Intercohort Risk Sharing in Euro Contracts

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executive summary to be added

1 Theoretical Underpinnings

Even in well-developed financial markets, aggregate risk can only be shared among investors participating in the market when the risk materializes. This limitation to risk sharing sometimes results in substantial losses. For example, in 2008, a fully diversified stock portfolio lost 40% of its value, while in 2022, a portfolio invested in euro area ten-year government bonds lost 25% of its value. Ideally, superior risk sharing could be achieved by distributing risk not just across investors in the same period, but also across time—between current and future investor cohorts. However, financial markets are inherently incomplete, as they do not allow intertemporal trades between present and future investors.

Financial intermediaries can, in principle, implement this type of intercohort risk sharing by managing reserves that smooth returns over time and redistribute risk among successive investor cohorts, as studied theoretically by Allen and Gale (1997). Intermediaries can achieve this by saving part of the returns during good years (building reserves) and using these reserves to supplement returns during bad years. This mechanism effectively transfers market risk across successive cohorts, reducing risk for households relative to an environment without such reserves. In a calibrated theoretical analysis, Gollier (2008) estimates that this smoothing can increase the certainty equivalent of capital income by 25%.

However, the mechanism is fragile. Allen and Gale (1997) also show that when contracts are liquid, and investors are fully informed and act strategically, intercohort risk sharing unravels. This is because reserves respond to market fluctuations. When reserves are depleted, future returns are predictably low, leading informed investors to delay entry or exit prematurely. Conversely, when reserves are high, future returns are predictably attractive, encouraging opportunistic entry. This "timing" behavior undermines the reserve system and unravels intertemporal risk sharing.

This theoretical framework maps closely to how French life insurers manage euro contracts. By actively using reserves to smooth returns, insurers create a de facto mechanism of intercohort risk sharing. Yet, unlike the breakdown scenario outlined by Allen and Gale (1997), euro contracts appear to sustain this mechanism in practice. In the next section, we show how regulatory rules and insurer behavior in France enable reserves to transfer risk across investor cohorts, providing households with insurance against market fluctuations.

2 Euro Contracts

Hombert and Lyonnet (2022) demonstrate that euro contracts issued by French life insurers resemble the intercohort risk-sharing instruments described by Allen and Gale (1997). Insurers pool household savings and invest in a diversified portfolio consisting on average of xx% bonds, xx% equities, xx% real estate, and the remainder in loans and cash. [Remplir ces chiffres à partir du FR05.]

Crucially, the annual return credited to investors' accounts differs from the mark-to-market return on the underlying assets. The gap between these two is managed via reserves—a buffer comprising profit-sharing reserves, capitalization reserves, and unrealized capital gains.[1]

At the end of each year, insurers allocate asset returns across three uses (see Ap-

1. These correspond to *provisions pour participation aux bénéfices (PPB)*, *réserve de capitalisation*, and *plus-values latentes*, respectively.

pendix A.1 for details)::

$$\text{Asset return} = \text{Contract return} + \Delta\text{Reserves} + \text{Insurer profit}. \quad (1)$$

This flexibility allows insurers to hedge contract return from shocks to asset return. The contract return differs from the asset return if the insurer chooses to use reserves or its profit as a buffer.

Two key regulatory features enable intercohort risk sharing. First, reserves belong to investors collectively but are not earmarked to individual contracts. Regulation mandates that at least 85% of asset income must go either to current contract returns or to reserves, capping insurer profits at 15% of asset income. While insurers cannot appropriate reserves for shareholders, they retain discretion over how reserves and contract returns are balanced over time. This mechanism effectively allows insurers to offer market risk insurance by redistributing returns across years.[2]

Second, reserves are pooled among all investors within a given euro contract fund, regardless of when they entered. New investors benefit from reserves accumulated by prior cohorts, while departing investors forgo any individual claim on reserves. This pooling across cohorts arises because all investors in the same fund receive the same contract return, independent of their date of entry into the contract.[3]

Finally, euro contracts also include a minimum guaranteed annual return set at subscription. Over time, insurers have substantially lowered guaranteed rates, especially in response to declining interest rates since the 1990s. During the 1999–2023 period analyzed in this note, guarantees were close to zero for most contracts and thus were rarely binding.

