

NEW LESSONS IN FINANCIAL FRAGILITY[‡]

Global Life Insurers during a Low Interest Rate Environment[†]

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The traditional role of life insurers is to insure idiosyncratic mortality and longevity risks. Over the last 20 years, their business model has changed with the growth of insurance products with minimum return guarantees that are exposed to market and interest risks. Examples include variable annuities in the United States and insurance with profit participation in Europe.¹ The secular decline of defined benefit pension plans partly explains the growing demand for such insurance products.

Life insurers must use complex financial engineering to price and hedge risks associated with minimum return guarantees (Kojien and Yogo 2021). Life insurers are exposed to interest risk if they do not sufficiently increase the maturity of their bond portfolio or use derivatives to offset the negative duration and negative convexity from minimum return guarantees. Life insurers are also exposed

to long-run volatility risk, which is difficult to hedge with traded options that are short term.

The fragility of the life insurance sector was first on display during the global financial crisis (McDonald and Paulson 2015; Kojien and Yogo 2017). Because of the long maturity of the minimum return guarantees, life insurers remain vulnerable in the low interest rate environment after the global financial crisis. We provide three new pieces of evidence on the fragility of the life insurance sector.

First, the interest risk exposure of European insurers' stock returns increased significantly in the low interest rate environment after the European sovereign debt crisis. Previous research found that the interest risk exposure of US life insurers' stock returns increased significantly after the global financial crisis (Paulson et al. 2012; Kojien and Yogo 2022b). We extend this evidence to European insurers.

Second, the relative fragility of life insurers is highly persistent across crises. In the cross section of US life insurers, the stock returns are highly correlated between the global financial crisis and the COVID-19 crisis. In the cross section of European insurers, the stock returns are highly correlated between the global financial crisis, the European sovereign debt crisis, and the COVID-19 crisis.

Third, European insurers with a higher share of liabilities with minimum return guarantees in 2016 had lower stock returns during the COVID-19 crisis. This finding suggests that minimum return guarantees indeed explain the relative fragility of life insurers and its persistence across crises.

I. Data Construction

The data on US variable annuity insurers' stock returns are from Kojien and Yogo (2022b).

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¹ See Kojien and Yogo (2022b) for an introduction to variable annuities and European Insurance and Occupational Pensions Authority (EIOPA) (2020) for examples of insurance with profit participation in Europe.

We refer to that paper for details about the data construction.

To construct the sample of European insurers, we start with insurers that are part of the stress test reports of the EIOPA (2014, 2018). There are 52 insurers when we combine the 31 insurers in 2014 and the 42 insurers in 2018. We then restrict the sample to 34 publicly traded insurers. Finally, we restrict the sample to insurers in Global Industry Classification Standard subindustry 40301020 (life and health insurance) or 40301030 (multiline insurance). This criterion eliminates insurers that are part of a financial conglomerate such as a banking group. Our final sample consists of 23 insurers.

The data on European insurers' daily stock return are from Compustat Global. In our factor regressions, the monthly stock market returns are those on the S&P Europe 350 index from Morningstar Direct. We construct the monthly 10-year bond returns from the zero-coupon yield curve for AAA-rated euro area government bonds from Eurostat.

We obtain balance sheet data for European insurers from Best's Financial Suite: Solvency II in 2016. We choose 2016 as the first year for which these data are available, well before the COVID-19 crisis. We construct the share of liabilities with minimum return guarantees based on form S.12.01.02. Our definition of insurance with minimum return guarantees includes insurance with profit participation (typically associated with guarantees), index-linked and unit-linked insurance with options or guarantees, and other life insurance with options or guarantees.² We aggregate the liabilities across all subsidiaries of the insurance group before computing the ratio.

We cannot directly measure the generosity of minimum return guarantees, which are part of the Solvency II filings that are only available to European insurance regulators. Thus, researchers with access to these data could refine our analysis in future work.

²Based on the row and column labels in the EIOPA filing template, our formula is $(C0020.R0030 + C0020.R0100 + C0020.R0120 + C0020.R0130 + C0050.R0030 + C0050.R0120 + C0080.R0030 + C0080.R0120)/(C0150.R0200)$. We have obtained similar results with a simpler measure based only on insurance with profit participation, $(C0020.R0200)/(C0150.R0200)$.

II. Interest Risk Exposure

We first examine how the interest risk exposure of US and European insurers' stock returns has changed in the low interest rate environment. Paulson et al. (2012) find that the US life insurers' interest risk exposure increases significantly after the global financial crisis. They do not find such change in interest risk exposure for US property and casualty insurers or UK life insurers, who do not sell products like variable annuities with options and high guaranteed rates (Sen and Humphry 2020).

