When the tide goes out: The Effect of QE on the Structure of the Financial System*

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Abstract

This paper shows that the prolonged period of low long-term interest rates fundamentally reshaped the European financial system by compressing the life-insurance sector—the main private holder of long-dated sovereign debt. Life insurers depend on high long-term yields to offer attractive guaranteed-return savings products to households. Using newly assembled supervisory data from EIOPA combined with flow-of-funds statistics, we show that the compression of term premia under quantitative easing (QE) reduced household inflows into life insurers by nearly €2 trillion between 2015 and 2022, leading to a sharp contraction in their bond holdings. Instrumenting the term premium with high-frequency monetary policy shocks, we find that insurers' inflows respond strongly to long-term rates, particularly among those most exposed to guaranteed-rate products. Because insurers invest roughly €0.70 in bonds for every €1 of inflows, this *liability-side channel* accounts for the bulk of their bond demand. The effects during QT were not symmetric: rising rates triggered widespread policy surrenders, turning insurers into net sellers of government bonds. Although inflows have begun to recover as yields normalized, the rebound remains limited. By compressing long-term yields, QE indirectly reshaped the investor base for sovereign debt—leaving bond markets more reliant on central bank demand and less anchored by private long-term investors.

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1. Introduction

Over the past decade, central banks have implemented unprecedented policies aimed at lowering long-term interest rates. Under its QE programmes, the ECB alone purchased more than €5 trillion in bonds, accumulating over one third of all outstanding Euro area government securities. From 2015 to 2022, its net purchases exceeded sovereign issuance in every year, leaving financial markets with virtually no new government debt to absorb.

These interventions pushed long-term yields and term premia to historic lows, with even 30-year bonds trading at negative rates. What did this environment mean for life insurers—the largest investors in long-term bonds in the Euro area? And as governments resume large-scale issuance under quantitative tightening, what are the implications for the demand and pricing of long-term debt?

As the chair of EIOPA—the European insurance regulator—remarked, "The low interest rate environment [. . .] has had *structural consequences* across the financial sector, and insurance is no exception in this regard." As insurers themselves acknowledged, "the business plans in the industry have not been built on the basis of zero returns."[1]

This paper shows that quantitative easing (QE) not only lowered the term premium but also has changed the structure of the financial system. By making the traditional products sold by life insurers less attractive, it reduced household inflows into the sector and, in turn, insurers' demand for long-term bonds. This development went unnoticed in the bond market during QE, as industry flows adjust slowly and long-term rates remained low. However, as the ECB unwinds its balance sheet, the implications for government financing become evident: insurers—typically stable, long-term investors in sovereign bonds—are no longer absorbing net issuance to the same extent as before QE. When the tide goes out, the structural changes in the investor base become visible, revealing a system that has grown more dependent on central bank demand.[2]

When examining the link between interest rates and insurers' bond portfolios, the literature has primarily emphasized *portfolio rebalancing* and duration-hedging behavior. For example, studies argue that when interest rates decline, insurers increase their demand for bonds to improve hedging (Domanski et al., 2017).[3] In practice, however, insurers' footprint

[1]The first quote is from Petra Hielkema, Chair of EIOPA, in her speech *"Navigating low rates, the pandemic and inflation – shifting patterns in life insurance"*. The second is from a presentation to the ECB by Peter Hegge, Head of Fixed Income, Allianz Investment Management SE.

[2]This asymmetry is not unique to the insurance sector. The waxing and waning of central bank balance sheets have proven far from symmetric elsewhere. Evidence from the U.S. shows that QE created liquidity dependence among commercial banks, as their balance sheets expanded during QE but failed to contract meaningfully during quantitative tightening (QT) (Acharya et al., 2023; Blickle et al., 2025). In this paper, we show that a similar form of dependence has emerged for long-term bonds.

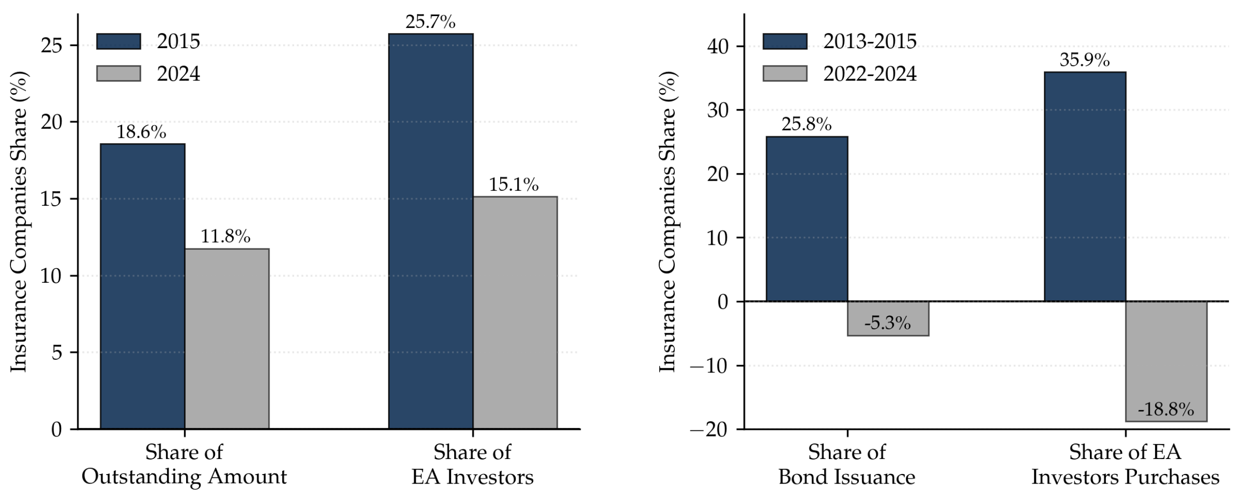
[3]This mechanism is further supported by evidence that insurers may exhibit upward-sloping demand for

in the government bond market has diminished markedly over the past decade as interest rates declined, as shown in Figure 1a. Between 2015 and 2024, their 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—over 40% lower than a decade earlier. These figures mark a structural retreat of the largest long-term investors from the sovereign bond market.

The decline in insurers' bond holdings is also difficult to reconcile with standard portfolio-rebalancing interpretations. One possibility is that, as interest rates fell, insurers engaged in a "search for yield," reallocating toward higher-return assets (Becker and Ivashina, 2015). However, if this mechanism were the dominant driver, the response should have been symmetric: rising yields during the ECB's quantitative tightening (QT) should have encouraged insurers to rebuild their bond portfolios. Yet, the opposite occurred. In the two years following the end of QE, insurers were net sellers of government bonds. This pattern contrasts sharply with the pre-QE period, when insurers consistently absorbed around 30 percent of government bond issuance, acting as a key stabilizing force in the sovereign debt market (see Figure 1b).

Figure 1: Insurance Companies, Shares of Bond Market

(a) Share of Bond Market (Stock) (b) Share of New Issuance (Flows)



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) shows insurers' net purchases as a share of net government bond issuance and of total bond purchases by Euro area investors.

Our paper shifts the focus from *asset-side management* to *liability-side inflows* as the primary driver of insurers' bond demand. Using newly assembled regulatory data from EIOPA

bonds at very low rates (Koijen et al., 2017). Moreover, the introduction of Solvency II in 2016 prompted insurers to increase their bond holdings to better hedge interest-rate risk, as shown by Jansen (2023).

supervisory filings since 2016, we construct quarterly measures of net-premium inflows and bond transactions for the entire Euro area life-insurance sector. We complement these data with flow-of-funds statistics—available since the inception of the euro—to trace the portfolio reallocation of households that shaped insurers' inflows over time. This integrated dataset allows us to link household saving behavior, insurers' balance-sheet dynamics, and government bond yields within a unified framework.

Insurance Sector in the Euro area In the Euro area, life insurance policies primarily take the form of long-term savings and retirement contracts that include a minimum return guarantee. These products—known as *profit-participation policies*—combine a guaranteed rate with participation in insurers' investment returns. In 2016, such contracts accounted for about 66% of life insurers' total liabilities. Owing to the structure of the European pension system,[4] life insurance policies represent a key vehicle for retirement saving in the Euro area. Before the introduction of QE in 2014, they accounted for 24% of households' financial portfolios—second only to bank deposits. Consequently, life insurers were the largest institutional holders of government bonds and, given their preference for long maturities, by far the dominant investors in bonds with maturities exceeding ten years.

Profit-participation policies are hybrid investment products that grant policyholders two embedded options: (i) a put option guaranteeing a minimum return and (ii) a surrender option that allows early redemption, typically at book value but subject to modest costs. Insurers back these contracts primarily with long-term bonds and set the guaranteed rate—a key contractual parameter—at a spread below prevailing long-term yields.[5]

Interest Rate and Life Insurance Policies Profit participation policies are closely related to the U.S. variable annuities studied by Koijen and Yogo (2022). In their framework, the' demand for insurance products by households is a function of the guaranteed rate compared to the return on outside assets. In the Euro area, the most relevant outside asset is bank deposits, reflecting the very low equity ownership among bottom 90% of the population. Because insurers typically set the guaranteed rate at a spread below long-term yields, the key driver of its variation over time is the slope of the yield curve or the term premium.[6] Historically, the yield curve has been upward sloping with a positive term

[4]The pension sector is largely pay-as-you-go and predominantly defined-benefit. The main exception is the Netherlands, where funded pension schemes are more prevalent. Overall, the European pension sector is roughly one-fifth the size of the life-insurance sector, with most assets concentrated in the Netherlands.

[5]The *fair* pricing of these policies implies a guaranteed rate that lies a spread below long-term yields. The size of this spread compensates insurers for the value of the embedded options and reflects the policyholder's agreed share in profit participation.

[6]Households may compare the guaranteed rate with the expected return from rolling over short-term deposits, that is, the average expected short-term rate over the horizon.

premium of approximately 1.5%, which has allowed insurance companies to issue policies that were attractive for households.[7] Based on these premises, we expect that a lower slope of the yield curve (or term premium) should reduce households' demand for life insurance policies.

Main Findings Against this backdrop, our paper presents several key findings. First, we show that the decline in the term premium associated with the low *long-term* interest rate environment led to a significant reduction in household inflows into the life-insurance sector. Although the decline in flows occurred gradually, the cumulative effect over several years is substantial—amounting to nearly €2 trillion in lost inflows. To quantify this relationship, we regress aggregate inflows—measured as the share of total household financial flows—on the term premium (or slope) and the variation in short-term rates. A simple two-factor model of the lagged term premium and the recent change in the short rate explains 80% of the time-series variation in insurance flows. We instrument term premium with high-frequency monetary policy shocks and we find that insurers' inflows respond strongly to long-term rates. Turning to the cross-section of insurance flows, we find that the sensitivity of inflows to the term premium is particularly strong among insurers with a larger share of profit-participation policies—those most exposed to guaranteed-rate products. The identification strategy includes firm fixed effects to capture insurer-specific heterogeneity and time fixed effects to control for common macro-financial shocks.

Second, we assess quantitatively how large this liability-side channel is relative to the traditional portfolio-rebalancing channel in explaining insurers' bond trading flows. We document a new empirical finding on the pass-through from inflows to bond purchases: insurers invest roughly €0.70 in bonds for every €1 of net inflows, and these liability-driven flows explain about 73% of the variation in insurers' bond purchases over time and across institutions.

Third, we show that flows did not recover once the ECB began quantitative tightening (QT). The sensitivity of surrenders to short-term interest rates plays a crucial role here, together with important path dependencies. This mechanism explains why our two-factor model incorporates variation in short-term rates. In the short run (2022–2023), policyholders surrendered contracts written during the low-rate period, causing the life-insurance sector to experience net outflows for the first time since the creation of the euro and turning insurers into net sellers of bonds. These outflows also increased solvency pressures within the sector and ultimately contributed to the failure of Eurovita, an Italian life insurer.

[7] Throughout the paper, when referring to the term premium, slope, or short-term rates, we use the German yield curve or, alternatively, OIS swap rates. Since the creation of the euro until 2014, the term premium has remained positive, averaging around 2%.

Fourth, we document two major structural adjustments that occurred during the prolonged low-interest-rate period. First, insurers reoriented their product offerings toward Unit-linked contracts—with full return pass-through—while scaling back traditional profit-participation policies that offered guaranteed returns.[8] Second, participation by working-age households in life insurance declined sharply. Together, these developments suggest that—even though the recent rise in term premia in 2024–2025 has spurred a modest rebound in inflows—the sector's overall size relative to the bond market is unlikely to return to pre-QE levels. Insurers themselves acknowledge in their investment reports that their business models have permanently shifted toward Unit-linked products. Moreover, the extended period of unattractive guaranteed rates is likely to leave lasting scars on households' portfolio preferences (Malmendier and Nagel, 2011).

The Bond Market After QE We assess how the contraction of the life insurance sector affected the European long-term bond market. The equilibrium impact of insurers on bond yields depends on three components: the magnitude of insurance flows, insurers' tilt toward long-term bonds relative to the intermediaries receiving their outflows, and the price impact of demand shifts. QE compressed term premia and triggered roughly $2 trillion in cumulative outflows from insurers (about 6% of household wealth) as households reallocated savings away from life-insurance products. These reallocations primarily went to bank deposits and mutual funds, all of which have far lower exposure to long-maturity bonds, so the fall in insurance inflows represented a genuine decline in aggregate long-term bond demand. Combining the size of flows, insurers' relative tilt, and empirical price multipliers implies that QE-induced insurance outflows lowered long-term yields by around 50 basis points, with plausible estimates ranging from 40 to 100 basis points.

We nest this insight in an equilibrium Vayanos–Vila model with endogenous preferred habitat. Households allocate their financial resources across sectors—most notably the insurance sector and an outside sector that aggregates all other investors—each of which exhibits a distinct portfolio tilt (i.e., a different *habitat*). We then simulate QE shocks within this framework and derive the resulting equilibrium demand curve. Our results show that the effects of QE on yields operate not only along a given demand curve but also through a shift of the demand curve itself, as QE induces reallocation across sectors within the financial industry.

[8] As discussed in Koijen and Yogo (2022), insurers do not offer negative minimum guaranteed rates, presumably because investors exhibit a psychological aversion to "negative interest rates." When even 30-year government bond yields turned negative, insurers could no longer profitably offer guaranteed-return products such as annuities and consequently withdrew from the market.

The Role of Solvency Regulation A concurrent regulatory shift further reinforced the decline in guaranteed-rate products. In 2016, the introduction of *Solvency II* replaced book-value regulation with a market-consistent framework. Under the new rules, products with embedded guarantees—such as profit-participation policies—became capital intensive, requiring insurers to hold substantial solvency buffers against interest-rate risk. This regulatory environment made insurers more cautious about offering long-term guarantees and heightened their sensitivity to prolonged periods of low rates. Importantly, both insurers and external observers—such as bank equity research analysts and supervisory reports—consistently linked the impact of Solvency II to the low-rate environment when explaining the shift in product design. In our interpretation, the regulation did not necessarily introduce new constraints but rather made pre-existing risks—previously obscured under book-value accounting—transparent.

This interpretation aligns with historical experience. In Japan, a temporary rise in long-term yields during the late 1980s prompted insurers to issue policies with unusually high guaranteed returns. When interest rates fell sharply in the 1990s, investment yields dropped below these guarantees—a *negative spread*—which eroded profitability. Because liabilities were valued at book value, losses remained unrecognized until several major insurers failed between 1997 and 2001, together accounting for roughly 15% of life-insurance assets. As Fukao (2003, p. 27) notes, "the negative spread losses were not recognized promptly because insurance liabilities were valued at book value, allowing life insurers to continue operations even after they had become economically insolvent."[9] The Japanese experience demonstrates that prolonged low rates can threaten solvency even under book-value accounting; Solvency II simply makes such risks observable rather than creating them.

2. Related Literature

First, our paper contributes to the literature on quantitative easing (QE). A large body of research has examined the effects of QE on bond markets and term premia (see, among

[9] According to the Bank of Japan (2013), under statutory accounting "insurance liabilities are valued at book value and therefore do not reflect market fluctuations," delaying recognition of economic losses. The Financial Services Agency of Japan (2003) notes that as interest rates declined, "the yields on assets became lower than the assumed interest rates on insurance contracts, resulting in a negative spread," which "significantly impaired insurers' profitability." Between 1997 and 2001, seven major life insurers—Nissan Mutual Life, Toho, Daihyaku, Taisho, Chiyoda, Kyoei, and Tokyo Life—entered bankruptcy. Hoshi and Ito (2004) quantifies their combined size at about 15% of total life-insurance assets and emphasizes that solvency ratios were "extremely lenient," allowing deferred tax assets and unrealized gains to be counted as capital, while the The Geneva Association (2015) characterizes the episode as one of "persistently negative spreads and hidden solvency erosion." Comparable pressures emerged in Taiwan and South Korea, where insurers that had promised guaranteed returns of up to 8 percent later faced persistent negative spreads and solvency deterioration (Han et al., 2010; Lee and Seo, 2015).

others, (Krishnamurthy and Vissing-Jorgensen, 2011; He and Krishnamurthy, 2013; Vayanos and Vila, 2021; Haddad et al., 2023, 2024)).

In particular, Koijen et al. (2017) analyze how financial intermediaries rebalance their portfolios in response to the ECB's asset purchases. 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 examine the QT episode and discuss how shifts in investor composition affect the slope of the demand elasticity, making the market more elastic and reducing the effect of QT.

We add to this literature by showing that, although insurance companies were not major sellers of bonds to the ECB, the prolonged period of low long-term rates that followed QE led to a sharp contraction in household inflows—reducing the overall footprint of the insurance sector in the bond market. Importantly, we also document that these effects were not symmetric. The impact of rising yields during quantitative tightening (QT) did not mirror the effects of QE. As the sector shrank, a key investor group in long-term bonds diminished in size. Our main insight is that this contraction shifts the demand curve inward, rather than altering its slope, thereby putting upward pressure on equilibrium yields.

This asymmetry is not unique to the insurance sector: evidence from the United States indicates that QE created liquidity dependence among commercial banks, as their balance sheets expanded during QE but failed to contract meaningfully during QT (Acharya et al., 2023; Blickle et al., 2025).

Our paper more broadly examines the implications of monetary policy for the bond market. Fang (2023); Fang and Xiao (2025); Jansen et al. (2024) study how financial intermediaries shape the transmission of monetary policy in the United States. We complement this literature by constructing and analyzing new data on inflows into the life-insurance sector. Our focus is on the slow-moving effects of a prolonged period of low long-term interest rates on insurers' balance sheets, liabilities, and bond-market behavior.

Second, our paper directly relates to the growing literature on the impact of pension funds and insurance companies on government bond markets (Greenwood and Vissing-Jorgensen, 2018; Jansen, 2023). This literature has predominantly focused on the cross-sectional portfolio allocation of these long-term investors due to duration gaps Domanski et al. (2017), regulatory accounting incentives Ellul et al. (2015); Sen (2023), reaching for yield Becker and Ivashina (2015), risk-bearing capacity Li (2024). We confirm the portfolio rebalancing channels across different asset classes and maturity profiles, but show that *economically* the rebalancing activity is swamped by the trading from liability flows, which are ultimately driven 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 secular trends, and are hence the key driver of insurance companies' bond demand, both in the cross-section of insurers and in the aggregate time series. A large literature documents the effects of interest rates on insurers' equity capital (Berends et al., 2013; Koijen and Yogo, 2021; Hartley et al., 2016; Ozdagli and Wang, 2019; Sen, 2023; Li, 2024). Under negative duration gaps, declining rates may hurt insurance companies which in turn may affect their asset holdings. We contribute to this literature by highlighting an additional (and economically very important) channel through which interest rates affect insurance companies: Lower rates depress liability flows by reducing the attractiveness of long-term savings products, which affect insurers' presence in long-term bond markets.

We examine how an increase in short-term interest rates affects surrender behavior and, in turn, the bond market. Grochola et al. (2023) study this mechanism for the German insurance sector. Using data covering all European countries, we quantify the role of surrender across markets and empirically estimate its impact on insurers' bond purchases. We show that the distribution channel and the volume of life-insurance policies issued at low guaranteed rates are central determinants of the strength of this mechanism. Consistent with these institutional differences, we find that surrender activity matters primarily in a subset of countries—most notably Italy and France.

Third, by focusing on insurers' liability flows, we 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, 2022). Wenning and Li (2025) show that life insurers in the US shifted to offering shorter-duration policies to hedge against rising duration gaps. Similarly, we find that EU insurers shifted their liabilities away from profit participation contracts with return guarantees towards Unit-linked products without guarantees. Barbu (2022) shows that return guarantees are more prevalent in countries with less stringent capital requirements, and that the share of return guarantee products affects insurers' interest rate exposure. Building on this, we show that these insurers received greater outflows as interest rates rose with QT. Barbu (2023) highlights insurers' incentives to induce customers owning high guarantee products to switch into products with less favorable terms.

Finally, our paper contributes to the growing literature on the interaction between households, financial intermediaries, and asset markets—what Haddad and Muir (2025) term the study of market macro-structure. Explicitly modeling intermediaries, their capital allocation decisions, and the frictions they introduce into household portfolio choices has proven remarkably successful in explaining the behaviour of asset prices (Vayanos and Vila, 2021; Koijen and Yogo, 2019; Gabaix and Koijen, 2021). The price impact of "preferred habitat agents" such as insurance companies and pension funds on bond markets has been widely documented in many event studies (Greenwood and Vayanos, 2010; Guibaud et al., 2013; Greenwood and Vayanos, 2014; Klingler and Sundaresan, 2019; Jansen, 2023; Coppola, 2025). We emphasize that market segmentation arising from preferred-habitat investors ultimately reflects households' allocation of capital across financial intermediaries. If households were to elastically reallocate savings between intermediaries, they would offset any frictions introduced by preferred habitats. In practice, however, household reallocations are slow-moving and subject to two key frictions: first, strong behavioral biases such as a preference for minimum-return guarantees—largely eroded by the prolonged low-rate environment (Wenning and Li (2025))—and second, the inherently inert nature of life-insurance products, as households typically allocate new savings at the margin rather than revisiting past purchase decisions. Households' allocation of capital across intermediaries thus has *material* consequences for the long-run composition of preferred-habitat investors. These slow-moving yet endogenous habitats offer a natural explanation for the recent excess volatility in long-term yields.