2. A regulatory rule stipulates that insurers must distribute the funds in the profit-sharing reserve within eight years, but in practice, this limit is rarely binding: the reserve typically represents less than one year of contract returns on average and up to two and a half years at the 99th percentile.

3. Insurers could, in theory, undermine this pooling by segmenting investors into new contract vintages when reserves are high (e.g., launching premium contracts for new money with higher returns). However, using contract-level data, Hombert and Lyonnet (2022) find little evidence of such behavior: insurers rarely close contracts strategically, suggesting reserves are indeed pooled across cohorts in practice.

3 Data and Summary Statistics

We quantify intercohort risk sharing using regulatory data collected by ACPR. Our primary source is the annual national reporting (RAN or ENS). We focus on insurers with at least 10 million euros in provisions for euro contracts and whose core activity is life insurance.[4] The resulting dataset comprises 73 unique insurers and 57 insurer-year observations, covering the period from 1999 to 2023.

Figure 1A shows the evolution of aggregate account value (i.e., provisions) in euro contracts over this period. Account values grew substantially throughout the 2000s, before stabilizing in the low interest rate environment that followed the European sovereign debt crisis.

Figure 1B plots the ratio of reserves to total account value. This reserve ratio exhibits pronounced cyclical fluctuations, ranging from just above zero to as much as 25%. These dynamics illustrate insurers' use of reserves to smooth contract returns through the cycle. During periods of market downturn—such as the 2008 financial crisis or the sharp rise in interest rates in 2022—insurers drew down reserves to shield contract returns from adverse asset performance. In contrast, during periods of strong asset returns, notably the persistent bond rally of the 2010s, insurers accumulated reserves.

These cyclical patterns in reserve management are at the heart of the intercohort risk sharing mechanism analyzed in the following section.

4 Intercohort risk sharing

Figure 2A compares the time series of asset returns (in blue) and contract returns (in red), averaged across insurers. A key observation is that contract returns are significantly less volatile than the returns on underlying assets. This indicates that euro contracts provide investors with insurance against market risk.

Equation (1) can be rewritten to identify the mechanisms of this market risk sharing:

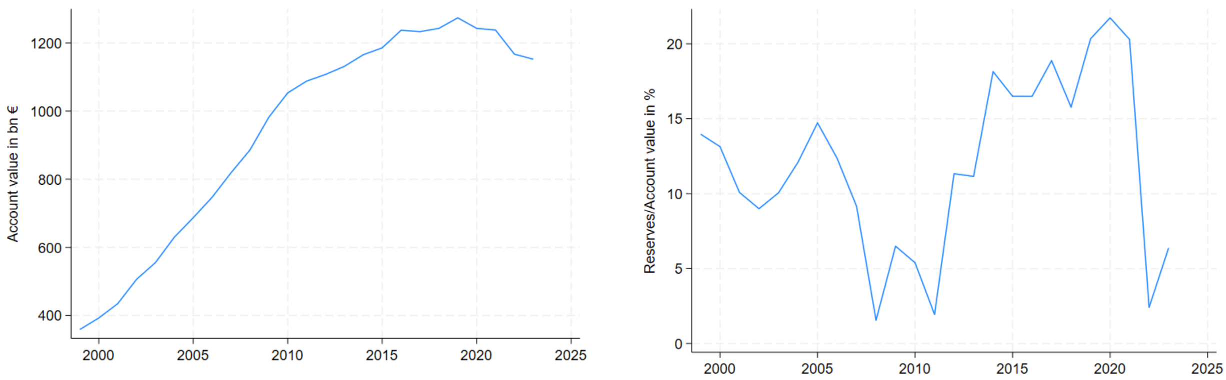
$$(\text{Contract return} - \text{Asset return}) = (-\text{Insurer profit}) + (-\Delta\text{Reserves}). \tag{2}$$

The left-hand side represents the total transfer to current investors, which is financed

4. Specifically, we exclude entities primarily engaged in social protection schemes (*"Instituts de prévoyance"*) and those governed by the *"Code de la mutualité."*

Figure 1: Euro Contracts 1999–2023

A. Account value (bn euros) B. Reserves (% account value)



Left: Total account value (i.e., provisions) in euro contracts for the sample of 73 life insurers from 1999 to 2023. Right: Total reserves (profit-sharing reserves, capitalization reserves, and unrealized capital gains) as a share of total account value.