In Kojien and Yogo (2022b), we focus on US variable annuity insurers and update the evidence on interest risk exposure. We estimate a factor regression:

$$(1) \quad R_{i,t} = \alpha + \beta_m R_{m,t} + \beta_b R_{b,t} + \epsilon_{i,t}$$

where $R_{i,t}$ are excess returns on a value-weighted portfolio of variable annuity insurers, $R_{m,t}$ are excess stock market returns, and $R_{b,t}$ are excess 10-year bond returns. The 10-year bond beta is -0.38 and statistically insignificant from 1999 to 2007, but it is -1.28 and statistically significant from 2010 to 2017. This estimate implies that variable annuity insurers' stock prices fall by 12.8 percent when the 10-year bond yield falls by approximately 1 percent.

We extend this evidence to European insurers. Table 1 reports monthly factor regressions for a value-weighted portfolio of euro area insurers. We restrict our sample to the euro area to match the stock and bond market factors that are in euros.

In the first column of Table 1, the 10-year bond beta is both economically and statistically insignificant in the entire sample from 2005 to 2019. However, this result masks the fact that the interest risk exposure has changed after the global financial crisis. In the second column, the 10-year bond beta is economically and statistically insignificant in the subsample from 2005 to 2007. However, in the third column, the 10-year bond beta is -0.60 and statistically significant in the subsample from 2010 to 2019.

In the aftermath of the European sovereign debt crisis, the European Central Bank started a quantitative easing program in March 2015, lowering interest rates (Kojien et al. 2021). In the fourth column of Table 1, the 10-year bond beta is -1.04 and statistically significant in the

TABLE 1—RISK EXPOSURE OF EUROPEAN INSURERS

	2005– 2019	2005– 2007	2010– 2019	2015– 2019
Stock market return	1.41 (0.11)	1.28 (0.15)	1.29 (0.08)	1.13 (0.10)
10-year bond return	–0.14 (0.20)	–0.20 (0.26)	–0.60 (0.23)	–1.04 (0.36)
Alpha (%)	–0.09 (0.31)	–0.33 (0.42)	0.32 (0.37)	0.54 (0.40)
Observations	180	36	120	60
R^2	0.68	0.70	0.65	0.71

Notes: This table reports monthly factor regressions for a value-weighted portfolio of euro area insurers. The monthly stock market returns are those on the S&P Europe 350 index. We construct the monthly 10-year bond returns from the zero-coupon yield curve for AAA-rated euro area government bonds. Heteroscedasticity-robust standard errors are reported in parentheses.

subsample from 2015 to 2019. This estimate implies that euro area insurers' stock prices fall by 10.4 percent when the 10-year bond yield falls by approximately 1 percent. Thus, the euro area insurers' stock prices have become more sensitive to movements in interest rates in the low interest rate environment.

This evidence is consistent with interest risk mismatch when the assets have much shorter duration than the liabilities. In principle, insurers could increase the maturity of their bond portfolio or use derivatives to offset the negative duration and the negative convexity from minimum return guarantees. In practice, insurers are limited by the supply of long-term bonds and derivatives. Moreover, insurers may prefer to hold corporate bonds that tend to have shorter duration in order to earn a credit risk premium (Kojen and Yogo, forthcoming).

A negative duration gap that is equivalent to a 10-year bond is surprisingly large. Another possibility is that the duration gap reflects the sensitivity of future underwriting profits to interest rates. When interest rates are low, insurers may not be able to offer sufficiently generous guarantees at competitive fees relative to the customers' outside investment options.

Based on the publicly available data, we cannot separately identify interest risk exposure that arises from the duration gap of the current balance sheet versus the interest risk of future underwriting profits. However, the European insurance regulators know the duration and

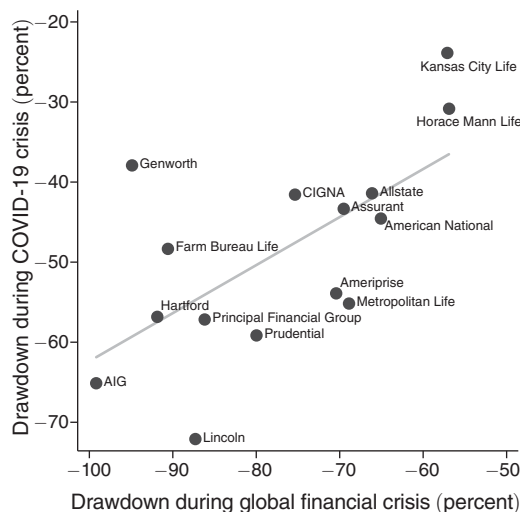


FIGURE 1. US VARIABLE ANNUITY INSURERS' EQUITY DRAWDOWNS

Notes: The equity drawdowns during the global financial crisis are based on stock returns from January 2, 2008, to June 30, 2009. The equity drawdowns during the COVID-19 crisis are based on stock returns from January 2 to April 2, 2020.