Our paper also contributes to the literature by documenting the evolution of the life-insurance market using newly available regulatory data. While Du et al. (2023a) 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.

3. Institutional Details

Insurance companies in the European Union are subject to the Solvency II framework, which took effect on 1 January 2016. Solvency II sets common standards for valuing assets and liabilities and specifies the associated capital requirements. Under Solvency II, firms are classified as life, non-life, composite, or reinsurance undertakings. An undertaking is designated as composite when it holds authorization to operate in both the life and non-life segments.

Balance Sheet We begin by reviewing the structure of Euro area insurers' balance sheets, as summarized in Table I. 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 reflects the fall in the market value of insurers' assets following the rise in interest rates.

Index-linked (IL) and Unit-linked (UL) assets constitute the largest component of insurers' balance sheets, totaling approximately €1.8 trillion in 2024. This represents a 77% increase relative to 2016 and corresponds to 21% of total assets. Government bonds are

Table I: 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.

the second-largest category, amounting to €1.6 trillion in 2024, though their value has declined markedly from €2 trillion in 2016. Corporate bonds rank third, with holdings of €1.3 trillion in 2024, down by roughly €300 billion compared with 2016. Collective Investment Undertakings (CIUs) have expanded substantially, rising from €0.68 trillion in 2016 to €1.25 trillion in 2024—an 84% increase. Participations also remain sizable, exceeding €1 trillion in 2024. Other asset classes—including loans and mortgages, equities, cash and deposits, and property—are smaller in absolute terms but contribute to the diversification of insurers' portfolios.

Assets by Country We also report the allocation by country in Table II, which presents the asset composition of insurers across Euro area countries for 2021Q3, the period preceding the recent increase in interest rates. France and Germany account for the largest balance sheets, with total assets of approximately €3.0 trillion and €2.6 trillion, respectively. Within these portfolios, collective investment undertakings (CIUs) constitute the largest asset class, amounting to €885 billion in France and €871 billion in Germany. Corporate bonds also represent a substantial share, totaling €662 billion in France and €445 billion in Germany. Government bonds remain a key component, at €711 billion in France and €390 billion in Germany, reflecting their role as liquid and low-risk assets. Italy and the Netherlands follow, with total assets of €1.1 trillion and €0.5 trillion, respectively, while other countries in the sample are considerably smaller in scale.

Technical Provisions On the liabilities side, the main item is technical provisions (TP), which represent insurers' obligations to policyholders. Under Solvency II, TP are calculated

Table II: 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.

as the sum of a best estimate and a risk margin. The best estimate corresponds to the discounted value of future cash flows expected to arise from insurance and reinsurance obligations, using risk-free interest rate term structures published by EIOPA. The risk margin ensures that the value of liabilities is sufficient for another undertaking to take them over, and is computed using a cost-of-capital approach.

Technical provisions for life insurance excluding UL stood at €3.8 trillion in 2024, down from €4.6 trillion in 2021. Technical provisions for UL reached €1.8 trillion, closely mirroring the increase on the asset side. Non-life technical provisions amounted to €0.8 trillion in 2024, while other liabilities remained stable at just under €0.9 trillion.

3.1 Measuring Insurance Flows

Throughout the paper we analyze net flows into insurance companies. We define total flows as the sum of three components: underwriting flows, investment income, funding and capital flows. In compact form, we write:

$$\text{Total Flows}_t = \text{Underwriting Flows}_t + \text{Investment Income}_t + \text{Funding Flows}_t + \text{Capital Flows}_t.$$

Underwriting flows. Underwriting flows are calculated as premiums minus claims (both net of reinsurance), minus expenses:

$$\begin{aligned}\text{Underwriting Flows}_t^{\text{proxy}} &= \text{Premiums (net of reinsurance)} \\ &\quad - \text{Claims (net of reinsurance)} - \text{Expenses} \quad (1) \\ &= \textit{Net Premiums}. \quad (2)\end{aligned}$$

Throughout the paper, we refer to underwriting flows as *net premium.* When underwritten premiums exceed claims, insurers accumulate capital, which can be held as cash or invested in securities. Conversely, when claims exceed premiums, they must draw down reserves or liquidate securities. Hence, net premiums (premiums minus claims) represent capital flows in and out of insurers, analogous to flows in and out of mutual funds (Lou, 2012).

Investment income. Investment income includes dividends, interest, and rental income. It excludes net or unrealised gains and losses, as these represent valuation effects that are separately captured in the revaluation component.

Funding and Capital flows Capital flows include transactions such as equity and debt issuance. For instance, when insurance companies issue equity or bonds, the proceeds can be used to purchase additional assets. In principle, market values of debt instruments reported in the Quantitative Reporting Templates could be used to track such flows. However, it is not possible to separate true issuance from valuation effects. For this reason, we do not incorporate capital flows into our analysis.

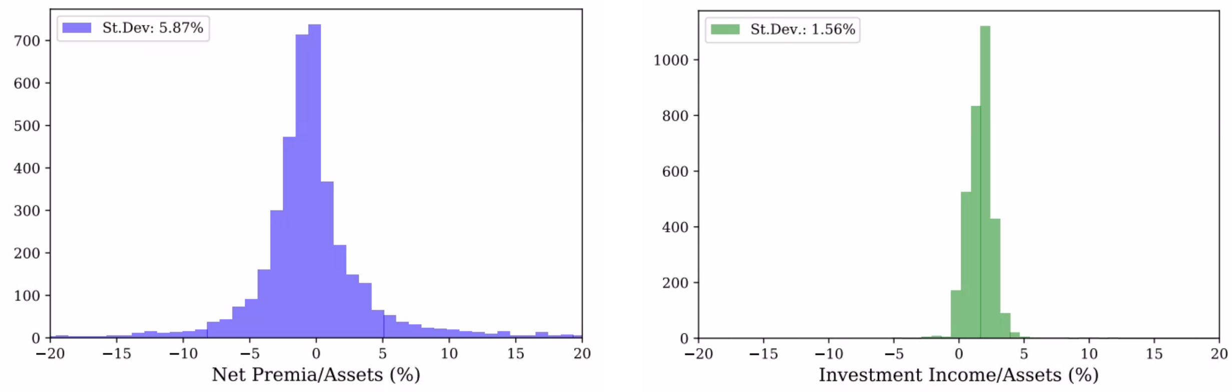
Funding flows would, in principle, capture cash movements arising from transactions such as repurchase agreements and securities lending, based on information contained in the funding and collateral Quantitative Reporting Templates. Yet, due to data limitations, we exclude funding flows from our empirical measure of total flows as well.

Technical details—including the mapping to specific Quantitative Reporting Template codes and precise variable definitions—are provided in Appendix H.

Figure 2 plots the distribution of net premiums, scaled by total assets and aggregated annually across all life and composite insurers in our sample. Insurers experience substantial inflows and outflows relative to assets. The interquartile range of net premiums is 3% of assets, implying very large capital reallocations given the size of the sector. It is not uncommon for insurers to experience capital inflows or outflows of around 10% of assets through net premiums. The volatility of net premiums is substantially higher than that of investment income (Panel b), which typically fluctuates within a narrower range of 0 to 5%.

Figure 2: Net Premiums and Investment Income Relative to Total Assets

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



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.

3.2 Life Insurance Products and Liabilities

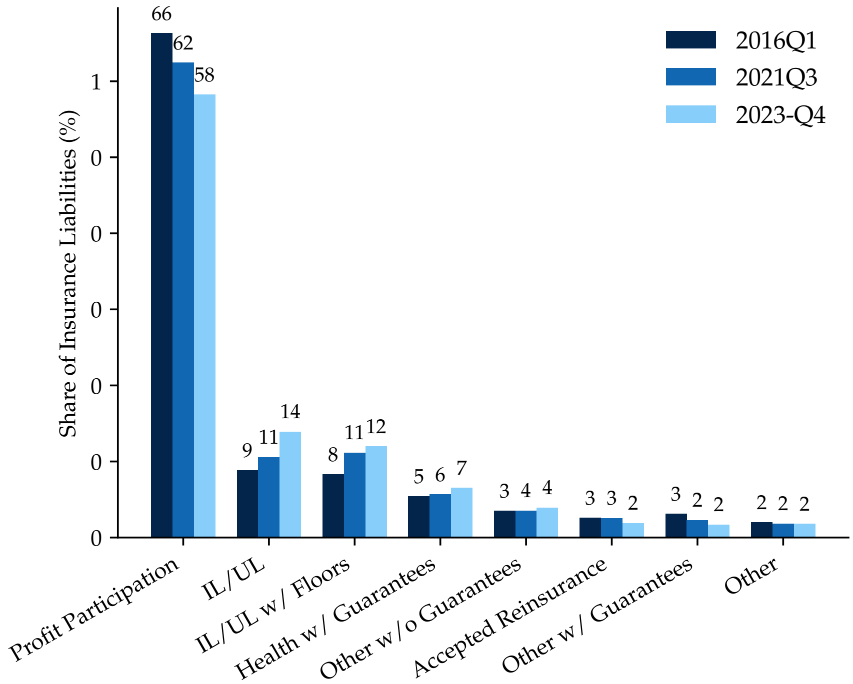
Life insurers offer two main products: Profit Participation (PP) and Unit-linked products.

Profit-participation (PP) contracts. PP contracts, often offered as retirement products, combine a guaranteed minimum return with discretionary bonuses linked to the performance of the underlying assets. In Germany, for example, traditional policies (*klassische Lebensversicherung*) guarantee a minimum credited rate—historically set by regulation as 60% of the 10-year AAA yield—and distribute additional surplus depending on investment performance. In practice, this means policyholders are assured a baseline return, while also participating in portfolio gains through annual bonus declarations.[10]

Unit-linked (UL) contracts Unit-linked (UL) contracts with guarantees tie benefits to an investment portfolio but include a guaranteed floor, introducing option-like features and exposure to both market dynamics and the cost of guarantees. By contrast, UL contracts without guarantees transfer investment risk entirely to policyholders, with benefits tracking asset values directly.

[10]Financial guarantees are widespread but heterogeneous across countries. Barbu (2022) report that 74% of liabilities include such guarantees. In France, all participating contracts carry a minimum return guarantee. In Germany, however, nearly one quarter of guarantees are binding, as they were historically set at 60% of 10-year AAA yields and became effective when rates fell. Hombert et al. (2023) show that this makes German insurers especially exposed to interest rate risk. More broadly, Barbu (2022) demonstrate that the prevalence of minimum guarantees explains 64% of the cross-country variation in capital held against market risk. This helps account for the large market-risk charges of insurers in France, Germany, and Italy, where PP contracts dominate.

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 (i.e., the total liability value). Source: EIOPA.

Figure 3 shows the composition of life insurance liabilities in Q1 2016, Q3 2021, and Q4 2023.

The most important liability item throughout the period is contracts with profit participation, which account for more than half of total liabilities. Their share, however, declined from about two thirds in 2016 to just under 60% in 2023. This reflects the gradual shift away from traditional guaranteed-return products as insurers adjust to the low interest rate environment and the capital charges under Solvency II.

In contrast, index-linked and Unit-linked (IL/UL) products have grown steadily. UL and IL contracts without guarantees increased from 9% in 2016 to nearly 14% in 2023, while those with guarantees rose from about 8% to 12% over the same period. Taken together, IL/UL liabilities now represent more than a quarter of life insurers' balance sheets, compared with less than one fifth in 2016.

This evolution highlights a structural shift in the industry: traditional profit participation products remain dominant but are gradually losing weight, while IL/UL products are becoming increasingly important as insurers transfer more investment risk to policyholders.

3.2.1 Life Insurance Liabilities by Country

As shown in Table III, France emerges as the largest insurance market in Europe, with total liabilities of €1.58 trillion. What distinguishes France is not only its scale but also the structure of its liabilities: nearly two-thirds (65.9%) are concentrated in Profit Participation products. These contracts combine guaranteed minimum returns with discretionary bonuses, making them particularly attractive as retirement savings vehicles and deeply embedded in the French regulatory and consumer landscape.

Germany, while also large at €1.30 trillion, has a more diversified structure, with significant shares in both Profit Participation and Health with Guarantees. Italy stands out for its heavier reliance on Unit-linked products without guarantees, reflecting differences in product design and market demand. Smaller markets such as the Netherlands and Ireland show much larger allocations to Unit-linked contracts.

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

Country	**Profit Participation** (%)	**IL/UL w/ Guarantees** (%)	**IL/UL w/o 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.

3.3 Surrender and Lapsation

Approximately 85 percent of life insurance liabilities in the EEA include a surrender or early-redemption option (see EIOPA (2019)). These clauses typically allow policyholders to redeem the contract at book value or at the accumulated cash value, often subject to a small penalty. When combining contracts without surrender rights and those where the surrender value never exceeds the corresponding asset value, about 34 percent of total liabilities are not exposed to lapse risk. In contrast, roughly two-thirds of liabilities can be redeemed at, or close to, book value. Disincentives to early surrender are generally mild: tax disincentives apply to about 27% of liabilities, monetary surrender penalties to 17 percent, and no disincentive at all to around 20 percent, allowing policyholders to redeem contracts almost at par.

Cross-country patterns reveal meaningful heterogeneity. In Germany, about 15 percent of life liabilities carry no surrender option, and most policies include only mild disincentives: roughly 45 percent are subject to small monetary penalties and 44 percent to tax-related penalties. In France, surrender options are widespread but are predominantly constrained through taxation: about 35 percent of liabilities face a tax penalty, whereas direct surrender fees are nearly absent (around 1 percent). In Italy, surrender rights are almost universal, with only 6 percent of liabilities lacking such an option; about half of contracts can be surrendered without any penalty, around one-third are subject to small monetary deductions, and roughly 7 percent face tax disincentives. In Spain, most contracts are freely redeemable, with limited tax-related restrictions (15 percent) and virtually no surrender penalties. Overall, the data indicate that in many Euro area countries, life insurance policies remain relatively liquid instruments, with surrender values typically close to the book value of the underlying assets.

4. The role of Interest Rates for Insurance Flows

4.1 Measuring Household Portfolio Flows

Understanding insurers' bond investment behavior ultimately requires examining the saving decisions of households—how they allocate wealth across deposits, investment funds, direct bond holdings, and insurance contracts. This connection is central because, as we show in Section 6, a large share of insurers' investment activity is driven by net premiums, which represent inflows from households into the life-insurance sector.

To study these patterns, we draw on Euro area flow-of-funds data, which provide a comprehensive view of household portfolios over time, including both the levels and the transactions of financial assets and liabilities.

The flow-of-funds statistics record transactions and positions across deposits and currency, bonds, loans, equities, mutual fund shares, pension entitlements, life insurance policies, and other financial assets. To contextualize our findings, it is useful to highlight a few key statistics on household portfolios. Deposits remain the dominant financial asset for Euro area households, accounting for roughly 32% of their financial portfolios, and this share has been remarkably stable since 2014. At that time, the second-largest category was life insurance policies at 24%, followed by equities (20%) and mutual funds (8%). These shares remained broadly stable until 2019, although much of this stability reflected valuation gains on life insurance contracts as interest rates declined. As we document later, this period coincided with weaker inflows rather than stronger ones. When interest rates began to rise in 2022, the portfolio share of life insurance policies declined to 19%, while the shares of equities and mutual funds increased to 25% and 11%, respectively. Figure N.2 shows the evolution of these portfolio shares over time.

Because the flow-of-funds statistics also report transactions, we can strip out valuation effects and focus directly on new savings. We use these data to compute the share of household financial flows directed toward insurance companies relative to total flows into financial assets. Conceptually, this corresponds to a portfolio choice problem in which households allocate new savings across available financial instruments.

Flows into the insurance sector—measured as net premiums minus claims—exhibit strong seasonality and are therefore highly volatile at the quarterly frequency. To mitigate this, all our specifications rely on quarterly data smoothed using a four-quarter (one-year) rolling average of past flows.[11] This transformation removes seasonality and valuation effects and yields a series that can be interpreted as the year-over-year change in households' assets held in life insurance (or in any other asset category), controlling for valuation changes.

4.2 A Two-Factor Model of Insurance Flows

Section 3 showed that the main type of policy offered by life insurance companies is the profit-participation contract with a minimum return guarantee. Motivated by Koijen and Yogo (2022) and Koijen et al. (2024), we argue that this structure naturally gives rise to a simple two-factor model in which insurance flows depend on the *term premium* and the recent *change in the short rate*. We show that this parsimonious specification explains roughly 80% of the time-series variation in insurance flows.

Our empirical specification is estimated at the quarterly frequency. However, as discussed above, the smoothed flow series can be interpreted as a year-on-year growth measure. For consistency, whenever we include lagged variables, we therefore adopt the same convention and use a four-quarter (one-year) lag.

The regression specification is given by:

$$\frac{\text{Insurance Inflows}_t}{\text{Total Household Flows}_t} = \gamma_0 + \gamma_1 \,\text{Term Premium}_{t-1} + \gamma_2 \,\Delta\text{Short-Term Rate}_t + \varepsilon_t.$$

The level of term premium (lagged) and recent changes in short-term interest rates capture the long- and short-term components of flow dynamics, respectively. We include both factors because they arise naturally from the structure of insurers' long-term savings products, as

[11] Formally, we construct

$$\bar{F}_t = \frac{1}{4}\sum_{k=0}^{3} F_{t-k},$$

where F_t denotes net flows in quarter t.

we discuss in detail below.

Throughout the paper, references to short-term rates, long-term rates, and the term premium refer to the German yield curve (or, equivalently, the closely aligned OIS curve). Whenever we refer instead to the sovereign yield curve of a specific country, we explicitly indicate this in the text.

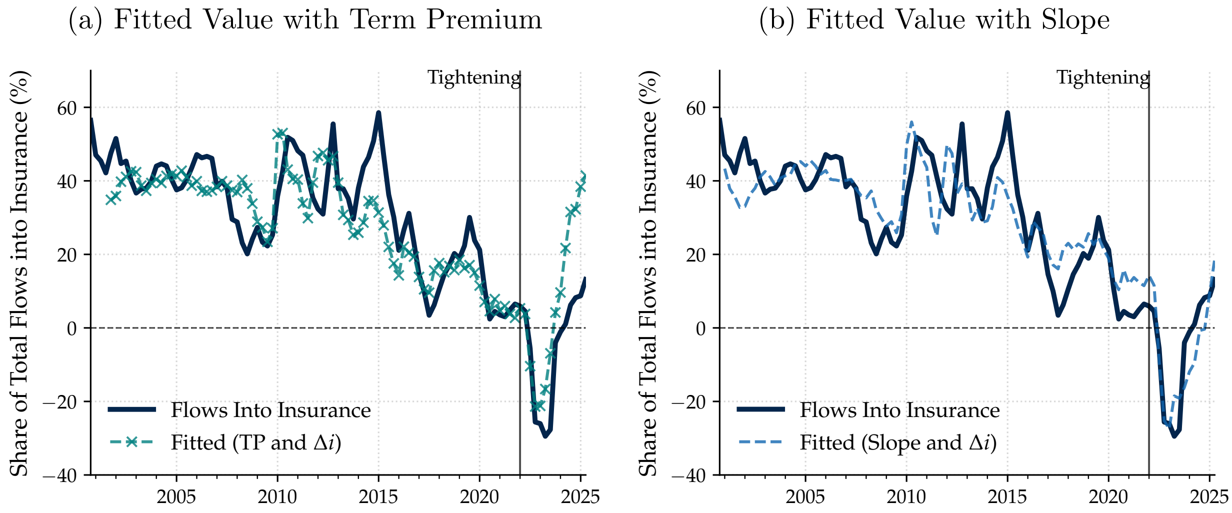
We estimate the two-factor model separately for the pre-2009 and post-2009 samples. As we show below, the effects of short-term rate changes—particularly the sharp increase in 2022—are asymmetric across these two periods.

Term Premium Our first factor, the term premium, is the key driver of insurance flows. The credited rate on profit participation contracts is closely linked to long-term interest rates, reflecting the duration of the underlying assets held by insurers. When households decide whether to purchase such policies, what matters is not the absolute level of long-term rates, but their return relative to available outside options. Because life insurance policies typically lock investors in for several years and involve significant surrender costs, the relevant benchmark is the return from repeatedly rolling over short-term assets. If households rationally account for expected changes in short-term interest rates, the term premium naturally captures how attractive long-term insurance contracts are relative to rolling over short-term liquid assets.[12]

By contrast, if households instead compare the credited rate only to the current short rate—ignoring expectations of future changes in the short-term rate—the yield curve slope becomes the relevant determinant of their behavior. The term premium – or, similarly, the slope of the yield curve – should serve as a natural proxy for how attractive these policies are relative to liquid, short-term alternatives. As our baseline measure, we use the term premium estimated for the German yield curve by Adrian et al. (2013) and Favero and Fernandez-Fuertes (2023). As an alternative, we use the slope of the yield curve, defined as the difference between the German 10-year government bond yield and the short-term rate. The slope and term premium are plotted in Figure N.13. Both the term premium and the slope remained positive—around 1.5%—until 2014, after which they began to decline. In 2013, the ECB introduced forward guidance aimed at lowering medium-term interest rates. In September 2014, it announced asset purchase programs for ABS and covered bonds, and at the Jackson Hole symposium in August 2014, ECB President Mario Draghi signaled the possibility of a full-scale quantitative easing (QE) program, which was officially launched in January 2015. Following these announcements, both the slope and the term premium fell sharply, reaching near-zero or even negative levels during the 2015–2022 period, when the

[12]Since our focus is on time variation in portfolio allocation, the same reasoning extends to equity holdings if the equity risk premium is assumed to be constant.