Figure 2: Contract Return Smoothing

A. Contract return vs asset return B. Change in reserves

Left: Insurers' average contract return (blue) and mark-to-market return on underlying assets (red). Right: Contract return minus asset return (blue) corresponds to the difference between the two series in the left panel. This difference closely tracks the negative change in reserves scaled by total account value (red).

either by the insurer (reducing its profit) or by changes in reserves. Static risk sharing occurs when insurers absorb market shocks by reducing their profits. Intertemporal (intercohort) risk sharing occurs when reserves are used to smooth returns across investor cohorts.

To disentangle these channels, Figure 2B plots the difference between contract and asset returns (in blue) alongside minus the change in reserves (in red). The two series closely track one another, showing that reserves account for almost all of the smoothing. Insurer profits contribute very little to risk sharing. Thus, reserves are the main mechanism through which euro contracts provide insurance against market fluctuations.

To quantify the magnitude of intercohort redistribution, we use the variation in reserves across years to infer the transfers between investors through time. The key idea is that smoothing of contract returns via reserves creates intertemporal wealth transfers, but not all these transfers represent redistribution across cohorts. This is because some transfers net out over an individual investor's holding period. To illustrate, consider a stylized example where an investor holds a contract for two years:

	Year 1	Year 2
Asset return	0	6
Contract return	4	4

Here, reserves absorb the gap between asset returns and contract returns. In Year 1, the investor receives a positive transfer from reserves of 4. In Year 2, the investor effectively transfers 2 back to reserves. The net transfer over the two-year holding period is therefore $4 - 2 = 2$, or 1 per year. Our methodology, outlined in Appendix A.2, mirrors this logic by netting out transfers within each investor's holding period to isolate and quantify the component of redistribution that occurs between investor cohorts, i.e., the intercohort transfers.

This approach allows us to identify which investor cohorts benefit from redistribution and which cohorts finance it. The net transfer received by an investor depends crucially on their holding period. Investors with the same holding period are positioned on the same side of redistribution, while investors with differing holding periods may find themselves on opposite sides.

Table 1 reports the net transfers for each combination of entry and exit dates within the sample period. The values correspond to additional annual returns relative to the constant-reserve counterfactual, expressed in percentage points of account value. For instance, an investor buying a euro contract at the beginning of 2006 and redeeming it at the end of 2011 earned an additional 1.6 percentage points per year relative to a counterfactual with no smoothing. This positive transfer reflects how insurers tapped into reserves during the 2008 stock market crash and the 2011 European sovereign debt crisis. Conversely, an investor holding a contract from the beginning of 2012 to the end of 2021 experienced a negative transfer of 2.3 percentage points per year, as insurers accumulated reserves by retaining the high bond returns generated by the persistent decline in interest rates over that period.

