{d\phi_2}\Big|_{\Delta\alpha_t = 0} = 0 \tag{78}$$

D.4.3 Proposition 2.2: Changes in Regulatory Capital Requirements

Under Assumption 1, and applying Cramer's rule:

$$\frac{df_t^{PP}}{d\phi_1} = \frac{-\partial \Pi_t/\partial \phi_1}{1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}} \tag{79}$$

$$\frac{df_t^{UL}}{d\phi_1} = 0 \tag{80}$$

The UL fee is unaffected by ϕ_1: with no cross-demand effects and the UL markup pinned by the inverse elasticity condition, there is no channel through which ϕ_1 disturbs the UL equilibrium. The sign of $\partial f_t^{PP}/\partial \phi_1$ depends on the sign of $\partial \Pi_t/\partial \phi_1$, which we now investigate. Differentiating $\Pi_t = f_t^{PP} - \lambda_t V_{t,t} - \frac{c_t}{1+c_t}\phi_2 \alpha_t$ with respect to ϕ_1, holding fees and portfolio shares fixed, one can show that:

$$\frac{\partial \Pi_t}{\partial \phi_1} = -\frac{c_t V_{t,t}}{1 + c_t} - C''(K_t) V_{t,t} Q_t^{PP} \cdot \frac{\phi_1 V_{t,t} + \phi_2 \alpha_t}{(1 + c_t)^2} < 0 \tag{81}$$

This term is unambiguously negative: higher ϕ_1 reduces profits. The first is the direct effect of increasing the regulatory cost of existing guarantees. The second is the indirect effect of the feedback effect through higher marginal regulatory costs by lowering the stock of statutory capital.

For the risky asset share, from equation (49) and rearranging, one can show that:

$$\frac{\partial \alpha_t}{\partial \phi_1} = \frac{\phi_2 \left(c_t^2 - C''(K_t) V_{t,t} Q_t^{PP}\right)}{\lambda_t^2 (1 + c_t)^2 \frac{\partial^2 V_{t,t}}{\partial \alpha_t^2}} \tag{82}$$

The effect of a change in ϕ_1 on α_t is ambiguous. On the one hand, if the regulatory constraint ϕ_1 rises, insurers have a greater incentive to improve their capital position. And since in equilibrium the value of the MRG falls when α_t rises, insurers want to increase α_t.

On the other hand, the stock of capital falls when ϕ_1 rises, increasing the marginal regulatory cost of raising α_t through the charge ϕ_2. The part that dominates depends on the calibration.

Finally, totally differentiating the demand functions with respect to price, holding portfolio shares constant:

$$\frac{dQ_t^{PP}}{d\phi_1} = \underbrace{-\frac{\partial \Pi_t/\partial \phi_1 \cdot \varepsilon_{PP}^{f^{PP}} Q_t^{PP}}{1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP}}}_{\text{supply channel}} < 0 \tag{83}$$

$$\frac{dQ_t^{UL}}{d\phi_1}\Big|_{\Delta\alpha_t = 0} = 0 \tag{84}$$

D.4.4 Proposition 3: Reallocation toward Unit-Linked Products

We show that UL new business falls when the long-term rate y_t rises, under the assumption that cross-price demand elasticities are positive but small, $\varepsilon_{UL}^{y} = 0$, and $\varepsilon_{PP}^{y} > 0$. We proceed in three steps: deriving the total derivatives of fees, signing them, and combining to get the effect on Q_t^{UL}.

Step 1: Total derivatives of fees Applying Cramer's rule to the system (37):

$$\frac{df_t^{PP}}{dy_t} = \frac{-F_y G_{f^{UL}} + G_y F_{f^{UL}}}{\Delta} \tag{85}$$

$$\frac{df_t^{UL}}{dy_t} = \frac{-G_y F_{f^{PP}} + F_y G_{f^{PP}}}{\Delta} \tag{86}$$

Under $\varepsilon_{UL}^{y} = 0$, the right-hand side vectors F_y and G_y simplify to:

$$F_y = -\frac{\partial \Pi_t}{\partial y_t} \varepsilon_{PP}^{f^{PP}} Q_t^{PP} - f_t^{UL} \varepsilon_{UL}^{f^{PP}} \varepsilon_{PP}^{y} Q_t^{UL} < 0 \tag{87}$$

$$G_y = \varepsilon_{PP}^{f^{UL}} Q_t^{PP} \left(\frac{\partial \Pi_t}{\partial y_t} + \varepsilon_{PP}^{y} \Pi_t \right) > 0 \tag{88}$$

where G_y is obtained by substituting $1 - f_t^{UL} \varepsilon_{UL}^{f^{UL}} = -\Pi_t \varepsilon_{PP}^{f^{UL}} Q_t^{PP} / Q_t^{UL}$ from $G_t = 0$ into the general expression. $F_y < 0$ since both terms are negative given $\partial \Pi_t / \partial y_t > 0$, $\varepsilon_{PP}^{f^{PP}}, \varepsilon_{UL}^{f^{PP}}, \varepsilon_{PP}^{y} > 0$. $G_y > 0$ since $\partial \Pi_t / \partial y_t > 0$, $\Pi_t > 0$ in equilibrium, $\varepsilon_{PP}^{y} > 0$, and $\varepsilon_{PP}^{f^{UL}} > 0$.

Step 2: Signs of fee responses **PP fee.** The numerator of (85) is:

$$-F_y G_{f^{UL}} + G_y F_{f^{UL}} \tag{89}$$

Since $F_y < 0$ and $G_{f^{UL}} < 0$, the first term $-F_y G_{f^{UL}} < 0$. The second term $G_y F_{f^{UL}}$ is second order in cross-price elasticities since both G_y and $F_{f^{UL}}$ are first order in $\varepsilon_{PP}^{f^{UL}}$ and $\varepsilon_{UL}^{f^{PP}}$ respectively. To first order in cross-elasticities, the numerator is dominated by $-F_y G_{f^{UL}} < 0$, and since $\Delta > 0$:

$$\frac{df_t^{PP}}{dy_t} \approx \frac{-F_y}{F_{f^{PP}}} = \frac{-\frac{\partial \Pi_t}{\partial y_t}\varepsilon_{PP}^{f^{PP}} Q_t^{PP} - f_t^{UL}\varepsilon_{UL}^{f^{PP}}\varepsilon_{PP}^{y} Q_t^{UL}}{-\varepsilon_{PP}^{f^{PP}} Q_t^{PP}(1 + \Gamma_t \varepsilon_{PP}^{f^{PP}} Q_t^{PP})} < 0 \tag{90}$$

Both terms in the numerator are negative and the denominator is positive, so $df_t^{PP}/dy_t < 0$ to first order in cross-elasticities. The PP fee falls when y_t rises.

UL fee. The numerator of (86) is:

$$-G_y F_{f^{PP}} + F_y G_{f^{PP}} \tag{91}$$

The first term $-G_y F_{f^{PP}}$: since $G_y > 0$ and $F_{f^{PP}} < 0$, this is unambiguously positive. The second term $F_y G_{f^{PP}}$: since $F_y < 0$ and $G_{f^{PP}} > 0$, this is unambiguously negative. To first order in cross-elasticities, $G_{f^{PP}}$ is first order in $\varepsilon_{PP}^{f^{UL}}$ and $\varepsilon_{UL}^{f^{PP}}$, while $-G_y F_{f^{PP}}$ has G_y first order in $\varepsilon_{PP}^{f^{UL}}$ and $F_{f^{PP}}$ zeroth order. So both terms are first order in cross-elasticities. To first order:

$$\frac{df_t^{UL}}{dy_t} \approx \frac{-G_y}{G_{f^{UL}}} = \frac{-\varepsilon_{PP}^{f^{UL}} Q_t^{PP}\left(\frac{\partial \Pi_t}{\partial y_t} + \varepsilon_{PP}^{y}\Pi_t\right)}{-\varepsilon_{UL}^{f^{UL}} Q_t^{UL}} = \frac{\varepsilon_{PP}^{f^{UL}} Q_t^{PP}\left(\frac{\partial \Pi_t}{\partial y_t} + \varepsilon_{PP}^{y}\Pi_t\right)}{\varepsilon_{UL}^{f^{UL}} Q_t^{UL}} > 0 \tag{92}$$

Since $\partial \Pi_t/\partial y_t > 0$, $\Pi_t > 0$, $\varepsilon_{PP}^{y} > 0$, and $\varepsilon_{PP}^{f^{UL}}, \varepsilon_{UL}^{f^{UL}} > 0$, we have $df_t^{UL}/dy_t > 0$ to first order in cross-elasticities. The UL fee rises when y_t rises.

Step 3: Effect on Q_t^{UL} Taking the total derivative of Q_t^{UL}:

$$\frac{dQ_t^{UL}}{dy_t} = \underbrace{\frac{\partial Q_t^{UL}}{\partial y_t}}_{=0} + \frac{\partial Q_t^{UL}}{\partial f_t^{PP}}\frac{df_t^{PP}}{dy_t} + \frac{\partial Q_t^{UL}}{\partial f_t^{UL}}\frac{df_t^{UL}}{dy_t} \tag{93}$$

The direct demand channel vanishes since $\varepsilon^{y}_{UL} = 0$. Substituting constant semi-elasticities and the fee responses from (90) and (92):

$$\frac{dQ_t^{UL}}{dy_t} = \varepsilon^{f^{PP}}_{UL} Q_t^{UL} \frac{df_t^{PP}}{dy_t} - \varepsilon^{f^{UL}}_{UL} Q_t^{UL} \frac{df_t^{UL}}{dy_t} \tag{94}$$

Substituting:

$$\frac{dQ_t^{UL}}{dy_t} = -\varepsilon^{f^{PP}}_{UL} Q_t^{UL} \cdot \frac{\frac{\partial \Pi_t}{\partial y_t} \varepsilon^{f^{PP}}_{PP} Q_t^{PP} + f_t^{UL} \varepsilon^{f^{PP}}_{UL} \varepsilon^{y}_{PP} Q_t^{UL}}{\varepsilon^{f^{PP}}_{PP} Q_t^{PP} (1 + \Gamma_t \varepsilon^{f^{PP}}_{PP} Q_t^{PP})} - \varepsilon^{f^{UL}}_{UL} Q_t^{UL} \cdot \frac{\varepsilon^{f^{UL}}_{PP} Q_t^{PP} \left(\frac{\partial \Pi_t}{\partial y_t} + \varepsilon^{y}_{PP} \Pi_t \right)}{\varepsilon^{f^{UL}}_{UL} Q_t^{UL}} \tag{95}$$

The second term simplifies immediately:

$$\frac{dQ_t^{UL}}{dy_t} = -\varepsilon^{f^{PP}}_{UL} Q_t^{UL} \cdot \frac{\frac{\partial \Pi_t}{\partial y_t} \varepsilon^{f^{PP}}_{PP} Q_t^{PP} + f_t^{UL} \varepsilon^{f^{PP}}_{UL} \varepsilon^{y}_{PP} Q_t^{UL}}{\varepsilon^{f^{PP}}_{PP} Q_t^{PP} (1 + \Gamma_t \varepsilon^{f^{PP}}_{PP} Q_t^{PP})} - \varepsilon^{f^{UL}}_{PP} Q_t^{PP} \left(\frac{\partial \Pi_t}{\partial y_t} + \varepsilon^{y}_{PP} \Pi_t \right) \tag{96}$$

Every term is negative: the first because $\varepsilon^{f^{PP}}_{UL}, \varepsilon^{f^{PP}}_{PP}, Q_t^{UL}, Q_t^{PP}, \partial \Pi_t / \partial y_t, \varepsilon^{y}_{PP} > 0$; the second because $\varepsilon^{f^{UL}}_{PP}, Q_t^{PP}, \partial \Pi_t / \partial y_t, \Pi_t, \varepsilon^{y}_{PP} > 0$. Therefore:

$$\frac{dQ_t^{UL}}{dy_t} < 0 \tag{97}$$

unambiguously to first order in cross-price elasticities. The intuition is clear: when y_t rises, the PP fee falls, drawing customers away from UL through the cross-demand channel ($\varepsilon^{f^{PP}}_{UL}$); simultaneously the UL fee rises as the insurer extracts rents from the diverted demand, further depressing UL new business through the own-price channel ($\varepsilon^{f^{UL}}_{UL}$). Both channels reinforce each other, making the decline in UL new business unambiguous.