Figure 4: Inflows to Insurance Companies



Note: Flows into life insurance as a share of household flows and fitted value from a two-factor model regression:

$$\frac{\text{Insurance Inflows}_t}{\text{Total Household Flows}_t} = \gamma_0 + \gamma_1 \text{ Term Premium}_{t-1} + \gamma_2 \,\Delta\text{Short-Term Rate}_t + \varepsilon_t$$

We estimate the regression separately for the pre-2009 and post-2009 samples. Panel (a) and (b) use the term premium and the yield curve slope as the first factor driving insurance flows respectively.

ECB's QE program was active.

Changes in the Short Rate Our second factor explaining insurance flows are recent changes in short-term interest rates. As discussed in Section 3, profit-participation policies embed a surrender option whose value differs across jurisdictions. When interest rates rise sharply, these options can move into the money, triggering abrupt and sizable policy surrenders. Indeed, in 2022, as interest rates began to rise, we observe a sharp increase in policy redemptions, or surrenders. We discuss this channel in Section 5.3.

4.3 Estimation Results

Figure 4 plots the realized insurance flows and the fitted flows from the two factor model. We use the one-year lagged term premium as an explanatory variable. This measure is likely to better capture the rates guaranteed in life insurance contracts, since insurers adjust their guaranteed rates only gradually in response to changes in market interest rates. This sluggish adjustment is analogous to the deposit channel of monetary policy, whereby banks slowly raise deposit rates following increases in policy rates (Drechsler et al., 2017).

Panel (a) displays the fitted values obtained using the one-year lagged term premium. The R^2 in the post-2009 sample exceeds 70%. The decline in the term premium accounts for the reduction in flows into insurance companies and also helps explain their recent recovery. However, the model predicts a somewhat faster rebound in flows than what is observed in the data. Panel (b) plots the fitted values using the one-year lagged slope and the change in the short-term rate. In this specification, the model fits the data even more closely, with an R^2 of nearly 80%. The slope also predicts a rebound in 2025—consistent with the term premium—although smaller in magnitude. As a result, the two-factor model using the slope is even closer to the actual data, which accounts for the higher R^2. Table IV reports the estimated coefficients.

Impact of the Term Premium A 1% increase in the (lagged) term premium leads to an economically large 11-14% increase in insurance flows. It is important to emphasize that our estimates pertain to *flows* rather than to total assets held by insurers. Over short horizons, total assets are only marginally affected by changes in interest rates. However, a prolonged period of low (or high) inflows can have substantial effects on the overall size of the insurance sector.[13]

Impact of Short-Rate Changes We estimate the two-factor model separately for the pre-2009 and post-2009 samples, as the effects of short-term rate changes—particularly the sharp rise in 2022—are likely to be asymmetric across these two periods: Increases in the short-rate should drive additional outflows due to surrenders. We discuss in detail in Section 5.3 why short-term rates play a central role in triggering surrenders. Alternatively, we can interact the short-rate change with a post crisis dummy (post-2009).[14] In fact, model (3) of Table IV shows that on average the short rate does not materially affect insurance flows beyond the term premium (or the slope). It is only the large positive realizations that lead to significant outflows via surrendered policies. On average, a 1% increase in the short rate leads to 10%-15% lower insurance flows.[15]

[13] We also re-estimate the model using the level of insurance flows (without scaling by total household flows). In this case, including variables that capture credit risk—such as the Italian sovereign spread vis-à-vis the German Bund or measures of corporate credit risk—improves the model's fit. This indicates that while credit risk factors play a limited role in explaining the *share* of household flows allocated to insurance companies (the portfolio choice), they have greater explanatory power for the *total* volume of household savings flowing into the financial sector. For instance, during the sovereign debt crisis, aggregate household savings were significantly lower.

[14] Alternatively we use a dummy for positive realizations of short-rate changes over the whole sample. See Table N3 in the Appendix.

[15] Adding other macroeconomic or financial variables does not materially affect the estimated coefficients or the R^2, as the two-factor model already explains a large share of the variation in flows.

Table IV: A two-factor model of Insurance Flows

	2010-2025		2001-2025	
	(1)	(2)	(3)	(4)
Term Premium (lag)	0.135***		0.115***	
	(0.017)		(0.010)	
Slope DE 10Y-3M (lag)		0.161***		0.143***
		(0.013)		(0.013)
Δ 3M Rate	-0.106***	-0.153***	0.035***	-0.033**
	(0.016)	(0.012)	(0.013)	(0.014)
Δ 3M Rate (Post)			-0.146***	-0.125***
			(0.019)	(0.020)
Constant	0.132***	0.121***	0.137***	0.179***
	(0.019)	(0.015)	(0.017)	(0.015)
Observations	62	62	95	98
R-squared	0.678	0.809	0.704	0.680
Adj. R-squared	0.667	0.802	0.695	0.669

Note: Flows into life insurance as a share of total household flows, along with fitted values from the two-factor model:

$$\frac{\text{Insurance Inflows}_t}{\text{Total Household Flows}_t} = \gamma_0 + \gamma_1 \text{ Term Premium}_{t-1} + \gamma_2 \, \Delta\text{Short-Term Rate}_t + \varepsilon_t$$

The regression is estimated separately for the post-2010 period (Models 1–2) and for the full sample (Models 3–4). We use either the lagged term premium or the yield slope (10-year minus 3-month German Bund yield) as the long-term factor. The variable Δ3M Rate (post) denotes the change in the 3-month rate interacted with a dummy equal to one for the post-2010 period.

The Macroeconomic Environment 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—driving outflows from the financial sector. 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.

The reduction in the term premium and the slowdown in life-insurance inflows took place primarily between 2014 and 2021. In January 2015, the ECB launched its large-scale asset purchase program. As President Mario Draghi emphasized, the main motivation was the risk that long-term inflation expectations were becoming de-anchored. Importantly, this period was not characterized by macroeconomic stress: 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.

4.4 Corroborating Evidence

While the two-factor model provides a remarkably close fit for insurance flows, several structural forces—such as demographic changes and the implementation of *Solvency II*—may also have contributed to the sector's contraction. Moreover, long-term interest rates are themselves endogenous to insurers' bond demand, raising identification concerns. To establish a causal interpretation, we present several complementary pieces of evidence showing that movements in the term premium were the primary driver of insurance outflows.

First, we instrument changes in the term premium using high-frequency monetary policy shocks around ECB announcements and find an even stronger relationship between term premia and insurance flows. Second, we regress insurance flows on instrumented yield changes across maturities from three months to thirty years and show that flow sensitivity increases *monotonically* with maturity—from strongly negative at the short end to strongly positive at the long end—consistent with households comparing guaranteed rates to long-term yields. Third, using micro-level data, we document that insurers with greater exposure to long-term savings products experienced disproportionately larger outflows following declines in long-term rates. Fourth, consistent with the negative coefficient on short-term rates in the two-factor model, we show that as the ECB tightened policy, insurers faced net outflows driven by a surge in policy surrenders. Finally, after this short-term adjustment, the post-QE rise in the term premium led to a gradual recovery in insurance inflows.

4.4.1 Monetary Policy Instrument

The term premium and insurance flows are jointly determined. In fact, higher inflows into insurance companies should lower the term premium since—as shown earlier—they translate into greater demand for long-term bonds. Consequently, the OLS estimate of γ_1 is likely to be biased downward, and hence conservative.

To address this endogeneity, we instrument the term premium using monetary policy shocks identified from high-frequency financial data. We construct these shocks by cumulating high-frequency monetary policy surprises to obtain measures at the same (quarterly) frequency as our regression data. The advantage of this approach is that it provides shocks at different maturities, allowing us to isolate innovations to long-term interest rates—primarily associated with announcements related to quantitative easing or forward guidance—from shocks to short-term rates, which mainly capture conventional policy actions. See Altavilla et al. (2019) and Leombroni et al. (2021) for a detailed discussion of monetary policy shocks in the Euro area. Figure N.14 plots the time series of identified shocks to short- and long-term rates.

We then estimate a two-stage least squares (2SLS) regression, instrumenting the term premium with what we refer to as *slope monetary shocks*. Specifically, we use high-frequency monetary policy shocks from Altavilla et al. (2019) 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. Since forward guidance and quantitative easing (QE) were introduced only in the post–global financial crisis period, we restrict the analysis to the post-crisis sample.

The first-stage results are reported in Table N6. We present estimates for the full sample from 2010 to 2025, as well as for the subsample prior to the 2022 rate hikes. The instrument is statistically significant, with an R^2 between 25% and 50% across the two samples. Hence, monetary policy shocks explain a substantial fraction of the variation in the term premium over these periods. The first-stage results also highlight the central role of QE and forward guidance in compressing long-term yields. In the 2010–2022 sample, a single monetary policy shock explains nearly half of the variation in the term premium—and, equivalently, in the slope of the yield curve—over the period.

The coefficient from the second stage is reported in the second row of Table V and equals 0.3, substantially larger than the reduced-form estimate. This difference is expected. A decline in the term premium induced by monetary policy actions—such as quantitative easing—reduces flows into the insurance sector, thereby lowering bond demand and exerting upward pressure on the term premium. This feedback mechanism implies that the reduced-form estimates of flows on the term premium should understate the total effect. This is consistent with our results.

We repeat the same set of exercises using the slope of the yield curve as the explanatory variable. The results are qualitatively similar and of comparable magnitude, with the instrumented slope exhibiting a stronger effect than the reduced-form specification. The corresponding estimates are reported in rows (4)–(6) of Table V.

4.4.2 Insurance Flows Along the Yield Curve

We have shown that the term premium influences household flows into the insurance sector. We now use our constructed monetary policy shocks to examine the direct effects of shocks at different maturities of the yield curve on insurance inflows. 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.

Table V: Flows and Term Premium

Model	Independent Variable	Coefficient	R-squared	Description
(1)	Term Premium (TP)	0.087** (0.035)	0.115	German 10Y TP using Adrian et al. (2013)
(2)	TP (Instrumented)	0.302*** (0.046)	0.342	TP instrumented w/ monetary policy shocks
(3)	TP (Lagged)	0.150*** (0.018)	0.430	One year lagged TP
(4)	Slope	0.157*** (0.025)	0.414	German 10Y minus 3 month slope
(5)	Slope (Instrumented)	0.204*** (0.032)	0.335	Slope instrumented w/ monetary policy shocks
(6)	Slope (Lagged)	0.127*** (0.029)	0.303	One year lagged Slope

Note: The table shows the results of the regression:

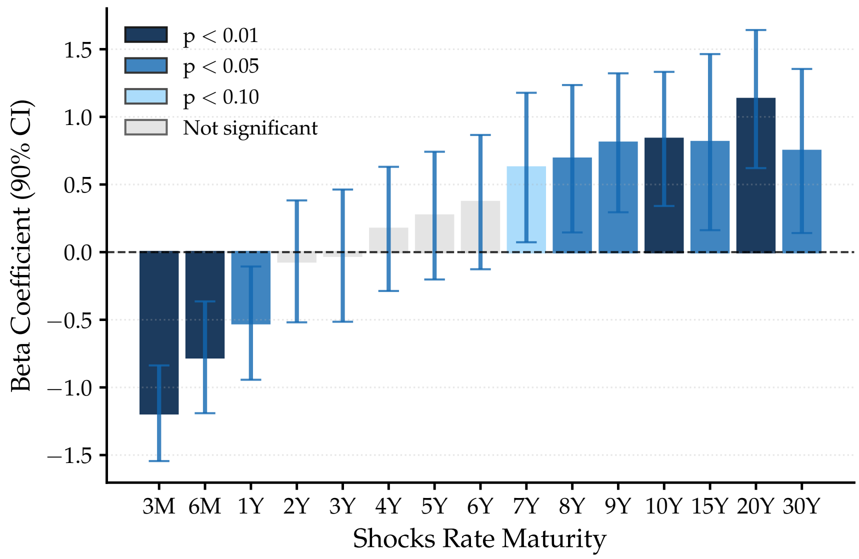
$$\frac{\text{Insurance Inflows}_t}{\text{Total Household Flows}_t} = \gamma_0 + \gamma_1 \text{Term Premium}_t + \varepsilon_t.$$

Each row is a different regression estimate with different proxy for term premium.

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. 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.[16] 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

[16] During the sovereign debt crisis, the ECB announced the Securities Markets Programme (SMP), which was primarily aimed at alleviating stress in the sovereign bond markets of countries facing higher default risk, rather than at lowering long-term interest rates to stimulate the broader economy. The "Whatever it takes" speech by ECB President Mario Draghi took place outside a scheduled Governing Council meeting, in July 2012. In that speech, the ECB President also hinted at the forthcoming Outright Monetary Transactions (OMT) programme, which helped lower sovereign spreads. Around that announcement, default-free rates increased rather than declined.

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.

between the 10-year and 1-year shocks—remains virtually identical across all sample periods.

4.4.3 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. This specification allows us to further corroborate that insurance flows respond directly to interest rate movements—rather than to slow-moving structural or demographic forces—and that the sector's decline would not have occurred absent the compression of long-term rates under QE.

We construct measures of net premiums at the insurer level. Specifically, we compute 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. For each insurer, we scale net premiums by total assets from the previous year. 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. Similarly, we use both the slope of the yield curve and its instrumented counterpart based on monetary policy shocks.[17]

We then regress net premiums on the slope for each individual insurer. The use of micro-level data allows us to include insurer fixed effects, which control for time-invariant characteristics that may affect inflows—such as business models, product mixes, or management structures—and isolate the response of flows to interest rate changes. This ensures that differences in inflows across insurers are not driven by idiosyncratic or structural factors unrelated to monetary policy.

We believe that a key reason for the decline in insurance inflows is that the minimum guaranteed returns on policies have become less attractive to households. 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. Because this interacting characteristic is measured cross-sectionally, we include both insurer and time fixed effects. 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. Formally, we estimate:

$$np_{i,t} = \alpha_i + \alpha_t + \beta_1\big(\text{Slope}_t \times PP_{i,2016}\big) + \beta_3 PP_{i,2016} + \varepsilon_{i,t}, \tag{3}$$

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.

We also include a dummy variable indicating whether an insurer is a pure life insurer. We expect that composite insurers—which also offer non-life products—may be better able to retain clients through cross-selling and thus display lower sensitivity of inflows to interest rate movements. This also helps verify that the estimated effects reflect the impact of interest rates rather than broader industry dynamics. Formally,

$$np_{i,t} = \alpha_i + \alpha_t + \beta_2\big(\text{Slope}_t \times \text{LifeDummy}_i\big) + \beta_4 \text{LifeDummy}_i + \varepsilon_{i,t}, \tag{4}$$

where LifeDummy_i equals one for pure life insurers and zero otherwise.

Table VI reports the results from estimating equations 3 and 4. Columns (1)–(4) focus on

[17] We use the slope of the yield curve because the term premium is not available in the micro-level datasets.

Table VI: 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)					
Instrumented Slope		1.380*	-2.166**	-0.985***	-4.329*	-0.502
		(0.617)	(0.914)	(0.242)	(2.169)	(0.800)
PP (2016) × Instr. Slope			2.734**		5.807*	
			(0.856)		(2.794)	
Life × Instr. Slope				3.004***		3.345
				(0.622)		(3.583)
Insurance FE	✓	✓	✓	✓	✓	✓
Time 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.

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.

5. Channels and Auxiliary Evidence

In the previous section, we showed that a lower term premium—or a flatter yield curve—reduces inflows into the insurance sector, while higher long-term rates raise them. We also documented that increases in short-term rates generate short-run outflows. Finally, we argued that these effects are persistent: although inflows have risen as interest rates increased, they remain below their pre-QE levels.

At first sight, these findings may seem surprising. Households typically adjust their financial decisions slowly, reflecting substantial inattention and portfolio inertia documented across many settings (e.g., Agnew et al., 2003; Brunnermeier and Nagel, 2008; Andersen et al., 2014).[18] Given this inertia, why do we observe insurance flows that respond strongly to changes in the yield curve? Moreover, why did flows not simply revert once rates normalized, and why does the system display such pronounced asymmetry?

In this section, we shed light on these questions.

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

First, our results concern *flows* rather than stocks. This is consistent with the idea that changes in the yield curve primarily affect how potential new buyers allocate their savings, rather than inducing active portfolio rebalancing among existing policyholders. In line with this view, we argue that a lower term premium mainly influences the participation of new buyers. By contrast, households that had already purchased a policy did not redeem it in the low-interest-rate environment. This is intuitive: policies purchased in the past typically promised returns above prevailing market rates, making surrender financially unattractive. As discussed in Section 5.1, the distribution channel and the way these products are marketed are also crucial for understanding why new customers stopped purchasing life insurance.

There is, however, one important exception in which households do redeem policies: when interest rates rise after a prolonged period of low rates. As we show in Section 5.3, this behavior generates a key asymmetry in the relationship between flows and interest rates.

It is also important to understand which households stopped purchasing policies. Section 5.2 examines this question using micro data from the Household Finance and Consumption Survey (HFCS). Finally, Section 5.4 provides evidence of a significant shift in the structure of the industry and in insurers' business models during the low-rate period. Together, these components provide insight into the mechanisms behind the asymmetric response of flows.

5.1 Distribution Channels

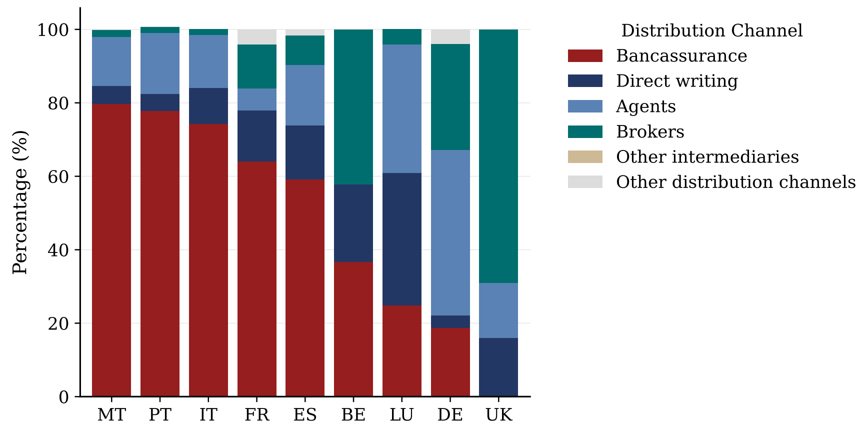
The *distribution channel* through which insurance products are sold can strongly influence how quickly—and in which direction—households adjust when the interest-rate environment changes.

Figure 6 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 6: 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.

5.2 Household Participation Rate in Life Insurance Policies

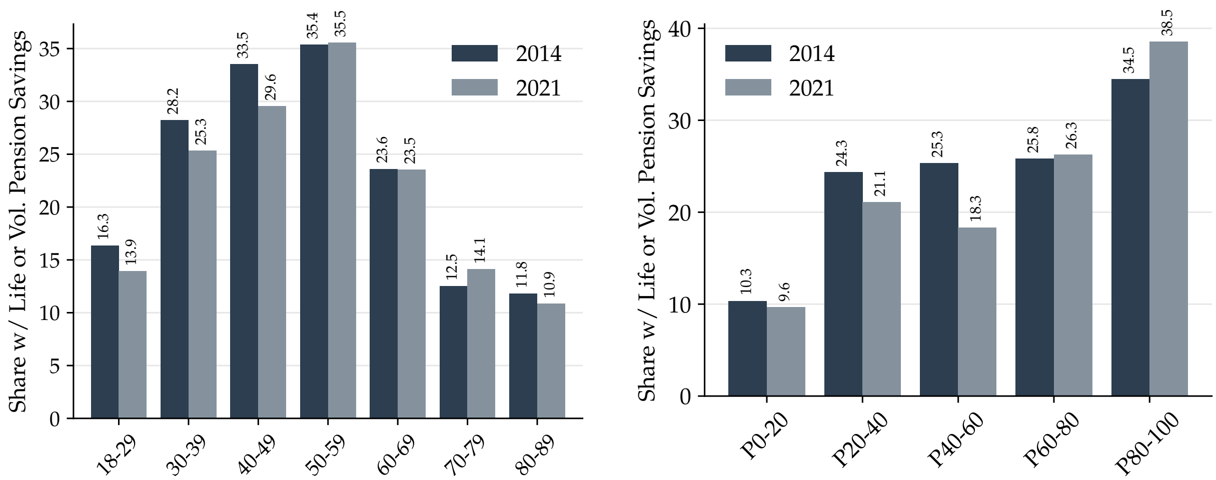
We use data from the ECB Household Finance and Consumption Survey (HFCS) to analyze changes in households' holdings of life insurance and retirement products. Specifically, we focus on households' participation in voluntary private pension plans and life insurance policies, which largely correspond to the instruments administered by life insurers in our study (see Appendix L for further details). Figure 7 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 growing share of households now hold neither life insurance nor voluntary pension plans, with significant implications for their exposure to longevity risk.

Figure 7: Participation in Voluntary Pension and Life Insurance Products

(a) By Age (b) By Net Wealth



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.

5.3 The 2022 Tightening and Surrender

The period from 2014 to 2021 was characterized by exceptionally low interest rates and a compressed term premium. This environment changed abruptly in 2022, when the ECB began raising policy rates, signaled the end of its QE program, and initiated the gradual unwinding of its balance sheet.

In a fully symmetric environment, higher interest rates should increase insurers' demand for long-term bonds. It is therefore striking that the rise in rates instead generated *outflows* from the insurance sector.

However, in the short run, an *increase* in rates can instead further depress insurance bond demand. We now use the ECB's tightening cycle as a case study to illustrate this mechanism.