Table 1: Intercohort Redistribution

EXIT YEAR

ENTRY YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2000		0.2	1.0	0.9	0.2	-0.3	-0.8	-0.5	-0.1	0.7	0.1	0.1	0.4	-0.4	-0.4	-0.8	-0.7	-0.7	-0.8	-0.7	-0.9	-0.9	-0.8	-0.1	-0.2
2001			1.8	1.2	0.2	-0.4	-1.0	-0.6	-0.1	0.8	0.1	0.1	0.4	-0.4	-0.4	-0.9	-0.7	-0.7	-0.8	-0.7	-1.0	-1.0	-0.9	-0.1	-0.2
2002				0.7	-0.5	-1.2	-1.7	-1.1	-0.4	0.6	-0.1	-0.1	0.3	-0.6	-0.6	-1.1	-0.9	-0.9	-1.0	-0.9	-1.1	-1.1	-1.0	-0.2	-0.3
2003					-1.8	-2.1	-2.5	-1.6	-0.6	0.6	-0.2	-0.2	0.2	-0.8	-0.7	-1.2	-1.0	-1.0	-1.1	-1.0	-1.3	-1.2	-1.1	-0.2	-0.4
2004						-2.4	-2.9	-1.5	-0.4	1.1	0.0	0.1	0.5	-0.7	-0.6	-1.2	-1.0	-0.9	-1.1	-0.9	-1.2	-1.2	-1.1	-0.1	-0.3
2005							-3.4	-1.1	0.3	1.9	0.5	0.5	0.9	-0.4	-0.4	-1.1	-0.9	-0.8	-1.0	-0.8	-1.1	-1.1	-1.0	0.0	-0.2
2006								1.3	2.2	3.7	1.5	1.3	1.6	0.0	0.0	-0.8	-0.6	-0.6	-0.8	-0.6	-1.0	-1.0	-0.8	0.2	0.0
2007									3.1	5.0	1.5	1.3	1.7	-0.2	-0.2	-1.1	-0.8	-0.8	-1.0	-0.8	-1.2	-1.1	-1.0	0.1	-0.1
2008										6.8	0.7	0.7	1.3	-0.9	-0.7	-1.7	-1.3	-1.2	-1.4	-1.1	-1.5	-1.5	-1.3	-0.1	-0.3
2009											-5.4	-2.4	-0.5	-2.8	-2.2	-3.1	-2.5	-2.2	-2.3	-1.9	-2.3	-2.2	-1.9	-0.5	-0.7
2010												0.5	1.9	-2.0	-1.5	-2.6	-2.0	-1.7	-1.9	-1.5	-2.0	-1.9	-1.6	-0.2	-0.4
2011													3.3	-3.2	-2.1	-3.4	-2.5	-2.1	-2.2	-1.8	-2.2	-2.1	-1.8	-0.2	-0.5
2012														-9.7	-4.8	-5.7	-3.9	-3.2	-3.1	-2.5	-2.9	-2.7	-2.3	-0.5	-0.8
2013															0.1	-3.7	-2.0	-1.6	-1.8	-1.3	-1.9	-1.8	-1.5	0.4	0.0
2014																-7.4	-3.0	-2.1	-2.3	-1.6	-2.3	-2.1	-1.7	0.4	0.0
2015																	1.3	0.5	-0.6	-0.1	-1.3	-1.2	-0.9	1.4	0.8
2016																		-0.3	-1.6	-0.6	-1.9	-1.7	-1.2	1.4	0.8
2017																			-2.9	-0.8	-2.5	-2.1	-1.4	1.7	0.9
2018																				1.2	-2.3	-1.9	-1.1	2.6	1.5
2019																					-5.8	-3.4	-1.9	2.9	1.6
2020																						-1.1	0.1	5.8	3.4
2021																							1.2	9.2	4.9
2022																								17.1	6.8
2023																									-3.6

Reading: An investor buying a euro contract at the beginning of 2006 and redeeming it at the end of 2011 earned an additional 1.6 percentage points per year relative to a counterfactual with no smoothing.

Shorter holding periods are associated with larger transfers in absolute value because investors are exposed to less of the smoothing cycle. Therefore, intercohort risk sharing affects both long- and short-term investors.

Overall, the redistribution is zero-sum: positive transfers for one cohort are matched by negative transfers for another. Summing the absolute value of these transfers weighted by the corresponding account value across cohorts (see Appendix A.2 for details), we find that the average transfer is equivalent to 1.6% of account value per year. At the 2023 aggregate account value of 1.48 trillion euros, this corresponds to an average annual reallocation of approximately 22 billion euros, or 0.8% of French GDP.

5 Do Investors Time Reserves?

Intercohort risk sharing could unravel if investors actively timed premiums and redemptions to take advantage of the level of reserves—investing when reserves are high and redeeming when reserves are low. This behavior would undermine the effectiveness of return smoothing via reserves. To assess this possibility, we first document that the level of reserves predicts future contract returns.

Table 2: Reserves and Contract Return

	Contract return	
	(1)	(2)
Reserves	.033***	.038***
	(.0072)	(.012)
Year FE	✓	✓
Insurer FE		✓
Observations	1,288	1,286

Panel regressions weighted by insurers' account value, 1999-2023. Dependent variable: insurer-level contract return. Independent variable: reserves-to-account value ratio.