The proof is essentially identical for regulatory changes, except that there is no direct channel of demand from changes in the long-term rate, and the partial derivative of Π_t is now with respect to ϕ_1 and ϕ_2.

E. Distribution Channels

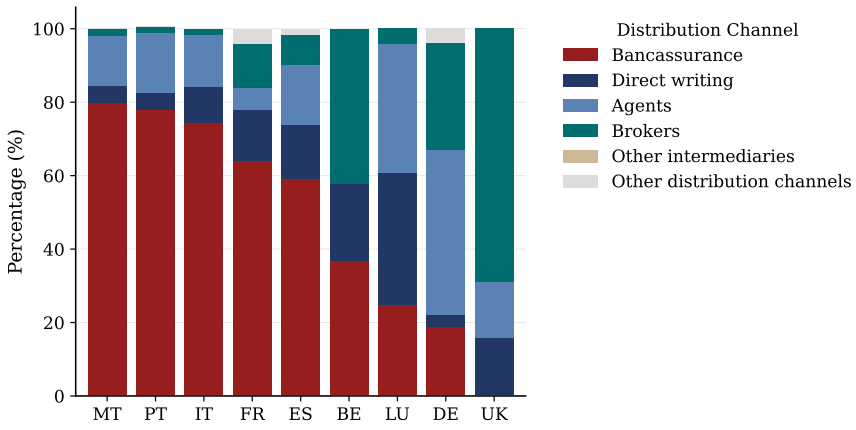
The *distribution channel* through which insurance products are sold can strongly influence how quickly—and in which direction—households adjust when the interest-rate environment changes.

Figure E.1 compares the composition of life insurance distribution channels across Euro area countries, including the United Kingdom for reference. Bancassurance—the sale of life insurance through banks—dominates in Southern Europe, accounting for roughly 74% of distribution in Italy and 64% in France. By contrast, the German market relies much more heavily on intermediaries, with around 45% of sales through agents and 29% through brokers. The United Kingdom represents an extreme case: its distribution is almost entirely intermediated, with brokers accounting for nearly 70% of sales.

These differences matter. Distribution structures shape the interaction between insurance products and competing savings instruments, especially bank deposits. In markets where bancassurance dominates, deposit products are natural substitutes and are marketed to the same customers, making households more likely to reallocate savings away from insurers when rates on bank products rise. In contrast, predominantly intermediated markets may exhibit more sluggish household responses, either because products are less directly comparable or because intermediaries influence the timing and direction of switches.

As an example, Barbu (2023) document that more than 160,000 U.S. households—nudged by life insurance brokers—converted their life insurance policies to less favorable terms when interest rates declined. This illustrates that households can be steered into making financial decisions even when those decisions are suboptimal, especially when intermediaries have strong incentives.

Figure E.1: Distribution Channels



Note: The figure shows the share of life insurance distribution channels in 2023 across Euro area countries and the United Kingdom. Bancassurance refers to insurance products sold through banks. Source: Insurance Europe.

F. Household Participation Rate in Life Insurance Policies

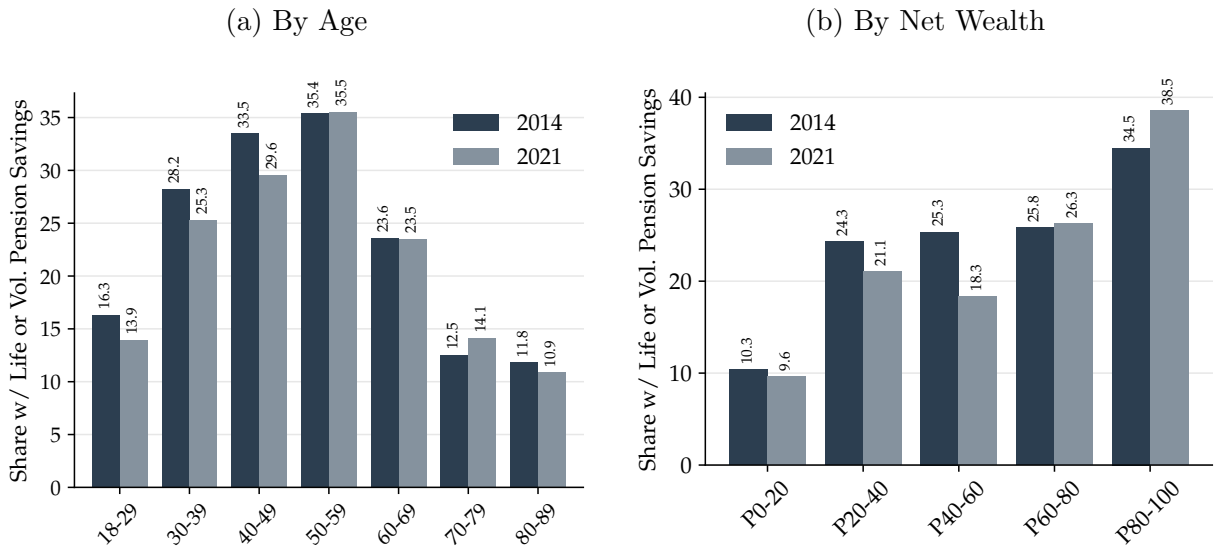
We use data from the ECB Household Finance and Consumption Survey (HFCS) to analyze changes in households' holdings of life insurance and retirement products. Specifically, we focus on households' participation in voluntary private pension plans and life insurance policies, which largely correspond to the instruments administered by life insurers in our study (see Appendix J for further details). Figure F.1 illustrates the change in participation rates by age group between 2014 and 2021. The figure shows that younger households experienced the largest decline in participation in voluntary retirement products, with participation rates falling by 2.4 percentage points for those aged 18–29, 2.9 percentage points for those aged 30–39, and 4.0 percentage points for those aged 40–49. This suggests that younger cohorts are increasingly refraining from allocating any funds to voluntary retirement policies.

When we split the sample by net wealth, we find that the decline in retirement policy participation is concentrated among households in the bottom 60th percentile of the wealth distribution. In contrast, households in the top 20% experienced a significant increase in participation, rising by about 4 percentage points.

Overall, these findings are important both for understanding the underlying mechanism and for assessing the implications of low interest rates. The decline in participation among younger households suggests that the reduction in inflows to insurance companies largely reflects lower demand for these products during the low-rate period. Consequently, a grow-

ing share of households now hold neither life insurance nor voluntary pension plans, with significant implications for their exposure to longevity risk.

Figure F.1: Participation in Voluntary Pension and Life Insurance Products



Note: The figure shows the share of individuals holding voluntary pension savings or life insurance with savings components across age and wealth groups, using HFCS 2014 and 2021. Panel (a) highlights the decline in participation among younger adults and a mild increase among older cohorts. Panel (b) illustrates a widening wealth gap, with participation rising among the top quintile and falling for the bottom 60%. All values are weighted using individual survey weights.

G. A Framework for Insurance Flows and Long-Term Bond Yields

This appendix presents the framework underlying the quantification of insurers' impact on long-term bond yields.

G.1 A Simplified Framework

To organize the discussion, we begin with a simple static framework that captures the essential mechanism linking insurer flows to long-term bond yields.

The simple model, adapted from Gabaix and Koijen (2021), serves only to connect quantities to prices. Its role is pragmatic: it translates existing elasticity estimates and measured flows into a common set of units, allowing us to make quantitative statements.

The model includes only two asset classes: a long-term bond and an outside asset. Let $F_{\text{Ins},t}$ denote household flows into insurance companies, and let W_t denote total household wealth. Let $w^B_{\text{ins},t}$ be the share of long-term bonds in insurers' portfolios and $w^B_{\text{O},t}$ the corresponding share in the portfolios of all other investors.

Market Segmentation We define the *relative portfolio tilt* (or, equivalently, *market segmentation*) as

$$\Psi_t \equiv \frac{w^B_{\text{ins},t} - w^B_{\text{O},t}}{w^B_t},$$

where w^B_t denotes the weight of long-term bonds in the aggregate market portfolio. When $\Psi_t > 0$, insurers hold disproportionately more long-term bonds than the rest of the market. Note that

$$w^B_t = \alpha_t \, w^B_{\text{ins},t} + (1 - \alpha_t) \, w^B_{\text{O},t},$$

where α_t is the asset share of insurance companies in the economy (i.e., their share of total household wealth).

Market segmentation in the long-term bond market thus measures the relative difference in long-term bond holdings between insurers and other investors. In a representative-agent economy, we would have $\Psi_t = 0$. However, due to their long-term funding structure, insurance companies are naturally positioned to hold long-term bonds in greater proportion than other investors, so that empirically $\Psi_t > 0$. Even though total flows across sectors sum to zero, any household reallocation away from insurance companies—toward deposits, mutual funds, or consumption—generates non-zero net demand for long-term bonds in general equilibrium whenever $\Psi_t \neq 0$.

Price Impact In a partial-equilibrium demand system for long-term bonds, the price impact of a net demand shift is given by

$$\Delta p_t^B = \underbrace{\frac{1}{\zeta}}_{\substack{\text{Price} \\ \text{Multiplier}}} \times \underbrace{\frac{F_{\text{Ins},t}}{W_t}}_{\substack{\text{Magnitude} \\ \text{of Flows}}} \times \underbrace{\Psi_t}_{\substack{\text{Market} \\ \text{Segmentation}}} \tag{98}$$

where $\frac{1}{\zeta}$ is the price multiplier that measures the response of long-term bond prices (relative to short-term bonds) to a 1% change in demand.[17]

Equation (98) summarizes the core logic: in an inelastic long-term bond market, net dollar flows, weighted by insurers' relative portfolio tilt, move prices. Even when total household flows sum to zero, reallocations across sectors affect bond yields whenever investors differ systematically in their maturity preferences.

The framework therefore highlights three factors: (i) the magnitude of insurance flows, (ii) the relative portfolio tilt of insurers toward long-term bonds, and (iii) the price elasticity of long-term bonds.

We now perform a back-of-the-envelope quantification of the three factors in Equation 98.

The Size of Insurance Flows To construct $F_{\text{Ins},t}$, we perform the following counterfactual experiment. Suppose that, throughout 2015–2025, households had continued to allocate the same shares of their financial flows (net savings into financial assets) as in the pre-QE period. We then compare the resulting counterfactual flows into insurance products with the flows observed in the data and define $F_{\text{Ins},t}$ as the difference between the two (counterfactual minus observed). This calculation implies a cumulative shortfall of about \$1.7 trillion in flows into insurance products between 2015 and 2025. Although these flows are measured relative to the pre-QE baseline allocation, we will, for simplicity, refer to them as "insurance flows" $F_{\text{Ins},t}$ whenever there is no ambiguity.

Let W_t denote total household wealth. With W_t averaging around \$30 trillion between 2015 and 2025, the cumulative shortfall corresponds to a *relative* outflow of about 5.6% of wealth (i.e., $F_t/W_t \approx -5.6\%$). These flows are large—not only relative to total household wealth, but especially when compared to the supply of long-term bonds with maturities above 10 years, which totaled \$9.5 trillion in June 2025 and represent the core allocation of insurance companies. Importantly, however, the outflows from insurance companies are reallocated to other intermediaries, such as banks (via deposits) or mutual funds, many of which also demand long-term bonds. What matters for the effect on the bond market is

[17] See Chaudhary et al. (2024) for recent estimates and an overview.

therefore the net equilibrium demand, which is determined by insurers' excess weight in long-term bonds relative to other investor sectors. The next section quantifies this equilibrium net demand effect.

Long-Term Bond Market Segmentation Insurance companies and pension funds are uniquely positioned to invest in long-term securities, given their long-dated liabilities. As a result, they are the primary private holders of long-term government bonds. Panel (a) of Figure G.1 shows the maturity composition of bond portfolios across investor sectors: insurers and pension funds allocate disproportionately to maturities above ten years, far more than mutual funds, banks, or households, which are tilted toward shorter maturities. This already suggests that outflows from insurance companies—unless redirected into pension products—are likely to move toward sectors with much lower long-term bond weights, thereby reducing net demand for long-dated bonds.