As discussed earlier, the decline in the term premium reduced flows into the insurance industry. Although overall inflows have fallen relative to the high-rate environment, insurers have continued to sign new policies during this period. These new contracts, however, were typically written with relatively low guaranteed rates. In the data, we observe that net premiums flowing into insurance companies remained elevated in several countries. Using EIOPA statistics, the two countries with the highest net premiums relative to the size of their insurance sectors during 2016–2022 are Italy and Luxembourg.

In terms of bond allocation, we find that Italian insurers primarily invest in Italian government bonds, whereas Luxembourg insurers hold a larger share of non–Euro area assets. As a result, Italian insurers can offer guaranteed rates that are relatively higher than those of, for instance, German insurers. Although Italian insurers are exposed to sovereign risk, domestic sovereign holdings are exempt from capital requirements under Solvency II.[19]

Finally, surrenders are inherently state contingent. In addition to the frictions and costs of surrender discussed in Section 3, the surge in surrenders reflects the fact that the recent rate hikes followed a prolonged period of low rates. The extent of redemptions therefore depends on how many policies were originally subscribed during that low-rate period. For example, Italy—where net premiums remained positive during the years of low interest rates—likely accumulated a large number of policies offering relatively low guaranteed returns.

Table VII reports the amount of policy surrenders by country. Interestingly, some countries—such as Germany and the Netherlands—did not experience an increase in surrenders and even recorded a decline. By contrast, surrenders rose markedly in Italy, France, and Luxembourg. In 2022-2023, countries that have experienced surrenders, were net sellers of government bonds, highlighting the importance of this channel.

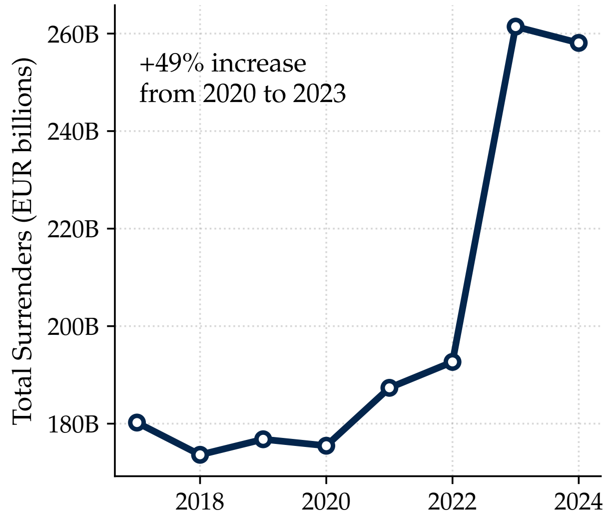
5.4 Investment in Unit-linked Products

Our results show that household flows into life insurers have declined sharply. At the same time, life insurance companies have shifted their product mix toward Unit-linked policies. Panel 9a plots the share of insurers' assets invested in Unit-linked products. This share has risen steadily since 2016 and shows no sign of reversing even after the start of quantitative tightening (QT) in 2022. This pattern points to a structural transformation of the life-insurance sector.

Figure 9b shows the composition of Unit-linked portfolios in 2024, totaling €1.83 trillion. From the figure, the largest component is the €600 billion allocation to equity funds, followed

[19] There are no hard constraints preventing German insurers from holding Italian sovereign bonds. However, we find that their allocations to Italian government debt are close to zero. A detailed discussion of the underlying reasons is beyond the scope of this paper. A broader analysis of insurers' portfolio allocations can be found in Du et al. (2023b).

Figure 8: Surrenders in the Euro area



Note: Amount of policy surrender for life insurance companies in the Euro area.

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

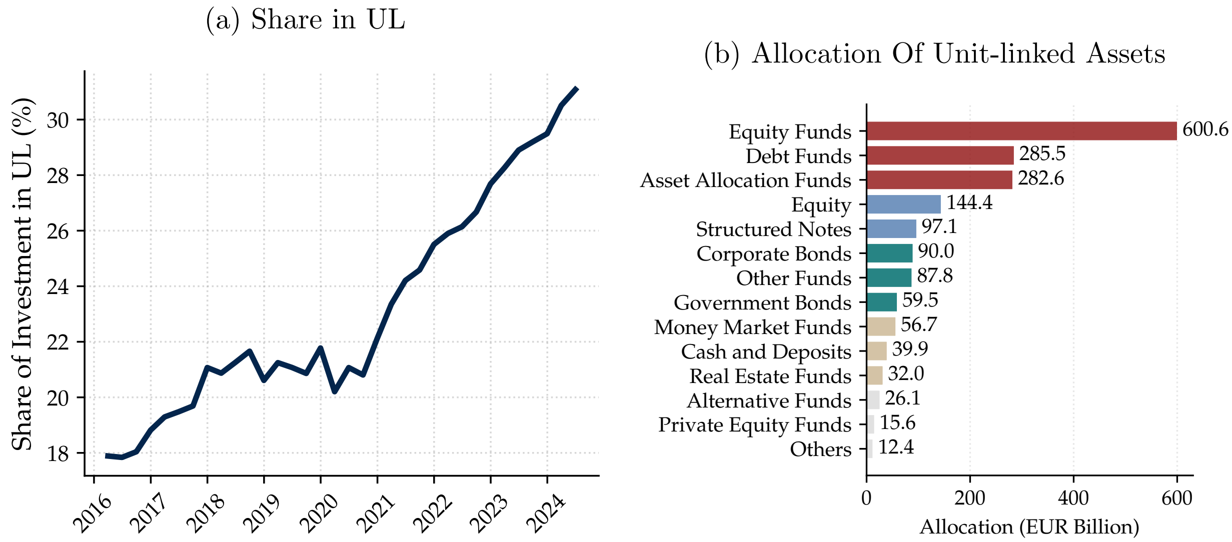
Country	2020 (EUR bn)	2023 (EUR bn)	Change (%)
Portugal	1.0	2.5	+142.6%
Greece	0.5	1.1	+133.7%
Austria	1.2	2.8	+133.3%
Italy	41.6	86.7	+108.3%
Luxembourg	13.6	25.7	+88.1%
France	54.6	81.2	+48.7%
Spain	8.8	12.5	+41.5%
Finland	1.9	2.3	+18.6%
Ireland	17.2	19.5	+13.5%
Belgium	7.8	6.8	-13.5%
Germany	21.8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

by €144.4 billion in direct equity holdings and €282 billion invested in asset-allocation funds. Assuming a 60/40 portfolio split within these funds, this implies an additional €169.2 billion allocation to equity. Including €16 billion in private equity, total equity exposure amounts to approximately €930 billion—or about 51% of total Unit-linked assets.

The large equity share within Unit-linked portfolios contrasts sharply with the allocation

Figure 9: Unit-linked Product



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

on insurers' balance sheets (excluding Unit-linked assets). Of the nearly €2 trillion held in these traditional accounts, only €59.5 billion is invested directly in government bonds and €90 billion in corporate bonds, while €285 billion is allocated to bond funds. Overall, the bond share within the Unit-linked segment remains substantially lower than in the non–Unit-linked portfolio.

Overall, the evidence in this section indicates that (i) households have reduced their participation in retirement-oriented life-insurance products, and (ii) insurers have reoriented their product offerings toward Unit-linked contracts. These developments suggest that a rapid return to the pre-QE equilibrium is unlikely. While further household-level evidence may require data from upcoming waves of the HFCS survey, insurers themselves have been explicit in their disclosures: their business plans have permanently shifted toward promoting Unit-linked products.

6. Flow-Induced Bond Demand

The previous section highlighted that interest rates are the primary driver of insurance flows and therefore critically determine the size of the insurance sector. We next assess to what extent these flows drive insurers' bond demand.

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.

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.[20] 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 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:

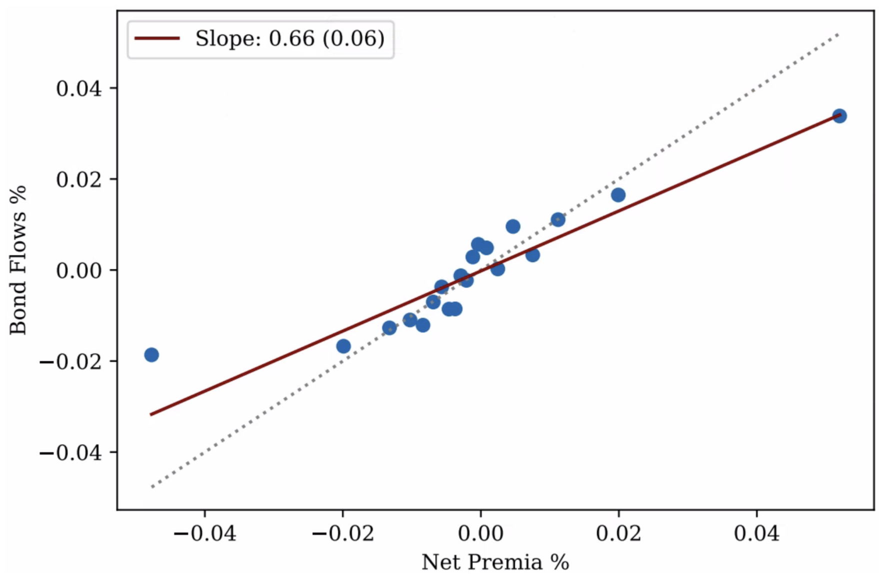
$$\Delta q_{i,t}^{B} = \alpha + \beta np_{i,t} + \epsilon_{i,t}, \tag{5}$$

[20] 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.[21]

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 N.1, 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.

[21]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 The 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.

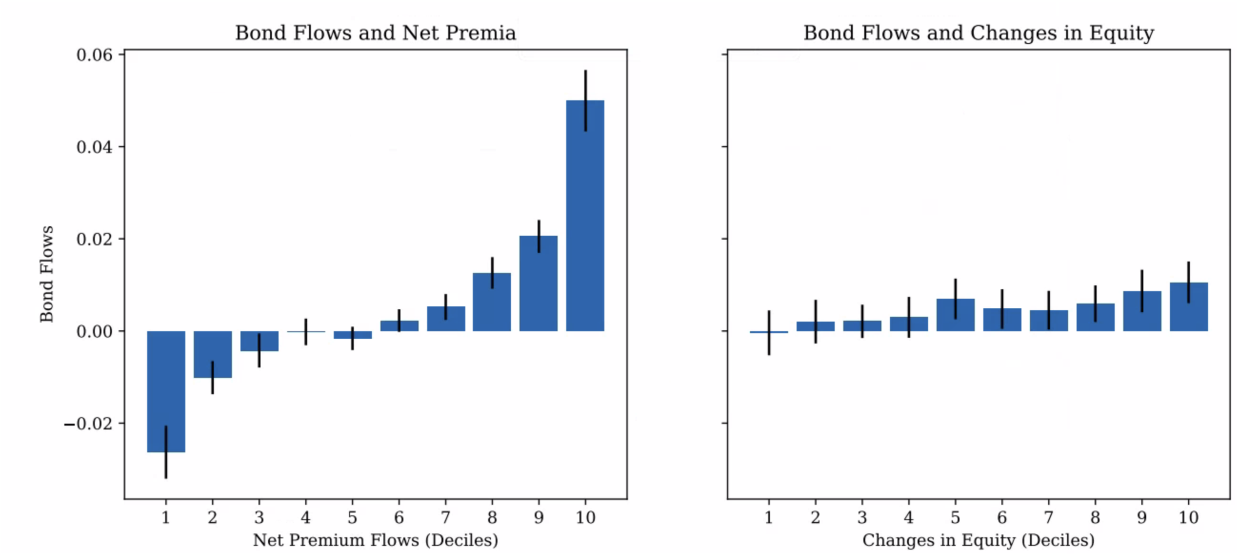
Simple Double Sort We sort all insurance companies into deciles based on their past annual net premiums $np_{i,t}$ and net equity flows $ne_{i,t}$. Note that net premiums may mechanically increase net equity due to accounting conventions. Therefore, we first sort based on net premiums and then, within 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.[22] 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 VIII 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.

[22] 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 VIII: Bond Flow Drivers: Net Premiums versus Net Equity

	All Bonds		Bonds by Subgroup			
	(1)	(2)	Corp.	Gov. Bonds	Long-Term	Low-Rated
const	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

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,

$$w^L_{i,t} = \frac{A^L_{i,t}}{A^B_{i,t}}, \qquad w^R_{i,t} = \frac{A^R_{i,t}}{A^B_{i,t}}.$$

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 towards long-term bonds in excess of proportionally scaling existing bond weights. We regress the cross-section of rebalancing towards 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 IX reports the estimated rebalancing for high-risk bonds (with lower credit ratings). Increases in net equity lead to a significant active rebalancing towards 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 X reports the estimates for the demand for long maturity bonds. Net premium

Table IX: 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 towards lower rated bonds versus investment grade bonds via Fama MacBeth regressions of $\Delta a^{\mathrm{R}}_{i,t}$ 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 towards longer maturity bonds. While we cannot decompose the underwritten premiums in their maturity (e.g. selling life policy 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 towards 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 X: 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 towards long versus short maturity bonds via Fama MacBeth regressions of $\Delta a^{\mathrm{L}}_{i,t}$ 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 Table N2 and N1 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, our results highlight the central economic importance of net premiums for understanding insurers' aggregate bond demand. By contrast, the effects of net equity and net premiums on the cross-sectional allocation across maturity and credit risk within bond portfolios play a more limited, secondary role.

6.5 Insurance Inflows and Bond Flows: 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.

To measure the resources funneled into insurers and available for investment, we focus on flows rather than levels. This strips out valuation effects, which is essential since our aim is to capture how interest rates influence saving behavior rather than accounting changes due to discount-rate movements. 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, bond issuance, and accrued receivables. Appendix K.1 provides further detail on their construction and mapping to ESA 2010 accounts.

As discussed in Section 3.1, these additional components are quantitatively smaller than net premiums, but including them yields a more complete measure of the liabilities insurers acquire from households.[23]

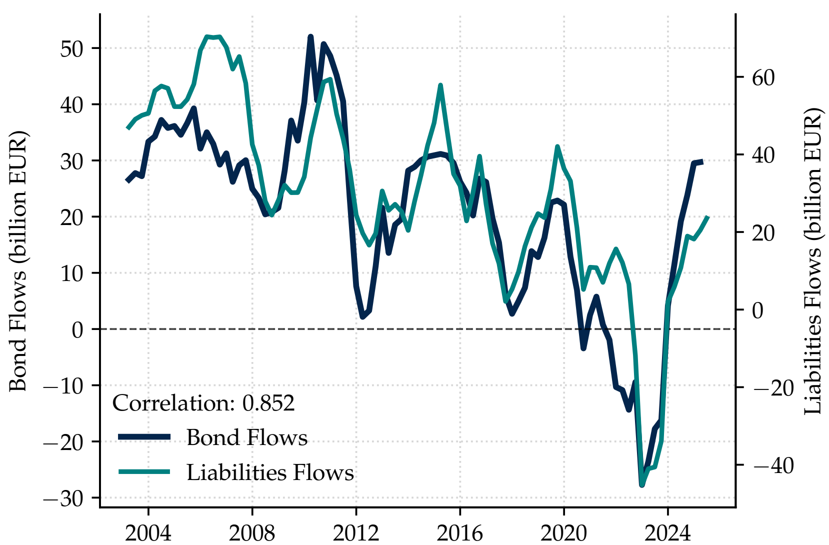
Figure 12 illustrates that bond purchases closely mirror insurance liability flows. Both series are constructed at a quarterly frequency using a rolling annual average. Insurance bond flows (in blue, left y-axis) move almost one-for-one with liability flows (in teal, right y-axis), with a correlation of about 85%. A simple univariate regression explains roughly

[23]Formally, we consider total inflows to include flows into life insurance policies and pension entitlements, net equity and bond inflows, and accrued receivables. For completeness, we also report results for a stricter definition that only considers life insurance flows. The results, displayed in Figure N.3, are broadly unchanged.

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 was 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.

To illustrate the volatility of bond demand, we compare the quarterly net purchases of bonds (bonds bought minus bonds sold) by insurance companies and mutual funds, each normalized by total bond holdings. Mutual fund flows are considerably more volatile: their standard deviation is 1.5 times that of insurers. Although insurers consistently act as net buyers—having never sold bonds on net between 2000 and 2022—their bond purchases nonetheless exhibit substantial variation over time.

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.

7. Quantifying Insurers' Impact on European Government Bonds

7.1 ECB QE and QT: Institutional Background

The ECB's asset purchase programmes have fundamentally shaped the supply of long-term government bonds available to private investors. For eight consecutive years, the ECB absorbed more than the entire net issuance of Euro area sovereigns. Figure 13a plots annual net issuance together with Eurosystem purchases. Net supply to the market—defined as issuance net of ECB purchases—has been *negative* since 2015, including during the period of elevated sovereign borrowing associated with the Covid crisis. As a result, private investors faced a persistent scarcity of long-term bonds.

This situation is now reversing. Toward the end of 2021, the ECB signalled a gradual reduction in the pace of its asset purchases. In June 2022, it ended net purchases under both the APP and the PEPP. Beginning in 2023, the ECB initiated what it termed *Quantitative Normalisation*: a run-off of its monetary-policy bond portfolios, whereby maturing securities are no longer fully reinvested rather than sold outright.

Going forward, market participants must therefore absorb a substantially larger share of long-term government issuance. The ECB itself anticipates that "the monetary policy bond portfolios will be run down completely."[24]

The QT phase was accompanied by a pronounced increase in long-term yields. Figure N.15 relates cross-country changes in household flows to changes in bond yields. The x-axis reports the change in household flows into life insurance—comparing the pre-QE period with the post-QE period—as a share of total household financial flows. The y-axis reports the change in 10-year government bond yields between the end of 2021, when the ECB began communicating about quantitative tightening (QT), and 2024. The figure provides suggestive evidence that countries in which the insurance sector contracted more relative to the pre-QE era experienced larger increases in long-term yields.

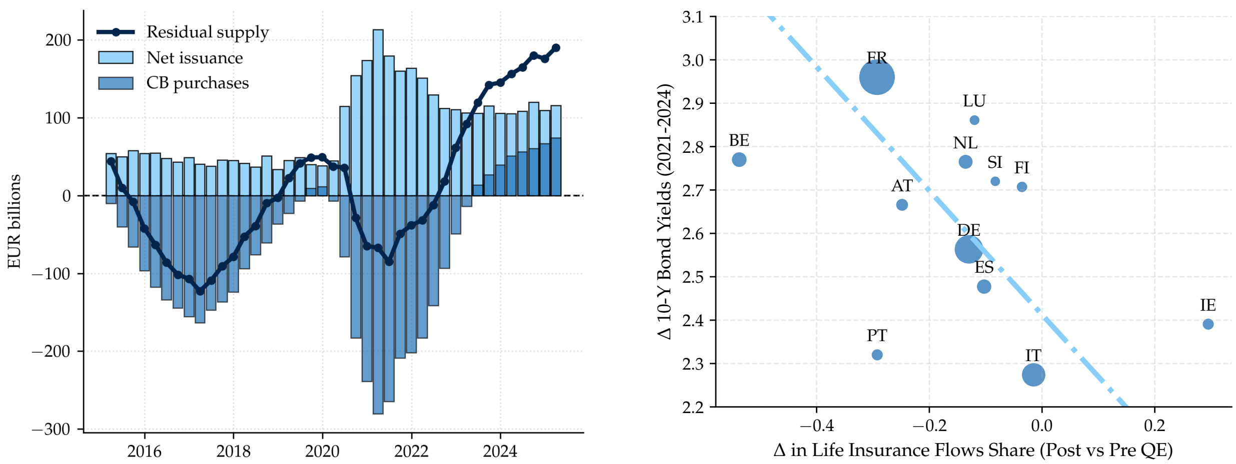
These developments motivate our analysis. As the central bank withdraws from the market, private-sector demand once again determines long-term yields. A key question is how the structural shrinkage of the insurance sector during the QE period affects the private sector's ability to absorb duration. We first develop a simplified framework that links insurer flows to long-term bond prices (Section 7.2), and then embed these insights into a Vayanos–Vila model with endogenous preferred-habitat investors (Section 8.1).

[24]Speech by Isabel Schnabel, Member of the Executive Board of the ECB, ECB Conference on Money Markets, 2025.

Figure 13: QE/QT and Long-term Bond Yields

(a) Supply of Bonds and ECB Purchases

(b) Outflows and Price Effects of QT



Note: Figure 13a plots the net supply of government bonds and the net purchases by the central banks. Net supply is measured as gross government bond issuance net of Eurosystem purchases (shown inversely). The residual series represents the amount of issuance that must be absorbed by private investors. Figure N.15 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.

7.2 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. We therefore relegate the details and derivations to Appendix I and focus here on the core equation that quantifies the price impact of flows into and out of the insurance sector.

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_t^B 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

$$w_t^B = \alpha_t \, w_{\text{ins},t}^B + (1 - \alpha_t) \, w_{\text{O},t}^B,$$

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

$$\Delta p_t^B = \underbrace{\frac{1}{\zeta}}_{\substack{\text{Price} \\ \text{Multiplier}}} \times \underbrace{\frac{F_{\text{Ins},t}}{W_t}}_{\substack{\text{Magnitude} \\ \text{of Flows}}} \times \underbrace{\Psi_t}_{\substack{\text{Market} \\ \text{Segmentation}}} \tag{6}$$

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.[25]

Equation (6) 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 6.

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

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

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 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 14 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.