Results in Table 2 imply that reserves predict returns. We regress the contract return on the lagged ratio of reserves to account value. We weight regressions by account value to ensure that results are representative of the average contract. The regression results show that a 10-percentage-point increase in the reserve ratio is associated with a 35 to 40 basis points increase in annual contract returns. This positive relationship confirms that reserves act as a buffer, boosting future returns when reserves are high. The relationship holds even after controlling for asset returns, year fixed effects, and insurer fixed effects.

However, we find little evidence that investors systematically time reserves. In Table 3, we regress investor inflow and outflow on the lagged reserve ratio. A 10-percentage-point increase in reserves leads to economically small and statistically insignificant 31-basis-points increase in premiums and xx-basis-points decrease in voluntary redemptions. The effect on total net flow, defined as premiums minus voluntary redemptions minus contract termination (due to expiry or death) is also statistically insignificant.

While the previous regression analysis examines the sensitivity of flows to reserves across insurers, Figure 3 shifts focus to aggregate flows over time. Aggregate premiums exhibit a structural decline after 2011, yet this decline moves inversely with reserves—suggesting behavior inconsistent with reserve timing. Aggregate redemptions show modest spikes when reserves dip, notably in 2011 and again in 2022/23, but these spikes remain limited in scale.

Table 3: Reserves and Investors Flow

	Premiums	Redemptions	Total net flow
	(1)	(2)	(3)
Reserves	.031	-.042	.075
	(.062)	(.03)	(.071)
Year FE	✓	✓	✓
Insurer FE	✓	✓	✓
Observations	1,286	1,286	1,286

Panel regressions weighted by insurers' account value, 1999–2023. Dependent variables: insurer-level premiums (column 1), redemptions (column 2), and net flow (premiums minus voluntary redemptions and outflows due to contract expiration or death) in column 3, all scaled by total account value. Independent variable: reserves-to-account value ratio.

Figure 3: Reserves and Investors Flow

Aggregate premiums (blue), redemptions (red), and reserves (green), all scaled by total account value.

Overall, investors do not engage in reserve timing at a scale sufficient to undermine the reserve mechanism and intercohort risk sharing.

The analysis of why investors react only modestly to reserve levels lies beyond the scope of this note. However, Hombert and Lyonnet (2022) provides some avenues for exploration on this question. One possible explanation is the tax lock-in effect associated with the preferential tax treatment of contracts held for more than eight years. However, inconsistent with this explanation, Hombert and Lyonnet (2022) show that purchases of new contracts are not more likely to be directed toward insurers with higher reserves, even though such purchases are not subject to this tax lock-in, as it applies uniformly across insurers. Entry fees could also play a role, but they similarly fail to explain why new contract purchases do not respond to reserve levels. While the tax lock-in and fees undoubtedly influence flows more broadly, they do not appear to account for the observed inelasticity of flows to reserves.

Instead, Hombert and Lyonnet (2022) provide evidence pointing to a lack of investor sophistication as a key explanation for this inelasticity. Investors may lack the ability to forecast contract returns based on reserve levels, either because they do not understand that reserves are predictive of returns or because they have limited access to reserve information. Supporting this view, the elasticity of flows to reserves is stronger and statistically significant for contracts with invested amounts above 250,000 euros, which are more likely to be held by sophisticated investors.

conclusion to be added

References

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Appendix

A Accounting Framework

A.1 Return Decomposition

For insurer j at year-end t, we denote:

- $V_{j,t}$: Total euro contract investors' account value.
- $A_{j,t}$: Market value of assets underlying the euro contracts.
- $R_{j,t} = A_{j,t} - V_{j,t}$: Reserves are given by the difference between asset value and account value. Reserves include the profit participation reserve (*Provisions pour participation aux bénéfices*), the capitalization reserve (*réserve de capitalisation*), and unrealized capital gains *plus-values latentes.*
- $x_{j,t}$: Annual asset return.
- $y_{j,t}$: Annual contract return.