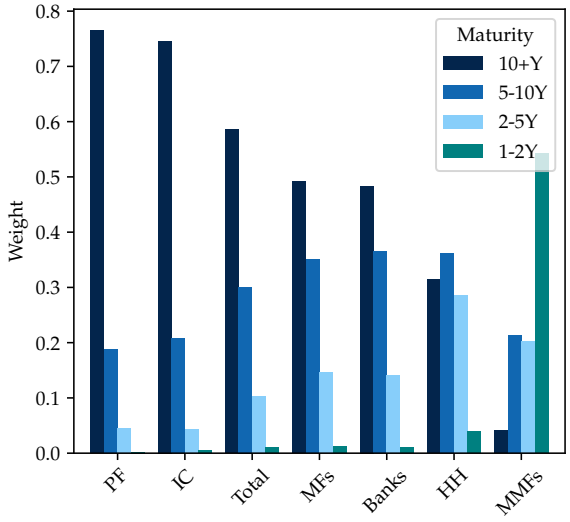
To quantify this, we consider each sector's total long-term bond share, not only its maturity tilt within the bond portfolio. We measure insurers' weight in long-term bonds, $w^B_{\text{ins},t}$, as long-term bond holdings relative to total insurer assets. The corresponding weight for all other investors, $w^B_{\text{O},t}$, is computed as the residual supply of long-term bonds (total supply minus insurer holdings) divided by residual assets (total EU assets minus insurer assets), yielding an asset-weighted average across all non-insurer sectors, including pension funds.

Insurers' preference for long-term bonds is much stronger than that of the rest of the market, with an average market segmentation of $\bar{\Psi} \approx 0.84$. Currently, insurers hold about 31% of their assets in long-term bonds, compared with only 16% for other investors. This implies that when one dollar flows out of the insurance sector and is absorbed by the remaining investors (pension funds, mutual funds, banks, etc.), roughly 15 cents flow out of long-term bonds. Because insurers also invest indirectly in mutual funds with long-duration exposure, this estimate likely understates their effective long-term bond tilt, making the implied net demand effects a strict lower bound.

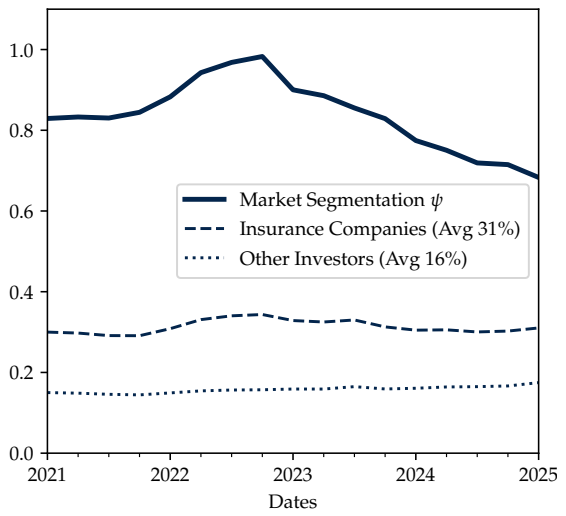
Price Impact of Demand Shifts While the magnitude of flows and market segmentation are directly observable, the impact of demand shifts on the term premium is unobservable. The literature has proposed three ways to estimate the multiplier, $\frac{1}{\zeta}$, which measures the price impact of buying 1% of long-term bond supply on the prices of long-term bonds relative to short-term bonds. First, reduced-form studies (e.g. Krishnamurthy and Vissing-Jorgensen (2012)) estimate the impact via regressions of (changes in) term premia onto plausibly exogenous demand shocks. Second, the semi-structural approach (e.g. Chaudhary et al. (2024)) estimates investor-level regressions of demand onto (changes in) term premia.

Figure G.1: Market Segmentation and Insurance Flows

(a) Maturity Habitats



(b) Long-Term Bond Market Segmentation



Note: Panel a) plots the weight in long-term bonds with maturity above 10 years *within* the bond portfolio of different investor sectors. Panel b) plots the portfolio allocation of long-term bonds relative to total assets for insurance companies (dashed line) and other investors (dotted line). The market segmentation measure ψ is given by $(w^B_{\text{Ins.},t} - w^B_{\text{Other.},t})/w^B_t$. Panel b) plots the share of flows into insurance companies $F_{\text{Ins.},t}$ as a fraction of total household flows F_t. Source: EIOPA Regulatory Filings.

The multiplier is given by the inverse of the weighted average investor-level elasticity.

As highlighted extensively in Chaudhary et al. (2024), there is considerable agreement across all three types of evidence on the price impact for 10-year U.S. Treasuries, with $\frac{1}{\zeta}$ estimated at around 1. See their Figure B.4 for a comprehensive overview of multiplier estimates in the literature.[18] Given our focus on maturities exceeding 10 years – where fewer close substitutes are available – we adopt a *conservative lower bound* of $\frac{1}{\zeta} \approx 0.99$. This corresponds to the benchmark estimate of Chaudhary et al. (2024), which we view as the most comprehensive and quantitatively careful study of aggregate bond market multipliers to date.

By contrast, Koijen et al. (2017) report a lower multiplier of 0.3 for EU government bonds. However, their estimate reflects an average across all maturities, making it less representative for the long end of the curve that we study. In addition, their cross-sectional approach relies on variation across EU countries, where government bonds are likely closer substitutes for each other than the aggregate market for long-term versus short-term bonds.

[18] Chaudhary et al. (2023) document a similar multiplier of 1.64 for long-term corporate bonds ($\geq$ 10 years) relative to short-term corporate bonds ($\leq$ 3 years) in the U.S.

Table G1: Price Impact Estimates for Long-Term Bonds

	Methodology	Asset	Multiplier
Jansen et al. (2024)	Structural	Treasuries	1.62
Chaudhary et al. (2024)	Semi-Structural	Treasuries	1.01
Gagnon et al. (2011)	Reduced-Form	Treasuries	1.34
Chaudhary et al. (2023)	Reduced-Form	US Corporate Bonds	1.64
Koijen et al. (2017)	Semi-Structural	EU Government Bonds	0.3

Note: Elasticity of long versus short-term treasuries and corporate bonds from previous studies. All of the papers study long-term treasuries with maturities $\geq$ 10 years, with the exception of Koijen et al. (2017), who estimate maturity weighted averages.

G.2 The Price Impact of Insurance Flows

Table G2 reports the calibration results for the three economic primitives. Our baseline calibration implies that insurance flows lowered long-term yields by about 50 basis points. We assess the sensitivity of this estimate to the three inputs. To highlight the role of each input, we vary them in line with plausible alternative assumptions. For example, we draw on external estimates of price impact, incorporate long-term bond exposures via CIUs, or use more recent household allocation shares as the baseline when computing excess flows relative to the pre-QE period. Across these variations, we find that the equilibrium effect on yields ranges between 40 and 102 basis points.

Table G2: Price Impact, Static Model

	ψ	$\frac{1}{\zeta}$	$\frac{F_{\text{Ins.},t}}{W_t}$	Price Impact	**Yield Impact (bp)**
Alternative Flows					
Baseline	0.84	0.99	-0.06	-0.05	48
Recent Insurance-Share	0.84	0.99	-0.08	-0.06	57
Alternative Market Segmentation					
Excluding Fin. Corporates	1.80	0.99	-0.06	-0.10	102
Include CIU Bond Exposure	1.34	0.99	-0.06	-0.08	76
Alternative Price Impact					
Kaminska and Zinna (2020)	0.84	0.84	-0.06	-0.04	40
Jansen et al. (2024)	0.84	1.62	-0.06	-0.08	77

Note: We report the inputs to several calibrations, with and without financial corporates. Excluding financial corporates affects the portfolio weights of the "Other investors", which results in a different market segmentation parameter ψ. The multipliers $\frac{1}{\zeta}$ are taken from previous studies. Relative flows $\frac{F_{\text{Ins.},t}}{W_t}$ are computed in excess of pre-QE allocation shares using FoF data. Yield impact is computed as the negated price impact divided by 10.

We showed that (i) flows into insurers fell sharply after 2015, (ii) insurers' long-term bond

tilt is large and persistent, and (iii) the price elasticity of long-term bonds is low. Combined, these three facts imply that QE-induced declines in insurer inflows have measurable consequences for the equilibrium term premium.

This static framework also clarifies the role of QE and QT. When the ECB absorbs long-term duration risk, the term premium declines; but the persistent compression in long-term rates also reduces household flows into the insurance sector. Through equation (98), this shrinkage reduces private-sector demand for long-term bonds—an effect that becomes particularly salient once QT increases the supply that private investors must absorb.

The model is intentionally simplified: it omits dynamics and does not explicitly capture the sequence of QE and QT events. We now embed these insights in a fully dynamic Vayanos–Vila framework with endogenous preferred-habitat investors.

G.3 A Static Sufficient-Statistic Representation

We consider a simple economy with two investor types: insurance companies and all other investors, indexed by $i \in \{\text{Ins.}, \text{Other}\}$. Let W_t denote total household wealth, and let $B_t = Q_t^B P_t^B$ denote the market value of long-term bonds (maturity above 10 years). The aggregate portfolio weight of long-term bonds is

$$w_t^B = \frac{B_t}{W_t}.$$

Let $w^B_{\text{Ins.},t}$ and $w^B_{\text{Other},t}$ denote the portfolio weights of insurers and other investors in long-term bonds. Define *market segmentation* as

$$\Psi_t \equiv \frac{w^B_{\text{Ins.},t} - w^B_{\text{Other},t}}{w_t^B}. \tag{99}$$

This object captures differences in maturity preferences across investor sectors. When $\Psi_t > 0$, insurers hold disproportionately more long-term bonds than the rest of the market.

Let $F_{\text{Ins.},t}$ denote flows into the insurance sector. Although total flows across sectors sum to zero, reallocations across intermediaries generate non-zero net demand for long-term bonds whenever $\Psi_t \neq 0$.

Under a partial-equilibrium demand system, the price impact of flows is given by:

$$\Delta p_t^B = \frac{1}{\zeta} \times \frac{F_{\text{Ins.},t}}{W_t} \times \Psi_t, \tag{100}$$

where $\frac{1}{\zeta}$ is the price multiplier. Equation (100) shows that the effect of flows on bond

prices depends on three sufficient statistics: the magnitude of flows, the degree of market segmentation, and the elasticity of demand.

H. Vayanos Vila Model

Our main message is that QE fundamentally altered the structure of the financial system. By lowering term premia, QE led to a prolonged period of substantially weaker household inflows into life insurance, which in turn materially reduced insurers' demand for long-term bonds. This contraction in the size of the insurance sector has important implications for term premia once QT begins, precisely because QE permanently reduced the role of a sector that has traditionally been a major marginal buyer of long-term bonds.

To assess the equilibrium effects of this structural change on the evolution of the term premia over QE/QT, we turn to a quantitative model of the yield curve. We follow a similar structure to (Vayanos and Vila, 2021) and (Greenwood et al., 2024) but include two distinct preferred habitat investors: insurance companies and 'other' investors. At a high level, households allocate new savings to either of these two investors, whose allocation tilts towards insurance companies as long-term rates rise. The final bond market investors are arbitrageurs, who are the marginal investors in the bond market.

H.1 Setting

State of Economy Time is discrete and infinite, and in each period there are default-free zero coupon bonds maturing at date 1 up to T. The price of the τ-period bond at time t is denoted by

$$P_{\tau,t} = \exp(-\tau y_{\tau,t})$$

where $y_{\tau,t}$ is the bond's continuously compounded yield to maturity. The short rate (r_t) is exogenous and follows the AR(1) process:

$$r_{t+1} = \bar{r} + \rho_r \left(r_t - \bar{r}\right) + \sigma_r \epsilon_{r,t+1}$$

Preferred Habitat Investors Households allocate wealth (A_t^H) to insurance (A_t^{ins}) and the other sector (A_t^O). The size of the insurance sector evolves according to the following law of motion:

$$A_t^{ins} = (1-\delta)A_{t-1}^{ins} + F_t \quad \text{s.t.} \quad F_t = \bar{F} + \eta_t^{ins}(y_{\bar{\tau},t} - r_t)$$

where F_t increases with the $\tau^\star$-year term spread $y_{\bar{\tau},t} - r_t$. δ is the fraction of investments by households that exit due to death or maturity. See Appendix **??** for the micro-foundations of the process for insurer assets. Intuitively, insurers have a portfolio tilt towards long-term

assets, and so when term spreads rise, the insurance sector becomes an attractive investment for new household savings.