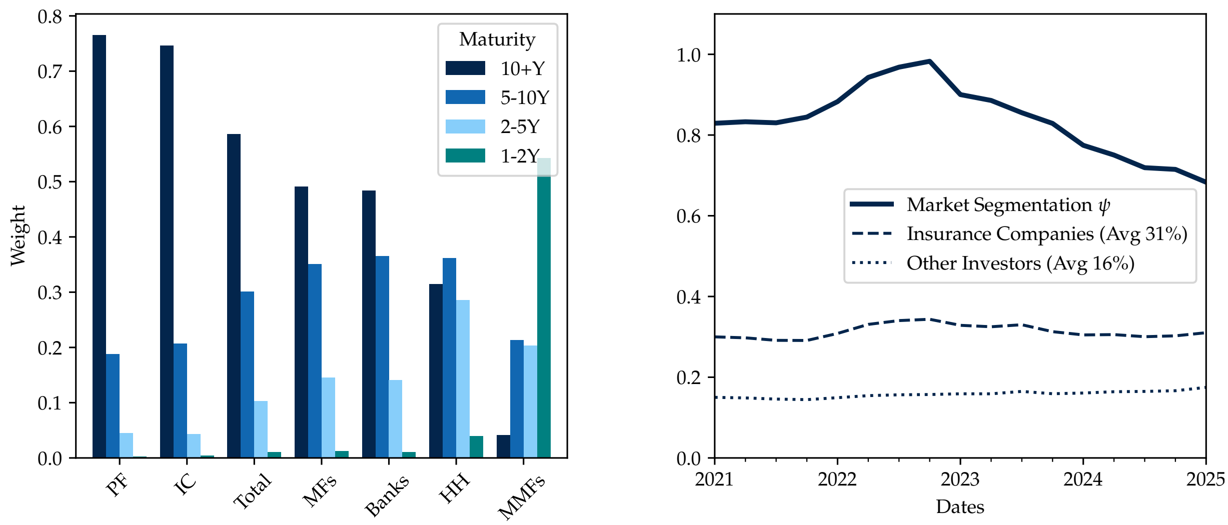
To quantify this, we consider each sector's total long-term bond share, not only its maturity tilt within the bond portfolio. We measure insurers' weight in long-term bonds, $w^B_{\text{ins},t}$, as long-term bond holdings relative to total insurer assets. The corresponding weight for all other investors, $w^B_{\text{O},t}$, 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.

Figure 14: 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.

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. 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

Table XI: 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.

estimates in the literature.[26] 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.

7.3 The Price Impact of Insurance Flows

Table XII 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.

[26] 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 XII: 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 (6), 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.

8. Model of Government Bond Market

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.

8.1 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:

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

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 M 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:

$$d_t^{ins}(\tau) = (1-\tilde{\delta})d_{t-1}^{ins}(\tau) + f_t(\tau) \tag{7}$$

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.

8.2 Calibration

Most of the calibration has been already discussed in Section 7.2.

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 (7), 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 $\tilde{\eta}^{ins} = 1.7$.[27]

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 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.

[27] 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 (7), the value of $\tilde{\eta}^{ins}$ is that which satisfies the equation: $\tilde{\eta}^{ins} * \Delta\bar{ts}^{(10)}\left(\frac{1}{\delta}\right)\left(1-(1-\delta)^7\right) = \bar{d}^{ins}(10) * \left(\frac{0.14-0.18}{0.18}\right)$

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 XIII.

Table XIII: 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

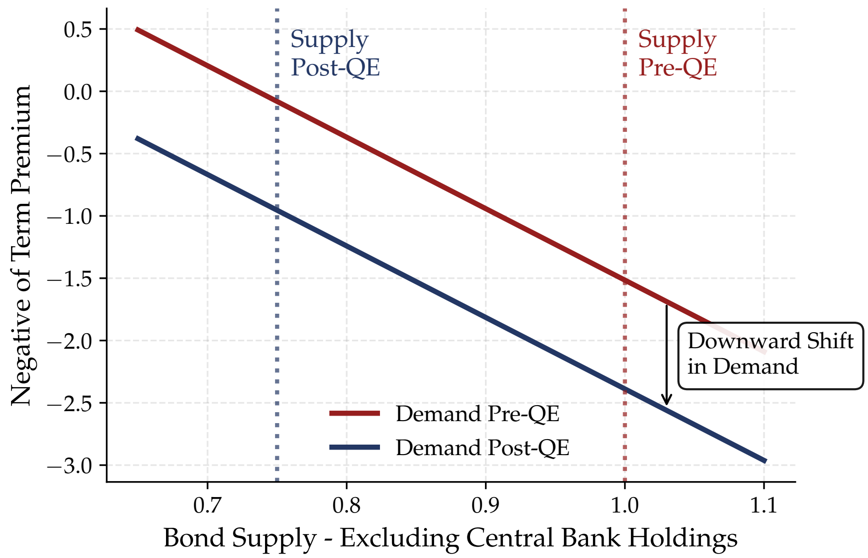
8.3 One-Time Permanent QE Shock

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 15 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 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

Figure 15: Demand Curve Pre- and Post- QE



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 15 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, $d_{t-1}^{ins}(\tau^{\star})$, 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.

8.4 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 13a 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.

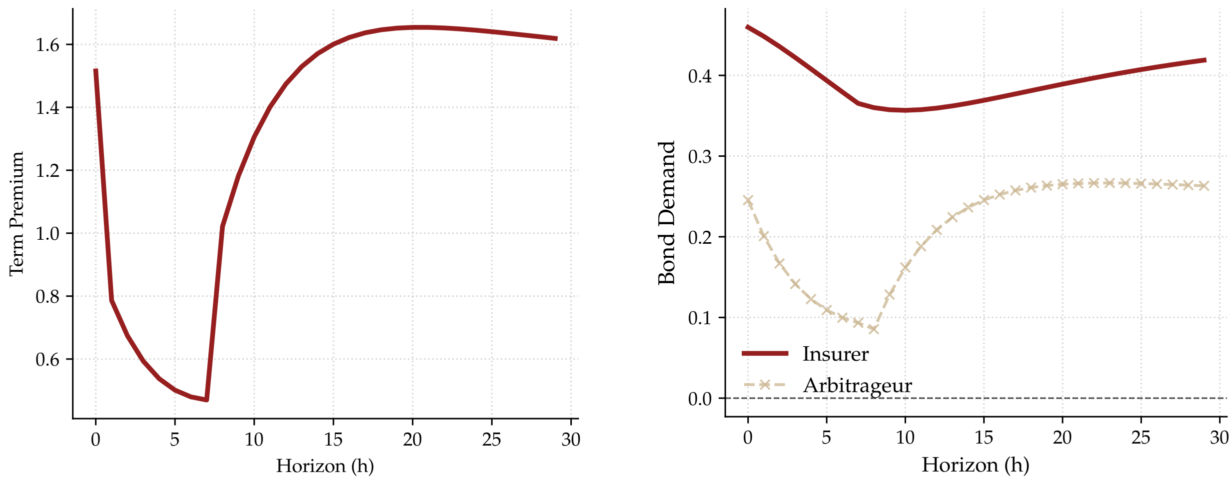
The impulse responses in Figure 16 summarize these dynamics. The initial impact on the term spread is large, falling from 1.5% to roughly 0.8%. This occurs even though actual purchases are gradual. Agents understand that the central bank will steadily accumulate a large portfolio position, which implies 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 16: Impulse Response Gradual QE Shock + Unwind

(a) Term Premium (b) Demand



9. Conclusion.

This paper has shown that the prolonged period of low long-term interest rates brought about by quantitative easing (QE) fundamentally reshaped the structure of the European financial system. By compressing term premia and making guaranteed-return products unattractive, QE weakened the main private pillar of long-term bond demand—the life-insurance sector. Using supervisory data from EIOPA combined with flow-of-funds statistics, we document that household inflows into life insurers fell by nearly €2 trillion between 2015 and 2022, leading to a sharp contraction in insurers' bond holdings. Because insurers invest roughly €0.70 in bonds for every €1 of inflows, this decline translated directly into lower demand for long-term government debt.

The adjustment was not symmetric. As the ECB began quantitative tightening (QT), rising rates triggered policy surrenders, turning insurers into net sellers of sovereign bonds for the first time since the creation of the euro. Although inflows have started to recover with the normalization of long-term yields, they remain well below pre-QE levels. The insurance industry has restructured around Unit-linked products, which transfer investment risk to households and substantially reduce the sector's appetite for duration. This transformation reflects a structural shift rather than a cyclical response to monetary conditions.

Taken together, these findings suggest that QE has permanently altered the composition of long-term investors in Europe. By eroding the traditional role of life insurers as stable holders of sovereign debt, it has left bond markets more dependent on central bank demand and on intermediaries with shorter investment horizons. As public debt issuance expands under QT, this new equilibrium—one characterized by a smaller pool of natural long-term buyers—poses fundamental challenges for the pricing and stability of European sovereign debt. For policymakers, the results highlight an important trade-off: while QE succeeded in lowering long-term yields, it also compressed the institutional foundations that previously anchored demand for those assets.

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A. Data

A.1 Government and Corporate Bond Holdings

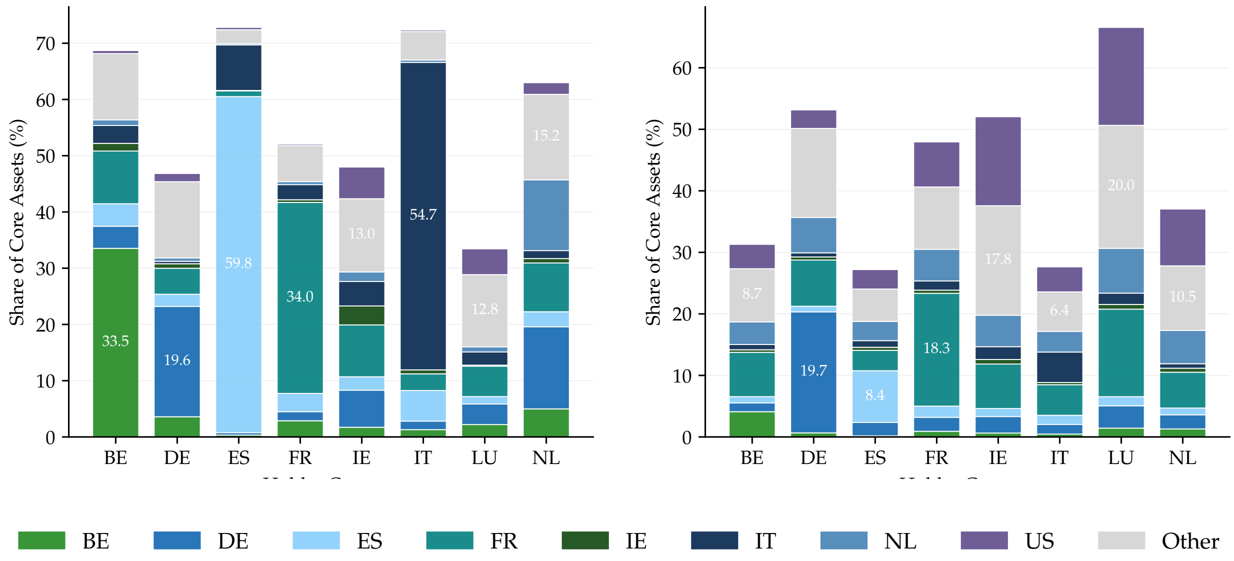
Figure A.1a illustrates the distribution of insurers' government bond holdings across countries. The x-axis shows the country of the holder, while the y-axis refers to the country of issuance. Each cell reports the share of core assets (government bonds, corporate bonds, and CIUs) invested in a given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

(a) Government Bonds (b) Corporate Bonds



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. Derivation of Interest Rate Betas

This appendix derives the relationship between insurers' balance-sheet sensitivities to interest rate and credit spread shocks and the empirical coefficients estimated in Section C.

B.1 Setup

Let A_t denote total assets, L_t total liabilities, and equity $E_t = A_t - L_t$. The effective yields on assets and liabilities are given by

$$y_t^A = \iota_t + \alpha^A s_t, \qquad y_t^L = \iota_t + \alpha^L s_t,$$

where ι_t is the risk-free rate, s_t a credit or sovereign spread factor, and α^A and α^L capture the sensitivity of asset and liability yields to spread changes. Intuitively, α^A reflects insurers' exposure to credit risk through their bond portfolios, whereas α^L reflects how much of that spread exposure is passed through to policyholders via profit-participation contracts or guarantee mechanisms.

B.2 Valuation Sensitivities

Using first-order approximations, log changes in the market values of assets and liabilities can be written as

$$\Delta \log A_t \simeq -D^A \left(\Delta\iota_t + \alpha^A \Delta s_t\right), \qquad \Delta \log L_t \simeq -D^L \left(\Delta\iota_t + \alpha^L \Delta s_t\right),$$

where D^A and D^L denote the effective durations of assets and liabilities.

Define leverage as $\lambda = L/A$, implying $A/E = 1/(1-\lambda)$ and $L/E = \lambda/(1-\lambda)$. Then, total equity sensitivity to changes in risk-free rates and spreads is

$$\Delta \log E_t \simeq -\frac{D^A - \lambda D^L}{1-\lambda}\,\Delta\iota_t - \frac{D^A\alpha^A - \lambda D^L\alpha^L}{1-\lambda}\,\Delta s_t. \tag{8}$$

The first term captures the leveraged *duration mismatch*, while the second term captures the *spread-loaded duration*, reflecting residual credit exposure after accounting for liabilities.

B.3 Decomposition of the Interest Rate Beta

Taking covariances with changes in the risk-free rate $\Delta\iota_t$, we obtain the total interest-rate beta:

$$\beta^{IR} \equiv \frac{\mathrm{Cov}(\Delta \log E_t, \Delta\iota_t)}{\mathrm{Var}(\Delta\iota_t)} \simeq -\frac{D^A - \lambda D^L}{1-\lambda} - \frac{D^A\alpha^A - \lambda D^L\alpha^L}{1-\lambda} \cdot \frac{\mathrm{Cov}(\Delta s_t, \Delta\iota_t)}{\mathrm{Var}(\Delta\iota_t)}. \tag{9}$$

Equation (9) decomposes the observed sensitivity of insurers' equity to interest rate changes into two components:

1. a **leveraged duration mismatch** term, $-\frac{D^A-\lambda D^L}{1-\lambda}$, which captures the direct effect of a change in risk-free rates when spreads are held constant;
2. a **spread-loaded duration** term, proportional to the covariance between spreads and risk-free rates, which captures the indirect effect through correlated spread movements.

When spreads and rates are uncorrelated, the second term vanishes, and β^{IR} isolates the pure effect of the duration gap. Conversely, if spreads and interest rates are negatively correlated—as during risk-off episodes or quantitative easing—the measured β^{IR} will be attenuated toward zero, since spread compressions offset the mark-to-market losses from higher rates.

B.4 Interpretation

Equation (9) provides a theoretical link between the regression coefficients estimated in Section C and insurers' balance-sheet structure:

$$\begin{aligned} \beta^{IR} &\longleftrightarrow \text{Interest rate sensitivity (duration mismatch)}, \\ \beta^{sov},\ \beta^{corp} &\longleftrightarrow \text{Direct exposure to sovereign and corporate spreads.} \end{aligned}$$

Empirically, these betas can be recovered from regressions of changes in insurers' net asset values on changes in interest rates and credit spreads. The resulting coefficients reflect both balance-sheet structure (through durations and leverage) and macro-financial co-movements (through $\mathrm{Cov}(\Delta s_t, \Delta\iota_t)$). Hence, the comparison between univariate and multivariate regressions in the main text reveals whether insurers' apparent sensitivity to interest rates stems primarily from duration mismatches or from correlated spread exposure.

B.5 Calibration Example

In the data, the median leverage parameter is $\lambda \approx 0.83$, implying $A/E \approx 6$. Assuming durations of $D^A = 8$ and $D^L = 10$, the leveraged duration gap is about -12, corresponding to an interest-rate beta near –1.2 when Δs_t is uncorrelated with $\Delta\iota_t$. This is broadly consistent with the empirical estimates reported in Section C, where the median β^{IR} is around –1.4 in the univariate case and –0.4 when controlling for spreads.

C. Interest Rates and Net Asset Value

We have discussed two main factors influencing insurers' bond investment decisions: liability inflows and equity valuations. The intuition is that when an insurer's equity value increases, its risk-bearing capacity improves, allowing it to take on more risk and potentially adjust its bond portfolio. Li (2024), for instance, highlights this mechanism.

The existing literature has typically measured insurers' exposure of assets net of liabilities (i.e., net assets) to interest rates by regressing equity returns on changes in the ten-year bond yield. Following this approach, we find results consistent with previous studies: higher interest rates are associated with higher equity returns, particularly during periods of low rates. However, as discussed throughout the paper, an increase in interest rates also implies stronger future inflows and potentially higher profit margins, since it is difficult to generate margins on minimum-guarantee products when rates are near zero. In this sense, the "franchise value" of insurers tends to rise with higher rates.

To directly assess the exposure of assets net of liabilities, we exploit the fact that Solvency II requires insurers to report the market value of both assets and liabilities, including adjustments for derivative exposures and other valuation effects. We then regress this measure on changes in interest rates. It is, however, worth clarifying what this estimate captures.

As shown in Appendix B, in a univariate regression of net assets on interest rates, the interest-rate beta, β^{IR}, can be decomposed into two components: (i) a *leveraged duration mismatch*, which measures the direct exposure to changes in risk-free rates; and (ii) a *spread-loaded component*, which arises when credit spreads and risk-free rates co-move. Therefore, the estimated β^{IR} reflects both the duration effect and the indirect exposure through correlated spread movements. When we control for credit spreads, we isolate the pure duration gap (component i).

The appropriate specification depends on the research question. One possible objective is to quantify the *duration mismatch* of insurers once leverage is considered—that is, to ask what would happen if risk-free rates rose while credit spreads remained constant. This counterfactual isolates the pure interest-rate effect.

A second, and arguably more relevant, question is what actually happens to insurers when interest rates rise in practice. This is more informative for understanding solvency and bond trading behavior, since in reality interest rates and credit spreads often move together. As we discuss later, the relationship between spreads and interest rates varies over time, depending on the nature of shocks hitting the economy and the central bank's policy response.

Specification and Variables. We begin by estimating a univariate regression of changes in insurers' net assets on changes in interest rates. The interest rate is measured using the overnight indexed swap (OIS) curve, which is also adopted by EIOPA for discounting insurance liabilities.[28] We then extend the specification by adding sovereign and corporate credit spreads as controls. The full empirical specification is:

$$\Delta \log NA_{i,t} = \beta^{IR}\, \Delta\iota_t + \beta^{sov}\, \Delta s_t^{sov} + \beta^{corp}\, \Delta s_t^{corp} + \gamma_i + \varepsilon_{i,t}, \tag{10}$$

where $\Delta \log NA_{i,t}$ denotes the change in net asset value, $\Delta\iota_t$ represents changes in the ten-year OIS rate, Δs_t^{sov} the spread between Italian–Spanish and German ten-year sovereign yields, and Δs_t^{corp} the corporate bond spread from the Markit iBoxx ten-year option-adjusted spread.

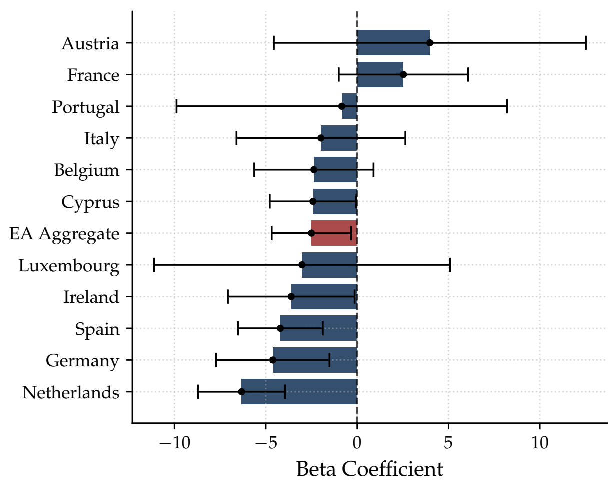
Interpretation. The coefficients β^{IR}, β^{sov}, and β^{corp} quantify insurers' sensitivities to risk-free and credit market factors. A negative β^{IR} implies that an increase in risk-free rates reduces the value of insurers' assets more than that of their liabilities, consistent with a positive residual duration gap once leverage is accounted for. Conversely, negative β^{sov} or β^{corp} coefficients reflect valuation losses from widening sovereign or corporate spreads, which lower bond prices on the asset side of the balance sheet.

We now discuss the results of both running the univariate regression and the multivariate regression. We start with the univariate regression using aggregate data and then we use individual insurers' data.

[28]The curve is based on EONIA from 2007 to 2021 and transitions to the OIS curve based on the €STR from 2021 onward. During the transition year, both series are available. Since €STR closely tracks EONIA with a stable spread, we adjust €STR by this constant spread to ensure continuity. This adjustment affects levels but not rate changes—the focus of our analysis.

Aggregate Results We begin by presenting the results of a simple univariate regression estimated separately for each country, as well as for the Euro area aggregate obtained by summing the net asset values across countries. Figure C.1 reports the corresponding estimates. For the Euro area as a whole, we find a negative coefficient of approximately -2.5, indicating that a one–percentage-point increase in interest rates is associated with a 2.5% decline in net asset value. The direction of this effect contrasts with the positive relationship typically found in the literature for equity returns. However, the R^2 is below 8%, suggesting that interest rate changes account for only a limited share of the variation in net asset values. We next turn to the results using individual-country data, estimating Equation 10 at the entity level.

Figure C.1: NAV Interest Rate Exposure Aggregate



Note: The figure reports the results of a univariate regression of the annual change in the logarithm of net asset value on the annual change in the ten-year interest rate. The estimation uses quarterly overlapping observations, and standard errors are computed using the Newey–West correction.