the convexity of assets and liabilities as part of the Solvency II filings. Thus, researchers with access to these data could answer this question in future work.

III. Persistent Fragility

Insurance products with minimum return guarantees are typically used for retirement savings and thus have long maturities. Consequently, the risks remain on insurers' balance sheets for long periods of time, especially during a low interest rate environment when policyholders value the high guaranteed rates. Thus, the relative fragility of insurers can be persistent, which we demonstrate through three major events in our sample: the 2008 global financial crisis, the 2011 European sovereign debt crisis, and the 2020 COVID-19 crisis.

For US variable annuity insurers, Figure 1 compares the equity drawdowns during the global financial crisis on the horizontal axis with the equity drawdowns during the COVID-19 crisis on the vertical axis. The equity drawdown is the cumulative stock return from peak to trough during the crisis period. The insurers with low

stock returns during the global financial crisis had low stock returns during the COVID-19 crisis, with a correlation of 0.64. In Koijen and Yogo (2022b), we show that the nine insurers with the largest variable annuity liabilities in 2007 are also the insurers that had the largest equity drawdowns during the COVID-19 crisis.

Figure 2 repeats the analysis for European insurers. In panel A, we again find that the insurers with low stock returns during the global financial crisis had low stock returns during the COVID-19 crisis, with a correlation of 0.32. For the European insurers, the European sovereign debt crisis was also a major event, especially in Greece, Italy, Portugal, and Spain. Panel B compares the equity drawdowns during the European sovereign debt crisis on the horizontal axis with the equity drawdowns during the COVID-19 crisis on the vertical axis. The correlation is 0.48.

We now provide direct evidence that the equity drawdowns during the COVID-19 crisis are related to minimum return guarantees. Figure 3 compares the share of liabilities with minimum return guarantees in 2016 on the horizontal axis with the equity drawdowns during the COVID-19 crisis on the vertical axis. The insurers with large shares of liabilities with minimum return guarantees in 2016 had low stock returns in the COVID-19 crisis with a correlation of -0.41 .³

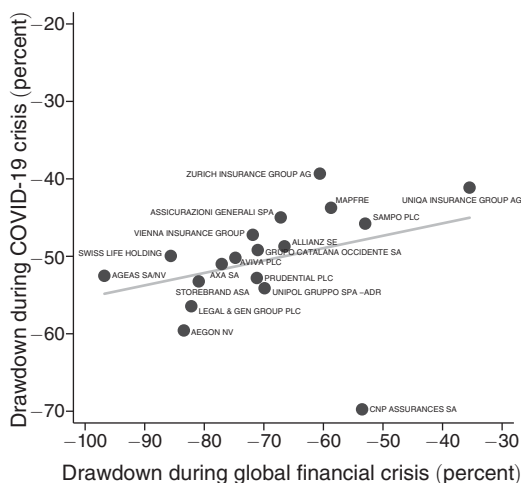
In summary, the evidence suggests that both US and European insurers remain vulnerable to low interest rates and stock market volatility due to minimum return guarantees. This fragility of the global life insurance sector is highly persistent because of the long-term nature of the minimum return guarantees.

IV. Broader Implications

We conclude by discussing the broader implications of our findings. First, an active literature finds that financial frictions and capital flows affect asset prices and real economic activity during times of financial market stress. This literature mostly focuses on short-lived episodes with binding constraints and large outflows that lead to asset fire sales (Haddad, Moreira, and Muir

³ UK insurers did not sell many products with options and high guaranteed rates (Sen and Humphry 2020). If we omit the 4 UK insurers in Figure 3, the correlation strengthens to -0.57 .