The portfolio shares allocated to each bond of maturity τ, $\zeta^{ins}(\tau)$, is taken as given such that the insurance sector's holdings of bonds of maturity τ, $D_t^{ins}(\tau)$, is equal to:

$$D_t^{ins}(\tau) = \zeta^{ins}(\tau) A_t^{ins}$$

This ensures that insurer holdings of each maturity follow the same law of motion as assets, re-scaled by the portfolio share.

The outside sector receives all remaining assets of households not allocated to the mutual fund sector i.e. $A_t^O = A_t^H - A_t^{ins}$. Again, we assume an exogenous and fixed portfolio allocation across maturities that can differ from insurers, such that:

$$D_t^O(\tau) = \zeta^O(\tau) A_t^O$$

Central Bank The central bank absorbs a quantity $D_t^{CB}(\tau)$ of each maturity τ that follows the rule

$$D_t^{CB}(\tau) = S_t(\tau) \left(\bar{d}^{CB}(\tau) + q_t \right)$$

where $\bar{d}^{CB}(\tau)$ is the long-run share of τ-maturity bond supply, $S_t(\tau)$, held by the central bank, while q_t represents persistent shocks to holdings that follows an AR(1) process:

$$q_{t+1} = \rho_Q q_t + \sigma_Q \epsilon_{Q,t+1} \quad \text{s.t.} \quad \epsilon_{Q,t+1} \sim N(0,1)$$

As we show later, QE/QT policies are represented as shocks to both the permanent and persistent components of the rule.

Arbitrageurs Arbitrageurs close the model by holding a bond portfolio that maximizes their mean-variance objective as follows:

$$\max_{X_t} E_t \left[W_{t+1} \right] - \frac{\gamma}{2} Var_t(W_{t+1})$$

where X_t is a $(T-1)$ vector with $X_t(\tau)$ denoting the arbitrageur's holdings of bonds of maturity $\tau > 1$, and W_{t+1} is their wealth that evolves according to their portfolio choice and the returns $R_{\tau,t+1}$ of the different bonds. Following (Greenwood et al., 2024), we log-linearize returns $r_{\tau,t+1} = \log(1 + R_{\tau,t+1})$ so that

$$R_{\tau,t+1} \approx r_{\tau,t+1} + \frac{1}{2}\text{Var}_t(r_{\tau,t+1})$$

This allows us write the evolution of wealth as approximately

$$W_{t+1} \approx W_t(1+r_t) + \sum_{\tau=2}^{T} X_t(\tau)\left[r_{\tau,t+1} + \frac{1}{2}\text{Var}(r_{\tau,t+1}) - r_t\right]$$

In this case, first-order condition yields the following demand function:

$$X_t = \frac{1}{\gamma}\Sigma_t^{-1}\mu_t$$

where μ_t is a vector of expected returns and Σ_t is the covariance matrix of bond returns.

Market Clearing We assume that the supply of bonds of maturity τ are exogenous at $S_t(\tau)$. As a result, for the market to clear, the arbitrageurs must absorb the residual supply i.e.

$$X_t(\tau) = S_t(\tau) - D_t^{ins}(\tau) - D_t^{O}(\tau) - D_t^{CB}(\tau)$$

Normalization In anticipation of calibrating the bond market, we assume that household wealth and bond supply grow at the same constant growth rate of g. We then normalize all demand/supply by $S_t(\tau)$ such that $z_t(\tau) \equiv Z_t(\tau)/S_t(\tau)$ represents normalized values. In particular, the evolution of insurer demand now follows:

$$d_t^{ins}(\tau) = (1-\tilde{\delta})d_{t-1}^{ins}(\tau) + f_t(\tau) \tag{101}$$

where $f_t(\tau) = \bar{f}(\tau) + \tilde{\eta}^{ins}(\tau)(y_{\bar{\tau},t} - r_t)$.

Affine Bond Pricing Solution We look for an equilibrium where bond yields are affine functions of the state variables $(r_t, q_t, d_{t-1}^{ins}(\tau^\star))$. In this case, the log price of a τ-maturity bond, $p_t(\tau)$, satisfies:

$$p_t(\tau) = -\tau y_{\tau,t} = -\left[C_\tau) + A_{\tau,t}(r_t - \bar{r}) + A_{\tau,q}q_t + A_{\tau,d}d_{t-1}^{ins}(\tau^\star)\right]$$

In the calibration, we assume there are only bonds supplied at maturity $\tau^\star$, allowing us to only have to carry $d_{t-1}^{ins}(\tau^\star)$ as an additional state variable in equilibrium.

H.2 Calibration

Most of the calibration has been already discussed in Section G.1.

Simplifying the Debt Maturity Structure When taking the model to the data, we make the additional simplifying assumption that the government only supplies a single maturity $\tau^\star$ every period. As this is a model for understanding the role of life insurers in the bond market, we select $\tau^\star = 10$, which one can think of as roughly the average duration of government bonds held by life insurers.

Insurer Demand Pre-normalization, the asset holdings of insurers in $\tau^\star$-period bonds is

$$D_t^{ins}(\tau^\star) = (1-\delta)D_{t-1}^{ins}(\tau^\star) + F_t(\tau^\star)$$

When this is normalized by dividing by $S_t(\tau^\star)$ on each side, we are left with equation (101), where $(1-\tilde{\delta}) = (1-\delta)(1+\bar{r}_{\tau^\star})/(1+g)$. Under stationarity, $d(\tau^\star)$ is constant at the steady state. As we wish to define the pre-QE steady state, we take the average insurer holdings share in 2000-2015. As we are focusing on the long-term segment, we take the share of 10+ maturity segment held by insurers, equalling 45%. Thus, $d(\tau^\star) = 0.45$.

Turning to insurer flows, we set the steady state ratio of flows to stocks, $\bar{f}/\bar{d}$, to match household savings allocations from the QSA. In 2000-2015, households allocation (stock) to insurance companies was 21% of total wealth. Average annual flows were 1.08%. This implies $\bar{f}/\bar{d} = 1.08/21 \approx 0.05$.

As a reminder, flows in our model exhibit the following process:

$$f_t = \bar{f} + \tilde{\eta}^{ins}\left(y_{\bar{\tau},t} - r_t - (\bar{y}_{\bar{\tau}} - \bar{r})\right)$$

where $\bar{y}_{\bar{\tau}} - \bar{r}$ is the steady state $\bar{\tau}$-year term spread. In the calibration, we also set $\bar{\tau}$ to 10. To calibrate $\tilde{\eta}^{ins}$, we target the change in the stock of bond holdings of insurers as a share of supply over 7 years post-QE, where we assume QE induced a 1% drop in the 10-year term spread. We then obtain a value of $\tilde{\eta}^{ins} = 1.7$.[19]

Market Segmentation We set the share of bonds held by mutual funds at $\bar{d}^O(\tau^\star) = 0.3$. As we are calibrating to the pre-QE steady state, the central bank does not hold any bonds in the baseline, i.e. $\bar{d}^{CB}(\tau^\star)$ equals 0, but will be shifted in experiments. Arbitrageurs hold the remaining 25% pre-QE. We interpret arbitrageurs as the foreign investors in the European bond market who are very price-elastic. Then, in order to represent portfolio shares of insurers vs. other investors, we set $\zeta^{ins}(\tau^\star) = 0.31$ and $\zeta^O(\tau^\star) = 0.16$ to reflect each investor's portfolio share in long-term bonds. As $\zeta^{ins}(\tau^\star) > \zeta^O(\tau^\star)$, insurers have a

[19] In particular, we see in the aggregate data that over the course of QE the share of total bonds outstanding held by insurers fell from 0.18 (2015) to 0.14 (2022). We therefore want to capture a percentage change in holdings of insurers equal to (0.14-0.18)/0.18. Iterating on equation (101), the value of $\tilde{\eta}^{ins}$ is that which satisfies the equation: $\tilde{\eta}^{ins} * \Delta\bar{ts}^{(10)}\left(\frac{1}{\delta}\right)(1-(1-\delta)^7) = \bar{d}^{ins}(10) * \left(\frac{0.14-0.18}{0.18}\right)$

portfolio tilt to long-term bonds, meaning that households rebalancing from other investors to insurers increases indirect long-term bond holdings.

Remaining Parameters We calibrate the yield curve pre-QE using the data from 2000-2015. We first set the value of $\bar{r} = 1.5\%$ to match the average ECB policy rate (all results are isomorphic to $\bar{r}$). We then estimate an AR(1) process for the short-term rate. Additionally, we set $\rho_Q = 0.85$ to reflect the observed persistence in the length of QE purchases programs. Finally, we set the risk aversion coefficient γ to 9 in order to match the average spread between the 1-year and 10-year swap rate of 1.5%.

The set of parameters are listed in Table H1.

Table H1: Calibrated Parameters

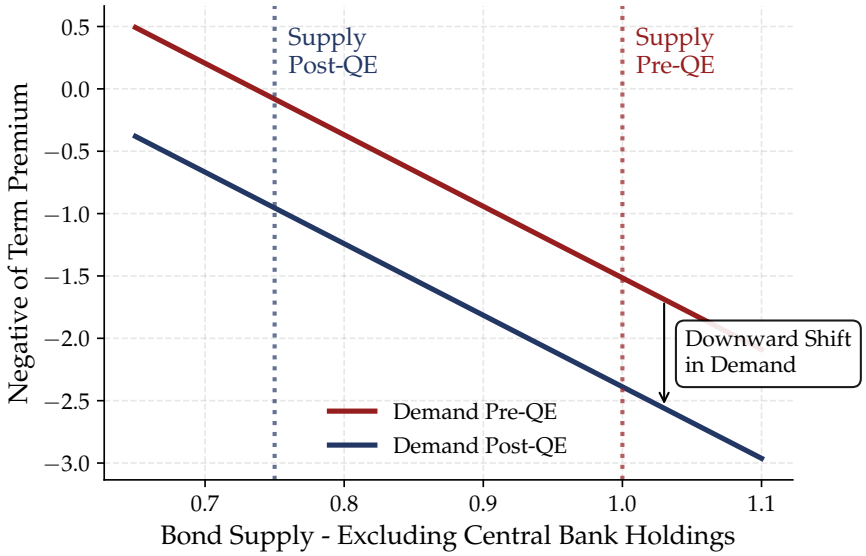
Parameter	Coefficient	Value	Description
Supply			
Bond Supply	$\bar{s}(10)$	1.0	normalise 10-year bond supply at 1
Insurers			
Steady State Holdings	$\bar{d}^{ins}(10)$	0.45	avg. share 10+ year bonds held by insurers
Steady State Flows	$\bar{f}^{ins}(10)/\bar{d}^{ins}(10)$	0.05	household savings in insurance: flows vs. stock
Elasticity	$\eta^{ins}(10)$	1.7	match Δ insurer holdings for 1% drop in term spread
Other Investors			
Steady State Holdings	$\bar{d}^{O}(10)$	0.30	share of private holdings of remaining EA investors
Market Segmentation	$\zeta^{ins}(10)/\zeta^{O}(10)$	1.95	match tilt insurer portfolio towards LT bonds
Remaining Parameters			
Risk Aversion	a	9	match 1.5% steady state 10-year term spread
Steady State Interest Rate	$\bar{r}$	3%	
Persistent IR Shocks	ρ_r	0.8	
Persistent Supply Shocks	ρ_q	0.85	match length of QE purchase programs

H.3 One-Time Permanent QE Shock

To illustrate the mechanics of the model with insurers in a transparent way, we begin by examining the response to a one-time permanent change in central bank holdings. Specifically, we consider a permanent increase in $\bar{d}^{CB}(\tau^\star)$ from 0 to 0.25, meaning that the central bank permanently absorbs 25% of the outstanding supply of $\tau^\star$-maturity bonds.