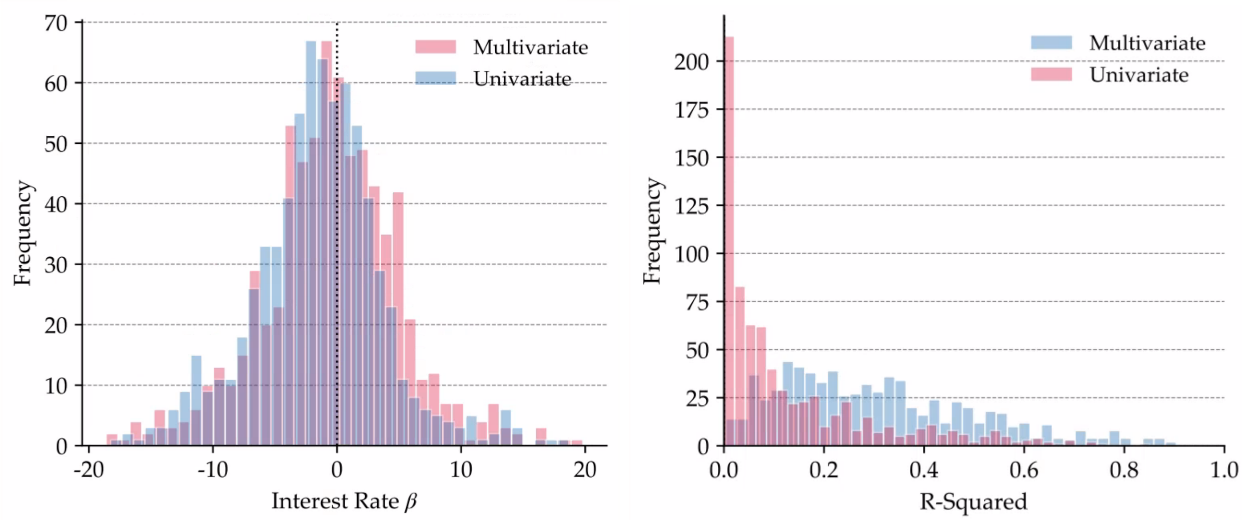
Individual Results We estimate Equation 10 separately for each individual insurer, first using only the variation in interest rates (univariate specification) and then adding credit spreads as additional controls. The distribution of the estimated betas is shown in Figure C.2a. In the univariate regression of $\Delta \log NA_{i,t}$ on $\Delta\iota_t$, the median β^{IR} is approximately -1.4, indicating that a one–percentage-point increase in interest rates is associated with a 1.4% decline in net asset value. On average, therefore, higher interest rates are linked to valuation losses for insurers, consistent with their residual duration mismatch.

When sovereign and corporate credit spreads are included as controls, the coefficient on the interest rate decreases in magnitude to about -0.4. This decline indicates that much of the sensitivity to interest rates observed in the univariate specification stems from insurers' exposure to credit spreads rather than from pure duration risk. Once spreads are accounted for, the remaining sensitivity corresponds to the pure duration component derived in Appendix B, which is comparatively modest.

Overall, these results suggest that insurers' balance-sheet exposure to interest rates arises primarily through their holdings of spread-risk assets rather than through direct duration mismatches. Figure C.2b further shows that interest rates alone explain little of the variation in insurers' NAVs (median R^2 around 6%), while including credit spreads increases explanatory power to nearly 30%. Thus, spreads rather than rates account for most of the balance-sheet valuation dynamics in the insurance sector.

Figure C.2: NAV Interest Rate Exposure

(a) Interest Rate β (b) R-squared



D. The Correlation Between Long-term Rates and Spreads

In section C, 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).

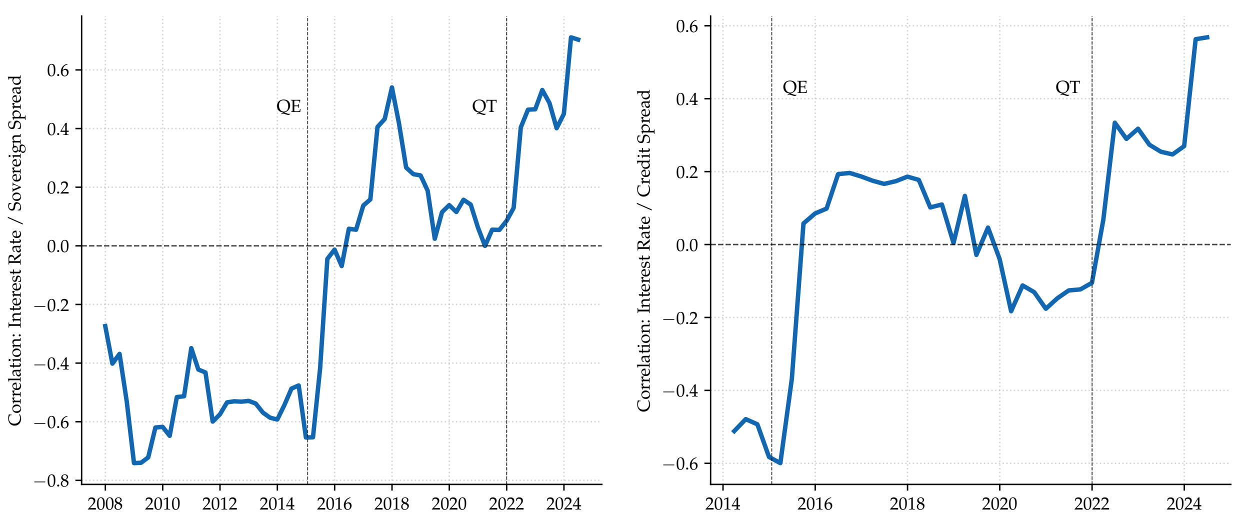
In the euro area, sovereign spreads and interest rates also used to move inversely. However, the ECB's unconventional monetary policies reshaped these dynamics (Haddad et al., 2024). Quantitative Easing simultaneously reduced long-term rates and compressed sovereign spreads, while Quantitative Tightening raised both, thereby generating a positive correlation.[29] Figure D.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 D.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 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.[30]

Figure D.1: Correlation between Interest Rates and Spreads

(a) Interest Rate / Sovereign Spread | (b) Interest Rate / Credit Spread



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.

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

[30]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."

E. Households Portfolios

While our focus is on insurance policies, it is useful to first place them in the context of the broader household balance sheet.[31] Figure E.1 shows the composition of euro area households' financial assets at the end of 2019. Insurance policies stand out, accounting for nearly one quarter of total financial wealth. This makes them larger than direct equity holdings (around 22%) and far larger than either direct bond holdings (1.5%) or mutual fund shares (9%). Deposits remain the single largest category at roughly one third of assets. The centrality of insurance products underscores their macroeconomic importance: shifts in household demand for these contracts directly shape insurers' balance sheets and, through them, the channeling of household savings into long-term and higher-risk bonds.

Figure E.1b plots the evolution of household financial assets in euro trillions. It is important to note that these levels combine both revaluation effects and transactions. Deposits remain the dominant asset class for households, with insurance policies consistently the second largest category. The sharp decline of almost €2 trillion in insurance assets between 2021 and 2022 is almost entirely due to revaluation: the rise in interest rates mechanically reduced the market value of insurers' assets and hence liabilities. Conversely, the preceding period of falling rates—especially after the introduction of QE—had inflated the value of insurance assets by a comparable amount. To separate genuine shifts in household saving behavior from valuation effects, our analysis therefore focuses on transactions (or flows) rather than levels.

Two additional trends are worth noting. First, household equity holdings have increased markedly since 2012, with a clear acceleration after 2015. A similar pattern emerges for assets held in investment funds, reflecting a gradual shift in household portfolios toward market-based instruments. Second, while direct bond holdings are relatively small, they began to decline after 2012, with the drop becoming more pronounced around 2015. Indeed, as we will show using fund flow transactions, households were net sellers of long-term bonds during this period.

[31] In the flow of funds, insurance products are reported under the categories "life insurance policies" and "pension entitlements." These labels do not map perfectly into institutional boundaries: some assets classified as pension entitlements are in practice administered by insurers (such as retirement products), while certain life insurance policies may be managed by pension funds. To align with our micro data, we classify household insurance policies as all assets corresponding to the liabilities of insurance companies (whether reported as insurance policies or as pension entitlements). Conversely, we classify as pension entitlements only those assets that correspond to the liabilities of pension funds. The European insurance sector is much larger than the pension sector—roughly four times its size—and pension assets are concentrated almost entirely in Dutch schemes.

F. 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 N.15 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 those with larger increase in yields. In Appendix F 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

$$\Delta y_{i,t} = \gamma_i + \gamma_t + \beta \Delta \frac{Flows_{i,t}}{Asset_{i,t-1}} + \varepsilon_{i,t} \tag{11}$$

where $\Delta Flows_{i,t}$ is the change in flow into insurance scaled by the total assets. The stan-

Figure E.1: Households Balance Sheets

(a) Share of Assets in 2019 (b) Evolution of Assets

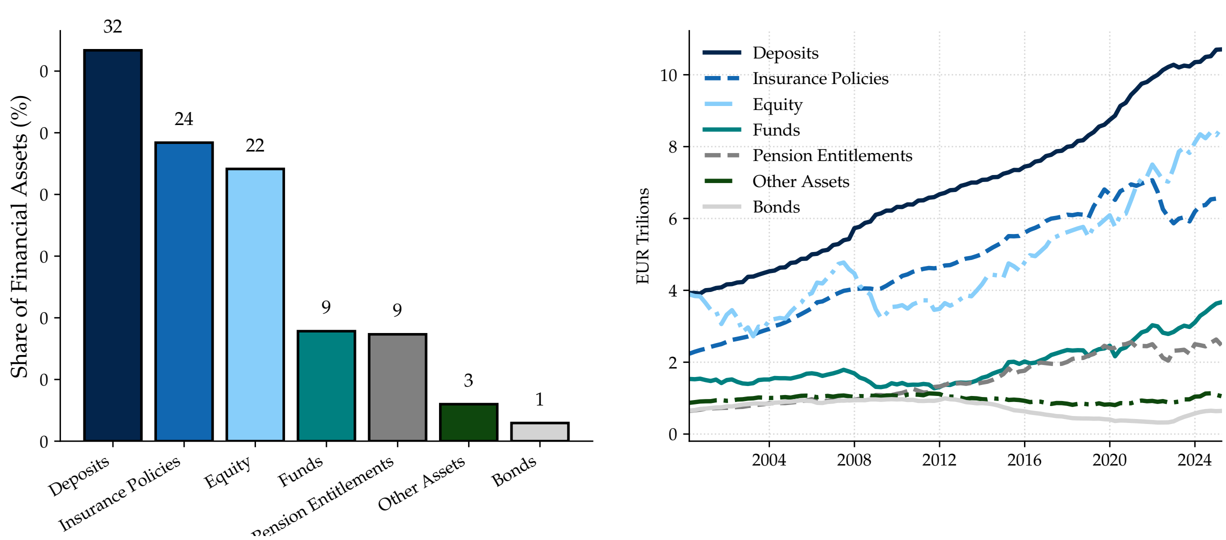
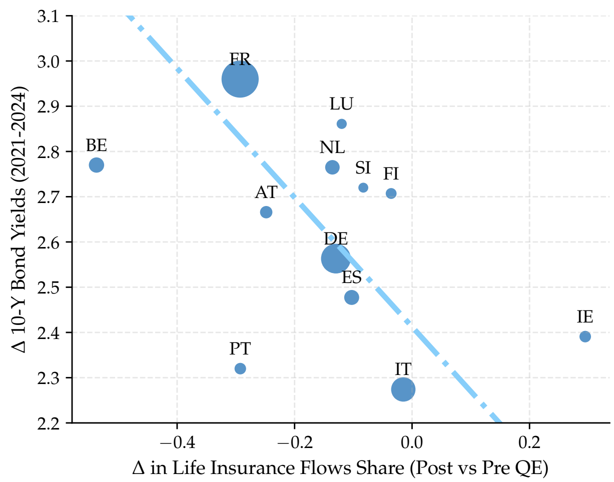


Figure F.1: QT Effects



Note: Figure N.15 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.

dard 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 F1: 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

G. SCR Ratio

subsubsectionSolvency Capital Requirement (SCR)

Do we need this subsection? I notice that SCR is not referenced at all in the whole main text of the paper, so perhaps drop it or leave details to an Appendix? In the European Union, the Solvency II framework sets the amount of capital that insurers must hold against a range of risks, with the aim of ensuring financial stability and policyholder protection. The Solvency Capital Requirement (SCR) is the main regulatory capital standard. It is calibrated so that insurers should be able to absorb unexpected losses over a one-year horizon with a probability of 99.5%. In other words, the SCR is the level of own funds required so that the likelihood of insolvency within the next year is no greater than 0.5%.

A central solvency indicator is the Solvency Capital Ratio (SCR ratio), defined as the ratio of available Own Funds to the Solvency Capital Requirement:

$$\text{SCR Ratio} = \frac{\text{Own Funds}}{\text{SCR}}.$$

The numerator, Own Funds, represents the capital resources eligible under Solvency II to cover losses. Own Funds start from the insurer's net assets, defined as assets minus liabilities under Solvency II valuation, but are then adjusted for regulatory purposes. Intangible assets and items that are not readily available to absorb losses are excluded, while subordinated debt or hybrid instruments may be included if they have sufficient loss-absorbing capacity.

The denominator, the SCR, is the required capital derived from the standard formula or an approved internal model. A ratio above 100% indicates that an insurer holds sufficient capital to meet the regulatory requirement, while a ratio below 100% signals a breach of the minimum solvency standard.

The SCR is not a measure of accounting shortfall, but rather a forward-looking risk-based buffer. It represents the minimum amount of eligible capital that an insurer must hold in order to continue meeting its obligations to policyholders under large but plausible adverse scenarios.

The framework distinguishes several broad categories of risk: i) *Market risk*, related to changes in interest rates, equity prices, property values, and exchange rates. An important regulatory convention is that euro area sovereign bonds denominated in domestic currency receive a zero risk weight, so that they do not contribute to the spread risk charge under the standard formula; ii) *Credit risk*, related to the possibility of counterparty defaults and wider credit spreads; iii) *Insurance risk*, related to underwriting uncertainty such as mortality, morbidity, or catastrophic events; and iv) *Operational risk*, related to losses from internal failures, external events, or weaknesses in systems, processes, or staff.

The SCR can be calculated either with the standard formula prescribed by regulators or with an internal model developed by the insurer. In the standard formula, the SCR is obtained by aggregating the capital requirements of the individual risk modules through a prescribed correlation structure:

$$SCR = \sqrt{\sum_i \sum_j \rho_{ij} \, SCR_i \, SCR_j},$$

where SCR_i denotes the capital requirement of module i and ρ_{ij} is the regulatory correlation coefficient between modules i and j.

The square-root form captures diversification effects across risks. If two modules are perfectly correlated, the required capital is close to the sum of their stand-alone charges. If they are less than perfectly correlated, the aggregation reduces the total requirement, reflecting the fact that adverse outcomes in different risk categories are unlikely to occur simultaneously at their worst levels.

The overall Solvency Capital Requirement (SCR) is obtained by aggregating the capital requirements of the individual risk modules through a correlation matrix:

$$SCR = \sqrt{\sum_i \sum_j \rho_{ij} \, SCR_i \, SCR_j},$$

where SCR_i denotes the capital requirement of module i and ρ_{ij} is the prescribed correlation coefficient between modules i and j.

The modules included in the aggregation are:

1. Market risk (SCR^{mkt}),
2. Counterparty default risk (SCR^{def}),
3. Life underwriting risk (SCR^{life}),
4. Health underwriting risk (SCR^{health}),
5. Non-life underwriting risk (SCR^{nl}).

The prescribed correlation matrix ρ_{ij} across these modules is:

	Market	Counterparty	Life	Health	Non-life
Market	1	0.25	0.25	0.25	0.25
Counterparty	0.25	1	0.25	0.25	0.50
Life	0.25	0.25	1	0.25	0
Health	0.25	0.25	0.25	1	0
Non-life	0.25	0.50	0	0	1

Thus, for example, the correlation between health and market risk is $\rho_{\text{health,market}} = 0.25$.

G.1 Market Risk Module (Articles 162–164)

1. The market risk module consists of the following sub-modules:

    (a) interest rate risk;

    (b) equity risk;

    (c) property risk;

    (d) spread risk;

    (e) currency risk;

    (f) market concentration risk.

2. The capital requirement for market risk is

$$SCR_{\text{market}} = \sqrt{\sum_i \sum_j \text{Corr}_{ij}\, SCR_i\, SCR_j},$$

   where Corr_{ij} denotes the prescribed correlation coefficients.

3. The correlation parameters are given in Table G1.

Table G1: Correlation matrix for market risk sub-modules (Articles 162–164)

$i\backslash j$	Interest rate	Equity	Property	Spread	Concentration	Currency
Interest rate	1	A	A	A	0	0.25
Equity	A	1	0.75	0.75	0	0.25
Property	A	0.75	1	0.5	0	0.25
Spread	A	0.75	0.5	1	0	0.25
Concentration	0	0	0	0	1	0
Currency	0.25	0.25	0.25	0.25	0	1

The parameter A is set to 0 if the interest rate requirement is based on the special case of Article 165(a). Otherwise, $A = 0.5$.

Example. Suppose $\mathrm{SCR}_{\mathrm{IR}} = 150$, $\mathrm{SCR}_{\mathrm{Spread}} = 100$, all others zero.

Case 1 (typical): $A = 0.5$.

$$SCR_{\text{market}} = \sqrt{150^2 + 100^2 + 2 \cdot 0.5 \cdot 150 \cdot 100} = \sqrt{47{,}500} \approx 217.9.$$

Case 2 (special): $A = 0$.

$$SCR_{\text{market}} = \sqrt{150^2 + 100^2} = \sqrt{32{,}500} \approx 180.3.$$

—

G.2 Interest Rate Risk Module (Article 165)

The capital requirement for interest rate risk is the maximum of:

1. the loss under an upward shock;
2. the loss under a downward shock.

Formally,

$$SCR_{\text{IR}} = \max\left\{ \sum_c SCR^{\uparrow}_{\text{IR},c},\ \sum_c SCR^{\downarrow}_{\text{IR},c} \right\}.$$

Upward shock. Apply the shocks in Table G2, linearly interpolating for other maturities. Shorter than 1 year: 70%. Longer than 90 years: 20%. Floor at 1pp.

Downward shock. Apply the shocks in Table G3. Shorter than 1 year: 75%. Longer than 90 years: 20%. If risk-free already negative, the downward shock is zero.

Implementation notes.

(i) Apply shocks pointwise to the curve, then revalue the balance sheet.

(ii) Per-currency capital is the loss in own funds.

(iii) Take the maximum across up and down scenarios.

Table G2: Interest rate upward shocks

Maturity (years)	Increase (%)
1	70
2	70
3	64
4	59
5	55
10	42
15	33
20	26
90	20

Table G3: Interest rate downward shocks

Maturity (years)	Decrease (%)
1	75
2	65
3	56
4	50
5	46
10	31
15	27
20	29
90	20

—

G.3 Spread Risk Module (Article 176)

1. **General definition.** For each position j with market value V_j,

$$\Delta V_j = V_j \cdot s(r_j, D_j),$$

where $s(\cdot)$ is the stress factor depending on credit quality step r_j and duration D_j. The capital requirement is $\mathrm{SCR}^{\mathrm{Spread}} = \sum_j \Delta V_j$. The CQS is the credit quality step. The match between CQS to standard rating is based on Table G4.

Table G4: Mapping from Credit Quality Step (CQS) to Rating Categories (ECAI equivalence)

CQS	**Generic Category**	**S&P**	**Moody's**	**Fitch**
0	AAA	AAA	Aaa	AAA
1	AA	AA+, AA, AA-	Aa1, Aa2, Aa3	AA+, AA, AA-
2	A	A+, A, A-	A1, A2, A3	A+, A, A-
3	BBB (investment grade)	BBB+, BBB, BBB-	Baa1, Baa2, Baa3	BBB+, BBB, BBB-
4	BB (speculative)	BB+, BB, BB-	Ba1, Ba2, Ba3	BB+, BB, BB-
5	B	B+, B, B-	B1, B2, B3	B+, B, B-
6	C (CCC and below)	CCC+, CCC, CCC-, CC, C, D	Caa1, Caa2, Caa3, Ca, C	CCC+, CCC, CCC-, CC, C, RD, D
None	NR (Not Rated)	–	–	–

2. **Rated bonds and loans.** Stress factors are piecewise linear in D, see Table G5.

3. **Unrated and uncollateralised.** Stress factors given in Table G6.

4. **Unrated with collateral.** If collateral C is posted against exposure V, the stress is adjusted:

$$s_{\text{coll}}(D, C, V) = \begin{cases} \frac{1}{2}\, s_u(D), & C \geq V, \\ \frac{1}{2}\left(s_u(D) + (1 - C/V)\right), & C < V \ \&\ s_u(D) > (1 - C/V), \\ s_u(D), & \text{otherwise.} \end{cases}$$

5. **Specific exposures (Article 180).**

   (a) Zero-stress for ECB, domestic-currency sovereigns, MDBs, IOs, and fully guaranteed exposures.

   (b) Covered bonds with CQS 0–1 have reduced factors (Table G7).

   (c) Other sovereigns: apply rated bond factors.