Account value increases when the contract return is credit on investors' account and when premiums are collected, while redemptions reduce account value. Therefore:

$$V_{j,t} = (1 + y_{j,t})V_{j,t-1} + Flow_{j,t} \tag{A.1}$$

where $Flow_{j,t}$ is annual premiums minus redemptions.

The value of assets underlying the contracts rises due to asset return, premiums collected net of redemptions, while the income accruing to the insurer reduces assets. Therefore:

$$A_{j,t} = (1 + x_{j,t})A_{j,t-1} + Flow_{j,t} - \Pi_{j,t}, \tag{A.2}$$

where $\Pi_{j,t}$ is insurer's profit.

Combining (A.1) and (A.2) and using that $R_{j,t} = A_{j,t} - V_{j,t}$, we obtain

$$x_{j,t}A_{j,t-1} = y_{j,t}V_{j,t-1} + \Pi_{j,t} + \Delta R_{j,t}, \tag{A.3}$$

where $\Delta R_{j,t} = R_{j,t} - R_{j,t-1}$. Equation (A.3) shows how the return earned on assets held is split into the return credited to euro contracts, reserves, and profit for the insurer. Dividing (A.3) by total account value, we obtain Equation (1):

$$\underbrace{\frac{x_{j,t}A_{j,t-1}}{V_{j,t-1}}}_{\text{Asset return}} = \underbrace{y_{j,t}}_{\text{Contract return}} + \underbrace{\frac{\Pi_{j,t}}{V_{j,t-1}}}_{\Delta\text{Reserves}} + \underbrace{\frac{\Delta R_{j,t}}{V_{j,t-1}}}_{\text{Insurer profit}} \tag{A.4}$$

A.2 Intercohort Redistribution

Net transfer. Transfer from reserves to investors in year t is equal to minus the change in reserves: $-\Delta R_{j,t}$. Consider investor i holding a contract from beginning of year t_0 to end of year t_1, and $V_{i,j,\tau-1}$ denotes their account value at the beginning of year τ. They receive in year τ a transfer proportional to their weight in the insurer's total account value, equal to $\frac{V_{i,j,\tau-1}}{V_{j,\tau-1}}(-\Delta R_{j,\tau})$. Summing over their holding period, we obtain investor i's holding period net transfer, which we apportion to each year in proportion to the beginning-of-year account value:

$$NetTransfer_{i,j,t} = \frac{V_{i,j,t-1}}{\sum_{\tau=t_0}^{t_1} V_{i,j,\tau-1}} \sum_{\tau=t_0}^{t_1} \frac{V_{i,j,\tau-1}}{V_{j,\tau-1}}(-\Delta R_{j,\tau}). \tag{A.5}$$

$NetTransfer_{i,j,t}$ represents the net annualized intercohort transfer received by investor i who holds a contract from year t_0 to year t_1.

Table 1 shows the net transfer (received by an investor as a function of the holding period, for every possible holding period within the sample period. We calculate the net transfer for an investor who holds the value-weighted average contract and keeps a constant investment amount of 100 by withdrawing interests paid at the end of each year.

Aggregate intercohort redistribution. The aggregate amount transferred across cohorts each year t is obtained by summing up the net transfers (A.5) across all investors in the set $\mathcal{I}^{j,t}$ of investors who hold a contract with insurer j in year t:

$$InterCohortTransfer_{j,t} = \sum_{i \in \mathcal{I}^{j,t}} |NetTransfer_{i,j,t}|. \tag{A.6}$$

To calculate (A.6) exactly, we need to observe the entire investment history of all investors, which is not possible, because the investment history of investors still holding a contract at the end of the sample period is not over. Two data limitations also exist. First, regulatory data start in 1999; therefore, we do not observe the entire investment history of investors who entered their contract before 1999. We can calculate the net transfer for investors with holding periods within 2000–2023 (we need one lagged year to calculate asset returns). Second, we observe inflows and outflows at the insurer level, but not at the investor level, which implies that we know the average holding period, but not its entire distribution. To calculate intercohort transfers, we assume the outflow rate is constant across cohorts at the insurer-year level and that investors only make one-off investments. Under this assumption, we can reconstruct the investment history of all cohorts of investors and calculate the total intercohort transfer.