Figure H.1 depicts how the bond market adjusts to this quantitative easing (QE) policy. The pre-QE equilibrium corresponds to the intersection of the vertical supply curve, labeled *Supply Pre-QE*, and the initial private-sector demand curve, labeled *Short-Term Pre-QE*. The supply curve is vertical because the total quantity of bonds outstanding is exogenous to prices. The short-term demand curve represents the demand for $\tau^\star$-maturity bonds at time $t = 0$, holding the state variables fixed at their pre-QE levels. Intuitively, as the term spread

Figure H.1: Demand Curve Pre- and Post- QE



declines, the yield on long-term bonds falls, making them less attractive both to arbitrageurs and to households investing via insurance companies.

When the central bank implements the one-time permanent purchase, the supply curve shifts leftward. The market moves along the short-term demand curve to a new equilibrium with a lower term spread. In the short run, most of the adjustment in demand comes from arbitrageurs, whose positions respond elastically to price changes. Insurance companies, by contrast, contribute little to the immediate adjustment because their demand can change only through balance-sheet flows, which are a small fraction of their total assets. This limited short-run flexibility makes the short-term demand curve relatively steep, amplifying the initial decline in the term spread on impact.

Over time, as the term premium remains compressed, insurer inflows continue to be subdued. Consequently, the size of insurers' balance sheets gradually shrinks, reducing their overall demand for long-term bonds. This gradual balance-sheet adjustment eases the burden on arbitrageurs and allows the term spread to rise toward its new steady-state level.

Graphically, Figure H.1 shows this process as a gradual downward shift of the demand curve—from the red *Short-Term Pre-QE* line to the blue *Short-Term Post-QE* line. As insurers' holdings of $\tau^\star$-maturity bonds, $d^{ins}_{t-1}(\tau^\star)$, decline, the aggregate demand curve shifts lower for any given term spread until it intersects the post-QE supply curve. Put differently, the long-run demand elasticity is greater than the short-run elasticity, since only over time can insurers fully adjust their portfolios to the permanently lower term spreads. This is why the long-run demand curve is flatter than the short-run demand curves.

H.4 Gradual QE and QT

The previous experiment highlights how the slow-moving nature of insurers' balance sheets is central to understanding the dynamics of term premia. We now apply the model to a more realistic description of ECB policy, in which asset purchases are implemented gradually over time rather than frontloaded in a single period. Figure **??** illustrates this clearly for both QE episodes: purchases were spread out and persistent.

In our framework, QE policy operates along two dimensions. First, there is a *permanent component*, given by the final target share of supply held by the central bank, $\bar{d}^{CB}(\tau^\star)$. We set this post-QE target share to 0.25 to match the ECB's holdings of long-maturity government bonds in 2022. Second, there is a *transitional component*, q_t, which captures the gradual pace of purchases. To model this, we set the initial innovation $\epsilon_{Q,0} = 0.25/\sigma_Q$ so that holdings do not change on impact. The parameter ρ_Q then governs the speed of accumulation: the higher is ρ_Q, the more gradual are the purchases. We set $\rho_Q = 0.85$ to align with the weighted average horizon of purchases observed since 2015.

We then introduce a quantitative tightening (QT) phase to represent the unwind of holdings. After seven years, the central bank unexpectedly adjusts its long-run target share back to the pre-QE level, again doing so in a gradual manner.

The impulse responses in Figure H.2 summarize these dynamics. The initial impact on the term spread is large, falling from 1.5% to roughly 0.8%. This occurs even though actual purchases are gradual. Agents understand that the central bank will steadily accumulate a large portfolio position, which implies lower future term premia. Because arbitrageurs price long-term bonds based on expected future returns, the anticipation of persistently lower future term premia raises expected future bond prices. A high expected future price makes holding the bond today more attractive, increasing current demand and pushing today's bond price up—and thus the current term spread down—immediately. In short, the term premium drops strongly on impact because investors internalize the entire future path of purchases.

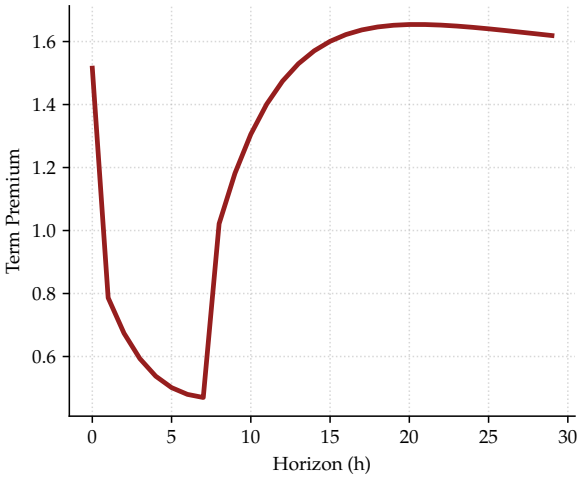
As the central bank's holdings build up over time, the term spread continues to decline, leading arbitrageurs to scale back their positions. In this gradual-purchase scenario, however, the insurer balance sheet adjusts more smoothly. Because purchases are spread over time, insurers have some opportunity to realign their balance sheets and partially accommodate the reduction in available supply, muting the extent of short-run overshooting during QE.

At time $t = 8$, the central bank announces a reversal of its policy, gradually reducing its holdings back toward pre-QE levels. The term spread rises in response but crucially *overshoots* its pre-QE level. The reason lies in the cumulative effect of QE on insurers'

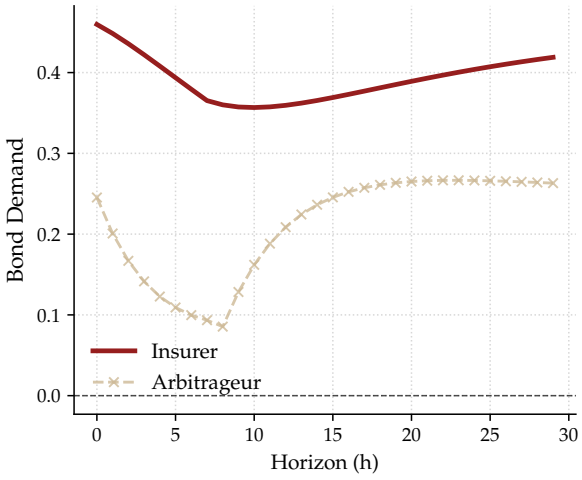
balance sheets: after years of depressed term premia, the insurer sector has shrunk relative to its pre-QE size. When QT begins, this smaller insurer sector is less able to absorb the returning supply of long-term bonds. As a result, arbitrageurs must hold more duration risk than before QE, which requires a higher term premium to clear the market. Hence, the term spread temporarily rises above its pre-QE level before gradually settling back as insurer balance sheets rebuild.

Figure H.2: Impulse Response Gradual QE Shock + Unwind

(a) Term Premium



(b) Demand



I. QSA Description

I.1 Flows into Insurance Liabilities

Aggregate. In the ESA 2010 financial accounts, instrument category F6 captures all entitlements arising from insurance, pensions, and standardised guarantee schemes. It is composed of three subcomponents:

$$F6 = F62 + F6M + F6O.$$

F62: Life insurance and annuity entitlements. These are policyholders' claims on life insurers, including both unit-linked and non-unit-linked products. Transactions are derived from premiums earned and premium supplements (investment income attributed to policyholders), net of benefits due and changes in technical reserves (ESA, 2013, ESA 2010, §16.52, p. 384). The full flow identity is reported in equation (102).

F6M: Pension entitlements and related items. This block consolidates three ESA 2010 categories: (i) pension entitlements (F63), i.e. accrued claims on employment-related pensions; (ii) claims of pension funds on pension managers (F64), which arise when the legal sponsor and the fund are separate units; and (iii) entitlements to non-pension benefits (F65), such as post-employment health schemes. Together these cover all pension-related liabilities not classified as life insurance.

F6O: Non-life insurance and standardised guarantees. This item comprises the reserves of non-life insurers for claims not yet settled, and provisions for calls under standardised guarantee schemes (e.g. deposit insurance or export credit guarantees). It reflects expected obligations from contracts other than life insurance and pensions.

I.1.1 Life Insurance (F62)

Instrument. F62 records policyholders' claims on life insurers and annuity providers. In ESA 2010, life insurance is treated as saving with risk coverage, with entitlements representing liabilities of insurers and assets of policyholders (ESA, 2013, ESA 2010, §§16.10–16.14, pp. 348–379; §16.31, p. 382).

Transactions vs. revaluations. To measure inflows "available to invest," we use *transactions* in F62, which exclude holding gains or losses from changes in interest rates or asset prices. These valuation effects are recorded separately under revaluations/other changes (ESA, 2013, ESA 2010, §§16.31–16.33, p. 382). National methodologies make this explicit: "nominal holding gains and losses on entitlements are not recorded as flows" (Banque de France, 2024, p. 11).

Flow identity. ESA 2010 defines the net transaction in AF.62 as:

$$\Delta \mathrm{F62}_t^{(\text{transactions})} = \underbrace{\text{premiums earned}_t}_{\text{accrual basis}} + \underbrace{\text{premium supplements}_t}_{\text{investment income attributed to policyholders}} - \underbrace{\text{benefits due}_t}_{\text{claims/benefits on an accrual basis}} - \underbrace{\Delta\text{technical reserves}_t}_{\text{increase (decrease) in life reserves}}. \tag{102}$$

Here, *premium supplements* are investment income on reserves attributed to policyholders; *benefits due* are obligations payable during the period; and *technical reserves* cover actuarial and with-profits components. Equation (102) corresponds to ESA 2010 §16.52 (p. 384), with definitions in §§16.31–16.33 (p. 382).

Recording in the accounts. Life-insurance premiums and claims are not recorded as separate transfers; instead, their net effect appears as a financial transaction in AF.62 (ESA, 2013, ESA 2010, §§16.70–16.71, p. 388).

I.1.2 Pension Entitlements and Related Items (F6M)

Instrument. F6M aggregates pension entitlements (F63), claims of pension funds on pension managers (F64), and entitlements to non-pension benefits (F65). These are assets of households and liabilities of pension funds, employers, or social security schemes (ESA, 2013, ESA 2010, §§17.95–17.106, pp. 410–412).

Transactions vs. revaluations. Transactions in F6M reflect contributions (actual and imputed) and premium supplements, net of pension benefits paid and changes in reserves. Valuation changes due to discount-rate movements are excluded and recorded as revaluations (ESA, 2013, ESA 2010, §17.99, p. 411).

Flow identity. The net transaction in F6M can be written as:

$$\Delta \mathrm{F6M}_t^{(\text{transactions})} = \text{contributions received}_t + \text{premium supplements}_t - \text{benefits paid}_t - \Delta\text{pension reserves}_t. \tag{103}$$

Recording in the accounts. Contributions and benefits are recorded in the secondary distribution of income account, with their net impact on accrued entitlements recorded as transactions in AF.6M (ESA, 2013, ESA 2010, §17.106, p. 412).

I.1.3 Non-life Insurance and Standardised Guarantees (F6O)

Instrument. F6O covers non-life insurance technical provisions and provisions for calls under standardised guarantee schemes. These are liabilities of insurers or guarantors, and assets of policyholders or beneficiaries (ESA, 2013, ESA 2010, §§16.85–16.92, pp. 389–391).

Transactions vs. revaluations. Transactions in F6O consist of premiums earned and premium supplements, net of claims due and changes in technical reserves. As with F62 and F6M, valuation effects are excluded (ESA, 2013, ESA 2010, §§16.89–16.90, p. 390).

Flow identity. The net transaction in F6O is:

$$\begin{aligned}\Delta\text{F6O}_t^{(\text{transactions})} = {} & \text{premiums earned}_t + \text{premium supplements}_t \\ & - \text{claims due}_t - \Delta\text{non-life technical reserves}_t. \end{aligned} \tag{104}$$

Recording in the accounts. Non-life premiums and claims are treated as current transfers in the allocation of primary income account. The adjustment for changes in technical reserves ensures that only the service charge is recorded as output; the corresponding financial transaction is in AF.6O (ESA, 2013, ESA 2010, §§16.85–16.92, pp. 389–391).