Table G5: Spread risk factors for rated bonds and loans

Duration D	Formula	CQS0	CQS1	CQS2	CQS3	CQS4	CQS5–6
$0 < D \leq 5$	bD	0.9%	1.1%	1.4%	2.5%	4.5%	7.5%
$5 < D \leq 10$	$a + b(D-5)$	4.5%,0.5%	5.5%,0.6%	7.0%,0.7%	12.5%,1.5%	22.5%,2.5%	37.5%,4.2%
$10 < D \leq 15$	$a + b(D-10)$	7.0%,0.5%	8.4%,0.5%	10.5%,0.5%	20.0%,1.0%	35.0%,1.8%	58.5%,0.5%
$15 < D \leq 20$	$a + b(D-15)$	9.5%,0.5%	10.9%,0.5%	13.0%,0.5%	25.0%,1.0%	44.0%,0.5%	61.0%,0.5%
$D > 20$	$\min[a + b(D-20), 1]$	12.0%,0.5%	13.4%,0.5%	15.5%,0.5%	30.0%,0.5%	46.5%,0.5%	63.5%,0.5%

Table G6: Spread risk factors for unrated and uncollateralised bonds/loans

Duration D	Formula	Stress
$0 < D \leq 5$	$3\%D$	linear
$5 < D \leq 10$	$15\% + 1.7\%(D-5)$	linear
$10 < D \leq 20$	$23.5\% + 1.2\%(D-10)$	linear
$D > 20$	$\min(35.5\% + 0.5\%(D-20), 1)$	capped

Table G7: Spread risk factors for covered bonds (CQS 0–1)

Duration D	Formula	CQS0	CQS1
$0 < D \leq 5$	bD	$0.7\%D$	$0.9\%D$
$D > 5$	$\min[a + b(D-5), 1]$	$3.5\% + 0.5\%(D-5)$	$4.5\% + 0.5\%(D-5)$

H. Appendix: Construction of Insurance Flows

H.1 Underwriting flows (proxy for policyholder cash)

We use template **S.05.01** for both non-life and life segments and take the net rows in each block. Concretely:

$$\begin{aligned}\text{UnderwritingFlows}_t^{\text{proxy}} = &\Big(\underbrace{\text{R0200}}_{\substack{\text{Net premiums}\\\text{written}}} - \underbrace{\text{R0400}}_{\substack{\text{Net claims}\\\text{incurred}}} - \underbrace{\text{R0550}}_{\substack{\text{Expenses}\\\text{incurred}}} + \underbrace{\text{R0500}}_{\substack{\text{Net changes}\\\text{other tech. prov.}}}\Big)_{\text{non-life}} \\ &+ \Big(\underbrace{\text{R1500}}_{\substack{\text{Net premiums}\\\text{written}}} - \underbrace{\text{R1700}}_{\substack{\text{Net claims}\\\text{incurred}}} - \underbrace{\text{R1900}}_{\substack{\text{Expenses}\\\text{incurred}}} + \underbrace{\text{R2500}}_{\substack{\text{Other}\\\text{technical balance}}}\Big)_{\text{life}}.\end{aligned} \tag{12}$$

All items are reported net of reinsurance in S.05.01. We exclude changes in *reinsurance recoverables* from S.02.01 and S.36.01, because these are receivables rather than cash.[32]

H.2 Investment income

Investment income is measured using the **S.09.01.01** template (*Income/gains and losses in the period*), which reports income at the asset level. We sum the following items:

$$\text{InvestmentIncome}_t = \sum_i \Big(\text{Dividends (C0070)}_{i,t} + \text{Interest (C0080)}_{i,t} + \text{Rent (C0090)}_{i,t}\Big). \tag{13}$$

We deliberately exclude *Net gains and losses* (C0100) and *Unrealised gains and losses* (C0110), which are valuation effects captured separately in our revaluation component.

H.3 Funding flows

Funding flows are in principle constructed from templates **S.08.01**, **S.08.02**, and **S.09.01**, focusing on cash collateral and repo transactions. A cash-only definition is given by:

$$\begin{aligned}\text{FundingFlows}_t = &\,\Delta\big(\text{Repo liabilities (S.09.01)}\big) \\ &+ \Delta\big(\text{Cash collateral received (S.08)} - \text{Cash collateral posted (S.08)}\big).\end{aligned} \tag{14}$$

Non-cash collateral movements are excluded to avoid introducing valuation or accrual elements. However, due to data limitations, we do not include funding flows in our empirical

[32] Codes verified from the QRTs: non-life R0200/R0400/R0500/R0550 and life R1500/R1700/R1900/R2500. See S.05.01 tables in the PDF.

measure of total flows.

I. An Equilibrium Model of Insurance Flows and Long-Term Bond Yields

I.1 Notation

We assume that there are only two intermediaries: Insurance companies and the outside financial sector, $i = \{\text{Ins.}, \text{Other}\}$. Let W_t denote total household wealth in the economy. We only consider the closed economy setting and ignore wealth held outide of the EU area. Let $B_t = Q_t^B P_t^B$ denote the total market value of EU area long term bonds with maturities above 10 years. The total market weight of EU area long-term bonds is given by $w_t^B = \frac{B_t}{W_t}$. Second, let $W_{\text{Ins.},t}$ and $W_{\text{Other},t}$ denote the total assets under management held by insurance companies and other investors, such that $W_t = W_{\text{Ins.},t} + W_{\text{Other},t}$. Similarly, $B_{\text{Ins.},t} = Q^B_{\text{Ins.},t} P_t^B$ and $B^{\text{Other},t} = Q^B_{\text{Other.},t} P_t^B$ denote the total bond holdings of insurance companies and other investors , such that $B_t = B_{\text{Ins.},t} + B_{\text{Other},t}$. The portfolio weight of insurance companies in long-term bonds is given by $w^B_{\text{Ins.},t} = \frac{B_{\text{Ins.},t}}{W_{\text{Ins.},t}}$. Similarly, the weight in long-term bonds by other investors is $w^B_{\text{Other},t} = \frac{B_{\text{Other},t}}{W_{\text{Other},t}}$.. The size weights of each sector are given by $S_{i,t} = \frac{B_{i,t}}{B_t}$. Note, that size-weights are not equal to portfolio weights which are given by $w^B_{i,t} = \frac{B_{i,t}}{W_{i,t}}$. Total household flows in dollars given by are F_t. Capital flows to insurance companies $F_{\text{Ins.},t}$ and other institutions $F_{\text{Other},t}$ sum to total flows.

$$F_{\text{Ins.},t} + F_{\text{Other.},t} = F_t \tag{15}$$

I.2 Investor Demand

There are only two assets, a long-term bond with maturity in N years and a short-term bond. The deviation of the term premium with respect to the steady state is given by $\hat{\pi}$. Following Gabaix and Koijen (2021), we model the generic demand curve of an investor i for the long-term bond as

$$\Delta q^B_{i,t} = \kappa \hat{\pi}_t + f_{i,t} \tag{16}$$

where $\Delta q^B_{i,t} = \frac{\Delta Q^B_{i,t}}{Q^B_{i,t-1}}$ is bond demand relative to the previous period and $f_{i,t} = \frac{F_{i,t}}{W_{i,t-1}}$ are flows relative to lagged assets. For simplicity we assume that all investors perfectly scale their bond holdings with respect to their inflows (i.e., the partial scaling coefficient is 1). $\kappa > 0$ is the sensitivity of demand with respect to the term premium (i.e. long-term bond prices), assumed constant across investors for simplicity. Log-linearizing the deviation of the term premium from its steady state value yields $\hat{\pi}_t = -\frac{1}{N}\Delta p_t^B$ where $\Delta p_t^B = \Delta \log P_t^B$ is the realized log return on long-term bonds. Plugging in yields

$$\Delta q_{i,t}^B = -\zeta \Delta p_t^B + f_{i,t} \tag{17}$$

where $\zeta = \frac{\kappa}{N}$ is the elasticity of demand with respect to the price of long-term bonds.

I.3 Market Clearing

Market clearing implies that the size weighted sum of bond demand $\Delta q_{S,t}^B \equiv \sum_i S_i \Delta q_{i,t}^B$ is equal to total issuance relative to previous supply $\Delta q_{\text{Supply},t} = \Delta Q_t^B P_{t-1}/B_{t-1}$. To see this note that $\sum_i S_{i,t-1} \frac{\Delta Q_{i,t}^B}{Q_{i,t-1}^B} = \frac{\Delta Q_t^B}{Q_{t-1}^B}$.

For simplicity of exposition, we assume that total net flows F_t are invested in outside sector weights in the absence of interest rate shocks and perfectly accommodate the total net supply $q_{\text{Supply},t} = \frac{F_t w_{\text{Other,t-1}}^B}{B_{t-1}}$. This will simplify the analytical framework below. What this implies is that on the balanced growth path, absence interest rate shocks, flows do not affect bond prices.

Importantly, the flows into flows into long-term bonds vary, as long as the bond weight of insurance companies differ from the bond-weight of the outside financial sector. The size-weighted sum of flows is given by

$$f_{S,t} = \sum_i S_{i,t} f_{i,t} = \frac{\sum_i F_{i,t} w_{i,t-1}^B}{B_{t-1}} \tag{18}$$

where $w_{i,t-1}^B$ is the lagged portfolio weight of intermediary i in bonds. Because there are just two intermediaries we can write

$$f_{S,t} = \frac{F_{\text{Ins},t} w_{\text{Ins},t-1}^B + (F_t - F_{\text{Ins},t}) w_{\text{Other},t-1}^B}{B_{t-1}} \tag{19}$$

Insurance companies have a greater weight in long-term bonds so that $F_{\text{Ins.},t} > 0$ implies total inflows into long-term bonds. Note, that because the dollar flows in and out of insurance companies must be offset with dollar flows in and out of the outside financial intermediary we can rewrite

$$f_{S,t} = \frac{F_{\text{Ins.},t}}{W_t} \Psi_t + \frac{F_t w_{\text{Other,t-1}}^B}{B_{t-1}} \tag{20}$$

where $\Psi_t = \frac{w_{\text{Ins.},t}^B - w_{\text{Other},t}^B}{w_t^B}$ measures market segmentation as defined above. The size-weighted sum of the representative demand curve is

$$\Delta q_{S,t} = -\zeta \Delta p_t^B + f_{S,t}. \tag{21}$$

I.4 Equilibrium Bond Response to Insurance Flows

Using the market clearing condition, $\Delta q_{S,t} = \Delta q_{\text{Supply},t}$, and plugging in the Solving for bond returns (as a deviation from the baseline) yields

$$\Delta p_t^B = \frac{1}{\zeta} \frac{F_{\text{Ins.},t} w_{x,t}}{B_t} \tag{22}$$

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

J. Dynamic Model

J.1 Intermediary Demand

For simplicity, we assume there are only two assets a long-term bond with maturity in N years and a short-term bond. The steady state dollar amount of long-term bonds outstanding is given by $\bar{Q}_t^B \bar{P}_t^B$. Total financial wealth in the economy is $\bar{W}_t = \text{Supply}_t^B + \text{Supply}^0$ where Supply^0 are the total dollar outstanding of short-term bonds and $\text{Supply}_t^B = \bar{Q}_t^B \bar{P}_t^B$ are the total dollar outstanding of long-term bonds. The deviation of the term premium with respect to the steady state is given by $\hat{\pi}$. Following Gabaix and Koijen (2021), we model the generic demand curve of an investor i for the long-term bond as

$$q_{i,t} = \kappa \hat{\pi}_t + f_{i,t} \tag{23}$$

where $q_{i,t} = \frac{Q_{i,t}^B}{\bar{Q}_{i,t}^B} - 1$ is bond demand in excess of the baseline steady state value $\bar{Q}_{i,t}^B$ and $f_{i,t} = \frac{F_{i,t} - \bar{F}_{i,t}}{\bar{W}_{i,t-1}}$ are flows relative to lagged assets in excess of the steady state baseline $\bar{F}_{i,t}$. For simplicity we assume that all investors perfectly scale their bond holdings with respect to their inflows (i.e., the partial scaling coefficient is 1). $\kappa > 0$ is the sensitivity of demand with respect to the term premium (i.e. long-term bond prices), assumed constant across investors for simplicity. Log-linearizing the deviation of the term premium from its steady state value yields

$$\hat{\pi}_t = -\frac{1}{N} p_t^B + E_t[\Delta p_t^B] \tag{24}$$

where $p_t^B = \log P_t^B$. Plugging in yields

$$q_{i,t} = -\frac{\kappa}{N} p_t^B + \kappa E_t[\Delta p_{t+1}^B] + f_{i,t} \tag{25}$$

J.2 Household Capital Flows

We further assume that there are only two investors: Insurance companies and the outside financial sector, $i = \{\text{Ins.}, \text{Fin.}\}$. The size weights of each sector are given by $S_{i,t} = \frac{P_t^B \bar{Q}_{i,t}^B}{\text{Supply}_t^B}$ where $\bar{Q}_t^B$ is the total steady state quantity of long-term bonds outstanding. Households allocate their total capital capital W_t across the two types of financial intermediaries. When interest rates rise, policy holder surrender leading to a drop in net premia and outflows out of insurance companies. However, higher levels of interest rates imply higher future net premia in the long term. To model these dynamics, we assume the following simple process for flows relative to the total capital as

$$\frac{F_{\text{Ins.},t}}{W_t} = -\gamma \Delta r_t - \Gamma p_t^B + \epsilon_t \tag{26}$$

where $\gamma > 0$ is the short-term response to interest rate changes, and $\Gamma > 0$ is the long-term response due to level shifts in the slope of the yield curve, and ϵ_t captures other shifts in premia and surrenders (e.g., due to exogenous environmental forces such as natural disasters).

J.3 Market Clearing

Market clearing implies that the bond-holdings weighted sum $q_{S,t} = \sum_i S_i q_{i,t} = 0$. Similarly total household flows sum to 0, i.e. $\sum_i F_{i,t} = 0$. Importantly, while total flows sum to 0, flows into long-term bonda are non-zero, as long as the bond weight of insurance companies differ from the bond-weight of the outside financial sector. Formally $F_{\text{Ins.},t} = F_{\text{Fin.},t}$ which implies

$$f_{S,t} = \sum_i S_{i,t} f_{i,t} = \frac{\sum_i F_{i,t} \bar{w}_{i,t}^B}{\text{Supply}_t^B} \neq 0 \tag{27}$$

where $w_{i,t}^B = \frac{Q_{i,t}^B P_t^B}{W_{i,t-1}}$ is the baseline portfolio weight of sector i in bonds. Insurance companies have a greater weight in long-term bonds so that $F_{\text{Ins.},t} > 0$ implies total inflows into long-term bonds. Note, that because the dollar flows in and out of insurance companies must be offset with dollar flows in and out of the outside financial intermediary we can rewrite

$$f_{S,t} = \frac{F_{\text{Ins.},t} w_{x,t}}{\text{Supply}_t^B} \neq 0 \tag{28}$$

where $w_{x,t} = (\bar{w}^B_{\text{Ins.},t} - \bar{w}^B_{\text{Fin.},t})$ is the difference in long-term bond weights of insurance companies versus other financial institutions. The size-weighted sum of the representative demand curve is

$$0 = -\frac{\kappa}{N}\Delta p^B_t + f_{S,t} \tag{29}$$

Plugging in $f_{S,t} = \frac{F_{\text{Ins.},t} w_{x,t}}{\text{Supply}^B_t}$ and the process for $\frac{F_{\text{Ins.},t}}{\text{Supply}^B_t}$ from equation (26) yields

$$q_{S,t} = -\zeta p^B_t + \kappa E_t[\Delta p^B_{t+1}] + w_{x,t}\epsilon_t - \gamma w_{x,t}\Delta r_t + d_{S,t} \tag{30}$$

where $\zeta = \frac{\kappa}{N} + \Gamma w_{x,t}$ is the price elasticity of demand, which contains i) the arbitrageurs sensitivity to the term premium κ and ii) endogenous response of flows to long-term bond yields by households. If households are aggressively allocating capital to insurance companies in response to rising long-term bond yields, then the elasticity is large resulting in small deviations of bond prices from their long-term steady state value.

J.4 Equilibrium Price of the Long-Term Bond

Note, that market clearing implies $q_{S,t} = 0$. We now solve the market clearing condition for equilibrium long term bond prices: Divide both sides by κ and define $\rho \equiv \frac{\zeta}{\kappa}$ as the macro market effective discount rate as in Gabaix and Koijen (2021). This yields

$$p^B_t = \frac{1}{1+\rho}E_t[\pi_t] + \frac{\rho}{1+\rho}\frac{\eta_t}{\zeta} \tag{31}$$

where $\eta_t = w_{x,t}\epsilon_t - \gamma w_{x,t}\Delta r_t + d_{S,t}$ Iterating forward yields the equilibrium price of long-term bonds relative to the steady state baseline

$$p^B_t = E_t \sum_{\tau=t}^{\infty} \frac{1}{(1+\rho)^{\tau-t+1}}\rho\frac{\eta_t}{\zeta}. \tag{32}$$

Defining Key Economic Quantities

- Total household wealth: W_t
- Market value of long-term bonds (maturity > 10y):

$$B_t = Q^B_t P^B_t, \qquad w^B_t = \frac{B_t}{W_t}$$

- Decompose by sector:

$$W_t = W_{\text{Ins.},t} + W_{\text{Other},t}, \quad B_t = B_{\text{Ins.},t} + B_{\text{Other},t}$$

- Portfolio weights:

$$w^B_{\text{Ins.},t} = \tfrac{B_{\text{Ins.},t}}{W_{\text{Ins.},t}}, \quad w^B_{\text{Other},t} = \tfrac{B_{\text{Other},t}}{W_{\text{Other},t}}$$

- Size weights:

$$S_{i,t} = \tfrac{B_{i,t}}{B_t}$$

Market Segmentation & Insurance Flows

- Define **market segmentation:**

$$\Psi_t = \frac{w^B_{\text{Ins.},t} - w^B_{\text{Other},t}}{w^B_t}$$

- $\Psi_t > 0$: insurers hold more long-term bonds than other investors
- Household reallocations $\Rightarrow$ non-zero net demand for bonds in equilibrium

- Total household flows: $F_t = F_{\text{Ins.},t} + F_{\text{Other},t}$

Equilibrium Response of Long-Term Bonds

Investor demand:

$$\Delta q^B_{i,t} = -\zeta \, \Delta p^B_t + f_{i,t}$$

$$f_{i,t} = \tfrac{F_{i,t}}{W_{i,t-1}}$$

Aggregate demand:

$$\Delta q_{S,t} = -\zeta \, \Delta p^B_t + f_{S,t}$$

Market clearing:

$$\Delta p^B_t = \underbrace{\tfrac{1}{\zeta}}_{\text{Price Multiplier}} \times \underbrace{\tfrac{F_{\text{Ins.},t}}{W_t}}_{\text{Magnitude of Flows}} \times \underbrace{\Psi_t}_{\text{Market Segmentation}}$$

$\rightarrow$ Price impact depends jointly on flows, segmentation, and demand elasticity.

K. QSA Description

K.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 (33).

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.

K.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:

$$\begin{aligned}\Delta\mathrm{F62}_t^{(\text{transactions})} &= \underbrace{\text{premiums earned}_t}_{\text{accrual basis}} + \underbrace{\text{premium supplements}_t}_{\text{investment income attributed to policyholders}} \\ &\quad - \underbrace{\text{benefits due}_t}_{\text{claims/benefits on an accrual basis}} - \underbrace{\Delta\text{technical reserves}_t}_{\text{increase (decrease) in life reserves}} . \end{aligned} \tag{33}$$

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 (33) 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).

K.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:

$$\begin{aligned}\Delta\mathrm{F6M}_t^{(\text{transactions})} &= \text{contributions received}_t + \text{premium supplements}_t \\ &\quad - \text{benefits paid}_t - \Delta\text{pension reserves}_t. \end{aligned} \tag{34}$$

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).

K.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:

$$\begin{aligned} \Delta \mathrm{F6O}_t^{(\text{transactions})} = {} & \text{premiums earned}_t + \text{premium supplements}_t \\ & - \text{claims due}_t - \Delta\text{non-life technical reserves}_t. \end{aligned} \tag{35}$$

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).

L. 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.

M. Microfoundations of Insurer Demand

This section offers microfoundations behind the process for insurer demand, and why the balance sheet exhibits such a slow-moving process.

Let M_t denote the stock of households currently paying premiums to the insurer. Each period, a fraction δ of M_t exits due to death or maturity of the contracts. A mass L of potential new policyholders are born each period, where a fraction m_t end up choosing to purchase a policy. This means that the law of motion for the stock of policyholders follows:

$$M_t = (1-\delta)M_{t-1} + Lm_t$$

We are left to understand what drives m_t. At time t insurers set the guaranteed return on new policies equal to:

$$g_t = r_t + \lambda TP_t$$

where TP_t is the spread between the long-term yield and the short-term rate. The higher is the guaranteed rate, the more attractive is the insurance contract relative to other savings instruments such as deposits and mutual funds. Moreo formally, insurance policies and outside options have a set of characteristics x (liquidity, tax advantage, protection from downside risk etc.). They have respective indirect utilities of:

$$U_{i,t}^{INS} = \alpha\, g_t + (x^{INS})'\beta + \varepsilon_{i,t}^{INS}, \qquad U_{i,t}^{O} = \alpha\, r_t + (x^{O})'\beta + \varepsilon_{i,t}^{O}$$

In deciding where to allocate savings, households compare the utility of the two options to make the choice

$$\Delta_t \equiv \alpha\big(g_{t-1} - r_t\big) + \big((x^{INS}) - (x^{O})\big)'\beta = \alpha \underbrace{\lambda TP_t}_{\substack{\text{Time-varying} \\ \text{Relative Price}}} + \Delta x_t'\beta$$

Assuming that characteristics beyond the interest being paid is broadly similar across savings products considered, the share of new entrants L buying the insurance product is equal to:

$$m_t = \frac{1}{1+\exp(-\Delta_t)} \approx 1 + \chi TP_t$$

Finally, let A_t^{ins} denote insurers' total assets. We assume that each policyholder pays a lump-eum p_t when they enter. We also assume that exiting policyholders receive a fraction

δ of the stock of assets. This results in the following law of motion for insurer assets:

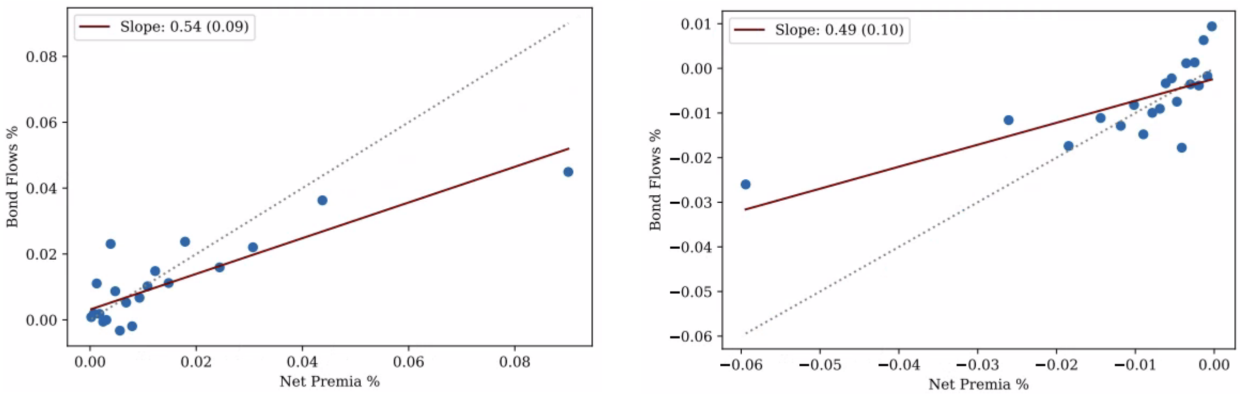
$$A_t^{ins} = (1 + r_{A,t})(1 - \delta)A_{t-1}^{ins} + p_t L\chi TP_t$$

In the calibration, we assume household wealth evolves at growth rate g, which requires $r_{A,t} = g$. If p_t also grows at rate g we arrive at the normalised expression for the evolution of insurer assets as a fraction of supply.