Panel A. Global financial crisis



Panel B. European debt crisis

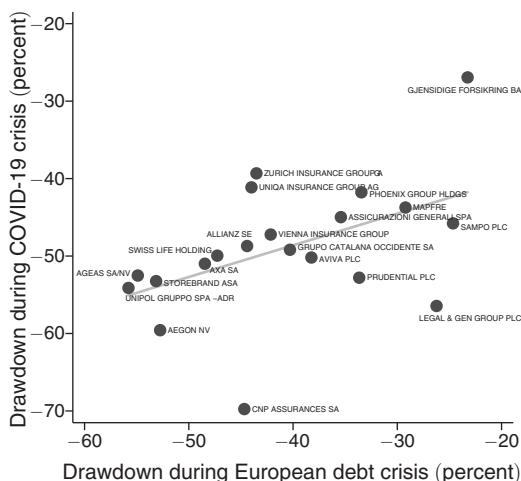


FIGURE 2. EUROPEAN INSURERS' EQUITY DRAWDOWNS

Notes: The equity drawdowns during the global financial crisis are based on stock returns from January 2, 2008, to June 30, 2009. The equity drawdowns during the European sovereign debt crisis are based on stock returns from January 3 to December 30, 2011. The equity drawdowns during the COVID-19 crisis are based on stock returns from January 2 to May 29, 2020.

2021; He, Nagel, and Song 2022; Ma, Xiao, and Zeng, forthcoming). An important aspect of life insurers is that their liabilities have long maturities that span decades. Thus, financial frictions can operate for long periods of time in a low interest rate environment.

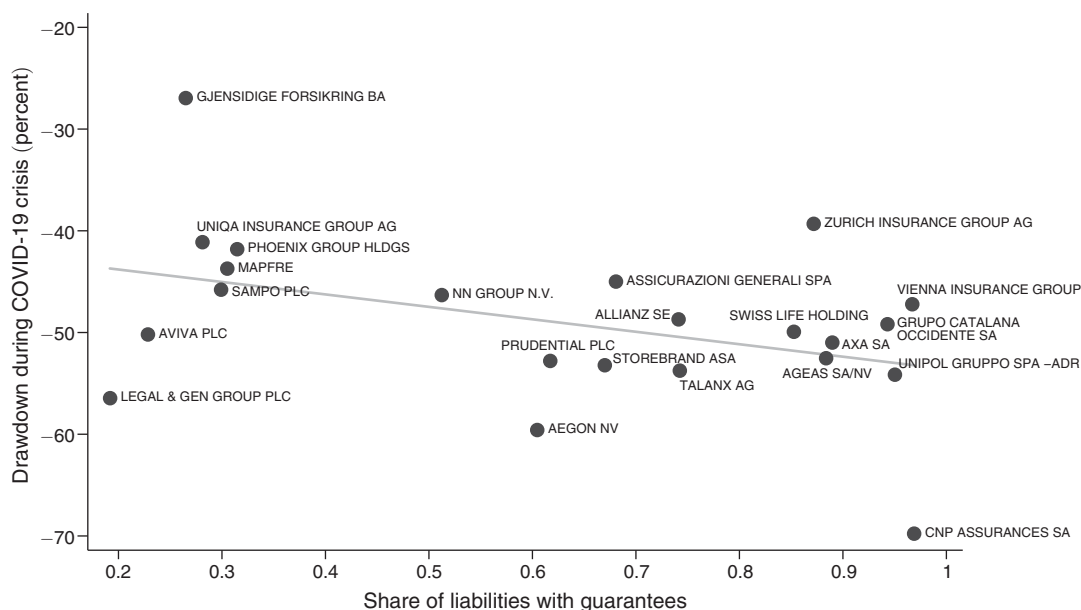


FIGURE 3. EUROPEAN INSURERS' LIABILITIES WITH MINIMUM RETURN GUARANTEES AND STOCK RETURNS DURING THE COVID-19 CRISIS

Note: The equity drawdowns during the COVID-19 crisis are based on stock returns from January 2 to May 29, 2020.

Because insurers are among the largest institutional investors in fixed income markets, financial frictions are important for asset prices at business cycle and higher frequency (Ellul, Jotikasthira, and Lundblad 2011; Ellul et al. 2015; Ge and Weisbach 2021). Although more difficult to identify, financial frictions could affect asset prices and firms' cost of capital at a lower frequency spanning decades.

Second, insurers have historically been less cyclical than other types of leveraged financial institutions like banks. Since the global financial crisis, this is no longer the case. The changing business model calls for a new framework to study the insurance sector. In Koijen and Yogo (2022a), we develop a unified framework to study the impact of financial and regulatory frictions on all decisions of insurers, including pricing, contract design, reinsurance, portfolio choice, and risk management. Yet, much work remains to better understand the insurance sector and its role in the broader economy.

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