J. Survey Evidence

We employ data from the European Central Bank's Household Finance and Consumption Survey (HFCS), specifically utilizing waves from 2014, 2017, and 2021. Our analysis covers 11 European countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain. The 2010 wave is excluded from our analysis as it was followed by the European Sovereign debt crisis.

The construction of our pension savings indicator requires careful harmonization across HFCS waves due to evolving survey questionnaires. For 2014, we use the variable PF0920 which directly captures voluntary pension savings holdings. For 2017 and 2021, due to changes in the HFCS questionnaire structure, we construct a combined variable that aggregates life insurance products with savings components (captured through PFA020 codes equal to 4) and voluntary pension savings products (captured through PFA020 codes equal to 3), with values extracted from PFA080 for each product category. This harmonization approach ensures comparability across survey waves while acknowledging the structural changes in data collection methodology.

Our analysis employs a person-level perspective, converting household-level survey weights to individual weights by dividing by household size. We restrict our sample to individuals aged 18-89 years, creating seven age groups: 18-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80-89 years. The penetration indicator is constructed as a binary variable taking the value 1 if an individual holds any positive amount in voluntary pension savings or life insurance with savings components, and 0 otherwise.

Our analysis reveals a gradual decline in voluntary pension savings penetration across the European sample. In 2014, 24.1% of the adult population held voluntary pension savings, declining to 22.8% in both 2017 and 2021. This represents a 1.3 percentage point decline over the seven-year period, suggesting potential structural changes in retirement savings behavior.

The data exhibit a pronounced life-cycle pattern in voluntary pension savings participation. Peak participation occurs in the 50-59 age group, with an average penetration rate of 35.2% across all survey years. This finding aligns with theoretical predictions that individuals maximize retirement savings in their peak earning years. Penetration increases substantially with age through the working years, rising from 15.6% among 18-29 year-olds to 26.8% among 30-39 year-olds, 31.5% among 40-49 year-olds, and reaching its maximum of 35.2% among 50-59 year-olds. Penetration rates decrease significantly in older age groups, falling to 22.8% among 60-69 year-olds, 12.8% among 70-79 year-olds, and 11.0% among 80-89 year-olds.

The analysis reveals heterogeneous trends across age cohorts between 2014 and 2021. Participation declined among younger working-age adults, with 18-29 year-olds experiencing a 2.4 percentage point decline (from 16.4% to 13.9%), 30-39 year-olds declining by 2.9 percentage points (from 28.2% to 25.3%), and 40-49 year-olds declining by 4.0 percentage points (from 33.5% to 29.6%). In contrast, the 50-59 age group showed remarkable stability with a marginal increase of 0.2 percentage points (from 35.4% to 35.5%). Older age groups exhibited mixed patterns, with 60-69 year-olds experiencing a slight decline of 0.1 percentage points, 70-79 year-olds showing an increase of 1.6 percentage points (from 12.5% to 14.1%), and 80-89 year-olds declining by 0.9 percentage points.

The documented decline in voluntary pension savings penetration among younger cohorts raises important policy considerations for retirement income adequacy. The 4.0 percentage point decline among 40-49 year-olds is particularly concerning, as this represents the prime wealth accumulation period for retirement planning. The robust age gradient in participation, with peak rates exceeding 35% in the 50-59 age group, confirms the importance of voluntary pension savings as a complement to public pension systems, particularly for individuals approaching retirement. The stability of penetration rates in the peak earning years suggests that established savers tend to maintain their retirement savings behavior, while the declining participation among younger cohorts may reflect changing economic conditions, labor market dynamics, or shifts in financial product preferences.

Penetration by Net Wealth Percentile To examine the relationship between household wealth and voluntary pension savings participation, we stratify our analysis by net worth quintiles. Net worth quintiles are constructed separately for each survey year using weighted population distributions to account for temporal changes in wealth accumulation and distribution. For each year, we calculate the 20th, 40th, 60th, and 80th percentiles of the net worth distribution using survey weights, creating five quintile groups: P0-20 (bottom quintile), P20-40, P40-60, P60-80, and P80-100 (top quintile).

The net worth thresholds demonstrate substantial variation across time and reveal the evolution of wealth distribution in our sample. In 2014, the quintile boundaries were positioned at €7,540 (20th percentile), €60,192 (40th percentile), €155,069 (60th percentile), and €310,375 (80th percentile). By 2021, these thresholds had increased to €11,956, €79,496, €190,527, and €392,604 respectively, reflecting both nominal wealth growth and potential shifts in wealth inequality across the survey period.

Our analysis reveals a pronounced wealth gradient in voluntary pension savings participation. The bottom quintile (P0-20) exhibits consistently low penetration rates, averaging 9.8% across the 2014-2021 period. Participation increases substantially through the wealth

distribution, reaching 22.3% in the P20-40 quintile, 21.7% in the P40-60 quintile, and 25.7% in the P60-80 quintile. The top quintile (P80-100) demonstrates the highest participation rate at 36.6% on average, creating a wealth gap of 26.7 percentage points between the richest and poorest quintiles.

The temporal dynamics reveal diverging trends across wealth quintiles between 2014 and 2021. Lower and middle-wealth households experienced declining participation rates, with the P0-20 quintile decreasing by 0.7 percentage points, the P20-40 quintile declining by 3.3 percentage points, and the P40-60 quintile showing the largest reduction of 7.0 percentage points. In contrast, the upper wealth quintiles exhibited stability or growth, with the P60-80 quintile increasing by 0.5 percentage points and the top quintile (P80-100) demonstrating a substantial increase of 4.1 percentage points, rising from 34.5% in 2014 to 38.5% in 2021.

These findings indicate increasing inequality in voluntary pension savings participation across the wealth distribution. The growing gap between wealthy and less wealthy households suggests that voluntary pension systems may be contributing to retirement income inequality, with high-wealth households increasingly utilizing these savings vehicles while middle and lower-wealth households reduce their participation. This pattern raises important policy considerations regarding the distributional effects of tax-advantaged voluntary pension savings and their role in overall retirement security across different wealth segments of the population.

Table K1: Euro Area Insurance Sector Balance Sheet

Assets	**2016Q3**	**2021Q3**	**2024Q4**	**Liabilities**	**2016Q3**	**2021Q3**	**2024Q4**
IL and UL Assets	1,037	1,550	1,831	TP Life excl. UL	4,417	4,603	3,817
Government Bonds	1,989	2,043	1,586	TP UL	1,036	1,542	1,807
Corporate Bonds	1,643	1,577	1,333	TP Non-life	554	718	789
CIUs	680	1,380	1,251	Other Liabilities	782	876	890
Participations	867	824	1,012				
Loans and mortgages	274	340	320				
Equities	131	163	137				
Cash & Deposits	148	136	125				
Structured notes	148	97	97				
Property	95	102	90				
Collateralised securities	30	24	31				
Other Assets	726	875	880				
Total Assets	**7,767**	**9,110**	**8,692**	**Total Liabilities**	**6,790**	**7,739**	**7,304**

Note: The table reports the aggregate balance sheet of insurance companies in the Euro area. Source: EIOPA. Numbers are reported as EUR billions, sorted by 2024-Q4.

K. Additional Tables and Figures

Table K2: Asset Allocation by Country (€ bn)

Country	**Government Bonds**	**Corporate Bonds**	**CIUs**	**Cash & Deposits**	**Equity**	**Total Assets**
Austria	23.2	26.1	40.1	4.5	25.6	145.0
Belgium	132.5	59.6	71.1	7.7	25.2	375.1
Germany	390.4	445.4	871.2	74.2	455.2	2555.4
Spain	152.6	56.7	37.7	18.3	21.2	337.1
Finland	3.3	11.7	58.1	5.1	5.3	87.5
France	710.6	661.7	885.4	70.4	292.7	3017.8
Ireland	45.0	48.3	214.9	39.8	70.2	528.1
Italy	426.1	163.8	314.0	22.0	114.8	1115.0
Luxembourg	19.5	37.9	115.8	24.6	34.0	299.5
Netherlands	112.4	66.1	126.7	13.1	32.7	530.5
Portugal	18.7	13.2	11.2	2.4	3.8	53.2

Note: Data as in 2023 Q3. Values are in billions of euros. CIUs denote collective investment undertakings. Totals include all reported asset categories.

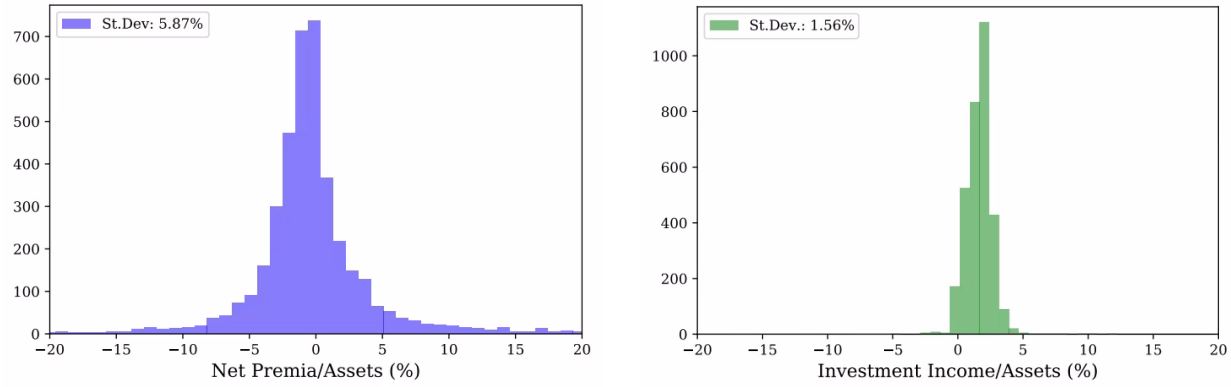
Table K3: Insurance Liabilities by Main Product Types (ranked by size)

Country	**Profit Participation w/** (%)	**IL/UL Guarantees w/o** (%)	**IL/UL Guarantees** (%)	**Total** (€ tn)
France	65.9	13.0	12.6	1.580
Germany	61.2	13.5	0.0	1.302
Italy	66.7	6.0	26.6	0.761
Netherlands	21.3	9.9	20.5	0.298
Belgium	75.4	12.2	5.2	0.203
Luxembourg	24.0	35.9	39.7	0.164
Spain	30.6	1.0	6.5	0.150
Ireland	21.4	10.4	49.5	0.105

Note: The table reports the distribution of contract types across Euro area countries. The last column shows total liabilities, expressed in trillion euros. Source: EIOPA.

Figure K.1: Net Premiums and Investment Income Relative to Total Assets

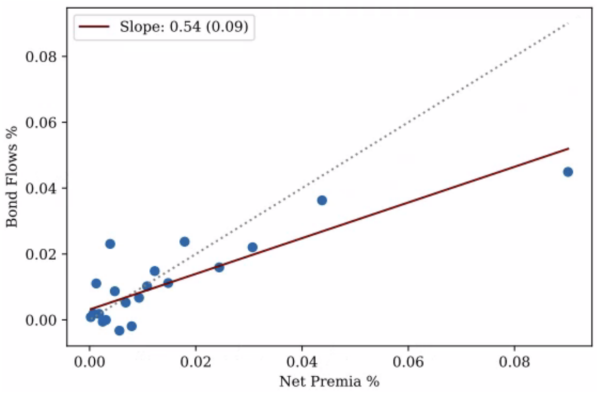
(a) Net Premiums/Assets (b) Investment Income/Assets



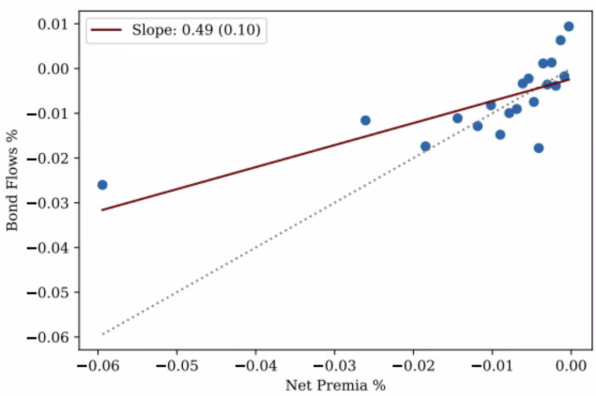
Note: Panel (a) plots the distribution of net premiums relative to total assets $np_{i,t} = \text{Net Premiums}_{i,t}/A_{i,t}$ for all life and composite insurers in our sample. Panel (b) plots the distribution of investment income relative to total assets $\text{Investment Income}_{i,t}/A_{i,t}$. We report the interquartile range (IQR) at the top of each panel. Source: EIOPA Regulatory Filings.