N. Additional Tables and Figures

Figure N.1: 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 N1: 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 N2: 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 N.2: Households Portfolio Shares

(a) 2014 (b) 2019 (c) 2024

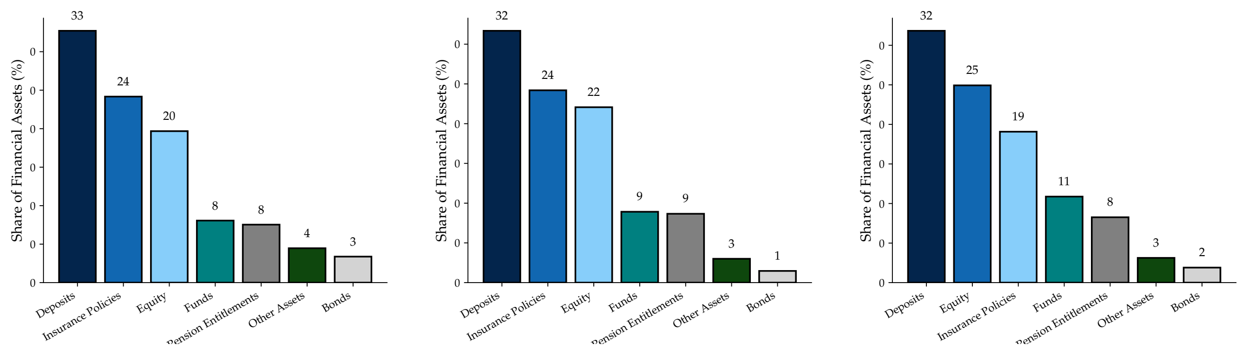


Table N3: A two factor model with Positive Δ Rate Dummmy

	2010-2025		2001-2025	
	(1)	(2)	(3)	(4)
Term Premium (lag)	0.135***		0.123***	
	(0.017)		(0.010)	
Slope DE 10Y-3M (lag)		0.161***		0.137***
		(0.013)		(0.016)
Δ 3M Rate	-0.106***	-0.153***	0.057***	-0.060***
	(0.016)	(0.012)	(0.015)	(0.020)
Δ 3M Rate (Positive)			-0.185***	-0.061**
			(0.024)	(0.030)
Constant	0.132***	0.121***	0.179***	0.192***
	(0.019)	(0.015)	(0.018)	(0.023)
Observations	62	62	95	98
R-squared	0.678	0.809	0.703	0.561
Adj. R-squared	0.667	0.802	0.693	0.547

Figure N.3: Net Premium to Insurance Companies

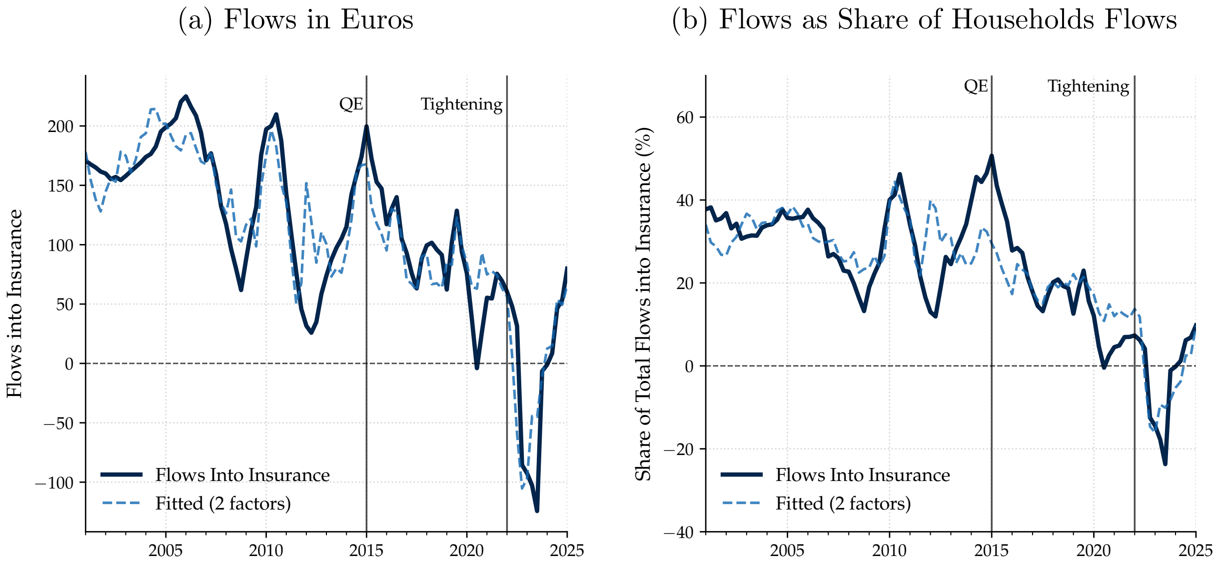
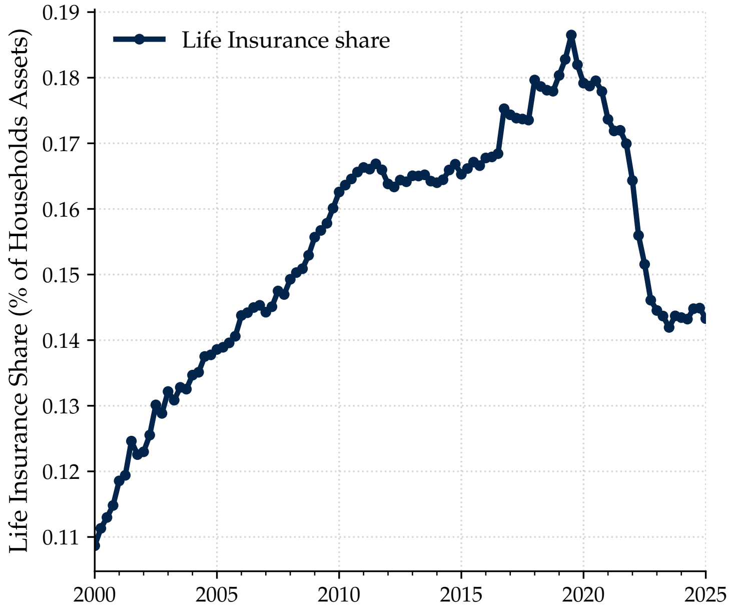
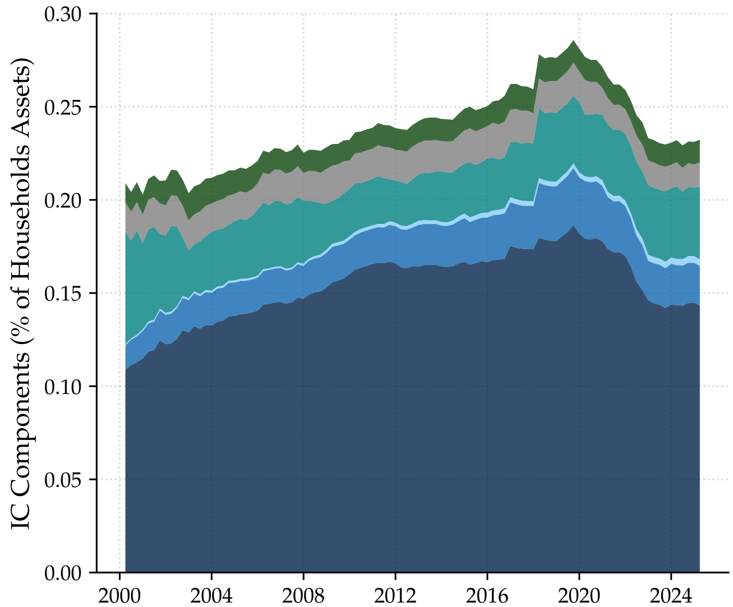


Figure N.4: Household Portfolio Share into Insurance Policies



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 N.5: 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 N.6: 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

$$\text{Net Premium} = \text{Premiums Written (R1500)} - \text{Claims Incurred (R1700)} - \text{Total Technical Expenses (R2600)}.$$

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 N4: 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 N5: Descriptive Statistics: OIS Rate Shocks (2010-2025)

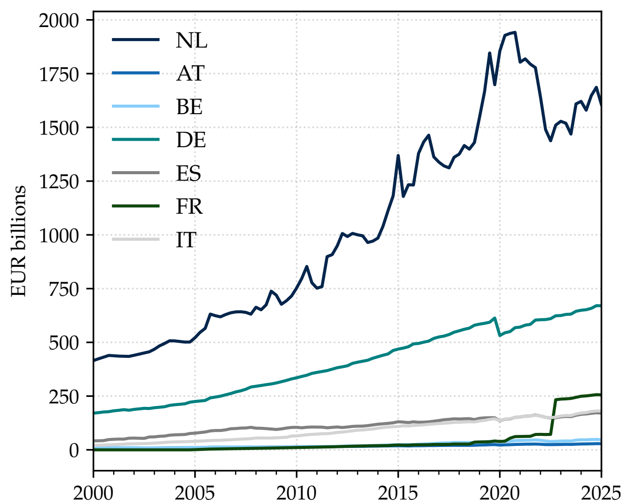
Maturity	Mean	Median	Std Dev	Min	Max	N
3M	0.0277	0.0119	0.0919	-0.1705	0.2925	61
6M	0.0190	0.0056	0.0986	-0.2310	0.2935	61
1Y	0.0148	0.0046	0.1076	-0.2970	0.2691	61
2Y	-0.0076	-0.0061	0.1160	-0.3387	0.2930	61
3Y	-0.0221	-0.0185	0.1149	-0.3484	0.2680	61
4Y	-0.0198	-0.0136	0.0964	-0.2705	0.2230	61
5Y	-0.0290	-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 N.7: Pension Sector

(a) Pension Sector by Country



(b) Life Insurance Liabilities of Pension Sector

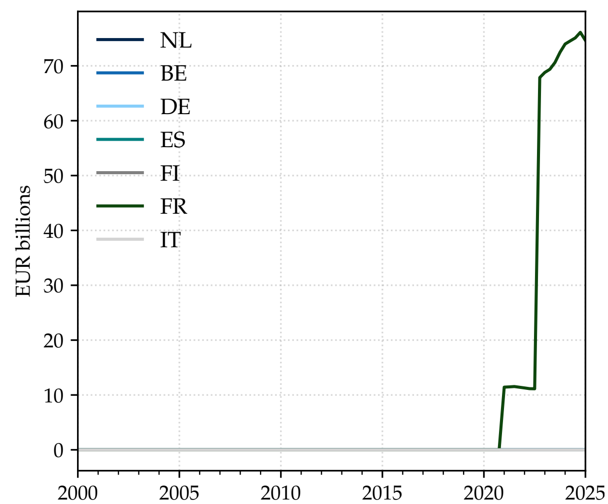


Figure N.8: German 30 Year Yield

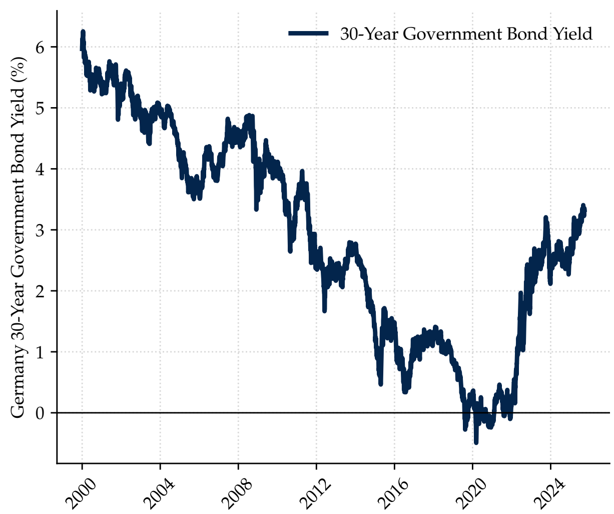


Figure N.9: German 30 Year Bond Return Volatility

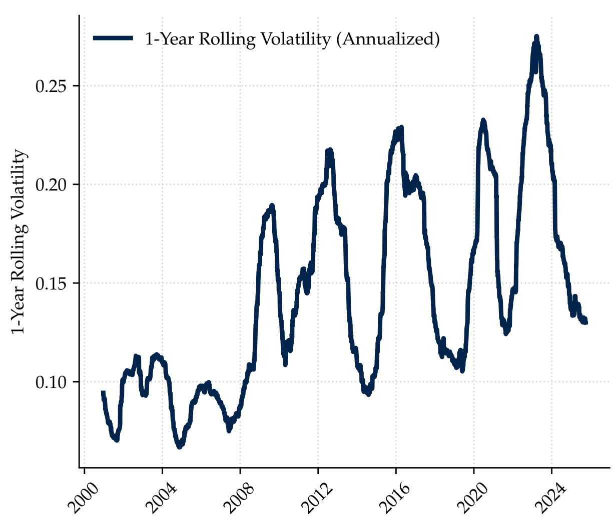
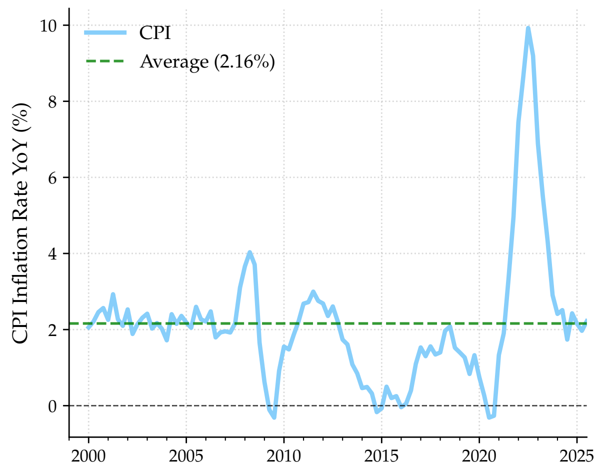
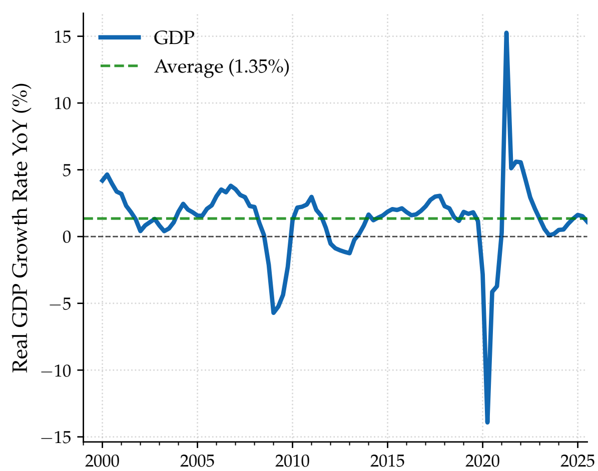


Figure N.10: Euro area Inflation



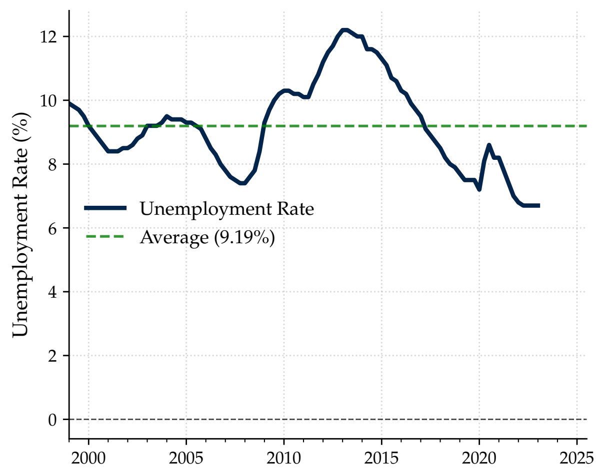
Note: The figure displays the evolution of the inflation rate in the euro area, along with its corresponding period average.

Figure N.11: 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 N.12: 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 N.13: Slope and Term-Premiun

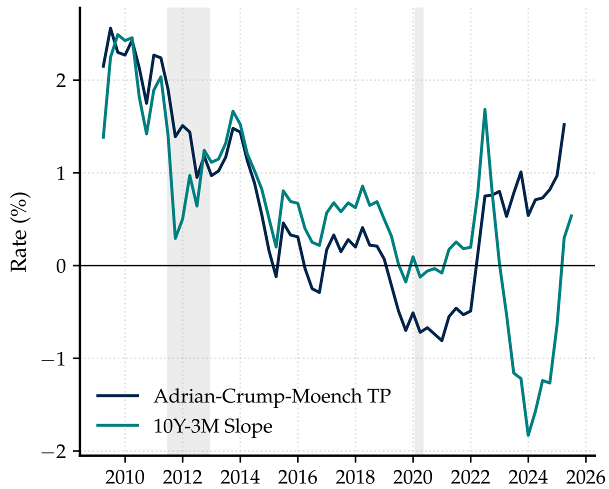
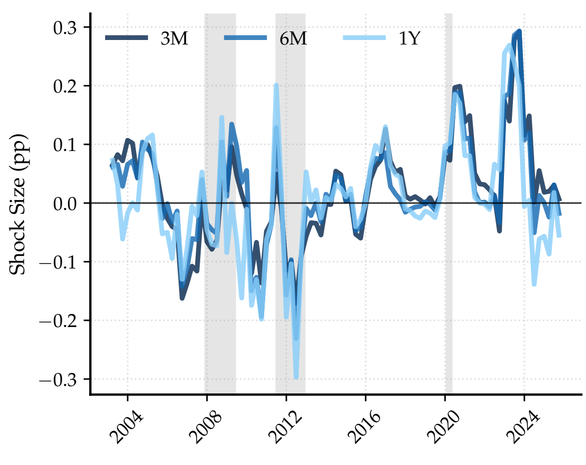


Figure N.14: Cumulated High-Frequency shocks around ECB announcements

(a) Short Term Rates

(b) Long-Term Rates



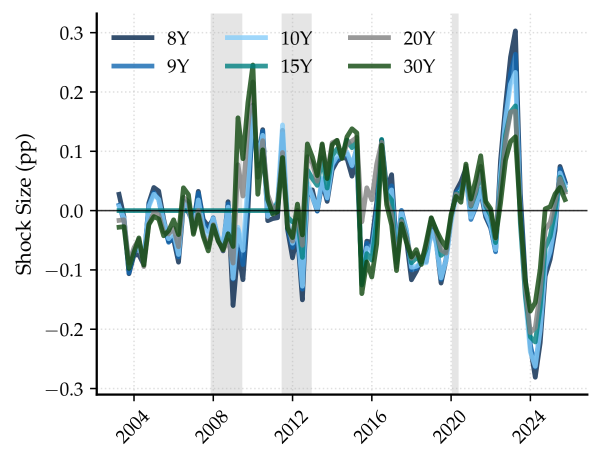


Figure N.15: Change in Flows to Insurance and Change in Yield During QT

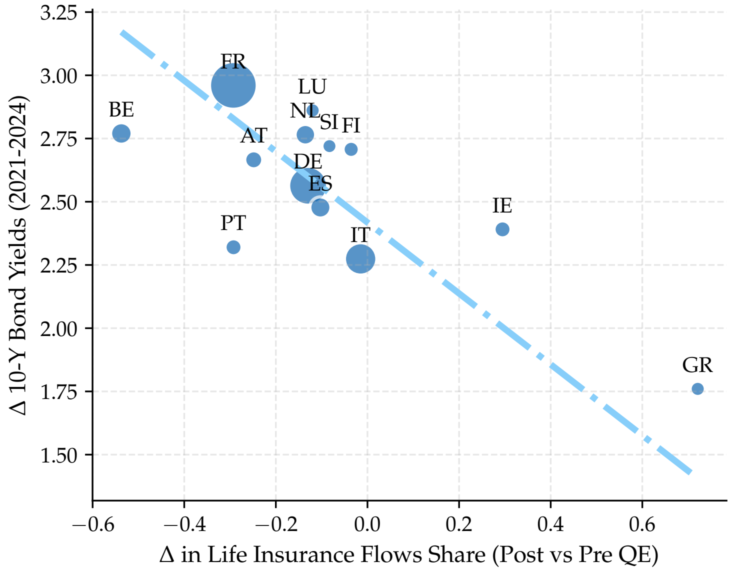


Table N6: First Stage Term-Premium on Shocks

	2010-2022		2010-2025	
	TP	Slope	TP	Slope
Slope MP	6.364***	3.990***	3.675**	5.380***
	(0.892)	(0.901)	(1.692)	(0.861)
Observations	52	52	61	62
R-squared	0.480	0.391	0.248	0.484

Note: Results of the first stage regression of Term-premium and slope on the slope monetary policy shock (the difference between a shock to a 10 year rate and 1 year rate).

Figure N.16: Fair Value Minimum Guarantee Rate and Deposit Rate