Figure K.2: Net Premia In- and Outflows

(a) Net Premia Inflows



(b) Net Premia Outflows



Note: We regresses % changes in bond holdings $\Delta q^B_{i,t}$ onto net premia $np_{i,t}$ at the quarterly horizon over the panel of insurer-quarter dates via WLS, where we weight observations by lagged bond holdings to reduce the effect of outliers. Panel (a) tests inflow scaling and uses only investor-quarter obervations with $np_{i,t} > 0$. Panel (b) tests outflow scaling and uses only investor-quarter obervations with $np_{i,t} < 0$. The standard error of the partial scaling coefficients (in parentheses) are clustered by quarter.

Table K4: Demand for High Credit Rating: Dummy Specification

	Rebalancing to Lower-Rated Bonds			
	1Q	4Q	8Q	12Q
NAV-Dummy	-0.08	0.04	0.15	0.36
	(0.05)	(0.10)	(0.19)	(0.22)
NP-Dummy	-0.02	-0.21**	-0.44**	-0.78***
	(0.04)	(0.09)	(0.18)	(0.24)
Avg. R^2	0.01	0.01	0.01	0.01
Avg. N	435	418	398	377

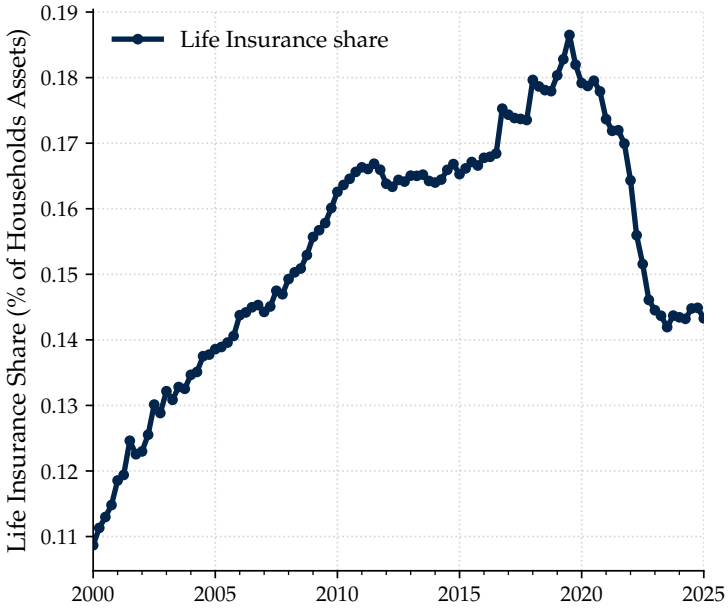
Note: We estimate the portfolio rebalancing towards investment grade versus high yield bonds via Fama MacBeth regressions of $\Delta a^C_{i,t}$ onto net premia dummies and changes in net equity dummies. The dummy variables are equal to 1, if net premia or changes in net equity are in the top decile. We scale both net premia and changes in equity by total lagged assets and estimate the rebalancing regression over 1, 4, 8, and 12 quarter horizon changes. The rightmost column reports cross-sectional regressions of portfolio tilts $w^{LS}_{i,t}$ onto net premia and net equity (in levels).* p<0.10, ** p<0.05, *** p<0.01.

Table K5: Demand for Long Maturity: Dummy Specification

	Rebalancing to Long-Term Bonds			
	1Q	4Q	8Q	12Q
NAV-Dummy	-0.01	-0.07	-0.78^{***}	-1.19^{***}
	(0.04)	(0.12)	(0.26)	(0.37)
NP-Dummy	0.15^{***}	0.66^{***}	1.43^{***}	2.37^{***}
	(0.04)	(0.15)	(0.28)	(0.29)
Avg. R^2	0.01	0.01	0.02	0.02
Avg. N	447	430	410	390

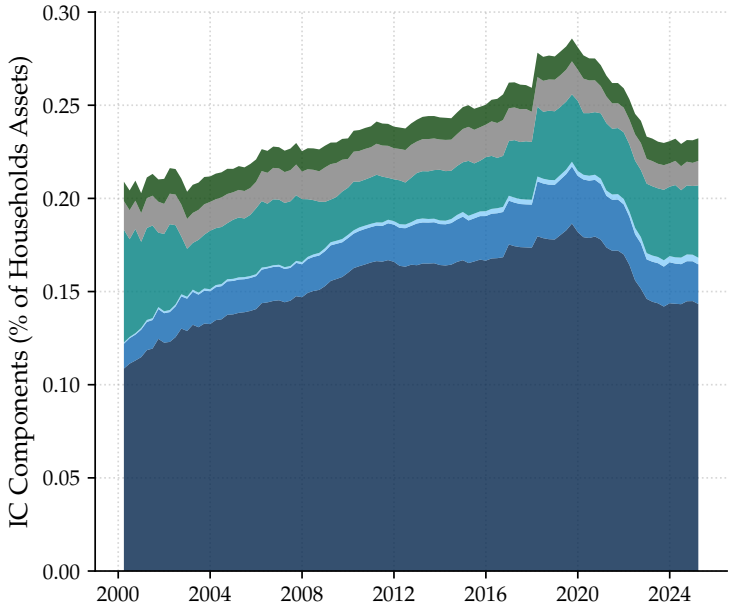
Note: We estimate the portfolio rebalancing towards long versus short maturity bonds via Fama MacBeth regressions of $\Delta q_{i,t}^{\text{LS}}$ onto net premia dummies and changes in net equity dummies. The dummy variables are equal to 1, if net premia or changes in net equity are in the top decile. We scale both net premia and changes in equity by total lagged assets and estimate the rebalancing regression over 1, 4, 8, and 12 quarter horizon changes. The rightmost column reports cross-ectional regressions of portfolio tilts $w_{i,t}^{\text{LS}}$ onto net premia and net equity (in levels).* p<0.10, ** p<0.05, *** p<0.01.

Figure K.3: Household Portfolio Share into Insurance Policies



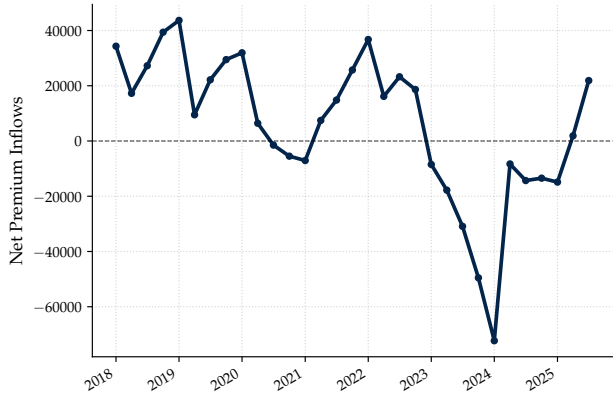
Note: This figure displays the share of life insurance in household financial portfolios. The life insurance share is defined as the stock of insurance corporations' liabilities for life insurance contracts (F62) as a percentage of total household financial assets (F). The numerator captures the outstanding liabilities of insurers in life insurance instruments, while the denominator includes all household financial instruments. The series illustrates the evolving importance of life insurance in household portfolios over time. Source: Quarterly Sector Accounts (QSA).

Figure K.4: Insurance Corporation Components in Household Financial Portfolios



Note: This figure shows the decomposition of insurance corporation components as shares of household financial assets in the Euro Area. The stacked area chart illustrates six components: life insurance, pension entitlements, debt securities, equity and funds, loans, and accounts receivable/payable. Each component represents the stock of insurance corporations' liabilities in the respective instrument as a percentage of total household financial assets. The decomposition reveals the relative composition and evolution of insurance corporation exposure within household portfolios, highlighting which components drive overall insurance corporation presence in household asset allocation over time. Source: Quarterly Sector Accounts (QSA).

Figure K.5: Life Net Premium EIOPA



Note: The figure shows the evolution of net premium inflows for life insurance companies in the Euro Area, based on aggregate public EIOPA data. Net premium is constructed as

Net Premium = Premiums Written (R1500) − Claims Incurred (R1700) − Total Technical Expenses (R2600).

All variables are reported net of reinsurance. The calculation is performed at the country level using EIOPA Solvency II quarterly disclosures, and the resulting series are then aggregated across all Euro Area member states. The plotted time series therefore captures the overall flow of net premiums into the life insurance sector in the Euro Area.

Table K6: Determinants of Underwritten Assets: One-Year Change in Rates

	(1)	(2)	(3)	(4)	(5)	(6)
Δ Slope	0.950***	0.666***				
	(0.096)	(0.151)				
Life ×Δ Slope		0.481**	0.522***			
		(0.198)	(0.193)			
Δ Swap				-0.108***	-0.067	
				(0.034)	(0.052)	
Life ×Δ Swap					-0.058	-0.026
					(0.070)	(0.067)
Firm FE		✓	✓		✓	✓
Year FE			✓			✓
Observations	3036	3036	3036	3036	3036	3036
R^2	0.560	0.562	0.572	0.555	0.558	0.573

Note: This table reports regressions of net premiums (scaled by assets) on one-year changes in the slope of the yield curve and swap rates. Robust standard errors in parentheses. Firm and year fixed effects are included as indicated.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table K7: Descriptive Statistics: OIS Rate Shocks (2010-2025)

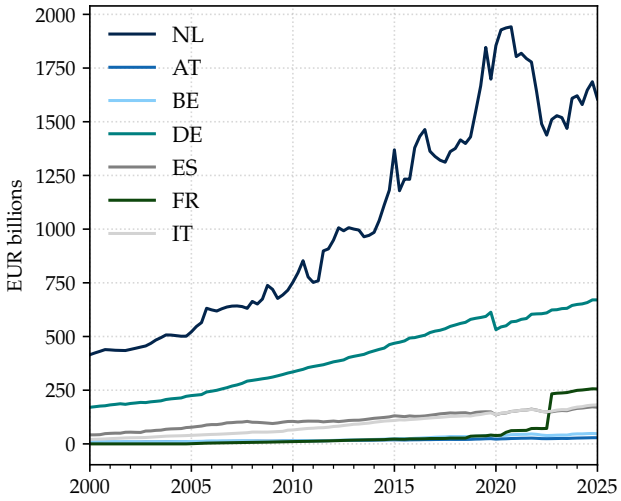
Maturity	Mean	Median	Std Dev	Min	Max	N
3M	0.0277	0.0119	0.0919	-0.1705	0.2925	61
6M	0.0190	0.0056	0.0986	-0.2310	0.2935	61
1Y	0.0148	0.0046	0.1076	-0.2970	0.2691	61
2Y	-0.0076	-0.0061	0.1160	-0.3387	0.2930	61
3Y	-0.0221	-0.0185	0.1149	-0.3484	0.2680	61
4Y	-0.0198	-0.0136	0.0964	-0.2705	0.2230	61
5Y	-0.0290	-0.0201	0.0952	-0.2615	0.2000	61
6Y	-0.0277	-0.0131	0.0886	-0.2630	0.1755	61
7Y	-0.0223	-0.0100	0.0803	-0.2585	0.1535	61
8Y	-0.0239	-0.0122	0.0762	-0.2425	0.1435	61
9Y	-0.0238	-0.0055	0.0769	-0.2570	0.1145	61
10Y	-0.0207	-0.0042	0.0688	-0.2340	0.0840	61
15Y	-0.0160	0.0000	0.0555	-0.1810	0.0900	61
20Y	-0.0081	0.0000	0.0547	-0.1610	0.1200	61

Note: This table presents descriptive statistics for overnight index swap (OIS) rate shocks across different maturities. Data covers the period from 2010 to 2025. All values are in percentage points. OIS shocks are calculated as 4-quarter rolling sums of identified monetary policy surprises.

The pension sector in the Euro area is €3.27 trilions.

Figure K.6: Pension Sector

(a) Pension Sector by Country



(b) Life Insurance Liabilities of Pension Sector

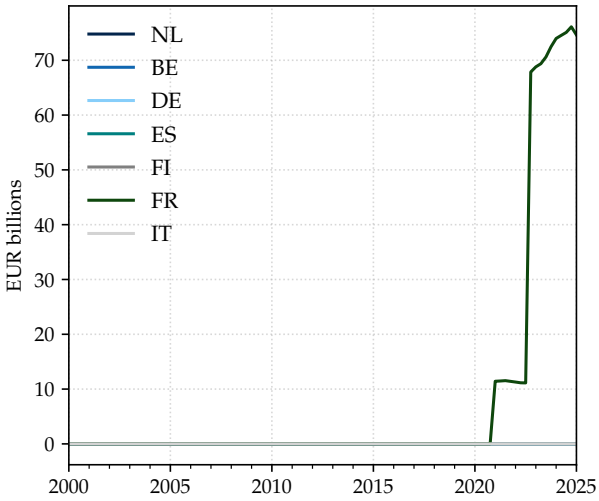


Figure K.7: German 30 Year Yield

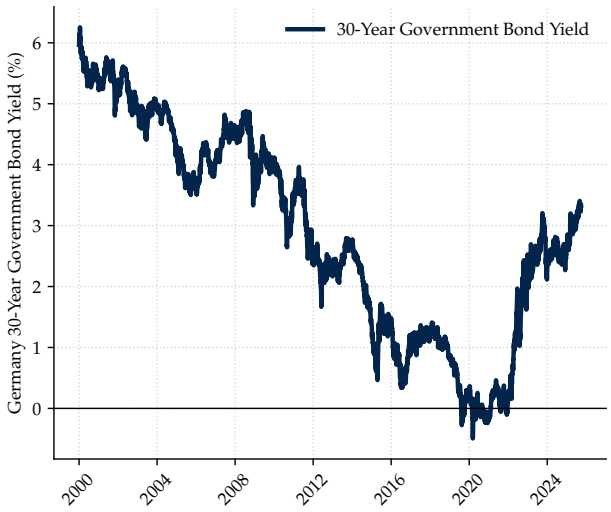


Figure K.8: German 30 Year Bond Return Volatility

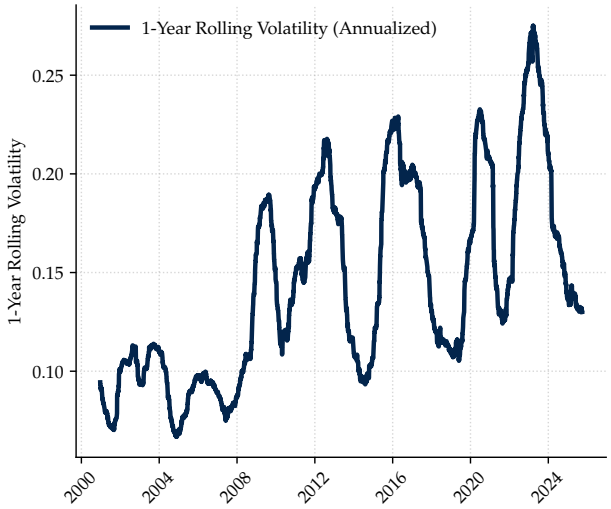
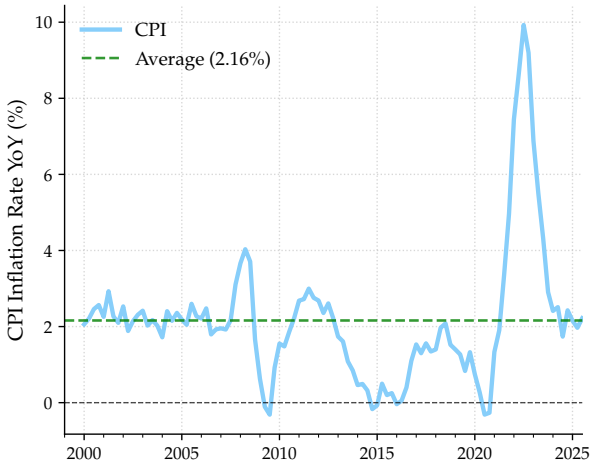
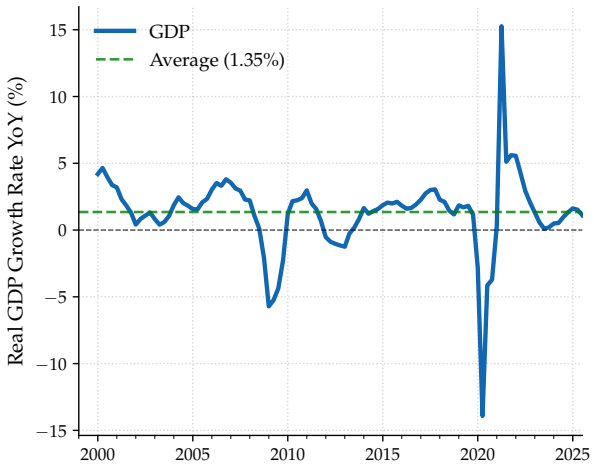


Figure K.9: Euro area Inflation



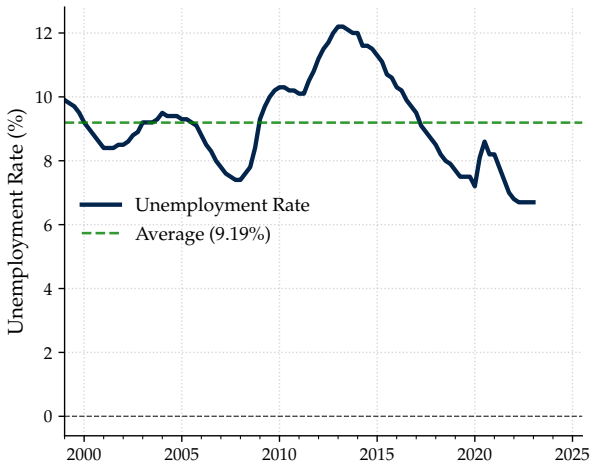
Note: The figure displays the evolution of the inflation rate in the euro area, along with its corresponding period average.

Figure K.10: Euro area GDP Growth



Note: The figure displays the evolution of the annual GDP growth rate in the euro area, along with its corresponding period average.

Figure K.11: Euro area Unemployment Rate



Note: The figure displays the evolution of the annual GDP growth rate in the euro area, along with its corresponding period average.

Figure K.12: Slope and Term-Premiun

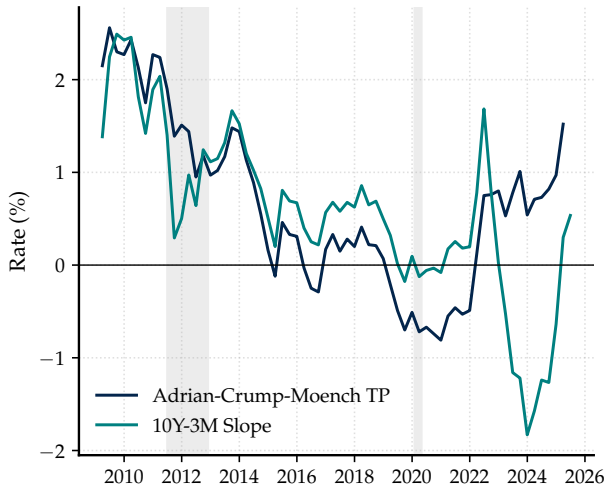
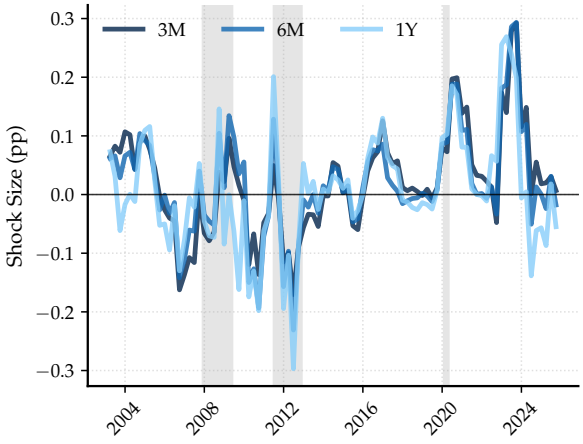


Figure K.13: Cumulated High-Frequency shocks around ECB announcements

(a) Short Term Rates



(b) Long-Term Rates

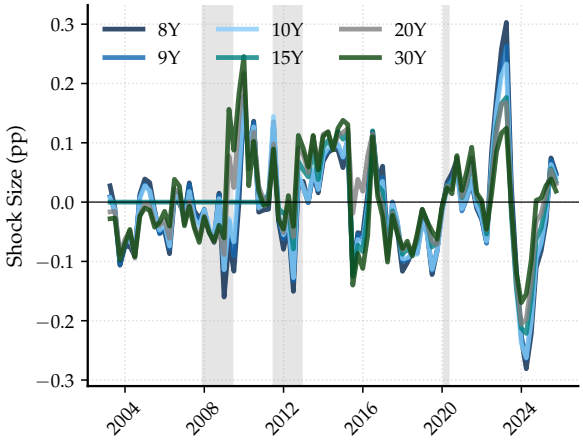


Table K8: Insurance Surrenders by Country (2020-2023)

Country	2020 (EUR bn)	2023 (EUR bn)	Change (%)
Portugal	1.0	2.5	+142.6%
Greece	0.5	1.1	+133.7%
Austria	1.2	2.8	+133.3%
Italy	41.6	86.7	+108.3%
Luxembourg	13.6	25.7	+88.1%
France	54.6	81.2	+48.7%
Spain	8.8	12.5	+41.5%
Finland	1.9	2.3	+18.6%
Ireland	17.2	19.5	+13.5%
Belgium	7.8	6.8	-13.5%
Germany	21.8	16.7	-23.2%
Netherlands	4.6	2.8	-38.1%
Euro area	**175.5**	**261.4**	**+49.0%**

Notes: Values represent total amount of surrenders in EUR billions. Change column shows percentage change from 2020 to 2023. Euro area total includes all Euro area countries.

Figure K.14: Change in Flows to Insurance and Change in Yield During QT

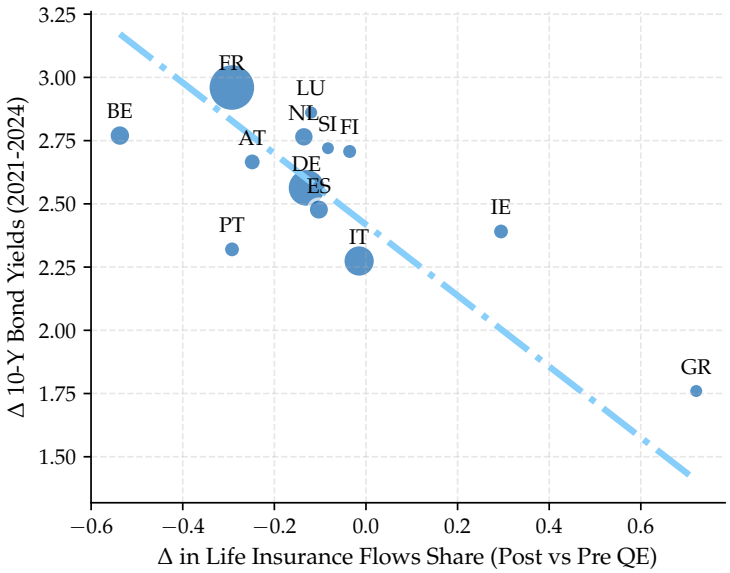


Figure K.15: Fair Value Minimum Guarantee Rate and Deposit Rate

